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A micro simulation model of demographic development and households' economic behavior in Italy

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FOREWORD

Albert Ando passed away over two years ago, but his long-standing co-operation with the Economic Research Department of the Bank of Italy is still producing tangible fruits today, as this article testifies. The tools of quantitative analysis that he taught to so many young economists and helped apply to concrete problems are still in use; the scores of economists at the Bank who have had the privilege of absorbing some of Albert's knowledge and passion use these assets in their daily work.

I first met Albert Ando at MIT in the fall term of the 1962-63 academic year. He collaborated with Paul Samuelson on the graduate course in Advanced Monetary Theory. Some years later I asked him to help in building the Bank of Italy's new quarterly model of the Italian economy, which had also benefited, in its earlier stages, from the advice of Franco Modigliani. The model was eventually finalized in the mid-1980's and, with regular updating, remains in constant use.

Albert's work with the econometric model constituted the bulk of his activities here at the Bank, but his contribution to our economic research was by no means limited to the model alone. He took part in reshaping the Survey of Household Income and Wealth which the Economic Research Department had started in the 1960's. He helped organize and develop a major research project on saving behavior. He developed tools for the design of policies to steer and stabilize "real" economies, i.e. economies that can only be represented by large-scale, complex models – tools that demanded intensive and efficient use of computers, another area in which Albert's stimulus was essential. And he set up the microsimulation model of households' behavior, whose main features are described in the article published here. More generally, Albert was indefatigable in stimulating and directing research, and unstinting in offering his knowledge and wisdom; more than one generation of young and less young economists of the Bank of Italy benefited from his advice and example.

In publishing one of his last works, I wish to remember Albert Ando as an inspiring professor and a long-time friend of mine, one of the most imaginative economists of the late twentieth century, a tireless and dedicated adviser of the Bank of Italy, a distinguished member of the academic community who realized what challenges face policymakers, and the possessor of an inquiring, investigative mind who was attracted by major intellectual pursuits as well as daily policy problems.

Antonio Fazio

Governor of the Bank of Italy

A MICRO SIMULATION MODEL OF DEMOGRAPHIC DEVELOPMENT AND HOUSEHOLDS' ECONOMIC BEHAVIOR IN ITALY

by Albert Ando✝ and Sergio Nicoletti-Altimari(*)

Abstract

The relationship between the demographic structure and the saving rate of a society is the reflection of the aggregation of the behaviour of heterogeneous households, differing from one another in the type of living arrangements and in the characteristics of their members. In order to contribute to the understanding of this relationship, we construct a dynamic micro model capable of simulating the demographic development of a population, including the creation, destruction, dimension and various other important characteristics of households and their members. The demographic model is then combined with a specification of the processes generating income, social security wealth, retirement and consumption behaviour of households, and applied to a data set derived from survey data on the Italian household sector.

Simulations of the model are used to study the evolution of aggregate income, saving and asset accumulation over the period 1994-2100. If fertility and mortality assumptions of recent official projections are adopted and marriage and divorce rates maintained at current levels, the dramatic ageing of the population and the marked decline in the share of population living in traditional households would lead, other things being equal, to a substantial decline in the aggregate saving rate. However, the reduction in the number of children per household and, above all, the decline in the ratio of social security wealth of households to disposable income as the effects of the recently introduced reforms begin to be felt act as offsetting factors. As a result, the aggregate saving rate increases over the initial 30 years of the simulation and moderately decreases thereafter, stabilizing slightly above the original level. Implications of changes in a number of key assumptions regarding the demographic evolution, productivity growth and individual behavioural responses are also analyzed.

JEL classification: D12, D31, D91, E21, H55, J10, J26.
Keywords: Demographic developments, family structure, consumption, saving, social security, micro simulation model.

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Contents

In memory of
Albert Ando

I. Introduction and main conclusions[1]

I.1 Demographic structure of the population and the aggregate saving rate

In the European countries and Japan, the birth rate has declined dramatically during the past several decades, accompanied by a continuous decline in mortality. This trend has so far led to a noticeable decline in the population of children in these countries, but there is no question that it will eventually lead to large shifts in the age structure of the adult population. The ratio of older, presumably retired, persons to younger, working adults will increase to unprecedented levels, with a number of potentially serious consequences. In public discussion, two points are most often emphasized.

First, as stressed by the life cycle model of Modigliani and Brumberg, the ageing of the adult population reduces the aggregate saving rate in the society, since the ratio of the retired, presumably dissaving, population to the working, presumably saving, population increases. One must be careful to remember that this well-known proposition applies to the comparison of two or more steady-state growth paths, and it neglects dynamic adjustment processes. Later in this section, we will illustrate how large and long-lasting these dynamic adjustment processes can be. A decline in the growth rate of the population, however, also reduces the ratio of investment to output needed to maintain any specific capital-output ratio, given the same rate of technical progress. The requirement, therefore, is not that the saving rate should

[1] A number of people have helped and made important contributions at various stages of this project. Luigi Cannari has provided a crucial input for the construction of the model of demographic evolution described in Section III, by developing the methodology that was finally adopted and by creating an initial stylized version of the demographic model. Dimitrios Christelis has provided great help in creating the data set and improving the consistency of the demographic model. Andrew Foster has helped to set up a suitable re-sampling procedure that was used to generate the sample used in the simulations of the model. Giuseppe Bruno has given suggestions and advice on computational problems. Massimo Rostagno has provided important insights regarding the features of the Italian social security system. We are also thankful to Victor Rios-Rull and Nicholas Souleles and an anonymous referee for very helpful comments and suggestions on various aspects of the study.

The Bank of Italy has provided all the facilities that have made it possible to carry out this project. We also wish to thank Filippo Altissimo, Luigi Guiso, Maria Rosaria Marino, Stefano Siviero, Daniele Terlizzese and Ignazio Visco for stimulating and helpful discussions over many years.

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The opinions expressed are those of the authors and do not necessarily reflect those of the European Central Bank.

remain stable when the rate of population growth declines. Both the saving rate and the ratio of investment to output would decline when population growth declines, but the behaviour of the two must be such that equilibrium between them is maintained at full employment with the interest rate remaining within a reasonable range and the external borrowing is not exploding.

A second concern often voiced in public debates relates to the impact of the ageing of a population on public finances. In most societies, the working population contributes taxes to the government, while the retired population must be provided with pensions and other support from the government. The ageing of the population will therefore undermine the stability of the government budget and its debt position unless significant adjustments are made to tax and transfer policies.

These considerations have induced economists to devote their attention to the economic consequences of the changing demographic structure of the population. Such studies typically involve three components: a description of the dependence of an individual's behaviour on his/her demographic characteristics; a dynamic model of the demographic structure of the society; and a procedure for combining these two components of the model to project various aggregate measures of interest into future periods for analysts and policy-makers. As soon as we attempt a detailed description of the dependence of the economic behaviour of an individual on his/her demographic characteristics, however, it becomes obvious that the latter depends not only on age but also on the nature of the family to which the individual belongs, and on the role he/she plays in the family. Indeed, for economic decisions, in most cases it is more natural to consider a family or a household rather than an individual as the decision-making unit. A group of persons living individually exhibits a very different pattern of consumption and saving from a group of similar persons living together as a family. Powerful economies of scale are involved here, together with possible adjustments of the planning horizon when a group of persons rather than individuals plan their lives on a joint basis.

A family is, however, a much more complex entity than an individual. Its distribution must necessarily be multi-dimensional, involving not only the age of the head of the household, but also the age of the spouse, the number, age and sex of the children and other dependants and their relation to one another. Other acquired characteristics of members, such as education and working status, as well as living arrangements are also of great importance.

When we look at these characteristics of families since the 1950s in developed countries, we recognize that a great deal more than the age distribution has changed fairly dramatically over time, partly as a consequence of the lower fertility and mortality rates, but also for a number of other reasons. Among the more important ones are the delayed start of the childbearing period, the decrease in the number of marriages, the postponement of marriage, the increased incidence of divorce and separation, the increase in the number of children outside marriage, the increase in the number of single persons living alone or in single-parent families and the decline in the number of families containing more than one generation.

Changes in the demographic pattern can exert a large and profound influence on the economic life of the society, but the dynamic process involved in the working of this causal structure can be quite slow. For this reason, it can be quite misleading to rely on the comparative steady-state propositions cited above when we are interested in analyzing the short- to medium-term responses of economic variables to changes in demographic patterns. To illustrate this point, let us consider the case in which the fertility and mortality rates have been constant for a long enough period of time that the demographic structure of the society has become stabilized and all segments of the population are growing at a constant rate. Suppose further that at a particular point in time the fertility rate declines sharply once and for all and remains at the new, lower rate thereafter.

If we assume that individuals enter the labour force at age 20, then for 20 years after the fertility declines, the relative size of the working age population and the older, retired population will remain unchanged. The only effect of the fertility decline is the reduction in the number of dependant children, which would (likely) induce their parents to decrease consumption. The aggregate saving rate for the society, therefore, is likely to increase during this period. Assuming further that individuals begin to retire at age 65, during the next 45 years the number of working age population relative to the number of retired persons must decline, inducing the aggregate saving-income ratio to fall during this period.

Finally, during the next 30 years, that is, 65 to 95 years after the initial decline in the fertility rate, the number of older, retired people decreases, and the aggregate saving rate recovers slightly. When the adjustment processes are completed, the weights of population will have shifted from the younger group to the older group. Since the older group maintains a much higher asset-income ratio than the younger group, the aggregate asset-income ratio rises as a result of the lower fertility rate, but not as much as the reciprocal of the growth rate of population. The saving-income ratio is the product of the rate of growth of assets and the asset income ratio. Its final equilibrium value, therefore, must be smaller than its initial value but not by as much as the decline in the growth rate of the population, confirming the proposition associated with the simple life cycle theory. It is important to recognize, however, that the saving-income ratio does not necessarily arrive at its final new equilibrium value monotonically. In the example that we have outlined above, it actually rises for a while, and only at the end declines rapidly to arrive at the new, lower value. The prediction of a falling saving-income ratio for the 1990s and beyond in Japan associated with the dramatic fall in the fertility rate was due to the neglect of the dynamic adjustment process.

For the purpose of organizing our discussion on the effects of dynamic changes in the distribution of age and other family characteristics for the population on the aggregate saving ratio over time, it is useful to keep in mind the following decomposition of the aggregate saving-income ratio.

$$\frac{S_t}{Y_t} = \sum_a \sum_f w_t(a,f) \frac{y_t(a,f)}{Y_t} \frac{s_t(a,f)}{y_t(a,f)} \tag{1}$$

S_t and Y_t are, respectively, the aggregate savings and the disposable income of the household sector, $w_t(a,f)$ is the weight of families with characteristics (a,f) (i.e., the total number of families defined by the age of the head a and their demographic characteristics f), and $y_t(a,f)$ and $s_t(a,f)$ represent the mean value of disposable income and savings of the group of families (a,f). Since (1) is an identity, we can see that the aggregate saving-income ratio can change as a result of changes in the micro saving-income ratio of individual groups, of the distribution of income among groups, or of shifts of weights among groups.

A number of studies have attempted to document the effects of changes in the composition of the population on aggregate saving on the basis of equation (1). Gokhale, Kotlikoff and Sabelhouse (1994) have found that the recent decline in the saving-income ratio in the U.S. can be attributed to a shift of resources from younger families to older households and to an increase in the consumption-income ratio of these older households, due in large part to a rise in medical costs. In a detailed study, J. P. Cordoba (1996) classified households by a variety of characteristics including household type, age, sex and the educational level of the head of the household, the number of earners and family size. While the saving rate of most groups remained reasonably stable between the 1960s and the late 1980s, the aggregate saving-income ratio declined significantly in the same period, because the distribution of families shifted dramatically from high saving groups (especially two-parent families) to low saving groups (single individuals and one-parent families). The former went from roughly 80% of total families in 1961 to only 60% in 1984-90. When corrected for these weight shifts, the saving-income ratio in 1984-90 is nearly the same as in 1960-61, although it is still lower than in 1972-73. Both studies have found little or no effect on the aggregate saving rate of the U.S. resulting from the change in the age structure of the population in the period since 1960. This last result is not surprising, because during this period the proportion of the working age population in the total population did not decline. If anything, it increased.

In Japan, studies found that, while single individuals living alone or in single-parent families are rare, families which contain young, working adults as dependants are quite common and contribute a disproportionately large share of saving (Ando, Yamashita and Murayama (1986); Ando (1996), Ando, Guiso and Terlizzese (1994), Hayashi, Ando, and Ferris (1989)). Equally important, older individuals in Japan appear to dissave less than in other countries, partly because the labour force participation rate of older males is very high, and partly because a large majority of older individuals tend to merge into the families of their children, thus taking advantage of the economy of scale associated with larger families. Thus, while the distribution of families by their characteristics in Japan is quite different from that observed in the U. S., the basic principle that some types of families save a much larger proportion of their income than other families holds, and changes in this distribution change the aggregate saving rate even if the saving rate of specific groups remains stable.

Unlike Japan, in Italy older individuals retire relatively early and tend to maintain independent households. On the other hand, Italy shares with Japan the family pattern in which most young, working adults live with their parents until marriage. This type of family again contributes a disproportionately large share of saving to society (Ando, Guiso and

Terlizzese (1994)). In Section II of this paper, we document that the declining proportion of families containing adult dependants accounts for about 40% of the decline in the aggregate saving ratio that took place in Italy between 1980 and 1995.

I.2. A micro simulation model of demographic developments and households' economic behaviour

All empirical studies recognize, however, that shifts in the weights in equation (1) are generally accompanied by changes in the distribution of income and in the saving-income ratios of the various groups of the population. To understand fully the implications of demographic changes for the aggregate saving rate and to be able to predict the quantitative effects of the former on the latter, therefore, a fully-fledged model integrating the demographic characteristics and the economic behaviour of households is required. In terms of equation (1) above, we need (a) a detailed demographic model describing the movement of $w_t(a,f)$ over time, (b) a model of income generation expressing the value of $y_t(a,f)$ as a function of age a and family characteristics *f* in year *t,* (c) a model of a household's savings behaviour capable of predicting the value of the saving-income ratio $s_t(a,f)/y_t(a,f)$ for all *a* and *f* for all *t*, and (d) an operational description of the aggregation process parallel to equation (1). This monograph reports on the result of our first attempt to build such a model for the Italian economy.

A schematic overview of the resulting micro model is depicted in Figure I.1 at the end of this section, in which the model has been divided into three main blocks. The first block describes the basic demographic dynamics. It consists of individuals' encounters with the main demographic events in life such as birth, marriage, divorce and death, leaving the parent family or merging with other households. The frequency with which households encounter these events and their responses are determined largely by probability distributions derived from observed demographic patterns. Their status within households and the characteristics of the households are changed every year according to these events. In earlier models constructed for the United States and for Japan, individual households were grouped into small, relatively homogeneous groups classified by the type of families (single male or female with or without children, married couples with or without children, etc.), the age of the head and the age of the spouse (if any), and the number of children. The mean values of variables for these groups and the weights associated with them served as the basic unit of our modeling. In this model for Italy, we work directly with individual households. To do so, we must transform the original stratified sample of households into an artificial proportional sample through a resampling procedure described in Section III.

In a second block, a number of important socio-economic characteristics of individuals, such as their education, their participation in the labour force, their employment status, their sector and occupational status, are initially assigned to new households and then updated accordingly to a set of transition probabilities. These transition probabilities are again estimated from patterns observed in the demographic data, and we have observed as far as possible the dependence of these probabilities on a number of factors. At any given period, therefore, individuals are indexed by their age, sex, role in the family, education, labour force status, sector and type of activity and other important characteristics.

In the third block, we specify the dependence of the process generating labour income for each household on its socio-economic characteristics. A set of rules governing the transfer of wealth among households and individuals is also specified here, but it should be noted that in the actual operation of the model the transfer of wealth is closely integrated with changes in the status of individuals and families. The total available resources (including expected earnings over remaining working years, accumulated assets and expected social security wealth) for a family at any point during its life-cycle are then specified and computed. This, in turn, enables us to describe the consumption-saving and retirement decisions in the tradition of the life-cycle hypothesis. Once saving for households is generated in this way, net worth for each household is updated in the usual way.

The final result of this exercise is a dynamic micro simulation model in which individuals and households are heterogeneous over a relatively large number of characteristics whose change over time is fully described. Since these characteristics play an important role in shaping the economic behaviour of households and individuals, recognizing the heterogeneity of households over these characteristics enables us to analyze a number of problems that cannot be dealt with in the framework of a model containing a single representative agent, or one containing relatively few types of agents.

Besides the rich heterogeneity of the structure and behaviour of households, the second feature of the model that we would like to emphasize is its close link with available micro data. The parameters of the model were estimated (and its dynamic behaviour was calibrated) using the data set generated by several waves of surveys of Italian households conducted by the Bank of Italy. Since we need to treat each observation in the survey data as though it were a single household, while the survey is based on a stratified sampling design, we have used a resampling procedure to generate a very large proportional sample of households. In the process, we have made a number of proportional adjustments to insure that the distribution of demographic and social characteristics closely matches the corresponding distribution of the Italian population, and that the aggregate economic variables generated from our sample are consistent with the National Accounts data.

There are several reasons that make the Italian household sector an ideal laboratory for our purposes. First of all, as the analysis of available data will show below (Section II), the structure of Italian households is extremely important in determining their economic behaviour, with different households exhibiting very different saving behaviour over their life. Very tight relations among the members of households, coupled with the imperfect working of the labour market and of the credit and insurance markets are probably the main reasons for the central role played by households in determining the economic behaviour of individuals. While demographic changes are exerting a marked impact on the composition of households, economic decisions continue to depend strongly on the characteristics of households. Second, while some of the demographic changes mentioned above are common to many developed countries, the scale of changes has been especially large in Italy. In particular, the fertility rate has reached the lowest level in the world, bringing the growth of the population to a halt, and life expectancy has lengthened relatively more than in other European countries. Net migration, which could have counteracted these developments, has been relatively small. Projections indicate that the process of ageing will proceed at a much higher pace than in other countries (with the possible exception of Japan). These conditions have accentuated the contribution of demographic factors to changes in the aggregate economic behaviour of the Italian household sector, and they provide an opportunity for a sharper test for the superiority of a model that allows for heterogeneity among households.

Furthermore, demographic changes coupled with pressures coming from a huge and ever-increasing public debt have led the Italian government to introduce a number of reforms to the Italian social security system in the 1990s. A major reform in 1995, which brought about the adoption of a contribution-based system and the gradual reduction of many different existing schemes in favour of a single one, is likely to have a major impact on aggregate saving in Italy. A comprehensive analysis of the possible implications of this change of regime is nearly impossible owing to the heterogeneity of existing schemes for different categories of workers and the complexity of the transition to the new regime, unless the framework for the analysis explicitly allows for different behaviour among individual households associated with their demographic and socio-economic characteristics. The model outlined above should constitute such a framework, and we present the result of an analysis of this regime change at the end of the paper.

I.3. Results of the simulations of the micro model

A number of simulations of the complete model have been performed, all covering the period 1994-2100. Our benchmark simulation assumes an unchanged growth of per-capita productivity in the Italian economy (2% per year) and utilizes the fertility and mortality rates of the main variant of recent official demographic forecasts, which predicts a substantial decline in the total population by 2050 and a dramatic decline thereafter. This is accompanied by a deep change in the age structure of the population (the fraction of those aged 65 or over rises from 17% in 1995 to more than 30% in 2050), a continual shrinking of the average family size, a marked decline in the proportion of the population living in traditional families and an increase of the proportion of people living alone.

Other things being equal, these changes would lead to a remarkable decline in the aggregate saving rate. The most striking result of this benchmark simulation, however, is that the aggregate saving rate increases up to year 2030 and then decreases slowly thereafter, stabilizing about 2 percentage points above the initial level. Three factors exert strong counteracting pressure on the saving rate: the decline in the number of children per household; the decline in the unemployment rate for young people (assumed in the benchmark simulation) which increases the proportion of high-saving non-nuclear households in the population; and the gradual decline in the ratio of social security wealth of households to disposable income as the effects of the recently introduced reforms begin to be felt. After a while, when the population begins to decline more rapidly, this last effect eventually becomes the dominant factor. The new social security regime is a contribution-based, pay-as-you-go system with an internal rate of return equal to the rate of growth of GDP, which therefore immediately "internalizes" the decline in the population in the form of lower future benefits. Estimated parameters of the model are such that the increased saving of relatively young households, which react to the reduction in future benefits both by accumulating more and by working longer years, partly compensates the effect produced by the increase in the weight of elderly households, so that the aggregate saving rate eventually rises.

Of course, these results depend on a number of parameters and assumptions that are subject to great uncertainty. We have therefore carried out several different simulations to check the sensitivity of the results with respect to the key parameters or assumptions.

A first set of simulations deals with the assumptions on fertility, mortality and productivity growth. Increases in fertility rates do not have a marked effect in the medium term, since the main demographic changes foreseen for Italy in the next 30 years are already under way. Over a longer time horizon the increase of the weight of the working age population relative to the benchmark case leads, as expected, to a higher saving rate; this effect is partly mitigated by the smaller decrease in the ratio of social security wealth to income compared with the benchmark case.

The benchmark simulation results imply the persistence of a relatively high saving rate in the Italian economy, even against a background of declining population and income growth. Two key factors contribute to this result: the assumed relatively high growth of per-capita productivity and the mechanism through which changes in social security wealth offset the impact of ageing on aggregate saving. A productivity slowdown can exert dramatic effects on the aggregate saving rate. Even relatively small declines in productivity growth can lead to substantial declines in the aggregate saving rate. In the extreme case, in which productivity growth is set to generate a rate of growth of aggregate labour income close to zero, the saving rate shrinks almost to zero at the end of the simulation period.

Changes in some key parameters that govern the response of individuals to the changing social security system can have a significant impact. The uncertainty regarding the measure of social security wealth used in our model (as opposed to the measure perceived by households) and the parameters governing behavioural responses to it (which have been estimated during a period of major changes in the system) is especially serious. This led us to perform a simulation in which the parameters of the saving choices are re-estimated on the assumption that, during the period of the calculation, households believe that only a part of the measured social security wealth is their real assets. In this case, the counter-effect from the social security system in the simulation we describe above is much weaker and the aggregate saving rate is lowered by almost 3 points with respect to the benchmark at the end of the simulation period.

When we change the rules of the social security system to incentivate a later retirement, two counter-effects come into play in the model. On the one hand, the need to accumulate assets for retirement during working years is reduced, generating a negative effect on savings. On the other hand, the increase in the proportion of the working population exerts a positive effect on saving. The net effect is that the saving rate remains very close to that of the benchmark simulation throughout the simulation period.

I.4. Other applications, limits and possible extensions

While the micro simulation model has been developed primarily for studying the implications of the rapidly changing Italian demographic structure for aggregate saving, potentially it can be used to analyze a number of other important issues. We have already suggested that the model can be used for an analysis of alternative designs of the social security system as it permits a fairly detailed description of the institutional features of the system and of the characteristics of the participants and their evolution over time.

The second potential application of this model is for studying the effects of the personal tax and transfer system on the distribution of personal income. Since in this model we can generate the earned income and net worth for all families, it is clear that we can generate the distribution of income before and after taxes and transfers, provided that in the model we describe in detail the rules governing them. By comparing the distribution of income before and after taxes and transfers, we can analyze how these affect the distribution. It is also clear, however, that our model must be extended in two directions for such an analysis to be fully satisfactory.

First, as we describe in detail in Section V below, our behavioural equation describing an individual's earnings from labour can account for some 45% of the variance of the logarithm of income. When working with cross section data, this result must be considered an indication that our equation is as successful as can be expected in explaining the earned income of individuals. However, it is also true that it leaves a very large part of income distribution unexplained, especially extreme values or tails of the distribution. For a study of income distribution, tails of the distribution are important and cannot be neglected. On the other hand, it is unlikely that we can improve the explanatory power of our equation by adjusting or elaborating the specification of the deterministic part of the explanatory equation. It is therefore essential that we supplement the specification reported in this paper by modeling explicitly the stochastic process generating the residual term of the income equation for the purpose of studying income distribution. It is also useful to model the stochastic process that generates the residual term of the equation generating consumption since this term has an important impact on the accumulation of net worth and hence on future income stream. Work on this extension is currently under way.[2]

Second, in all simulations reported in this paper we take the labour force participation decision (both the decision whether or not to participate as well as the number of hours workers wish to work) as simple functions of the demographic and socio-economic characteristics of individuals. That is, we have ignored the response of the labour force participation decisions on the wage rate. This issue must be investigated and our description of labour force participation decisions by individuals must be based on the result of a more careful empirical analysis.

Finally, it should be taken into account that in this study we proceed within a partial equilibrium framework. In particular, the real wage rate and the real rate of interest are also taken as exogenous. Ultimately, the dependence of the real wage rate on the demand and supply of labour must be recognized, and through it, the relationship between labour productivity and the real wage rate. We should also remember that the real rate of interest must be consistent with the efficiency conditions of production and the saving decision of the household sector.[3]

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[2] Simulations reported in this paper have been carried out using programs written in STATA. At the current stage of development, our programs are too slow to implement stochastic simulations involving a large number of replications. In order to incorporate a stochastic process generating the residual terms in some of our equations, we are currently rewriting our programs in FORTRAN. This will allow us to incorporate stochastic processes generating the residual terms of equations in our model and perform stochastic simulations.

[3] One way of handling this issue satisfactorily is to link the present model with a macro-econometric model, such as that maintained and operated by the Research Department of the Bank of Italy. Once the FORTRAN version of our model is operating, we believe such a link is well within our reach.

I. 5. Related literature on the subject

As detailed data on individual households have become more readily available and our ability to work with these large data sets on computers rapidly improved, more frequent attempts have been made to build dynamic micro-simulation models of household behaviour. As a comprehensive review of such models is outside the scope of this study, we confine ourselves to listing several studies that are closest to ours in design. Comprehensive reviews can be found in Harding (1996) and Zaidi and Rake (2001). Pioneering attempts to construct dynamic micro-simulation models are those by Orcutt (1957) and Orcutt et al. (1976), which led to the creation of the DYNASIM model for the United States. In the last two decades, a large number of dynamic micro-simulation models have been built for a number of countries.[4] Broadly speaking, they can be divided into two categories: dynamic cohort models and dynamic population models. While the former work with means of variables for cohorts of individuals, the latter (to which our model belongs) use individual observations and project their characteristics in the future. Most existing models normally contain a description of the demographic evolution (of individuals or cohorts of individuals), of social and economic attainments (labour market participation, employment status, etc.), of the income generating process, and often a fairly detailed description of the tax/benefit and social security systems. These models have been and are successfully used to study a number of important policy issues, such as the distributional effects of fiscal policies, the effects of ageing on fiscal budgets or the consequences of reforms to the social security systems.

With respect to these existing models, we believe that the main value added of our model is to introduce a detailed modeling of households' consumption and saving decisions, which is grounded in the life-cycle theory, and their relation to household characteristics. Ando (1996) and Cordoba (l996) report studies parallel to the present one using data sets for Japan and for the United States. Their studies are very similar to this one except that they worked with cohort means of variables rather than with observations of variables for individual households. For Italy, M. Baldini (1997) presents a dynamic cohort model

4 Some examples are DYNASIM-2 and CORSIM for the US, DYNAMOD and the Harding models for Australia, LIFEMOD for the UK, DESTINIE for France, MOSART for Norway. For an overview of these and other micro-simulation models see Harding (1996) and Zaidi and Rake (2001). An ambitious project is

describing the life cycle of a sample of four thousands individuals that is also drawn from the Bank of Italy Survey of Households' Income and Wealth.

I.6. Organization of the study

The remainder of this paper is organized as follows. Section II gives a brief survey of the main demographic changes under way in Italy and describes the dependence of economic behaviour, especially the pattern of savings by families, on their demographic and socio-economic characteristics visible in the raw data. Section III presents the dynamic model of demographic development. Section IV describes the mechanism generating the other characteristics of individuals that are needed to determine their economic behaviour, including the labour force participation status of working age individuals.

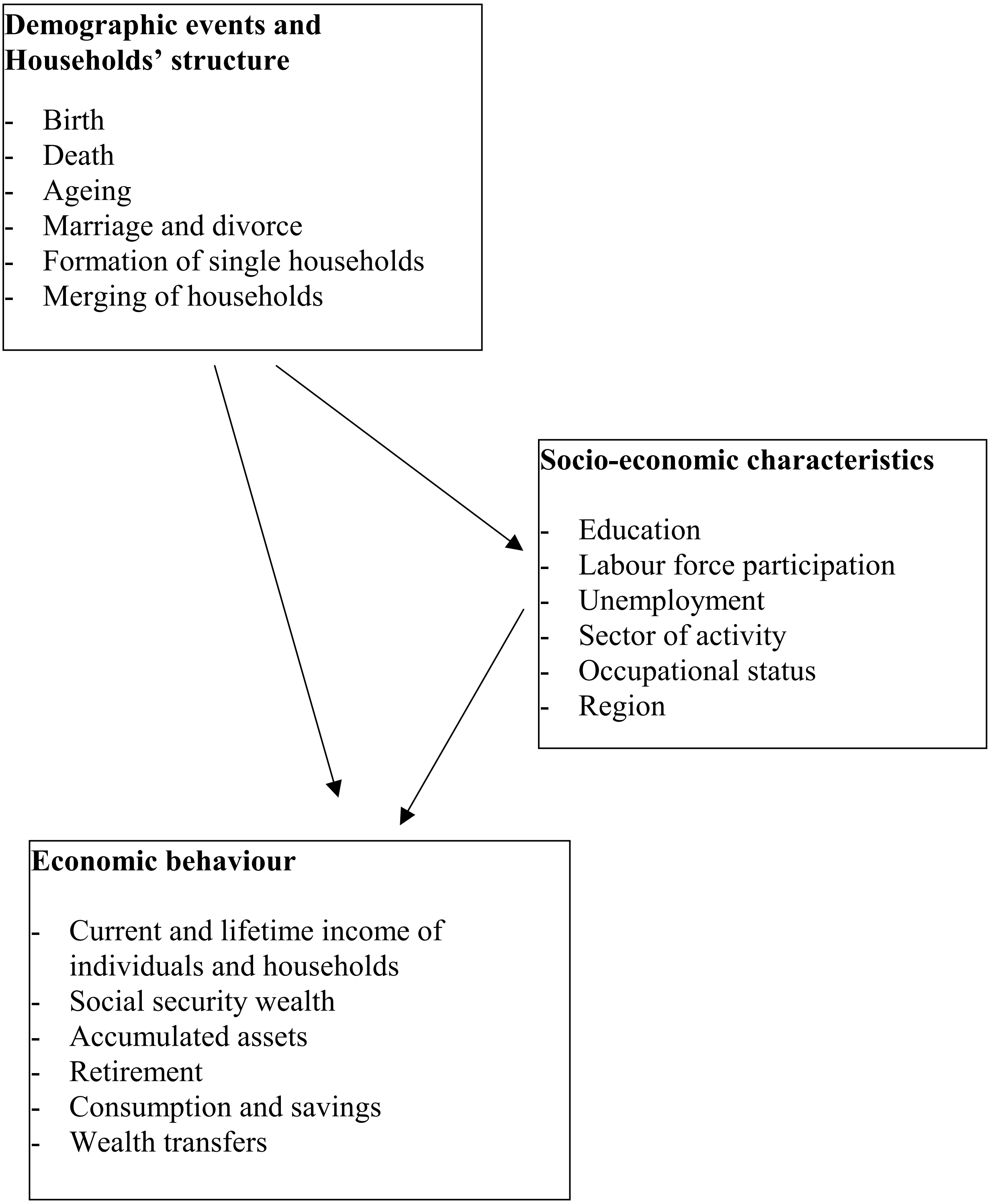
Section V presents the generation of the main economic variables of the simulation model and individual choices, include the prediction of households' total available resources, their saving and retirement decisions. This section also describes the rules governing the transfer of wealth among households. Section VI summarizes the main simulation results regarding demographic changes and the aggregate saving pattern that we may anticipate for the period between 1993 and 2100.

Finally, the Appendix describes the data set generated by the Bank of Italy Survey of Households' Income and Wealth and the modifications we have applied to this data set so that it can serve as the basis for the analysis reported in this paper.

EUROMOD (see Sutherland, ed., 2001) which is the first attempt to construct an integrated pan-European micro-simulation model.

Section I – Charts and Tables

Figure I.1. Overview of the micro simulation model



II Demographic characteristics and the saving behaviour of Italian households

II.1 Introduction

This Section is mainly descriptive. The intention is, on the one hand, to give a broad, synthetic picture of the structure of the Italian population and households and, on the other, to describe the link between the observed characteristics of households and their saving behaviour with the help of available micro data. This is organized as follows.

In Section II.2 we give a brief overview of the main demographic changes that have occurred in Italy in the recent past, providing some comparisons with the experience of other countries. The necessarily brief and incomplete investigation reveals that the main processes that are contributing to the deep changes in the structure of the Italian population are common to many other developed countries. However, some important differences can be seen in the intensity of some of these processes. In particular, the process of ageing of the population has been particularly pronounced and is likely to continue at a faster pace than in other developed countries. The degree of instability of living arrangements due to divorce and separation is increasing but is still much lower than observed in other developed countries. The reduction in the average number of members has been remarkable. Moreover, the structure of the Italian family presents some peculiarities. In particular, one of the main distinctive characteristics is that young people tend to live with their original families for a prolonged period and in a far greater proportion than in other developed countries, while cohabitation and living as singles when young are very limited phenomena.

In Section II.3 we briefly present the micro data that will be used in the next chapters to develop our micro simulation model.

In Section II.4 we use the micro data to describe the links existing between the demographic structure of Italian households and their saving behaviour.[5] We find that different types of households exhibit very different patterns of saving behaviour over their life. Also, an important contribution to the aggregate Italian saving rate comes from households in which several generations coexist and contribute to family expenditure and consumption. Most of these family units consist of couples or single parents living with adult

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5 A more formal, econometrically based analysis is conducted later in Section V.

children, many of whom are working. Both saving and retirement decisions of parents are strongly affected by the presence and characteristics of younger individuals.

Looking at the micro data from an historical perspective we find that changes in the demographic characteristics of households, and especially changes in the weight of different types of households, help to explain, at least in part, the reduction in the personal saving rate in Italy between the 1980's and the 1990's. Most of the decline is due, however, to an increase in the average propensity to consume across all groups considered.

The overall picture indicates that, in studying the saving behaviour of Italian households and projecting its possible evolution, it is important to take into account a broad range of demographic features and family characteristics.

II.2 Demographic evolution of the Italian population and the structure of the Italian family

II.2.1 Fertility, mortality and net migration: the evolution of total population and its age structure

Fertility and mortality rates

The decline in the number of new births in European countries reflects the secular tendency of the decline of total fertility rates (TFR; see Table II.1). In all countries the total fertility rate is below the rate needed to replace the existing population. The decline has been more pronounced in countries where the fertility rate was higher, with the result that today the degree of dispersion among the European countries is lower than it was 30 years ago. The Italian fertility rate was already below the average in 1960 and is today the lowest in Europe, with only 1.2 children per woman. The decline in the total fertility rate is the consequence of both the decrease in the desired number of children per woman and of the delay in the start of reproductive life. To disentangle data from this latter effect we also report the trend in fertility rates of successive cohorts of women born between 1930 and 1960. Even if the qualitative conclusions do not change, it is clear that the tendency towards a decline in the cohorts' specific fertility rates is milder than that of the total period fertility rates. In Italy, the TFR for the same period is well below that of the cohort rate. This is the consequence of the dramatic increase in the average age of the mother when the first child is born (from 25.5 to 27.5 in the ten years from 1983 to 1993).

Table II.2 reports the movement of life expectancy at birth and at various ages in the period from 1960 to 1995 for selected EU countries. The increase in life expectancy at all ages is a phenomenon common to all developed countries, and Italy is not an exception. It should be noted, however, that Italy presents a life expectancy at old ages that is above the average of the EU15 countries.

Total population

Fertility, mortality and net migration from other countries determine the dynamics of population. Table II.3 shows the trend in the total population for some selected countries and for the average of the EU15 between 1960 and 1995. From the 1980s, Italy's demographic dynamics tended to diverge from those of its European partners, resulting in an almost stagnant population. Only in the 1990s do we observe a degree of recovery, albeit at a remarkably lower rate than in the rest of the EU. Table II.4 presents a breakdown of the rate of growth of the total population in the component due to the natural balance and that due to net migration: in all the European countries there is a marked decline in the rate of natural growth, which is partially offset by an increase in net migration. The decline in the natural increase between the 1970s and the 1990s in Italy is extremely large, while the contribution due to net migration is smaller than in other countries. Together with Germany, Italy is the only country in which the increase in the total population in the 1990s is entirely due to migration.

Population structure by age

The decline in fertility rates, the increase in life expectancy and the relatively limited effect of net migration have already had a big impact on the age structure of the population (Table II.5). A synthetic comparison with other European countries is presented in Table II.8, which shows the dependency index of young people (the population aged up to 19 over the population aged 20 to 59) and of old people (the population aged 60 or more over the population aged 20 to 59). Italy has an old age dependency ratio of 39.5%, which is above the European average (37.1%), and a dependency ratio of young people of 38.2%, which is similarly well below the European average (43.1%).

Projections of the total population and its age structure

Table II.6 presents the expected variations in the total population by age groups in selected EU countries and for the average of the EU15 in the main variant projection prepared by Eurostat (1996).[6] Italy is the only country for which a decline in the total population is expected before 2020, with 1.8 million fewer young people and 3.8 million more old people. The demographic conditions are then expected to worsen even further between 2020 and 2050. The old age dependency ratio is expected to be one of the highest in Europe (Table II.9).

Figure II.1 presents the projected age structure of the Italian population according to three variants of the Istat (1997) projections. Even under the more optimistic scenario of high fertility and sustained net migration (1.76 children per woman and an average of 76 thousand net flows of immigrants per year), the proportion of the population aged 65 or over is predicted to increase from the present 17% to 30% in 2050.

II.2.2 Marriage, separation and divorce rates

Parallel to the decline in fertility rates and rise in the average age at the first birth, Italy, like other Western countries, has witnessed a continuous decline in the number of marriages per number of inhabitants (from the record high of 7.9 per thousand at the beginning of the 1960s to 4.9 in 1995) and an increase in the average age at the first marriage (Tables II.8 and II.9). Separations and divorces have also increased steadily, especially in the more recent period (the rate of dissolution of marriages has risen from 97.9 per thousand marriages in 1985 to 158.4 per thousand in 1995). Only slightly more than half of all legal separations actually end in divorce.[7] In Italy, however, marriage instability does not reach the level it has in other Western countries: the rate of divorce in 1995 was only 0.5 per thousand inhabitants as opposed to 2.9 in the United Kingdom, 2.5 in Germany, and 2 in France. If one considers, probably more correctly, the rate of legal separation, the picture does not change substantially, with an Italian rate of 1 per thousand inhabitants.[8] Similarly, cohabitation and

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[6] The main variant of the Eurostat projection is based on the assumption of a moderate increase in fertility rates (up to 1.65 children per woman), a moderate increase in life expectancy at birth (up to 80 years for men and 85 for women in 2050) and a reduction in flows of net migration of 20% from 1995 to 2020 and stabilization thereafter.

[7] This is due to a number of factors, among which the most important are the fear of having to go through another round of legal proceedings and changing previous agreements, the limited propensity to re-marry and, last but not least, the desire to maintain the right to pension benefits for the survivors.

[8] With the rise in cohabitation in most countries the issue of the dissolution of unions is becoming more complex as the true number of separations is not captured. In Italy, as in other southern European countries, cohabitation still seems to be somewhat rarer than in northern Europe. See Kiernan (1996) for an international comparison.

extra-marital births are rare phenomena in Italy if compared with other countries, even if they seem to be in rapid expansion, especially in large urban areas.[9]

II.2.3 Family types and family size

The history of the structure of the Italian family in the post-war period has been characterized, as in many other industrialized countries, by the progressive emergence of the "nuclear family" (a family with only one nucleus) and the progressive disappearance (especially in the north of Italy) of "multiple" families related to the agricultural society of the pre-war period.[10] Today, the predominant family structure is that of one couple (68.5% of the total number of families in 1995). However, like other developed countries and as a consequence of some of the phenomena described above, some important changes are under way. Table II.10 shows the evolution of the proportions of principal household types in Italy in the recent past, according to various sources. The most evident trends are: (i) the decrease in the proportion of couples with children and an increase in those without children (from 56% and 17.3%, respectively, in 1971 to 47.7% and 20.8% in 1995); (ii) the sharp rise in the proportion of households formed by a single person (from 12.9% in 1971 to 20.5% in 1995); and (iii) the mild increase in the proportion of single-parent households (from 7.1% in 1983 to 8.1% in 1995).

While this evolution is in line with what is observed in other countries, some differences emerge. In particular, the increase in the proportion of singles appears to have been less pronounced than in other countries, especially at young ages.[11] This is mainly because the increase in the average age at the first marriage has been matched by a prolonged stay within the original family, a phenomenon that is typically Italian. Table II.11 shows the composition of individuals aged 18 to 39 according to official statistics: in 1995 only about

[9] According to official statistics (Istat, 1997) families composed of non-married couples represented only about 2% of the total number of family couples in 1994. Only a small percentage of marriages are preceded by cohabitation (8% in 1994 as opposed to 3.5% in 1983) and extra-marital births represented about 7-8% of the total number of births in 1994. There are, however, many reasons to believe that these figures are underestimates of actual figures (see Zanatta (1997).

[10] The structure of Italian families still varies very markedly according to geographical area (the southern versus the central and northern regions and urban versus non-urban areas). For a detailed discussion see Golini (1988) and Barbagli (1988). More recent changes in the Italian family structure are described in Barbagli and Saraceno (1997) and Saraceno (1998).

4% of the total were living as singles and more than 45% lived in their original family. According to Istat (1997), more recently there has been an increase in this phenomenon: the proportion of young individuals aged between 18 and 34 living with their parents increased from 51.8% in 1990 to 58.5% in 1996 (Istat, 1997). Among the causes of this behaviour, the most important seem to be the prolonged period of education, the difficulty of finding a home or of obtaining a mortgage, the uncertainties of the labour market and the difficulty of finding a job, especially more recently . The increased proportion of young individuals living with their parents in the recent past has paralleled the rise in the unemployment rate among young people.

The gradual disappearance of "multiple" families, together with the increase in the number of couples without children, of singles and of single parents, has caused a continuous reduction in the average size of households. Table II.12 shows the remarkable increase over time of the percentage of families composed of one or two persons and the gradual disappearance of large families with five or more components. The average number of family members has declined continuously from 4.0 in 1951 to 2.8 in 1995.

II.3. The micro data set

In order to analyze the relation between the structure of households and their economic behaviour we need, of course, household survey data.

The basic source of data for this purpose and for the development of the micro simulation model in the following sections is the Survey of Household Income and Wealth (SHIW), the household survey sponsored by the Bank of Italy. In this section we only give a very brief overview of the Survey and describe some modifications that we have made to the original survey data for the purpose of building our model. A detailed description of the data can be found in the Appendix.

The main purpose of the SHIW is to collect data on household consumption, income and wealth.[12]

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[11] Attanasio et al. report an increase in the proportion of singles in the United Kingdom from 16% in 1968 to 27% in 1996. In the U.S. the proportion of singles increased from 17.1% in 1970 to 24.6% in 1990 (see J.P. Cordoba (1997)).

[12] In particular, the SHIW is the only reliable source for the analysis of household income and wealth in Italy. These data are not available in the Italian survey of consumer expenditure run by Istat, the Italian public

The unit of observation is the family, which is defined as including all persons residing in the same dwelling who are related by blood, marriage or affection. For each family member detailed information is also given on his/her age, sex, education, employment status, sector of work and other social characteristics. Data on consumption expenditure is collected separately as durable and non-durable components: further disaggregation is not available. More detailed information is available on income: net income receipts are collected for each income earner in the family, divided by type of income (dependant payroll employment, self-employment, pension benefits and other transfers, interest income, etc.). Information on taxes is not collected. Information on households' real estate is very detailed and, since 1987, fairly detailed information on financial assets and liabilities holdings has also been collected.

We made a careful comparison of the survey data with the National Accounts (NA) data for the households and individual firms sector,[13] in order to assess the comparability between the two sources of data.[14] We found that NA income is underestimated by 25% to 35% by survey data (depending on the survey), while the underestimation of consumption expenditure ranges between 35 and 40%. The underestimation of income is particularly severe for some categories, especially for the self-employed and for interest receipts.

Since the main purpose of our analysis is to give a description of the behaviour of families so as to provide an insight into the aggregate behaviour of the Italian economy, we have decided to take the extreme position of re-proportioning the survey data on income (by type of income) and consumption to exactly match the corresponding NA figures for the household sector. In so doing we have been careful to maintain, as far as possible, the distribution of the variables observed in the data of the original surveys.[15]

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statistical agency. The latter provides, however, far more detailed statistics on household consumption expenditures.

13 This is the institutional sector that most closely matches the sort of data collected in the surveys. Individual firms are defined as firms employing fewer than 15 employees.

14 As explained in the Appendix, the comparison between the survey data and the NA aggregates requires a number of assumptions, some of which are necessarily arbitrary. In particular, it is often necessary to make a slight change to the definition of the NA aggregates of reference or the survey measures in order to obtain a common base of comparison between the two sources. In addition, the comparison is made more difficult in Italy by the uncertainty surrounding the size of the total population. For a similar exercise on the SHIW surveys up to 1989, see Brandolini (1993).

15 Again, the full details are given in the Appendix. The re-proportioning procedure entails a series of assumptions that are needed, in particular, to re-allocate personal taxes to the various types of income (the breakdown is not given in the National Accounts) and to attribute tax evasion to the different incomes.

For households' financial wealth, which severely underestimates the corresponding figure of the National Financial Accounts, we have adopted the adjustment developed by Cannari and D'Alessio (1993). This is a non-proportional adjustment obtained by matching the survey data, for a series of defining characteristics of households, with data of clients in the banking system. After this adjustment, the total value of financial wealth held by the households covered by the survey represents almost 90% of the corresponding total obtainable from the flow-of-funds statistics. Using this reconstructed level of financial assets we have corrected disposable income (re-proportioned to the NA figures) to take account of the effect of inflation ("Hicksian correction").

The final result of the adjustments on the average consumption over income ratio can be viewed in Table II.13, where we have pooled together all the surveys between 1987 and 1995. The adjustment to NA figures increases the average propensity to consume by 9 percentage points (consumption is more underestimated than income, as already mentioned), while the adjustment for inflation increases it by 6.3 points. The age pattern of the average propensity to consume remains relatively flat for old age classes, as in the original survey data. This pattern is explored in more detail in the next section.

II.4. Household characteristics and savings in Italy: an overview of the data

II.4.1. Household types and the age pattern of savings

After a preliminary investigation, we have defined five types of households that seem to be relevant for the analysis of saving behaviour. We first distinguish families (i.e., households formed by one couple alone and/or with other members) from single-parent households and singles. Families and single-parent households are further split into nuclear and non-nuclear households. Nuclear households are defined as households composed of a couple or a single head with or without dependant children; non-nuclear households are defined as residuals and therefore include all households in which different generations coexist and share income and expenditure.[16] The five types of households are therefore:

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[16] This definition therefore also includes, but should not be confused with, the multiple families typical of the agricultural society of the past, which have now almost disappeared, as we have already mentioned. As we shall see, non-nuclear households are mostly made up of families or single-parent households with adult working children, who are not married and have not yet formed a new household.

Nuclear families: These are the closest to a traditional family living arrangement. They are composed of a head (male or female) and a spouse or partner,[17] and they may or may not have young dependants. Young dependants are defined as any children under 18 (own offspring of the head and/or spouse/partner or not) or any adult child not working.

Non-nuclear families: These are defined as all residual families. They therefore also include all families in which adult children (older than 18) work.

Nuclear single-head households: These are households composed of one head (male or female), young dependants (defined as above) and no spouse or partner.

Non-nuclear single-head households: These are defined as all residual single-head households.

Singles: These are the simplest types of households, composed of just one person (male or female) living alone.

Table II.14a presents the distribution by age of income, consumption saving rates and other selected variables from the SHIW for all households and for different household types, while Table II.14b shows the breakdown by age and sex.[18] Clearly, it should be kept in mind that cross-section data can be misleading as a single household can belong to different groups or types of households over its life. A more rigorous statistical analysis will be presented in Section VI. Nevertheless, some features of the simple descriptive statistics deserve attention.

The breakdown by type of household reveals that the saving pattern of the different types differs greatly. Nuclear families save very little up to age 40 and present a relatively flat saving rate thereafter. Nuclear single-head households continuously dissave through their life. Singles present a relatively U-shaped saving profile by age. But perhaps the most interesting feature of Tables II.14a and II.14b is that non-nuclear households (both families and single-head households) tend to show much higher income and lower consumption-to-income ratio than nuclear families during their whole life and especially at old age. It should be noted that these households represent a considerable proportion of the total number of

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[17] Note that we have not made any distinction between married and unmarried couples. A preliminary investigation has shown that the behaviour of unmarried couples does not appear to diverge substantially from that of married couples of the same age group. Furthermore, as we have already seen, unmarried couples still represent a small minority.

[18] The table has been obtained by pooling all five surveys from 1987 to 1995. In addition, the figures refer to the data re-proportioned to the National Accounts data and are expressed at 1995 prices.

households, especially in the age group 50 to 60 (47%) and 60 to 70 (33%), and that their saving rate at that age (when most of the saving is done) is about 10 percentage points higher than for traditional nuclear families. The contribution of non-nuclear households to aggregate saving can be appreciated by looking at Table II.16: while accounting for one-fourth of the total number of families, they contribute to almost two-thirds of the total saving of the Italian household sector. It would be tempting to say that the Italian saving rate is high (by international standards) because of the presence of these households.

On the assets side, households headed by old people tend to have larger asset-income ratios, as is also found in many surveys of other countries.[19] Again, a clear difference between nuclear and non-nuclear households can be observed. On average, the asset-income ratio is much lower for non-nuclear households at old ages. This is to be expected, since these households are formed by young and old generations living together and contributing to the household income: their income is high, on average, compared with their accumulated assets. Singles are the only group for which the asset-income ratio shows some sign of decline after age 70.[20] This might be an indication of a lower bequest motive for saving in this group.[21] Nuclear single-head households continuously dissave across their life but, in spite of this, they possess on average a substantial amount of assets. As observed by Ando (1996), this is the consequence of a complex process of movement in and out of the group, in which households headed by a woman (representing the vast majority of such households, as can be gathered from Table II.14b) are created by divorce or widowhood. In general, the older the newly created household, the larger its starting net worth. At the same time, existing female-headed single-parent households disappear because of remarriages if they are relatively young, or through merging into younger households, especially if the former are older and their net worth is small.

Households headed by females save less than male-headed households in almost all age groups. This is a consequence of the fact that these households are, on average, relatively

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[19] For example, see Quadrini and Rios-Rull (1997) for the U.S., Ando and Moro (1995) and Ando (1996) for Japan.

[20] However, since we are not adjusting the level of assets for the cohort-specific productivity level, caution must be used in interpreting the figures over different age groups. On this issue, see Ando, Guiso and Terlizzese (1994).

[21] Clearly, however, many old people living alone might have children and leave bequests. The possibility of inter-vivos transfers might further complicate the analysis. See Cox (1992) and Guiso and Jappelli (1995).

poorer and a greater proportion of them consists of nuclear single-parent households and singles (especially at old ages) – that is, by groups with very low saving rates.

In Tables II.14a and II.14b we also report the ratio for consumption over total resources. Total resources are defined as the sum of assets, expected lifetime income and expected gross social security wealth (the details of the construction of this variable will be given in Section V). According to the life-cycle hypothesis, the consumption/total resources ratio should increase smoothly as individuals age and increase at faster rates as they become old. This pattern is clearly present for nuclear households and single persons. For non-nuclear households, however, the ratio peaks in the age group 50-60 and then stops or even decreases at later ages. The presence of young working individuals in these families (their total resources and their consumption choices) becomes relatively more important as the head of the household ages.

Looking at the life pattern of saving for the total number of households in Tables II.14a and II.14b, one could argue that there is not much evidence of a life-cycle pattern of saving behaviour. However, as pointed out by Modigliani and Jappelli (1998), the saving rates computed on microeconomic data are based on a concept of disposable income that does not take into account the presence of pension arrangements. In particular, the traditional definition concept of income, which we have adopted, treats contributions to social security as personal taxes and pension benefits as transfers. Alternatively, one could consider social security contributions as (mandatory) saving and pension benefits as drawings from the pension wealth accumulated up to retirement. We have reported the age pattern of the saving rate computed using this alternative definition in Table II.15. In particular, following Modigliani and Japelli we define ‘total saving’ as the difference between earned income (i.e., earnings plus capital income, but with the exclusion of pensions) and consumption, while ‘private saving’ (also reported in Table II.15 for comparison) is defined as the difference between disposable income (as traditionally defined) and consumption. It is obvious from the tables that the difference between these two measures is quite dramatic especially in old age classes, reflecting the very high social security contributions levied by the Italian pension system and the fact that pension benefits represent an extremely large part of the disposable income of Italian households after retirement.[22] Total saving is negative for households headed by individuals aged over 60s for most household types. Nevertheless, large differences are still visible across different types of households and it is worth noting that non-nuclear families still show substantial saving rates even when the alternative (total saving) definition is adopted.

In the rest of this work we will continue to refer to the traditional definition of disposable income (and therefore of saving) while keeping in mind, however, the implications of the pension arrangements and referring to the alternative definition when needed.

II.4.2. Family size and the number of income earners

Differences in household types are clearly related to the number of components and of income earners present in the household (non-nuclear households tend to have a larger number of both). The relation between household size and saving is illustrated in Table II.17. Apparently, for households headed by relatively old people (from age 50 onward) one might be tempted to argue that the relation between family size and saving is positive, with larger households consuming relatively less of their income. It is clear, however, that the crucial variable here is the number of income earners: for a given number of earners the consumption-income ratio increases with family size, as expected. It is worth noting that households with only one income earner do very little saving, even at ages at which most saving is usually made.

II.4.3 Non-nuclear households

II.4.3.1 Young working individuals living with their parents

Non-nuclear households are mainly composed of households whose head is aged between 50 and 70 and in which at least one working child is present.[23] As we have already said, children in Italy tend to live with their parents for a longer time and in a much greater proportion than in other industrialized countries. According to the SHIW (see Table II.18, in which various aspects of the phenomenon are reported) the proportion of young individuals

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[22] We address the issue of the impact of social security provisions on the consumption-saving choices of households in some detail in Sections V and VI.

[23] Non-nuclear households with young working children represent 64% of the total number of non-nuclear households. This percentage reaches 75.7% in the 50-70 age group.

living with their parents (on average in the period between 1987 and 1995) is as high as 85% up to age 25 then declines to 47% between age 25 and 30 and is still about 20% in the 30-35 age group. A large proportion of these individuals are working (45% in the 20-25 age group and over 60% in older age groups) and a considerable percentage is unemployed (almost 20% in the 20-30 age group).

Among the possible economic causes of this behaviour one certainly seems to be the possibility of saving more, especially with a view to buying a house.[24] The young individuals can take advantage of the economies of scale generated by living at home, partially compressing their housing consumption (and that of their parents) in order to save more. Table II.19 reports an (admittedly rough) measure of the implicit saving of young working individuals staying at home. Column A shows income, consumption and the saving rate of pure nuclear families whose head is aged between 55 and 65. Column B does the same for families of the same age group having one, and only one, young working child aged between 25 and 30. Column C reports the figures for a young individual aged between 25 and 30 living alone. Finally, column D presents the sum of columns A and C and represents a fictitious family comparable with that in column B. The saving-to-income ratio of the extended family in column B is 0.22 while that of the fictitious family in column D is 0.032. The qualitative result does not change if we further restrict the sample to compare more similar couples in the 55-65 age group.

Another important economic reason for the prolonged presence of young individuals in their parents' house is the income and job uncertainty that characterize the labour market for young individuals, especially in the most recent past. As shown in Table II.18, the proportion of young individuals living at home is high in areas where the unemployment rate for the young is high, and has increased the most in areas where the unemployment rate has risen the most (notably in the centre of Italy).

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[24] For a discussion of this issue, see Ando, Guiso and Terlizzese (1994). The need to accumulate substantial assets to buy a house is related to the conditions of the Italian credit market. As Guiso, Jappelli and Terlizzese (1994) show, down-payments are very large in Italy compared with other countries (often well above 50%) and the cost of mortgages is higher. Analyzing the 1991 SHIW, Guiso and Jappelli (1996) report that only 10.2% of the households have mortgage debt and, on average, outstanding housing liabilities represent only 2.4% of the gross value of the house. They also report that the saving time for houses (defined as age at acquisition less 25) was around 10 years, substantially above the experience of other countries (2-3 years in the U.S., for example).

II.4.3.2 Older individuals merged with younger families

The phenomenon of old people merging with their children appears to be relatively less important. Only around 6% of the individuals aged between 50 and 65 live with their children; the percentage then rises to 20% in the 76-80 age group and to 34.5% for people over 80 years of age (see Table II.20). These figures are far below those reported, for example, by Ando (1996) for Japan, another country where family ties are close.

Table II.21 repeats the previous simple exercise done for young working individuals. The qualitative effect of the presence of an older person living with a younger household is the same as that of the young working individual; i.e., households with the addition of the old person save significantly more than the fictitious household obtained by summing the nuclear household and the old person living alone. It may also be observed that the old person living with the younger household seems to be poorer than the corresponding old person living alone (the difference of the income in columns B and A as opposed to the income in column C). As in the Japanese case, this fact therefore helps to explain the relative little dissaving that we observe at old ages: relatively poorer old people tend to merge with younger households so that the remaining households are relatively wealthy and high saving.

II.4.4 Young dependants

The relation between saving and the number of young (non-working) dependants present in the household is shown in Table II.22. As one would expect, the higher the number of young dependants, the lower the saving in any given age group. However, this does not necessarily imply that households with more young dependants will actually accumulate less during their life-time: the pattern of the consumption/total resources ratio by number of young dependants is in fact fairly flat after age 40, and it becomes even negatively sloped at older ages (and this still holds true when we control for the number of income earners in the family). The apparent contradiction between a declining saving rate out of current income and a stable or increasing saving rate out of total resources can be resolved by looking at the retirement behaviour of the head of the household. Table II.23 shows the proportion of heads of household who are already retired and the planned retirement age (collected in the SHIW for each working individual) of the head in relation to the number of income earners. The retirement age is clearly strongly positively correlated with the number of young dependants present in the family, a phenomenon that tends to increase the total resources available relative to the consumption needs of the households.[25]

II.4.5 An alternative definition of the head of the household

It is clear from the above discussion that a potential problem in evaluating the lifetime saving pattern for Italian households is that many of them are made up of several generations living together. In these circumstances, it is unclear which is the relevant "age of the household" to be considered when analyzing the life pattern of saving. Following tradition, we have identified the age of the household with the age of the head. In the SHIW the latter is identified during the interviews as the person who is "mainly responsible for economic decisions". A possibly more objective way of proceeding might be to define the head of the household as the person earning the highest income.[26] It seems worth checking whether this alternative definition would change the broad picture outlined above. On average in the SHIW covering the period from 1987 to 1995, 8.9% of all households would have a different head if the alternative definition were adopted (see Table II.24). In almost half of the cases the new head would be the partner of the original head, and most of these cases occur in non-nuclear households. In Table II.25 we report the pattern of the ratios of consumption and net worth over income by age and family type when the head is redefined as the main income earner in the household. As can be seen easily by comparing these figures with those of Table II.14, the pattern is very similar to that observed using the original definition.

II.4.6 Demographic changes and the decline of the saving rate in the households sector

The past 20 years have witnessed a substantial decline in the aggregate saving rate of the private sector in Italy. The National Accounts record a drop in the personal saving rate of more than 6 percentage points (from 20.4% in 1980-81 to 14.1% in 1994-95) in a 15 year period. In this section we try to assess whether the changes in the demographic characteristics of Italian households that we have outlined above help to explain the observed reduction in the private saving rate. To this end, we use the Historical Database of the SHIW.

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25 This issue will be further discussed in Section V, where we show that the age difference between the head and the young dependants is also an important factor.

26 This is the case, for example, for the National Survey of Family Income and Expenditure in Japan analyzed by Ando (1996).

In this data set the original SHIW data have been adjusted to enhance their comparability over time (see D'Alessio, 1998).[27] On the other hand, income and consumption in this data set are not rescaled to match the corresponding National Accounts data. It also excludes interest received from the definition of income because the necessary information is not available before 1987. For these reasons, an analysis based on the Historical Database is not easily comparable with results reported in other parts of this paper. In spite of this, the Historical Database of the SHIW shows a historical pattern of the saving rate similar to that derived from the National Accounts, with a fall in the implied aggregate saving rate of more than 4 percentage points (from 27% in 1980-81 to 22.7% in 1995). Following the methodology of Bosworth et al (1991) applied by Cannari (1994) to the case of Italy,[28] the importance of demographic changes can be assessed using two successive cross-section data sets. In a given year t the sample can divided into G_h groups according to a classificatory variable h. The economy-wide average propensity to save in period t is given by:

$$C_t = \sum_{i=1}^{G_h} w_{it}^h y_{it}^h s_{it}^h \qquad (1)$$

where w^h_{it} is the proportion of households in the i-th group, y^h_{it} is the average income for the i-th group, and s^h_{it} is the average saving of the i-th group. Using equation (1), replacing w^h_{it} with $w^h_{it'}$ and setting t' = 1980-81 and t = 1993-95, we can estimate the economy-wide propensity to save that we would have observed had the total weight of the different groups with respect to variable h remained at the values observed on average in the 1980-81 surveys and had the propensity to save of the different groups been that observed on average in the 1993-95 surveys. This gives us the hypothetical propensity to save in 1993-95 if the distribution of the population and of income with respect to variable h had remained the same as in 1980-81.

Table II.26 (column A) shows the results obtained by splitting the sample according to a number of household characteristics; column B reports the difference between the

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27 In particular, weights attached to households have been re-proportioned for each survey using an iterative method to match the distribution of some socio-demographic characteristics of the population provided by official statistics (sex, age, region of residence, demographic dimension of town of residence, labour force characteristics). In addition, data for income components, consumption and wealth have been re-calculated using homogeneous criteria over the different surveys. See D'Alessio (1998).

estimated average propensity to save and the observed value in 1993-95. As shown in the table, demographic changes alone cannot fully explain the decline in the saving rate, and in this sense the results found by Cannari (1994) are confirmed. However, it is interesting to note that the change in the weights of different household types (using the definition outlined in the previous paragraphs) is the most significant factor among those considered, accounting for a reduction of 1.7 points in the aggregate saving rate and 40% of the total decline. The contribution made by the change in the age distribution of the population is very small (0.3), while that of changes in the number of children and income earners in the family is nil.

As is well known, this methodology is based on the assumption that changes in the demographic structure do not affect the propensity to save of any population group, an assumption that is not necessarily valid.[29] In Table II.27 we decompose the contribution to aggregate saving and to the change in the aggregate saving rate in the two sub-periods for the different family types in the basic components of equation 1. Across all groups, in addition to changes in weights, we can see that changes in the propensity to save have not been negligible; in fact, they have been particularly marked for some household types. It is noticeable that two-thirds of the total change in the ratio of aggregate saving to income across the two sub-periods is accounted for by non-nuclear families, whose contribution to aggregate saving has declined from 0.11 to 0.08. Changes in the relative weights and propensity to save of other groups have been far less significant.

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[28] Cannari (1994) uses the original SHIW data and his analysis ends in 1989; he does not consider the evolution of family types, a variable of interest to us.

[29] A number of arguments against this assumption have been put forward in the literature. For example, a decline in the fertility rate might weaken the bequest motive for saving. In models with endogenous fertility there might exist complex relations between saving behaviour and decisions to have children (see Becker (1991) and Cigno and Rosati (1993), among others). A higher instability of living arrangements caused by an increase in the divorce rate might reduce the incentive to save (Cubeddu and Rios-Rull, 1997).

Section II - Charts and Tables

Figure II.1: Age composition of the population in 2050 in three projection variants
(source: Istat 1997)

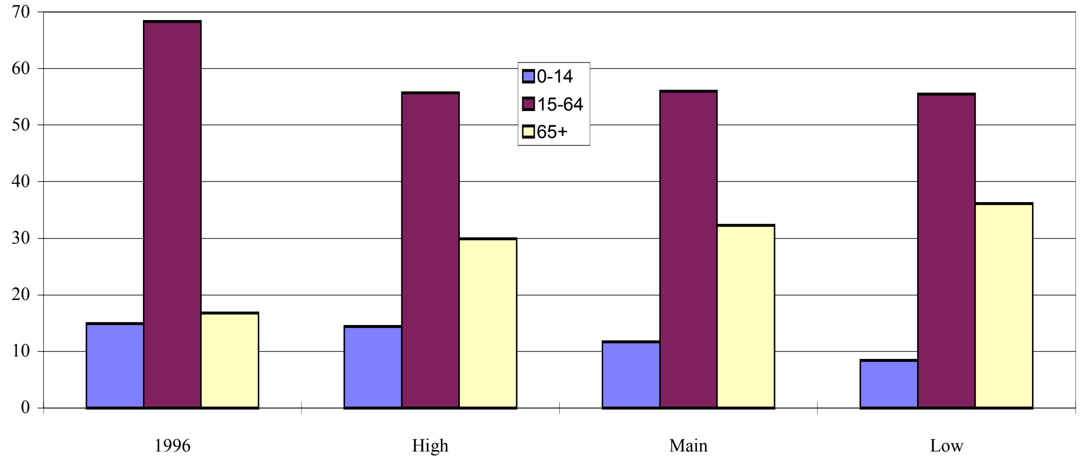

Table II.1: Total and cohort-specific fertility rates
(source: Eurostat 1996)

	Total fertility rate			Cohort fertility rate			
	1960	1994	change	1930	1940	1950 (*)	1960 (*)
France	2.73	1.65	-1.08	2.64	2.41	2.11	2.07
Germany	2.37	1.26	-1.11	2.17	1.98	1.72	1.63
Italy	2.41	1.22	-1.19	2.29	2.14	1.90	1.63
U.K.	2.72	1.74	-0.98	2.35	2.36	2.03	1.94
Spain	2.86	1.22	-1.64	2.59	2.59	2.19	1.69
EU15	2.59	1.45	-1.14			1.96	1.80

(*) Estimated.

Table II.2: Life expectancy at various ages in 1995
(source: Eurostat 1996)

	Males		Females	
	60	75	60	75
France	19.7	9.9	25.0	12.7
Germany	18.2	8.8	22.5	11.0
Italy	19.0	9.4	23.4	11.5
U.K.	18.3	8.8	23.3	11.4
Spain	19.4	9.4	23.9	11.6
EU15	18.5	9.0	23.0	11.3

Table II.3: Total population

(In millions at the beginning of the year; source: Eurostat 1996)

	1960	1970	1980	1990	1995
France	45.5	50.5	53.7	56.6	58
Germany	72.5	78.3	78.2	79.1	81.5
Italy	50.0	53.7	56.4	56.7	57.3
U.K.	52.2	55.5	56.3	57.5	58.5
Spain	30.3	33.6	37.2	38.8	39.2
EU15	314.8	340.0	354.6	363.7	371.6

Table II.4: Annual rate of change of total population

(per 1,000 inhabitants; source: Eurostat 1996)

	Natural balance		Net migration		Total balance	
	70-'74	90-'94	70-'74	90-'94	70-'74	90-'94
France	5.8	3.7	2.2	1.3	8.0	5.0
Germany	-0.7	-1.0	2.2	7.0	1.6	6.0
Italy	6.7	0.1	-0.8	1.9	5.9	2.0
U.K.	3.0	2.3	-6.0	1.2	2.4	3.6
Spain	11.1	1.4	-0.9	0.5	10.2	1.9
EU15	4.5	1.4	0.6	2.9	5.0	4.3

Table II.5: Resident population by age

(as a percentage of total population; source: Istat)

	Censuses			Current survey
Age class	1971	1981	1991	1996
TOTAL: <5	8.2	6.0	4.9	4.8
5-14	16.3	15.5	11.0	10.1
15-19	7.1	8.3	7.6	6.1
20-39	27.9	27.4	30.1	30.9
40-59	23.9	25.4	25.3	25.6
60-74	12.7	12.7	14.4	15.8
75+	3.9	4.7	6.7	6.7
total (thousands)	54137	56557	56778	57333
MALES: <5	8.6	6.3	5.1	5.1
5-14	17.0	16.3	11.6	10.6
15-19	7.4	8.7	8.0	6.4
20-39	28.6	28.2	31.3	32.1
40-59	23.6	25.4	25.6	26.0
60-74	11.8	11.6	13.4	14.8
75+	3.0	3.5	5.0	5.0
total (thousands)	26476	27506	27558	27817
FEMALES: <5	7.8	5.6	4.6	4.5
5-14	15.5	14.7	10.4	9.6
15-19	6.8	7.9	7.2	5.8
20-39	27.3	26.7	29.1	29.6
40-59	24.2	25.5	25.1	25.3
60-74	13.7	13.7	15.4	16.8
75+	4.7	5.9	8.2	8.4
total (thousands)	27661	29051	29220	29516

Table II.6: Expected change in total population from 1995, by age class

(in thousands; source: Eurostat 1996)

	Year	Age class				Total
		0-19	20-59	60-79	80+	
France	2020	-1021	603	4002	1229	4811
	2050	-2269	-2470	4950	3831	4043
Germany	2020	-1612	-1902	4934	1700	3131
	2050	-3778	-10377	5023	1617	-4450
Italy	2020	-1763	-2790	2293	1534	-726
	2050	-3842	-9749	2167	3441	-7982
U.K.	2020	-1527	483	2947	643	2546
	2050	-2551	-3468	3551	3292	823
Spain	2020	-1668	416	1402	980	1127
	2050	-3345	-4704	3064	2546	-2444
EU15	2020	-8704	-2820	20562	7456	16495
	2050	-17844	-33917	24782	22380	-4600

Table II.7: Dependency ratio in year 1995 and projections to 2020 and 2050

(per cent; source: Eurostat 1996)

	Young			Old			Total		
	1995	2020	2050	1995	2020	2050	1995	2020	2050
France	48.6	44.4	44.8	37.1	52.9	70.8	85.7	97.3	115.7
Germany	37.3	35.3	37.5	35.8	52.0	64.0	73.1	87.3	101.5
Italy	38.2	35.8	37.7	39.5	56.2	81.5	77.7	92.0	119.2
U.K.	46.7	41.3	43.4	37.8	48.4	66.7	84.5	89.7	110.1
Spain	46.0	37.4	38.9	37.9	48.2	82.5	83.9	85.6	121.4
EU15	43.1	39.4	41.2	37.1	51.4	71.8	80.2	80.2	113.0

Notes: Young dependency ratio: population aged up to 19 over population aged 20 to 59. Old dependency ratio: population aged 60 or more over population aged 20 to 59

Table II.8: Number of marriages, separations and divorces

(absolute values; source: Istat)

Years	Marriages		Separations	Divorces
	Abs. value	per 1,000 inhab.		
1951	328255	6.9	5196	
1961	397461	7.9	6032	
1971	404464	7.5	19338	17134
1981	316953	5.6	30899	12606
1991	312061	5.5	44920	27350
1992	312348	5.5	45754	26997
1993	302230	5.1	48198	23863
1994	291607	5.1	51445	27510
1995	283025	4.9	52323	27038

Table II.9: Distribution of first marriages by age
(percentage values; source: Istat)

	Males		Females	
Age class	1984	1994	1984	1994
16-19	1.6	0.7	16.5	5.9
20-24	32.5	15.0	51.8	36.7
25-29	45.1	48.9	23.6	40.9
30-34	14.5	25.8	5.4	12.8
35-44	5.1	8.4	2.1	3.2
45+	1.2	1.2	0.6	0.5
Total	100.0	100.0	100.0	100.0

Table II.10: Principal household types
(percentage values; source: Istat)

	1971	1983	1987	1995-1996
Single persons	12.9	13.0	18.4	20.5
Couples with children	56.0	57.3	53.3	47.7
Couples without children	17.3	18.3	19.1	20.8
Single parents with children	8.0	7.1	7.7	8.1
Other	5.8	4.3	1.5	2.9
Total	100.0	100.0	100.0	100.0

Table II.11: Individuals aged 18 to 39, composition by sex and role in family
(years 1995-96; percentage values; source: Istat)

	Males	Females
Single	5.1	2.9
Children	53.4	40.2
Married	38.1	51.2
Partnership	1.2	1.6
Other	2.2	4.1

Table II.12: Distribution of households by number of components

(years 1951-96; percentage values; source: Istat)

	Censuses					Current surveys
Components	1951	1961	1971	1981	1991	1995-1996
1	9.5	10.6	12.9	17.9	20.6	20.5
2	17.4	19.6	22.0	23.6	24.7	26.3
3	20.7	22.4	22.4	22.1	22.2	23.2
4	19.0	20.4	21.2	21.5	21.2	21.8
5	13.3	12.6	11.8	9.5	7.9	6.5
6	8.4	7.0	5.3	3.4	2.4	1.7 (*)
7+	11.7	7.4	4.4	2.0	1.0	
Total (thousand)	11814.0	13747.0	15981.0	18632.0	19909.0	20855.0
Mean number	4.0	3.6	3.4	3.0	2.8	2.8

(*) 6 or more members

Table II.13: Comparison between original SHIW and SHIW adjusted to National Accounts

(1987-1989-1991-1993-1995 SHIW data)

	Original survey data	Adjusted to N.A			
	C/Y	C/Y	C/Y*	A/Y*	W/Y*
Totals:	0.742	0.834	0.898	1.776	5.191
by age groups:					
<30	0.816	0.996	1.023	0.628	3.461
31-40	0.785	0.947	0.980	0.813	3.670
41-50	0.756	0.880	0.926	1.200	4.675
51-60	0.716	0.803	0.863	1.727	5.457
61-70	0.702	0.732	0.822	2.842	6.496
71-80	0.723	0.726	0.838	3.558	7.076
>80	0.733	0.690	0.820	4.358	7.500

Legend:
C: total consumption expenditures
Y: total disposable income
Y*: inflation-adjusted total disposable income
A: total financial assets (adj. for non-reporting and under-reporting)
W: total assets (adj. for non-reporting and under-reporting)

Table II.14a: Selected economic variables by family type and age

(1987-1989-1991-1993-1995 SHIW data at 1995 prices - thousands lira)

Family type		Age class						
		<30	31-40	41-50	51-60	61-70	71-80	>80
All families:								
	Consumption	53475.1	58309.0	63925.0	61837.5	44044.5	31117.2	26787.4
	Income	52281.6	59876.0	68831.7	72099.3	53598.1	37121.7	32722.6
	Cons./inc.	1.023	0.974	0.929	0.858	0.822	0.838	0.819
	Ass./inc.	3.464	3.681	4.705	5.451	6.501	7.077	7.515
	Cons./tot. res.	0.023	0.028	0.037	0.043	0.042	0.047	0.058
	Weight (*)	0.064	0.179	0.217	0.213	0.187	0.106	0.034
Families:								
nuclear:	Consumption	54539.2	59365.4	64408.0	59323.4	43580.6	34221.7	31793.1
	Income	51867.7	60991.7	68380.1	66683.4	49985.5	39379.2	37550.0
	Cons./inc.	1.052	0.973	0.942	0.890	0.872	0.869	0.847
	Ass./inc.	2.777	3.660	4.951	6.208	7.148	7.520	8.423
	Cons./tot. res.	0.023	0.027	0.035	0.042	0.046	0.053	0.061
	Weight (**)	0.706	0.797	0.662	0.427	0.410	0.377	0.252
non-nuclear:	Consumption	65622.4	61911.7	74561.7	73812.7	66014.4	55792.1	54072.9
	Income	73653.0	68498.7	83781.7	89579.8	87252.6	82952.7	74511.4
	Cons./inc.	0.891	0.904	0.890	0.824	0.757	0.673	0.726
	Ass./inc.	2.617	3.547	4.151	4.724	5.442	6.715	6.404
	Cons./tot. res.	0.024	0.030	0.040	0.044	0.040	0.031	0.039
	Weight (**)	0.029	0.045	0.186	0.377	0.228	0.091	0.047
Single-head households:								
nuclear:	Consumption	34960.5	39956.3	40755.0	42426.4	28807.5	22479.1	28221.6
	Income	31279.2	33622.4	39785.0	41997.3	29040.2	20547.2	27858.3
	Cons./inc.	1.118	1.188	1.024	1.010	0.992	1.094	1.013
	Ass./inc.	2.493	3.654	4.808	7.903	9.265	5.596	8.045
	Cons./tot. res.	0.024	0.035	0.037	0.038	0.033	0.048	0.063
	Weight (**)	0.020	0.031	0.040	0.029	0.023	0.019	0.015
non-nuclear:	Consumption	55736.3	58448.8	51792.3	53078.5	47498.1	42642.1	37353.2
	Income	68102.1	64034.8	56770.5	65394.6	59608.6	51620.2	55422.6
	Cons./inc.	0.8184	0.9128	0.9123	0.8117	0.7968	0.8261	0.6740
	Ass./inc.	6.5824	4.4013	4.0961	5.0728	5.2802	5.6255	6.2322
	Cons./tot. res.	0.0241	0.0301	0.0395	0.0411	0.0372	0.0376	0.0426
	Weight (**)	0.092	0.048	0.064	0.090	0.101	0.084	0.131
Singles:								
	Consumption	47334.0	52647.0	51693.9	34411.8	23833.1	21335.9	19674.5
	Income	43374.5	51379.7	57606.2	35334.5	27455.2	23393.1	21764.1
	Cons./inc.	1.091	1.025	0.897	0.974	0.868	0.912	0.904
	Ass./inc.	4.668	3.507	4.542	6.284	8.530	7.375	7.879
	Cons./tot. res.	0.024	0.028	0.039	0.045	0.045	0.060	0.073
	Weight (**)	0.153	0.079	0.048	0.077	0.238	0.430	0.555

(*) proportion with respect to the total number of families

(**) proportion with respect to the total number of families in the same age class

Notes: Survey data re-proportioned to National Accounts. Disposable income is inflation adjusted

Table II.14b: Selected economic variables by family type and age

(1987-1989-1991-1993-1995 SHIW data at 1995 prices)

MALES		Age class						
		<31	31-40	41-50	51-60	61-70	71-80	>80
Total	C/Y	1.027	0.965	0.924	0.852	0.806	0.806	0.812
	A/Y	3.21	3.64	4.75	5.43	6.62	7.32	8.01
	w(*)	0.815	0.876	0.868	0.851	0.692	0.563	0.399
Families:								
nuclear	C/Y	1.057	0.969	0.941	0.888	0.871	0.866	0.848
	A/Y	2.85	3.63	4.97	6.14	7.14	7.56	8.44
	w(*)	0.639	0.752	0.641	0.414	0.396	0.363	0.250
non-nuclear	C/Y	0.884	0.910	0.890	0.824	0.756	0.676	0.722
	A/Y	2.58	3.24	4.19	4.72	5.41	6.79	6.46
	w(*)	0.026	0.040	0.173	0.364	0.221	0.087	0.046
Single-head hhld.								
nuclear	C/Y	1.123	1.013	0.916	0.939	0.819	1.059	1.228
	A/Y	0.62	3.52	3.49	8.63	9.87	5.12	7.97
	w(*)	0.001	0.002	0.005	0.008	0.004	0.004	0.004
non-nuclear	C/Y	0.816	0.881	0.782	0.744	0.766	0.787	0.677
	A/Y	4.45	4.68	4.10	5.61	5.44	5.91	8.48
	w(*)	0.063	0.029	0.022	0.030	0.020	0.025	0.025
Singles	C/Y	1.074	1.019	0.901	0.943	0.673	0.842	0.895
	A/Y	4.97	3.48	4.63	6.34	13.26	8.55	8.41
	w(*)	0.085	0.054	0.028	0.035	0.051	0.083	0.075
FEMALES		Age class						
		<31	31-40	41-50	51-60	61-70	71-80	>80
Total	C/Y	0.999	1.049	0.968	0.904	0.886	0.909	0.825
	A/Y	4.79	4.02	4.31	5.64	6.01	6.53	7.03
	w(*)	0.185	0.124	0.132	0.149	0.308	0.437	0.601
Families:								
nuclear	C/Y	0.997	1.052	0.969	0.929	0.904	0.964	0.710
	A/Y	2.12	4.11	4.41	8.23	7.25	6.32	7.19
	w(*)	0.067	0.045	0.022	0.013	0.014	0.013	0.002
non-nuclear	C/Y	0.976	0.853	0.896	0.823	0.770	0.576	0.995
	A/Y	3.070	6.305	3.635	4.779	6.832	4.780	1.905
	w(*)	0.003	0.005	0.013	0.013	0.007	0.004	0.001
Single-head hhld.								
nuclear	C/Y	1.117	1.205	1.044	1.055	1.053	1.108	0.976
	A/Y	2.625	3.667	5.039	7.443	9.053	5.788	8.059
	w(*)	0.019	0.029	0.035	0.021	0.019	0.014	0.011
non-nuclear	C/Y	0.824	0.972	0.986	0.857	0.806	0.847	0.673
	A/Y	11.397	3.879	4.092	4.712	5.234	5.477	5.664
	w(*)	0.029	0.019	0.042	0.060	0.081	0.059	0.106
Singles	C/Y	1.126	1.041	0.890	1.013	0.964	0.933	0.906
	A/Y	4.048	3.571	4.358	6.217	6.211	7.023	7.787
	w(*)	0.068	0.025	0.021	0.042	0.187	0.347	0.481

(*) proportion with respect to the total number of families in the same age class

Notes: see legend in Table II.13; Survey data re-proportioned to National Accounts. Disposable income is inflation adjusted.

Table II.15: Total and private savings by family type and age

(1987-1989-1991-1993-1995 SHIW data at 1995 prices – thousands of lira)

Family type		Age class						
		<30	31-40	41-50	51-60	61-70	71-80	>80
All families:								
	Earned income	60697.04	69395.40	78013.07	70806.85	35260.34	18096.88	14953.38
	Total saving	7221.98	11086.45	14088.10	8969.37	-8784.13	-13020.33	-11834.06
	Total saving rate	0.12	0.16	0.18	0.13	-0.25	-0.72	-0.79
	Disp. income	52281.64	59875.99	68831.71	72099.33	53598.06	37121.69	32722.65
	Private saving	-1193.42	1567.04	4906.74	10261.85	9553.59	6004.49	5935.20
	Priv. saving rate	-0.02	0.03	0.07	0.14	0.18	0.16	0.18
Families:								
nuclear:	Earned income	60601.37	71035.36	78915.89	67702.24	31100.44	18716.37	17745.87
	Total saving	6062.13	11669.93	14507.92	8378.87	-12480.16	-15505.30	-14047.26
	Total saving rate	0.10	0.16	0.18	0.12	-0.40	-0.83	-0.79
	Disp. income	51867.67	60991.67	68380.09	66683.43	49985.50	39379.25	37550.02
	Private saving	-2671.57	1626.23	3972.12	7360.05	6404.90	5157.58	5756.89
	Priv. saving rate	-0.05	0.03	0.06	0.11	0.13	0.13	0.15
non-nuclear:	Earned income	80526.86	76608.71	92336.68	88781.05	68969.47	62238.29	52731.12
	Total saving	14904.47	14697.04	17774.99	14968.39	2955.06	6446.21	-1341.74
	Total saving rate	0.19	0.19	0.19	0.17	0.04	0.10	-0.03
	Disp. income	73653.04	68498.69	83781.66	89579.80	87252.59	82952.68	74511.38
	Private saving	8030.65	6587.02	9219.98	15767.13	21238.18	27160.60	20438.52
	Priv. saving rate	0.11	0.10	0.11	0.18	0.24	0.33	0.27
Single-head households:								
nuclear:	Earned income	36879.11	36998.69	38821.05	31526.81	10393.34	3659.89	11112.61
	Total saving	1918.62	-2957.58	-1934.00	-10899.54	-18414.20	-18819.26	-17108.99
	Total saving rate	0.05	-0.08	-0.05	-0.35	-1.77	-5.14	-1.54
	Disp. income	31279.16	33622.38	39784.99	41997.25	29040.20	20547.20	27858.25
	Private saving	-3681.33	-6333.89	-970.06	-429.10	232.67	-1931.95	-363.36
	Priv. saving rate	-0.12	-0.19	-0.02	-0.01	0.01	-0.09	-0.01
non-nuclear:	Earned income	74995.23	70791.94	60344.44	59195.30	41933.95	34139.54	39458.78
	Total saving	19258.88	12343.18	8552.10	6116.75	-5564.11	-8502.53	2105.63
	Total saving rate	0.26	0.17	0.14	0.10	-0.13	-0.25	0.05
	Disp. income	68102.09	64034.79	56770.51	65394.62	59608.59	51620.21	55422.63
	Private saving	12365.75	5586.03	4978.17	12316.08	12110.53	8978.15	18069.48
	Priv. saving rate	0.18	0.09	0.09	0.19	0.20	0.17	0.33
Singles:	Earned income	51898.90	60483.69	66472.52	27907.74	9757.92	5764.84	4803.34
	Total saving	4564.89	7836.68	14778.62	-6504.09	-14075.15	-15571.11	-14871.14
	Total saving rate	0.09	0.13	0.22	-0.23	-1.44	-2.70	-3.10
	Disp. income	43374.52	51379.73	57606.16	35334.46	27455.20	23393.10	21764.12
	Private saving	-3959.48	-1267.28	5912.26	922.63	3622.14	2057.15	2089.64
	Priv. saving rate	-0.09	-0.02	0.10	0.03	0.13	0.09	0.10

Notes: Earned income is equal to disposable income plus social security contributions less pension benefits

Total saving: earned income less consumption. Private saving: disposable income less consumption

Survey data re-proportioned to National Accounts.

Table II.16: Contributions to the aggregate saving rate by type of household
(1987-1989-1991-1993-1995 SHIW data at 1995 prices; ratios)

Family type			
Families:			
nuclear	weight	A	0.541
	relative income	B	1.010
	total weight	C=A*B	0.546
	saving rate	D	0.065
	contribution	E=C*D	0.035
non-nuclear	weight	A	0.179
	relative income	B	1.475
	total weight	C=A*B	0.264
	saving rate	D	0.186
	contribution	F=C*D	0.049
Single-head hhld.			
nuclear	weight	A	0.028
	relative income	B	0.600
	total weight	C=A*B	0.017
	saving rate	D	-0.054
	contribution	G=C*D	-0.001
non-nuclear	weight	A	0.080
	relative income	B	1.031
	total weight	C=A*B	0.083
	saving rate	D	0.171
	contribution	H=C*D	0.014
Singles	weight	A	0.172
	relative income	B	0.525
	total weight	C=A*B	0.090
	saving rate	D	0.064
	contribution	I=C*D	0.006
Total	saving rate	E+F+G+H+I	0.104

Legend: A: proportion of households in the category with respect to the total number of households
B: ratio of average income with respect to average overall income.
Notes: Survey data re-proportioned to National Accounts.

Table II.17: Consumption - income ratio and family size

(1987-1989-1991-1993-1995 SHIW data at 1995 prices)

	Age class						
Number of components	<31	31-40	41-50	51-60	61-70	71-80	>80
1	1.091	1.025	0.897	0.974	0.868	0.912	0.904
2	1.013	0.906	0.922	0.856	0.856	0.867	0.820
3	1.021	0.939	0.919	0.870	0.801	0.711	0.758
4	0.980	1.014	0.941	0.850	0.794	0.687	0.685
5>	1.061	1.027	0.925	0.832	0.754	0.803	0.517
Number of income earners							
1	1.151	1.077	1.033	0.979	0.915	0.913	0.914
2	1.038	0.973	0.946	0.903	0.858	0.865	0.827
3	1.053	0.982	0.939	0.882	0.816	0.777	0.758
4	1.048	1.001	0.944	0.869	0.799	0.742	0.717
5>	0.965	0.992	0.949	0.851	0.780	0.713	0.656

Number of income earners	Number of components							
	1	2	3	4	5	6	7	8>
1	0.936	0.982	1.038	1.056	1.108	1.073	1.130	1.094
2	-	0.853	0.873	0.917	0.827	0.993	1.109	1.014
3	-	-	0.788	0.815	0.865	0.895	0.969	0.893
4	-	-	-	0.722	0.740	0.857	0.913	0.951
5>	-	-	-	-	0.643	0.752	0.927	0.547

Table II.18: Young individuals living with their parents, by age

(as a percentage of total number of individuals; 1987-1989-1991-1993-1995 SHIW data)

Age class	<21	21-25	26-30	31-35
(%)	99.76	85.40	46.84	19.77
of which:				
working	5.28	44.63	62.75	69.65
unemployed	5.81	19.31	18.29	15.12

Percentage of families with at least 1 young dependant over 19

	1989	1991	1993	1995
All	14.35	15.21	16.13	16.58
North	9.56	10.93	10.76	10.70
Centre	13.17	12.77	15.96	19.65
South	22.88	22.92	24.51	23.53

Percentage of families with at least 1 young dependant unemployed

	1989	1991	1993	1995
All	10.60	8.98	10.55	9.18
North	5.99	5.26	5.75	4.24
Centre	8.99	6.88	9.95	10.99
South	19.08	15.67	18.29	15.42

Mean age of young dependant over 19

	1989	1991	1993	1995
All	24.27	24.34	24.48	24.84
North	23.51	23.05	24.12	24.32
Centre	23.99	25.23	24.01	24.39
South	24.88	24.92	24.89	25.40

Table II.19: Implicit saving of young individuals living with their parents

(1987-1989-1991-1993-1995 SHIW data at 1995 prices – thousands of lira)

	A All nuclear couples aged 55 to 65	B All couples aged 55 to 65 with only 1 young working dependant aged 25 to 30	C Young singles aged 25 to 30	D (A+C)
Income	59628	91904	45774	105402
Consumption	52644	71799	49372	102016
Saving rate	0.117	0.219	-0.079	0.032
No. of obs.	3951	1304	314	
	A Couples aged 55 to 65 with 0 dependants	B Couples aged 55 to 65 with only 1 young working dependant aged 25 to 30	C Young singles aged 25 to 30	D (A+C)
Income	53597	84046	45774	99371
Consumption	45738	65639	49371	95109
Saving rate	0.147	0.219	-0.079	0.043
No. of obs.	1879	616	314	

Notes: Survey data re-proportioned to National Accounts.

Table II.20: Number of individuals living with younger households, by age

(as a percentage of total number of individuals; 1987-1989-1991-1993-1995 SHIW data)

Age class	51-55	56-60	61-65	66-70	71-75	76-80	>80
(%)	6.35	5.89	6.73	8.20	13.08	19.90	34.47

Table II.21: Implicit saving of old individuals living with younger households

(1987-1989-1991-1993-1995 SHIW data at 1995 prices – thousands of lira)

	A All nuclear couples aged 40 to 60	B All couples aged 40 to 60 with only 1 parent dependant aged 65 or more	C Singles aged more than 65	D (A+C)
Income	68024	79646	23749	91773
Consumption	62736	67241	21495	84231
Saving rate	0.078	0.156	0.095	0.082
No. of obs.	9602	594	3326	

Table II.22: Propensity to consume by number of young dependants and age class
(1987-1989-1991-1993-1995 SHIW data at 1995 prices)

No. of young dependants	Age class				
	<31	31-40	41-50	51-60	61-70
	Consumption-income ratio				
0	0.994	0.918	0.894	0.818	0.809
1	1.047	0.946	0.912	0.872	0.867
2	1.028	1.017	0.953	0.919	0.837
3	1.318	1.056	0.911	0.863	0.847
4	1.181	1.212	1.079	1.027	0.947
5>	1.872	1.138	1.048	0.971	1.004
	Consumption-total resources ratio				
0	0.023	0.026	0.039	0.044	0.043
1	0.023	0.026	0.036	0.042	0.041
2	0.025	0.029	0.036	0.043	0.039
3	0.031	0.031	0.035	0.045	0.038
4	0.025	0.037	0.037	0.040	0.030
5>	0.027	0.040	0.041	0.031	0.023

Table II.23: Expected retirement age and number of young dependants
(1989-1991-1993-1995 SHIW data)

		Age of the head							
		46-50		51-55		56-60		61-65	
		% heads retired	planned age of retirement	% heads retired	planned age of retirement	% heads retired	planned age of retirement	% heads retired	planned age of retirement
All families									
No. young dep.	0	7.89	58.17	29.09	60.12	59.83	61.90	82.31	64.52
	1	9.65	58.92	18.88	60.47	44.03	62.09	74.14	64.38
	2	5.18	59.81	15.29	60.90	38.25	62.72	66.12	64.48
	3	8.08	60.33	14.34	62.10	23.57	62.89	46.53	65.33
	4>	6.02	61.62	13.68	62.18	30.64	63.95	62.10	65.04
Families w. 1 inc. earn.									
No. young dep.	0	8.64	59.05	35.32	60.31	62.59	62.82	85.51	64.70
	1	14.09	59.13	24.79	61.21	48.32	61.89	76.86	64.26
	2	4.13	60.09	18.40	61.38	37.01	62.74	53.83	64.55
	3	6.75	60.36	9.50	62.10	24.75	62.30	55.76	65.64
	4>	6.46	60.75	18.70	61.60	25.51	63.20	75.06	64.53
All Families									
No. young dep.	0	7.46	59.26	24.62	60.39	56.25	62.03	82.11	64.51
over age 19	1	6.90	59.43	16.34	60.71	42.23	62.36	71.97	64.26
	2	7.01	59.80	16.96	61.50	35.04	62.58	60.55	65.09
	3>	19.70	60.59	15.99	62.67	31.96	63.12	41.14	65.18
All Families									
No. young dep.	0	6.86	59.20	22.63	60.43	53.40	62.07	80.06	64.44
unemployed	1	9.37	59.45	17.27	61.19	41.22	62.72	77.16	64.74
	2>	10.75	60.87	17.07	61.59	40.35	62.40	58.32	65.26
Families with young dep. >0									
No. young dep.	1	6.47	59.57	16.66	60.67	39.61	62.31	67.19	64.20
unemployed	2	9.37	59.45	17.27	61.19	41.22	62.72	77.16	64.74
	3>	10.75	60.87	17.07	61.59	40.35	62.40	58.32	65.26

Table II.24: Households whose head is not the main income earner, by age and family type (as a percentage of total number of households in the same category)
(1987-1989-1991-1993-1995 SHIW data)

	Age class						
	<31	31-40	41-50	51-60	61-70	71-80	>80
Nuclear couples	10.94	9.26	5.85	6.35	4.14	3.27	1.01
Non-nucl. couples	26.01	16.02	12.52	17.96	20.83	26.42	22.58
Non-nucl. single-head	29.21	21.78	22.58	23.34	27.91	22.85	17.48
Total (*)	8.91						
Main income earner is:							
the partner	4.27						
other member	4.64						

(*) Percentage with respect to the total number of households

Table II.25: Consumption-income and asset-income ratios by age and family type (head of household = main income earner)
(1987-1989-1991-1993-1995 SHIW data at 1995 prices)

		Age class						
Family type		<31	31-40	41-50	51-60	61-70	71-80	>80
All types	C/Y	0.953	0.907	0.901	0.856	0.887	0.939	0.993
	A/Y	3.218	3.588	4.700	5.593	6.857	7.346	7.770
Families:								
nuclear	C/Y	0.977	0.919	0.923	0.904	0.932	0.964	1.014
	A/Y	2.792	3.603	5.022	6.353	7.238	7.658	8.544
non-nuclear	C/Y	0.825	0.845	0.849	0.815	0.799	0.759	0.923
	A/Y	3.355	3.417	4.170	4.842	5.999	7.652	7.635
Single-head of hous.								
nuclear	C/Y	1.047	1.164	1.001	1.017	1.046	1.142	0.993
	A/Y	2.383	3.576	4.767	7.993	9.261	5.590	7.992
non-nuclear	C/Y	0.809	0.846	0.866	0.814	0.853	0.892	0.879
	A/Y	4.282	4.588	4.439	5.706	6.072	6.583	8.001

Table II.26: Effects of demographic characteristics on the change in the average propensity to consume between 1980-81 and 1993-95

(SHIW: historical archive; original (non-reproportioned) survey data)

Classificatory variable used to define 1980-81 weights	Estimated average saving rate in 1993-95 at 1980-81 weights (a) and difference with respect to present (b)	
	(a)	(b)
Age of the head	23.0	0.3
Household type	24.4	1.7
Household size	24.0	1.3
Number of children	22.7	0.0
Number of income earners	22.7	0.0
	Estimated average saving rate in 1993-95 at 1980-81 weights and relative income (a) and difference with respect to present (b)	
	(a)	(b)
Age of the head	22.7	0.0
Household type	23.3	0.5
Household size	23.1	0.4
Number of children	22.2	-0.5
Number of income earners	21.8	-0.9

Table II.27: Contributions to the aggregate saving rate by type of household

(SHIW: historical archive; original (non-reproportioned) survey data)

Family type		1980-81	1993-95	Δ
Families:				
nuclear	weight	0.568	0.529	-0.039
	relative income	0.966	1.039	0.073
	total weight	0.549	0.550	0.001
	saving rate	0.213	0.197	-0.016
	contribution	0.117	0.108	-0.009
non-nuclear	weight	0.210	0.173	-0.037
	relative income	1.411	1.457	0.046
	total weight	0.296	0.252	-0.044
	saving rate	0.376	0.317	-0.059
	contribution	0.111	0.080	-0.032
Single-head hhld.:				
nuclear	weight	0.022	0.028	0.007
	relative income	0.856	0.644	-0.212
	total weight	0.018	0.018	0.000
	saving rate	0.132	0.057	-0.075
	contribution	0.002	0.001	-0.001
non-nuclear	weight	0.077	0.091	0.014
	relative income	1.033	1.004	-0.029
	total weight	0.080	0.092	0.012
	saving rate	0.340	0.290	-0.050
	contribution	0.027	0.027	0.000
Singles	weight	0.124	0.178	0.054
	relative income	0.463	0.495	0.032
	total weight	0.057	0.088	0.031
	saving rate	0.214	0.126	-0.088
	contribution	0.012	0.011	-0.001
Total	saving rate	0.270	0.227	-0.043

Notes: see footnotes to Table II.16.

III A model of demographic development[30]

III.1 Introduction

In this section we will describe the basic structure of our model of demographic development. Official forecasts and population projections usually describe the demographic evolution as a dynamic process responding to three basic accounting identities: mortality, fertility and (possibly) net migration.[31] As already explained in Section I, the model described here is more complex and detailed as our aim is to keep track of the status of individuals in relation to families and to describe the process of formation of new families, the dissolution of old ones, and the merging of individuals from different families. Besides following the three basic steps of population projections, we consider a number of other events, including the process of divorce and remarriage, new marriages, the movement of young dependant adults to the unattached single status and the merging of old people into younger families.

Our basic strategy is to start with a sample of the Italian population, derived from the 1993 Survey of Households Income and Wealth (SHIW) carried out by the Bank of Italy. This sample is obtained by adjusting the original data in order to match some of the basic demographic features of the Italian population disclosed by the 1991 Population Census and applying a re-sampling procedure to obtain a large proportional sample of individuals. The demographic model can then be applied to this initial adjusted, large, proportional sample of the Italian population to project it into the future. In so doing we are careful to calibrate the model to reproduce, as far as possible, the main distinctive features of the population as described by the available official projections.

III.2 The micro simulation database: which method?

As illustrated in Section II of this paper, the structure of households has a crucial effect on the behaviour of variables such as income, wealth, saving and consumption. Since our interest is in creating a model capable of making predictions on these variables, we cannot avoid tracing how families will evolve in the future.

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30 The model of demographic development has been developed in collaboration with Luigi Cannari.

31 Official projections for the Italian population are prepared by IRP (Istituto di Ricerche sulla Popolazione) and Istat (the Italian statistical agency).

In order to model the demographic transition process starting from a sample of individuals, two different basic methods have been adopted in the literature: (a) creating cohorts of families[32] according to a variety of characteristics (age of the head of the household and spouse, age of children and other dependants, and so on) or (b) working directly with individual data, i.e., with a sample of individuals grouped into households.

If a relatively small number of characteristics is taken into consideration, method (a) is likely to be preferable because the number of cohorts will not be very large and the demographic evolution of cohorts over time can be traced using deterministic methods. For instance, from time *t* to time *t*+1, the weight of the cohort made up of unattached individuals aged 80 can be reduced according to the probability of death occurring between the ages of 80 and 81. Managing cohorts becomes, however, much more complicated as the number of characteristics increases because relationships among cohorts have to be taken into account. For instance, if a child gets married and leaves the original family we should reduce the weight of his/her original cohort and increase the weight of the cohort made up of couples with the same age as the child and the latter's spouse. When considering a large number of characteristics such as education, labour force participation, sector of activity and so on, the method of cohorts implies a very complicated scheme to generate the required pattern of weights of the various cohorts. Another limitation of this method is that any information on the distribution of economic variables, such as income or wealth, among cohorts and on its evolution over time is necessarily lost.

For these reasons we use individual data and resort to stochastic methods: individuals die, get married, divorce, study and participate in the labour force according to given probabilities. This method is not free of problems either. The variability of estimates tends to increase when stochastic methods are used; thus, the database must be reasonably large if we want to obtain precise estimates of relatively rare events. In addition, the sample should be proportional in order to avoid modifying weights when specific events occur. The first problem that emerges, in fact, when this strategy is pursued is that observations in survey samples (and the SHIW is no exception) carry sampling weights, reflecting the number of individuals (or families) of the total original population represented by each sampled

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[32] This is the method used by A. Ando (1996) and J. P. Cordoba (1995).

individual (or family). Of course, it would make no sense to marry a woman with a weight of 73 with a man with a weight of 48 without making any correction.

For instance, if a man with a weight equal to w_0 marries a woman with a different weight (say w_1, $w_0 > w_1$) the new couple should be given a weight equal to w_1 and a new record should be generated (an unmarried male with a weight equal to w_0 - w_1). Therefore, a non-proportional sample requires the management of weights, as in the cohort-based method, and gives rise, in addition, to an increase in the original sample size (owing to the necessary duplication of some records).

To overcome this problem we have developed a statistical procedure to re-sample the original survey observations in order to construct a new sample in which all individuals have the same weight (that is, they will represent a constant fraction of the total population). In the next section we show how we generate a representative (large) proportional sample starting from the original (weighted) survey data.

III.3 Setting initial conditions and the construction of a proportional sample

Our simulation model is based on micro data from the 1993 Survey of Italian Household Income and Wealth (SHIW) carried out by the Bank of Italy. This survey is based on a non-proportional sample of about 8,000 households (about 25,000 individuals). In order to avoid the problems highlighted in the previous section, we need to generate a proportional sample that is large enough to obtain precise estimates of the phenomena under investigation.

Before doing that, however, a preliminary adjustment to the original sample is necessary. Since we want to be able to obtain estimates of the future population structure that are as close as possible to the official projections, it is important to ensure that the initial sample matches, as closely as possible and for a number of basic demographic characteristics, the corresponding distribution of demographic variables exhibited by the Italian population. Therefore, we first split the SHIW sample by age, sex and marital status of the household members and compute the sampling weights of each cell. Then, we match the weights of cells by age, sex and marital status to the corresponding numbers from the

1991 Population Census (Table III.1) and adjust the sampling weights accordingly, using an interactive method.[33]

To obtain a proportional sample from this original Census-adjusted sample, we then proceed by applying a simple re-sampling procedure. The basic idea behind this re-sampling procedure can be illustrated as follows. Each observation in the original sample carries a weight, called w_i, representing the number of elementary household units represented by the single observation. Our purpose is to draw a sample in which all the elementary units will have the same probability of being represented. We thus fix this probability at p and proceed as follows: for any arbitrary p, it is easy to calculate the probability of choosing zero, one, two, …, r households from the first observation with weight w_1. We can indeed plot the cumulative distribution of r as in Figure III.1 (reported at the end of this section).

We can then randomly draw a number x from the uniform distribution [0,1] and mark it on the vertical axis of the above chart. Then we can read the corresponding value on the horizontal axis using the plotted cumulative distribution. This represents the number of samples that should be drawn from the first observation.

Following the above reasoning for each observation i, we generate a random number x_i according to a binomial distribution with parameters w_i and p, where p is constant across different households. Then each record is replicated x_i times. The final sample can then be considered a proportional one. Its size is, of course, determined by the p parameter. The choice of p is, to a certain degree, arbitrary but certainly it has to be chosen so that relatively rare characteristics of individuals and families present in the original data have a non-trivial probability of being included in the new sample. We have found that this requirement can be relatively well fulfilled by making a choice of p such that the final sample consists of about 200,000 individuals (about ten times the original data).

III.4 The demographic transition process

Our model of demographic dynamics applies to the Census-adjusted large proportional sample drawn from the original SHIW data. The status of each individual in a family is changed from one year to the next according to the following events: death, ageing, birth,

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33 As the distribution of population by sex, age and marital status shows some discrepancies between the SHIW sample and the Census data (for instance, the survey underestimates young married women), in some

divorce and separation, marriage; the movement of young dependant adults to the unattached single status and the merging of older people into a younger family.

III.4.1 Mortality and ageing

Mortality. Every year each individual in the sample faces the probability of dying (q), conditional on his/her age and sex. Initial probabilities are taken from mortality tables estimated by Istat (Italian Mortality Tables, reported in the Annuario Statistico Italiano). In the simulation, probabilities of dying by age are then updated in line with the Istat (1997) projections.[34] Table III.2 reports life expectancy at birth and at other selected ages implied by the mortality rates used in the simulation.

We then generate a random binary variable d, which takes the value 1 with probability q, and delete all records having d equal to 1. If a married head of household dies, the marital status of the spouse is changed to widow(er) and she (he) becomes the head of the household. If an unmarried head of household dies, the oldest adult in the family becomes the head. If there is no surviving adult in the family, children merge with probability one into a randomly selected family; the merging is constrained to the average intergenerational age gap.

Ageing. This part of the population dynamics is straightforward and does not require any discussion: the age of each individual in the sample is increased by one year.

III.4.2 Birth

As in the case of death, we compute the probability of giving birth to a child (b) from one year to the next for each married woman in the sample and generate a random binary variable n which takes the value 1 with probability b. Then we select all records with n equal to 1 and append the newborn babies to the household of the mother. The sex of newborn babies is imputed according to the corresponding distribution by sex from the 1991 Census. No changes in the sex distribution of newborns are assumed to occur in the simulation of the model for future years.

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cases the adjustment to the sampling weights was necessarily rather large.

34 We are grateful to Istat for providing us with their projected probabilities. The future development of mortality rates is simulated using a four-parameter model based on a logit system for survival rates estimated at a regional level. The model is then adapted to be consistent with the projections made using an age-period-cohort model, reporting forecasts by leading causes of death at the national level (see Istat 1997).

There are, however, some problems with the appropriate birth rates. The birth rate is given as the overall average for the entire female population of a particular age.[35] In our simulation, however, to preserve the distribution of family size that we observe in the data we need the probability of new births ordered by age, marital status and number of children already present. That is, we have to distinguish married women from unmarried ones and to take account of the number of children that each married woman already has. As to the first point, we adjust the overall fertility rate using the ratio of married women to total women in each age group (Table III.3). As to the second, we follow the method used by Ando (1996). In Table III.4 we show the distribution of families by the number of children. Let the relative frequency of the number of children be represented by f_0, f_1, f_2, f_3, f_4 and f_5, and the birth rate for a woman with no children in any specific year be given by $x(1-f_0)$. We then assume that the birth rate for women with one or more children is given by the values displayed in Table III.5.

We then determine the value of x for women of specific ages by solving the equation:

$$b(a)=x[(1-f_0)+(1-f_0-f_1)+(1-f_0-f_1-f_2)+(1-f_0-f_1-f_2-f_3)+(1-f_0-f_1-f_2-f_3-f_4)]$$

where $b(a)$ is the birth rate for women of age a, adjusted for married women. The results produced by this method are given in Table III.3.

A re-proportioning coefficient is finally applied to the computed fertility rates in order to replicate the number of new births in the base year. In addition, in the base simulation the ordered fertility rates by age are changed to match the number of new births in the Istat (1997) projections. The total fertility rate, broken down by order of birth, observed and forecast in the Istat main variant projection (the middle fertility rate assumption), is reported in Figure III.2. As can be observed from the figure, the total fertility rate is assumed to recover somewhat from the present depressed level (from slightly above 1.2 up to 1.45 children per woman) because younger cohorts who have considerably postponed the start of reproductive life will partially offset the decline at a later age. This partial recovery of the fertility rate is expected to be concentrated on the first and second order rates. Accordingly, we limit our adjustment to those two orders and concentrate the increase at relatively old

35 In the Istat (1997) projections, however, (cohort-specific) fertility rates by age and order of birth have been used.

ages. The resulting distribution of fertility rates by age may, however, be slightly different from that of the Istat projections.

III.4.3. Marriage, divorce and separation

Marriage and divorce are complex phenomena that involve choices which – in addition to the role played by love, attraction or repulsion – are certainly conditioned by a number of social factors (culture, tradition, religion, etc.) as well as by the characteristics of the individuals involved (their location, education, social and economic status, etc.). For the time being, in our model we make the (extremely) simplifying assumption that the only conditioning factor is the age of the individuals involved, leaving the possibility of introducing a more detailed description of the phenomena to future work.[36] Moreover, we do not distinguish between legally married couples and informal couples (nor is a distinction reported in the original survey). Our main goal, at this stage, is therefore merely to preserve the age characteristics of the couples and to replicate the frequency of marriages observed in the Italian population.

Marriage. We estimate the probability of marrying by age, using the 1991 Census data and reconstructing the number of "new" marriages for each age (shown in Figure III.2). Using the (unconditional) probabilities of marrying by age for females we select the candidate husband in the usual way. We then estimate using the SHIW survey data the males' conditional probability by age of marrying a woman of a given age (these are shown in Table III.6). Using these probabilities, we select the potential spouses from the resulting age groups.[37] Finally, we randomly match husbands and spouses on a one-to-one basis. The status of the head of the newly formed household is randomly assigned to males and females according to the proportions observed in the survey data.

Divorce and separation. Using the 1991 Census tabulations we estimate the probability of a separation occurring at every age (shown in Figure III.2) and generate the relative binary variable as in the previous phases. No distinction is made between separation and divorce.

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[36] In particular it would be important to use probabilities of marriage conditional to the wealth levels of the original families.

[37] Ideally, to construct these probabilities one would have to take a series of consecutive census results and look at the frequency of marriage in a given cohort as it ages. Given the very low frequency of Italian census data (10 years), however, this method is not applicable. We plan in the future to refine probabilities of marriage using information from current population surveys.

After separation or divorce individuals are not allowed to remarry for five years. Children of a separated couple are assigned to the mother with a very high rate of probability (92% as estimated by the 1991 legal statistics elaborated by Istat).

III.4.4. Independent children, merging households and unattached individuals

The movement of young dependant adults to the unattached single status and the merging of older persons into younger families are somewhat complex phases. Men and women can choose to live with their parents as adult dependants because they wish to save and accumulate a substantial amount of wealth by living in their parents' homes, or for other economic reasons (for instance, difficulty in finding a job or buying a house). Analogously, the merging of older persons into younger families can depend on the decision to go into retirement or on the economic resources of the elderly.

We do not tackle these issues in the present procedure. Adult dependants and older persons move out of their original families or merge into younger families according to probabilities that depend only on their age. These probabilities are, for the time being and given the limited information available, simply calibrated in order to replicate the relative frequencies (by age) observed in the survey base year.[38] It is likely, however, that these simplifications fail to lead to marked biases because the proportion of young people living as singles compared with the total population of young people is relatively small and because, as we have seen in Section II, a large number of older people live alone. Table III.7 gives the proportion of unattached individuals compared with the total population by age group.

[38] In future work we might try to estimate some of these probabilities using the Panel of Istat survey on the labour force (Istat, Indagine sulla forza lavoro).

Section III - Charts and Tables

Figure III.1: Cumulative distribution of *r*

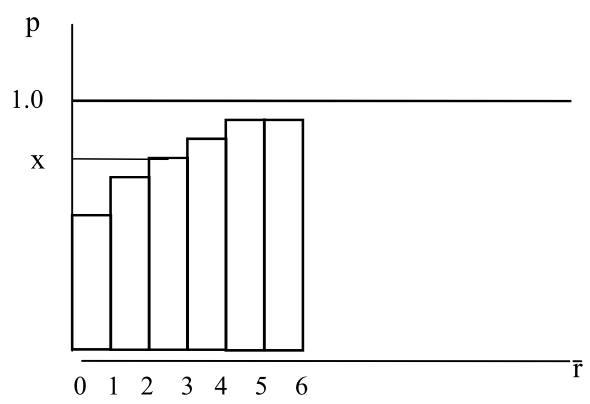
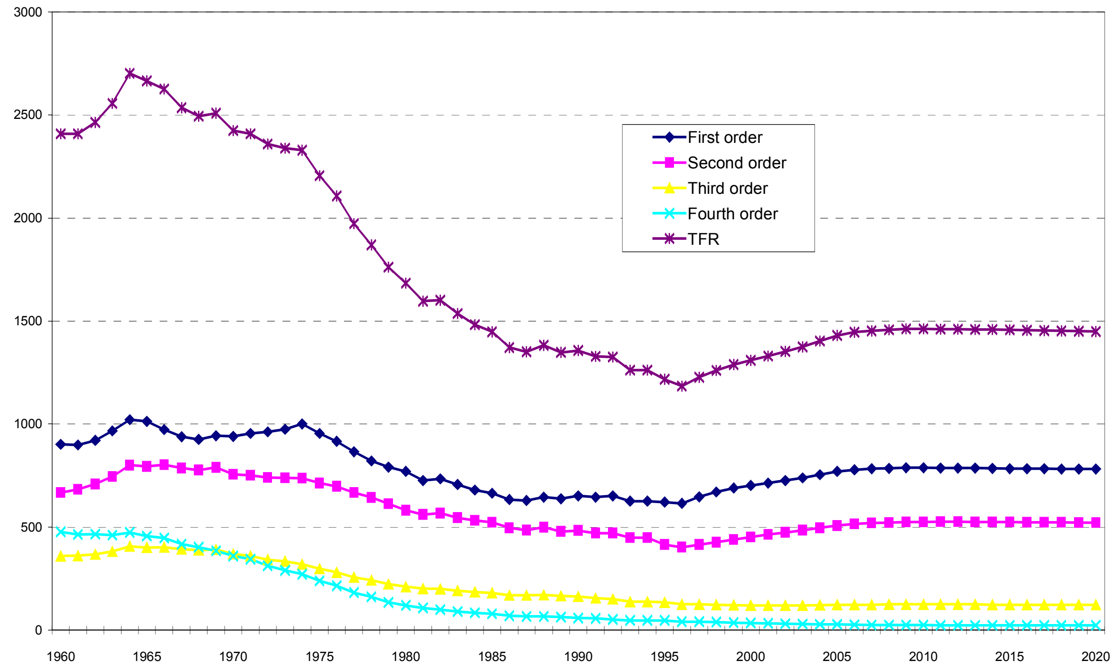


Figure III.2: Fertility rate by period and order of birth

(per thousand; observed up to 1996 and forecast thereafter; source: Istat 1997)



Notes: first order: fertility rate for first children; second order: fertility rate for second children etc.

Figure III.3: Rate of marriage by age and sex

(estimates based on 1991 Census; per thousand)

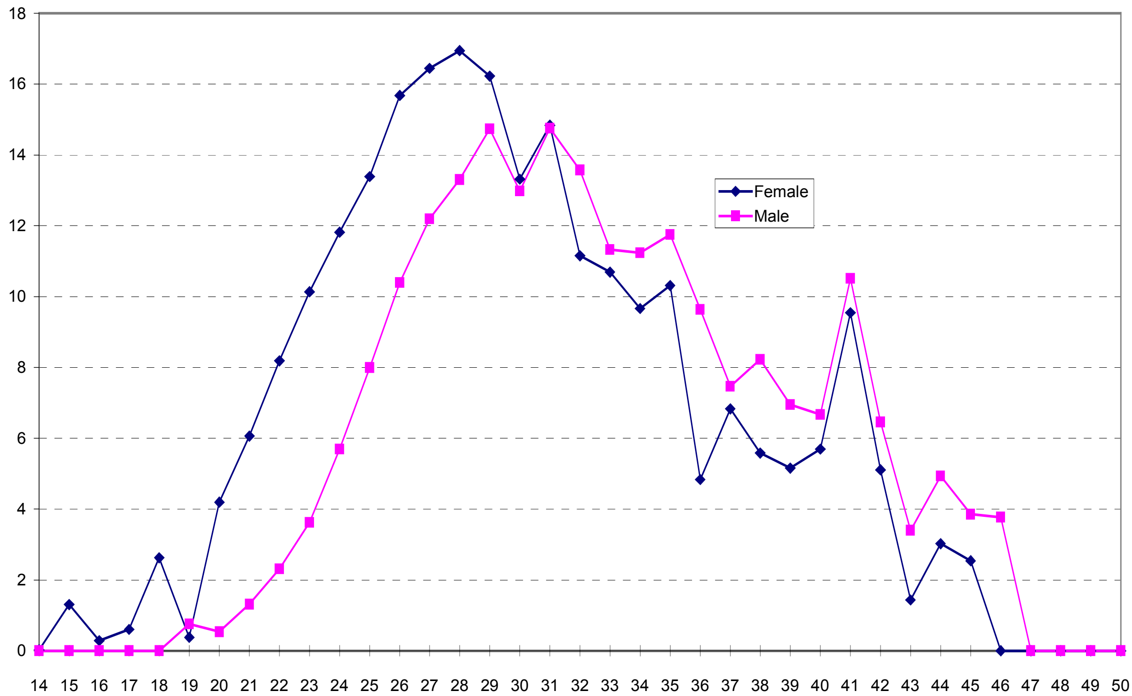


Table III.1: Italian population by sex, age and marital status

(source: 1991 Census; absolute values)

	Male					Female				
Age	Unmarried	Married (1)	Separated (2)	Widower	All	Unmarried	Married (1)	Separated (2)	Widow	All
0-4	1413955	0	0	0	1413955	1334966	0	0	0	1334966
5-9	1481097	0	0	0	1481097	1404214	0	0	0	1404214
10-14	1728273	2	0	0	1728275	1646365	103	0	0	1646468
15-19	2171772	15088	1514	1807	2190181	2043680	58789	1760	4156	2108385
20-24	2162490	137036	2974	842	2303342	1725194	493254	9993	2603	2231044
25-29	1478981	842357	18919	1968	2342225	902786	1348912	42810	7812	2302320
30-34	640241	1374806	46425	3027	2064499	366350	1588396	75203	14836	2044785
35-39	331906	1499027	65681	4902	1901516	213959	1582390	87103	24866	1908318
40-44	230501	1638588	74215	8575	1951879	163645	1677150	87690	46082	1974567
45-49	167651	1455567	61484	13798	1698500	131348	1459152	71592	74827	1736919
50-54	166963	1538177	54728	25582	1785450	144023	1515118	61795	144431	1865367
55-59	146049	1396485	39197	39538	1621269	148569	1320556	44132	236012	1749269
60-64	134926	1318769	30384	62267	1546346	170663	1161809	35149	375069	1742690
65-69	107585	1119964	21752	89640	1338941	179067	919963	27561	532091	1658682
70-74	59810	651464	11212	82314	804800	123063	473223	14852	494057	1105195
75-79	53129	543078	8066	127021	731294	130467	326729	9411	639642	1106249
>79	45666	380928	5396	222404	654394	166292	183901	6831	943606	1300630
Total	12520995	13911336	441947	683685	27557963	10994651	14109445	575882	3540090	29220068

(1) Net of de facto separated.

(2) De facto separated, legally separated, divorced.

Table III.2: Life expectancy by sex at various ages
(source: Annuario Statistico Italiano, for 1994; Istat, 1997 projections for other years)

	Males			Females		
	Age: 0	50	65	Age: 0	50	65
Year 1994	74.3	27.4	15.4	80.7	32.5	19.2
2000	75.9	28.1	16.3	82.3	33.5	20.0
2010	77.1	29.1	17.0	83.5	34.5	20.8
2020	78.3	30.2	17.8	84.7	35.6	21.8

Table III.3: Estimated fertility rates by number of existing children

Age	Percentage of married females (1)	Fertility rate (X1000)	Adjusted fertility rate: Mean	Number of existing children: 0	1	2	3	4	5
15-19	2.8	6.4	229.5	464.2	252.3	70.3	16.5	4.3	0.0
20-24	22.1	51.9	234.7	474.8	258.0	71.9	16.9	4.4	0.0
25-29	58.6	92.9	158.6	320.7	174.3	48.5	11.4	2.9	0.0
30-34	77.7	73.4	94.5	191.1	103.9	28.9	6.8	1.8	0.0
35-39	82.9	30.0	36.2	73.2	39.8	11.1	2.6	0.7	0.0
40-44	84.9	5.4	6.4	12.9	7.0	1.9	0.5	0.1	0.0
45-49	84.0	0.2	0.2	0.5	0.3	0.1	0.0	0.0	0.0

(1) Net of de facto separated.

Table III.4: Families by number of children
(source: 1991 Census; absolute values)

Number of children	Families (No.obs)	(%)
0	4,123,590	26.5
1	5,210,632	33.5
2	4,476,201	28.8
3	1,321,810	8.5
4	301,273	1.9
5 or more	104,829	0.7
Total	15,538,335	100.0

Table III.5: Fertility of women with a given number of existing children

Number of existing children	0	1	2	3	4
Birth rate	$x(1-f_0)$	$x(1-f_0-f_1)$	$x(1-f_0-f_1-f_2)$	$x(1-f_0-f_1-f_2-f_3)$	$x(1-f_0-f_1-f_2-f_3-f_4)$

Table III.6: Estimated conditional probability of marriage by age
(estimates based on SHIW data)

Age of wife	Age of husband						
	20	25	30	35	40	45	50
17	0.03	0.01	-	-	-	-	-
18	0.04	0.02	-	-	-	-	-
19	0.05	0.03	0.00	-	-	-	-
20	0.07	0.04	0.01	0.00	-	-	-
21	0.12	0.07	0.02	0.00	-	-	-
22	0.21	0.12	0.03	0.01	-	-	-
23	0.14	0.11	0.05	0.02	0.00	-	-
24	0.10	0.12	0.08	0.03	0.01	-	-
25	0.08	0.12	0.10	0.04	0.01	-	-
26	0.05	0.12	0.12	0.07	0.03	0.01	-
27	0.05	0.10	0.13	0.09	0.04	0.01	-
28	0.04	0.07	0.12	0.11	0.05	0.01	-
29	0.02	0.05	0.12	0.12	0.07	0.02	-
30	-	0.02	0.09	0.12	0.08	0.02	-
31	-	0.01	0.06	0.10	0.08	0.02	-
32	-	0.01	0.04	0.09	0.08	0.04	0.02
33	-	0.00	0.02	0.07	0.07	0.04	0.02
34	-	0.00	0.02	0.04	0.06	0.05	0.04
35	-	0.00	0.01	0.03	0.06	0.06	0.05
36	-	-	0.00	0.02	0.07	0.08	0.07
37	-	-	-	0.02	0.07	0.09	0.09
38	-	-	-	0.02	0.07	0.09	0.09
39	-	-	-	0.01	0.06	0.09	0.09
40	-	-	-	0.00	0.04	0.09	0.11
41	-	-	-	-	0.03	0.09	0.11
42	-	-	-	-	0.02	0.07	0.09
43	-	-	-	-	0.01	0.05	0.07
44	-	-	-	-	-	0.03	0.05
45	-	-	-	-	-	0.02	0.04
46	-	-	-	-	-	0.02	0.04
47	-	-	-	-	-	0.01	0.02
48	-	-	-	-	-	0.01	0.02

Notes: see text in section III.4.3.

Table III.7: Total population and unattached individuals

(source: 1991 Census; absolute values)

Age	Total population (a)	Unattached individuals (b)	(b)/(a) %
<20	13307541	17733	0.13
20-24	4534386	107297	2.37
25-29	4644545	218296	4.70
30-34	4109284	224337	5.46
35-39	3809834	186460	4.89
40-44	3926446	166456	4.24
45-49	3435419	153822	4.48
50-54	3650817	192950	5.29
55-59	3370538	251066	7.45
60-64	3289036	384957	11.70
65-69	2997623	528358	17.63
70-74	1909995	458004	23.98
75-79	1837543	551059	29.99
>79	1955024	659175	33.72
Total	56778031	4099970	7.22

IV The generation of individual characteristics

IV.1 Introduction

In addition to the process of demographic evolution, to make the model operational we need to generate those socio-economic characteristics of individuals that are important to predict their economic behaviour. While the information on variables such as education, participation in the labour force, and so forth is given in the initial sample, these characteristics might change over time and, as the population evolves, new individuals will become able to generate income and make consumption choices. For these individuals we need to create characteristics such as their education, their willingness to participate in the labour force, that are necessary to make any prediction of their economic behaviour.

In this section we describe how we generate the relevant characteristics of individuals which will be used in the next section to determine their (current and lifetime) income, including their future claims for pension benefits. In doing this we try to take into account as far as possible the correlation existing among different characteristics, in order to preserve the proportions of the combination of characteristics of individuals observed in the data, for each age group and type of individual. This implies, for example, that more highly educated people will be more likely to participate in the labour force, to work and to have access to a higher employment status than people with less education. In the same vein, we maintain different distributions of characteristics across Italian regions, as observed in the actual data.

It must be borne in mind, however, that at the present stage the process of attribution of characteristics is based on extremely simplified assumptions and does not pretend to represent a complete model of individual choices. Rather, it should be interpreted as a sensitive mechanism that generates some key proportions observed in the data (such as labour force participation or unemployment rates for various types of individuals). This mechanism also allows to preserve the observed heterogeneity of individual characteristics. However, we should recognize that this is probably the area of the model that is the most susceptible to future developments and improvements.

The set of individual characteristics generated by the model consists of: region of residence, education, labour force participation and unemployment, sector of work and occupational status. We review them in turn.

IV.2 Region of residence

In Italy regional differentiation is a very important factor to consider, both from an economic and a social point of view. We therefore decided to maintain it as a distinguishing characteristic of individuals. Three broad areas are considered: the North, the Centre and the South of Italy (administrative regions were assigned to these areas according to the official (Istat) classification).

In our simulation model region is attributed in a very simple manner. All families are given the residence of the head of the household, which is then simply inherited by the children. Similarly, after any demographic event involving the merging of individuals, we assign the region of the head of the new family to all other members. Therefore, for the time being, we do not consider the possibility of infra-regional migration of families.

IV.3 Educational levels

Education is one of the most crucial individual characteristics whose importance in determining individuals' ability to generate income is well understood. In the model we distinguish four educational levels (no education, elementary school education, high school education, university degree). No education (i.e., no elementary school certificate) is eliminated for new individuals, however, since its frequency among young cohorts is close to zero (whereas still there is a quite substantial proportion of people in the old cohorts of the survey data reported as not having studied at all). We do not consider post-college education, since it is quite a rare phenomenon in Italy.

In assigning an educational level to new individuals we proceed as follows: at age 20 the individual is randomly assigned an educational level for the rest of his/her life or he/she can keep studying (about one-third of that age group in the initial sample); to determine the educational level achieved, or whether the individuals go to university, we use probabilities conditional on the educational level of the head of the household to which those individuals belong, the region in which they live and their sex. We have estimated these conditional probabilities from an ordered probit estimate based on the 20-35 age group in the original survey data. The estimated probabilities are shown in Table IV.1.

People who go to university randomly withdraw from their studies up to the age of 25 at a rate such that the remaining people who graduate at age 25 match the observed proportion (by sex) of graduates in the 25-35 age group (slightly above 10% in the survey data). Conditional on an individual having decided to go to university, therefore, the educational level or the region of the head of the household ceases to matter in establishing whether the individual completes his/her university studies.

It is important to note that in the base simulation, the educational level of the whole society rises for a while as younger cohorts possess higher educational levels, with the result that their children will also receive higher education, before reaching a steady state. Both the dependency of the region of residence and of the educational level on parents' residence and educational level generates in the simulation an auto-correlation of the evolution of these characteristics over time.

IV.4 Labour force participation and unemployment

Individuals who have finished their studies will participate in the labour force randomly, with probabilities that are conditional on whether they are heads of household, age, sex and education. Probabilities are chosen to match observed proportions of the different groups in the survey data (which are shown in Table IV.2). In the benchmark simulation we allow the overall rate of participation among women to increase somewhat over time. This is consistent with the observation that young female cohorts participate more than older ones and also takes into account that fact that the participation rate for Italian women is still substantially lower than in other European countries. The participation rates by age group for the other groups remain roughly constant. Students do not participate in the labour force, while graduates participate with probability one. There is no withdrawal from the labour force except when the individual reaches retirement age.

Given that an individual participates in the labour force, he/she can become unemployed with probabilities that depend on whether he/she is the head of the household, age, sex and region, and are different if the individual is a new entrant in the labour force (much higher probabilities of unemployment) or is already employed. If unemployed, the individual can find a job with probabilities which depend on the same characteristics. Up to age 28 (25 for heads of households) the process is a Markov process, with different probabilities of finding a job for employed and unemployed persons. After that age, the probability of being unemployed in the next period is the same for the unemployed and the employed (but still different for different groups of individuals according to their age, sex and role in the family). Again, probabilities are chosen to match the observed unemployment rates for the different groups; in the benchmark simulation, however, they are assumed to evolve in future years so that the overall unemployment rate reaches a steady state level of about 8% by the year 2005.[39]

When the individual reaches retirement age (a choice variable that will be described in the next Section) he/she retires and becomes a pensioner. In the present version of the model there is no possibility of returning to work. Furthermore, working while receiving a pension is not allowed.

It should be noted that the procedure described above entails that no exiting from the labour force (and thus re-entering) is allowed (before retirement). Moreover, while observed aggregate proportions (for both labour force participation and unemployment) are broadly preserved, individual probabilities of entering the labour force or becoming unemployed may not match accurately the actual individual experiences. These are obvious drawbacks of the current model that need to be eliminated in future versions.

IV.5 Sector and occupation

Individuals entering the labour force are randomly assigned to one of three possible sectors (agriculture, public or private non-agriculture) and to one of four possible occupational statuses (manual worker, clerk, manager or self-employed). Transitional probabilities for these characteristics depend only on education. We have estimated them using a multi-probit estimate on the survey data to ensure that the simulation of the model will maintain the relevant proportions observed in the data. Table IV.3 shows the relevant transitional probabilities for individuals entering the labour force for the first time.

Previously employed people who are currently unemployed maintain the previous characteristics when they find a new job. As a worker ages, he/she is subject to a probability of improving his/her occupational status (for example, from manual worker to clerk and from clerk to manager). Probabilities have again been calibrated to match the observed distribution of occupational status by age in the initial sample.

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[39] This is approximately the NAIRU level as estimated in a number of studies on the Italian labour market.

Section IV – Charts and Tables

Table IV.1: Estimated probability of educational level of children at age 20 conditional on education of the head of the household and region of residence

(ordered probit regression; based on 1987-1989-1991-1993-1995 SHIW)

		Education of child at age 20					
		Males			Females		
Education of the head		elementary	high school	university	elementary	high school	university
None	South	0.77	0.16	0.07	0.74	0.18	0.08
	Centre	0.75	0.17	0.08	0.71	0.19	0.10
	North	0.68	0.21	0.11	0.64	0.23	0.14
Elementary	South	0.43	0.28	0.28	0.39	0.29	0.32
	Centre	0.40	0.29	0.31	0.36	0.29	0.35
	North	0.33	0.29	0.39	0.28	0.28	0.43
High-school	South	0.14	0.23	0.63	0.12	0.21	0.67
	Centre	0.13	0.22	0.66	0.10	0.20	0.70
	North	0.09	0.18	0.73	0.07	0.16	0.77
University	South	0.05	0.13	0.82	0.04	0.11	0.85
	Centre	0.04	0.12	0.84	0.03	0.10	0.87
	North	0.03	0.09	0.88	0.02	0.07	0.91

Table IV.2: Participation and unemployment rates of heads of households and dependants

(source: 1987-1989-1991-1993-1995 SHIW)

	Head of household				Non-head			
	Male		Female		Male		Female	
	Particip.	Unempl.	Particip.	Unempl.	Particip.	Unempl.	Particip.	Unempl.
Age class								
<20	0.779	0.241	0.659	-	0.349	0.475	0.323	0.490
21-25	0.957	0.033	0.819	0.133	0.698	0.278	0.587	0.294
26-30	0.990	0.022	0.798	0.100	0.864	0.198	0.622	0.169
31-35	0.996	0.032	0.779	0.077	0.916	0.178	0.576	0.088
36-40	0.998	0.024	0.806	0.059	0.902	0.128	0.510	0.037
41-45	0.989	0.019	0.776	0.037	0.905	0.110	0.464	0.043
46-50	0.961	0.021	0.660	0.035	0.901	0.115	0.371	0.028
51-55	0.841	0.023	0.419	0.046	0.784	0.147	0.274	0.019
56-60	0.583	0.033	0.200	0.002	0.576	0.236	0.146	0.019
60-65	0.268	0.020	0.074	0.019	0.166	0.265	0.054	-
>65	0.055	0.001	0.010	0.006	0.036	0.048	0.012	-

Table IV.3: Estimated probability of employment status and sector of occupation by educational level

(ordered probit regression; based on 1987-1989-1991-1993-1995 SHIW)

		Elementary	High school	University
Manual:	agriculture	0.032	0.005	0.001
	other sect.	0.535	0.287	0.139
	public	0.021	0.018	0.012
Clerk:	other sect.	0.255	0.304	0.252
	public	0.052	0.091	0.098
Manager:	other sect.	0.020	0.041	0.049
	public	0.005	0.011	0.014
Self empl.:	agriculture	0.006	0.013	0.017
	other sect.	0.073	0.230	0.418

V The economic behaviour of households

V. 1 Introduction: the basic framework

A part of our task in this project is to describe the behaviour of households in allocating resources among consumption in various periods of their lives as their needs change. We want our description to be capable of matching basic features of our data as closely as possible, while at the same time being represented by computable algebraic expressions so that they can be incorporated into our dynamic simulation programs. A model of a utility maximization subject to dynamic budget constraints can lead to a closed form decision rule only under very restrictive conditions, and we need to be more flexible in order to meet our practical needs. It is nevertheless useful to lay out an approximate optimizing model of household behaviour so that the assumptions needed to arrive at our empirical formulation are clearly visible. For this purpose, we begin with a fairly general formulation given by the following:

$$Max \quad E\, U_a(C_a^t\,, C_{a+1}^t\,, \ldots, C_T^t\,, C_{T+1}^t\,; L_a^t\,, L_{a+}^t\,, \ldots, L_T^t\,; F) \tag{1}$$

Subject to

$$\begin{aligned} &C_a^t + A_a^t + B_{a-1}^{t-1}(1+rb_{a-1}^{t-1}) \le w_a^t L_a^t + B_a^t + A_{a-1}^{t-1}(1+r_{a-1}^{t-1}) + P_a^t \\ &C_{a+1}^t + A_{a+1}^t + B_a^t(1+rb_a^t) \le w_{a+1}^t L_{a+1}^t + B_{a+1}^t + A_a^t(1+r_a^t) + P_{a+1}^t \\ &\qquad\qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \\ &\qquad\qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \\ &C_{T+1}^t + B_T^t(1+rb_T^t) \le A_T^t(1+r_T^t) + P_{T+1}^t \end{aligned} \tag{2}$$

Definitions of the variables are as follows. (We adopt the convention that when a variable carries the age subscript a and time superscript t, the variable represents the current value. When it carries the age subscript $a+i$ and the time superscript t, the variable represents the plans – or expectation if the variable is outside the control of households – of the household for i^{th} period ahead made in period *t*.)

C_a^t Consumption of a family whose head is at age *a* in calendar year *t*.

C_{T+1}^t: Planned bequest at the end of the life of this household.

L_a^t: Supply of labour in hours by all members of the household.

w^t: The wage rate (net of social security contributions) per hour prevailing in period *t*.

F: Present and future characteristics of households.

A_a^t: Total value of assets acquired in period *t* when the age of the household is *a* and carried over to period *t+1*.

B_a^t: Total value of borrowings incurred in period *t* and carried over to period *t+1*.

r_a^t: The real interest rate in terms of consumption goods earned on A_a^t.

rb_a^t: The real interest rate charged on B_a^t.

P_a^t: Net transfers (including social security transfers) received in period *t* measured in units of consumption goods.

a: The age of the head of the household in period *t*.

T : The age of the head at the age of death of surviving spouse. That is, if the current age of the head is 40 and his spouse is 35, and the head expected to survive until he is 80 while his wife is expected to survive until 85, T is 40+50=90.

Formula (1) is a standard dynamic utility function, while (2) is a period-by-period cash flow constraint. We adopt the convention that lending and borrowing contracts are all for a single period. In each period, the sum of consumption, the amount of assets that the household wishes to carry into the next period, and the amount of debt incurred in the previous period that must be repaid with interest must be less than or equal to the sum of earned income, borrowing that the household plans to carry over to the next period, and the assets that the household has carried over from the previous period with interest. If the borrowing and lending rates are the same for each period, then the constraints for all future periods can be discounted back to the initial period and the constraints (2) can be reduced to a single constraint in terms of the present value, given by (3) and (4) below.

$$\sum_{i=0}^{T+1-a} d_{a+i}^t C_{a+i}^t \leq TR(i, F, a) \tag{3}$$

where:

$$TR(i,F,a) = \sum_{i=0}^{T+1-a} d_{a+i}^{t}\left[w_{a+i}^{t}L_{a+i}^{t} + P_{a+i}^{t}\right] + A_{a-1}^{t-1}(1+r_{a-1}^{t-1}) - B_{a-1}^{t-1}(1+rb_{a-1}^{t-1}) \tag{4}$$

represents the (expected) total (life-time) resources of the households

In this study, we work with the formulations (1), (3) and (4) most of the time. This means that we are ignoring the possibility of liquidity constraints (the inability of borrowing against future income) on households to finance their consumption expenditures.

The difficulty of dealing with a system like (1), (3) and (4) is largely due to uncertainty. Even if uncertainty is limited to w and no other variable is random, by the time (3) and (4) are substituted into (1), U becomes a complex non-linear function of w and it is impossible to obtain a closed form solution for Cs maximizing the expected value of U unless U is a special form of exponential function, which does not fit the data.

Furthermore, a moment's reflection makes it clear that the uncertainty cannot be limited to w. Members of households cannot be sure of the future values of the interest rates, future values of gifts and transfers, any more than the future value of the wage rate. They do not know the exact timing of the termination date of their family, nor the specific characteristics that the family will acquire in the future. It is clear, therefore, that the optimization of the simpler problem (1), (3) and (4) cannot yield a closed form solution, let alone the dynamic programming problem (1) and (2). For us to proceed with analysis, therefore, we must resort to a number of heuristic approximations. We first ask under what conditions we can obtain a reasonable solution to this problem if there is no uncertainty. If U is completely separable in Cs and L, and in addition the part of U containing Cs is strictly homothetic, we can derive the consumption decision rule given by (5).

$$C_a^t(F) = f\left(a, T, F; \frac{TR(i,F,a)}{TR(a)}\right) TR(i,F,a) \tag{5}$$

where TR(a) is the average TR of households whose head is aged a. We therefore allow the relative position in the distribution of TR to be introduced as an argument in f (which implies the assumption that TR for a household can be generated without reference to the household's decision on consumption).

We therefore hypothesize that, faced with the difficulty of solving the above problem, the households attempt to deal with it by solving a drastically simplified problem so as to enable them to avoid the worst consequences of uncertainty. Equation (5) is essentially the form of the consumption function that we have used in our empirical analysis (see Section V.5 below).

Before turning to the empirical specification of households' consumption decisions, we need to be able to construct for each household in our sample, its total expected resources TR. This requires, inter alia, the evaluation of households lifetime labour income and social security wealth, which is the topic of the next sections.

V.2 Income and lifetime income profiles of individuals and families

The first problem that occurs when attempting to predict families' labour income is whether one should directly predict the labour income of the family as a whole or whether one should predict individuals' labour income and aggregate it ex post over the family members. After a preliminary investigation we have decided to adopt the latter method even if both methods present advantages and disadvantages.[40] The details of the procedure and the assumptions needed to reconstruct the families' total lifetime income are described in the next sections.

V.2.1 Individual income profiles and lifetime income

[40] Estimating labour income at the level of the individual has the advantage that one could, at least in principle, take into account the interactions that exist among members of the family with respect to the decision to work. However, this might be a difficult task to carry out at the empirical level and actually some authors (see Ando, 1996) have found that, in some countries, estimating the total family income gave rise to smaller prediction errors than aggregating predictions for individuals. We have investigated this issue empirically using the survey data and found: (a) prediction errors of family labour income are relatively large when aggregating predictions for individuals derived from simple regressions that do not take into account participation decisions of individuals; (b) the difference between the two methods was very small if participation decisions were taken into account using a two-stage Heckman procedure. Given these findings and considering, moreover, the practical need to reconstruct net incomes from estimated gross income, which is more easily accomplished in

V.2.1.1 The estimate of individual labour income profiles

Tables V.1 and V.2 (at the end of this section) show the basic equations that we use to predict labour income for individuals in our sample. Estimates are made using all the SHIW surveys from 1987 to 1995. Individual gross labour income is predicted using a Heckman two-stage estimate on the survey data.

The first stage is a probit estimate for labour force participation that is consistent with the generation of labour force characteristics outlined above (see Section IV.4). Here we consider a number of characteristics of individuals, namely sex, marital status, whether he/she is the head of the family, the region of residence, the number of other income earners and the number of children in the family. Cohort dummies are introduced to account for the secular (positive) trend in the Italian labour force participation, while year dummies account for the decrease in the labour force in the past few years due to the recession of 1991-93, which probably increased the number of discouraged workers. All coefficients have plausible signs.

In the second stage of the estimation procedure, the logarithm of gross labour income[41] is regressed on age, sex, education, region, sector, occupational status and a dummy of whether he/she is the head of the household (some of these characteristics are interacted with age and age square terms) and the inverse Mill's ratio estimated in the first stage.

A well-known problem in estimating the age pattern of earnings using a series of cross-sectional data is the impossibility (without introducing any restrictions in the specification) of separating pure age effects from calendar years and cohort-specific effects of productivity growth. In the first specification that we report in Table V.2 we have simply ignored the problem and not introduced cohort dummies: in this case cohort effects will be captured by both age and year dummies. In the second specification we follow the method used by Deaton and Paxon (1993), imposing the restriction that the calendar year effect is only a cyclical effect by restricting year dummies to be orthogonal to a time trend, and assuming that all productivity growth is due either to age or to cohort-specific effects.

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the case of Italy by having information on each family component earner, we have decided to proceed to predict individuals' labour incomes. These are then aggregated to obtain the total income of the family.

[41] We used labour earnings gross of personal income taxes and inclusive of social security contributions paid by the employees.

The explanatory power of both formulations is quite good, with almost half of the total variance explained. The Mill's ratio term is always significant, indicating that selection bias is present. It must be noticed, however, that cohort effects in the second specification take an unusual pattern indicating lower productivity for younger cohorts. One possible explanation is that our data set is spread over a period (1987 to 1995) of cyclical downturn, which we are unable to capture completely with the year dummies. Another plausible possibility is, however, that the cohort dummies are instead capturing some important features of the development of the Italian labour market in the recent past: unemployment is highly concentrated in younger cohorts and new entrants must accept lower wages than their predecessors. It is clear, however, that cohort-effect estimates over such a short and peculiar period cannot be taken as an estimate of secular productivity growth. This is why in the construction of lifetime income and in our simulations we use the first specification and supplement it with a measure of productivity growth given from outside sources.

In Figure V.1 we show the age profiles of gross labour income implied by the preferred specification for different types of workers and for different educational levels. In most cases earnings appear to peak between age 45 and 50. The importance of education for achieving high income levels in a shorter time is apparent.[42]

An alternative specification based on a linear first order auto-regression estimated on the (gross) income earning histories given in the SHIW panel (about 4,000 rotating households) is shown in Table V.3. The regressors are the same as those used in the cross-section estimate. The implied age profile of labour earnings is very similar to that found using the previous specification. The effects of some characteristics, such as education, are also quantitatively similar. The degree of income persistency over time is also relatively high, with a first-order auto-regressive coefficient of about 0.7. The panel estimate has the advantage of permitting a dynamic specification of the income-generating process and, therefore, a better representation of the evolution of earnings over the life of individuals. As

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[42] The logarithmic specification of our income equation yields the best linear unbiased estimates of the slope coefficients and it is therefore a correct specification if the main focus of study is to obtain estimates of elasticity terms. However, as Kennedy (1983) points out, the estimate of the intercept term in the logarithmic specification is biased and, therefore, if one wants to use the equation to make predictions of the dependant variable in level (especially for out-of-sample predictions, as in our case), one must take the magnitude of the bias into consideration. We thus compute the bias, which sometimes resulted in an under-prediction as high as 20% (with an average for all individuals of 16%), and adjust for it in the simulation of the model.

these estimates are still preliminary, however, they are not used in the simulations of the model shown in this paper.

The regression model predicts gross labour income. From this, net income is reconstructed by applying legal provisions on personal income taxes and tax credits. As explained in the Appendix to this study, the method takes account of the main features of Italian tax legislation as well as the survey information on the structure of the family (whether the spouse works, the number of young dependants in the family, etc.) when computing family-related tax credits. It also takes account of tax evasion for some groups of workers thus generating an aggregate labour tax receipt that is consistent with the total actual receipts of the government in the base year.

V.2.1.2 The prediction of lifetime individual labour income

We can use the previous estimates to generate a measure for expected lifetime individual labour income. We proceed as follows.

First, suppose that the distribution of characteristics x years from the current period faced by an individual aged a whose current characteristics are F_a denoted by F_{a+x} is given as $f_{a,x}(F_{a+x}| F_a, a)$. Then, let $y(F,a)=w_aL_a$ denote the current predicted income from our equation for the same individual. His/her expected income x years from the current period will be given by:

$$y^f_x(F,a) = \int e^{g\,x}\, y(F_{a+x}, a+x)\, f_{a,x}(F_{a+x}| F_a, a)\, dF_{a+x} \quad (4)$$

where g is the expected productivity growth.[43]

Lifetime individual gross labour income is then defined as:

$$ylt^f_x = \sum_{x=1}^{\tau-a} S_{a,x} e^{-x\rho} y^f_x(F,a) \quad (5)$$

where $S_{a,x}$ is the survival probability from age a to age x (consistent with the mortality rates used in Section 2), τ is the age of retirement ρ the subjective discount rate of the individual.

When attempting to reconstruct net lifetime income from the gross income of the individual a serious problem is that one needs a prediction of the expected evolution of the

43 Note that, in principle, F should include all the right-hand side variables of the equations in Tables V.1 and V.2. For the time being we have taken into consideration only the distribution by age of the occupational status of the individuals (that is, the probability by age of a white collar worker becoming a manager, and so on)

tax rates and credits in the future. On the basis of the observation that the average effective tax rate usually tends to remain stable over the long run (which is certainly the horizon of our simulations), we adopt the following simplification. The absolute level of tax brackets corresponding to a given tax rate is increased every year by the rate of productivity growth. The average effective tax rate for each individual therefore only changes if his/her income growth differs from the growth of productivity (and thus the average effective rate for the whole society changes only if the distribution of income changes, which is not an unreasonable assumption). More complex is the treatment of tax credits related to the structure of the family, which obviously changes over the life cycle. For the time being, they are assumed to remain a constant proportion (depending on the structure of each family) of gross labour income over the life cycle.

V.2.1.3 The prediction of family income and lifetime income

As we have already said, current family labour income is simply computed as the sum of predicted incomes of all income earners in the family. More complex is the prediction of families' lifetime income since it requires an assessment of the time horizon applying to the family's decisions. While this is a very familiar problem in the theoretical literature, in the empirical literature the issue is either ignored or is the object of extreme assumptions. In the absence of more detailed information, we define (net) family lifetime labour income as the sum of the net lifetime income of the head of the household and the spouse, plus that of other family components over 40 years of age, plus the income of younger components computed over as many years as they are expected to remain with the family. That is, we consider family components (other than the head of the household and the spouse) over 40 to be permanent components of the family, while account is taken of the fact that working children may leave the family. We compute the expected number of years of permanence in the family consistently with the demographic part of the model, using the probabilities of marriage and of becoming independent described in Section III. While this is clearly an approximation that can be improved if any extra information becomes available, we find, as

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while considering all other characteristics time invariant. This is, of course, a major simplification that can be improved in future versions of the model.

we will show later, that the resulting pattern by age of the ratio of consumption over total resources constructed in this way appears to be very plausible.[44]

V.3 The estimate of social security wealth

V.3.1 The computation of workers' social security wealth

In the period covered by our micro data, the Italian social security system incorporated a number of different schemes covering different types of workers. Moreover, two major reforms were introduced (in 1992 and 1995).[45] This has forced us to compute the social security wealth for the individuals in our sample in line with the major schemes and according to legal provisions for the different cohorts of workers and for each of the survey years.

Individual social security wealth is computed in a similar manner to Jappelli (1995) and Visco and Rossi (1995) for the pre-reform system and to Peracchi, Rossi and Venturini (1996) for the post-reform system. Individuals covered by the old regimes who fall totally or partially under the new social security regime are recognized according to legal provisions. Their social security wealth is computed taking account of the different schemes for the broad groups that we include in the model (workers in the agricultural sector, public employees, private employees and the self-employed). For the retirement age we make use of the survey data on expected retirement age described in the next Section; however, we use legal provisions when the expected retirement age turns out to be less than the minimum age legally required. Since we use net (of contributions) lifetime income to reconstruct families' total lifetime resources, social security wealth (relevant for consumption decisions) is computed on a gross basis as the sum of future benefits, appropriately discounted by subjective discount rate and survival probabilities.

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44 If, for example, we do not consider at least part of the future income of working children, a large part of families in the middle-age groups show very implausible values of the ratio of consumption over total resources. We will return to this issue in Section V.5.

45 For a detailed description of the Italian social security system until the 1993 reform, see G. Cazzola (1993) and INPS (1993). Institutional details of the Italian 1995 pension reform are provided in Banca d'Italia (1995), Peracchi and Rossi (1995), Peracchi, Rossi and Venturini (1995), and Brugiavini (1997). On the problems affecting the system of public pensions before the reform and the attempts to streamline the system that were made throughout the first half of the 1990s, see Castellino (1976 and 1994, respectively).

Specifically, let us define $P(a,\tau,t)$ as the social security benefits that an individual whose age is a in calendar year t expects to receive when he/she retires at age τ in calendar year $t+(\tau-a)$.

The expected social security wealth of an individual aged a can then be defined as:

$$SSW(a,\tau,t) = S_{a,\tau}P(a,\tau,t)\left(\frac{1}{1+\rho}\right)^{\tau-a}\sum_{n=\tau+1}^{T}S_{\tau,n}\left[\frac{1+g_p}{1+\rho}\right]^{n-\tau} \qquad (6)$$

where $S_{a,n}$ is the survival probability from age a to age n, r the subjective discount rate, g_p the rate of growth of pensions during retirement and T the maximum possible age (in the computation we set it to be 105).

In the following we describe how we compute expected social security benefits of individuals in our sample for the different regimes (before and after the reforms) and for the different categories of workers.

V.3.1.1 The pre-1992 system and the 1992 reform

The pre-1992 system and the system after the 1992 reform were defined-benefit systems. Benefits were computed as a proportion (the replacement ratio) of a reference earning at retirement. This proportion was computed by adding 0.02 for each year of paid contributions up to a maximum of 0.8 (0.94 for civil servants). The reference earning at retirement age was computed on the basis of the last five years' earnings prior to retirement (extended to the whole working life by the 1992 reform). Pensions were indexed to current earnings growth before the 1992 reform and to the rate of inflation thereafter.

Let $y(a,t)$ be the actual labour income of an individual whose age is a in calendar year t. It is best to interpret "t" as the year in which the survey is conducted and $y(a,t)$ as the income generated by the income equation in the model.

For this individual, income at age $a + x$ is

$$y(a+x,t+x) = y(a+x,t)e^{gx} \qquad (7)$$

where g again denotes the rate of growth of productivity.

Under the pre-1992 scheme a reference income at retirement age, y_p, of an individual whose age is *a* and who expects to retire at age τ is computed on the basis of his/her earnings five years prior to retirement:

$$y_p[\tau, t+(\tau-a)] = \sum_{\alpha=\tau-5}^{\tau-1} \frac{y(\alpha, t+\alpha-a)}{5} = \sum_{\alpha=\tau-5}^{\tau-1} \frac{y(\alpha,t)\,e^{(\alpha-a)g}}{5} \tag{8}$$

After 1992, the reference income at retirement is computed on the basis of the average earnings for the whole working life of the individuals, i.e.:

$$y_p[a, t+(\tau-a)] = \sum_{\alpha=L}^{\tau-1} \frac{y(\alpha, t+\alpha-a))}{(\tau-L)} = \sum_{\alpha=L}^{\tau-1} \frac{y(\alpha,t)e^{(\alpha-a)g}}{(\tau-L)} \tag{9}$$

Benefits for private dependant workers are then defined by

$$B(a,\tau,t) = 0.02(\tau-L)y_p[\tau, t+(\tau-a)] \tag{10}$$

where *L* is the age at which contributions began,

or $$= 0.8 y_p[\tau, t+(\tau-a)] \tag{11}$$

whichever is smaller. For public dependant workers, (11) must be replaced by:

$$B(a,\tau,t) = 0.94 y_p[\tau, t+(\tau-a)] \tag{12}$$

As mentioned, in the actual computation of benefits the retirement age is set equal to the expected retirement age as declared by individuals in the Bank of Italy's surveys. However, when this is less than the legal required retirement, we do apply the law provision. Therefore, in the computation τ = *max* (expected retirement age, legal age), where legal age = *min* (old age, legal years of contribution). Table V.4 gives the minimum age of eligibility for old-age pension and the minimum number of years of contributions to be paid before a person becomes eligible for a seniority pension.

As regards the rate of growth of productivity, of pension benefits and the discount rate we set:

g = 2%; g_p = 2% (0% after the 1992 reform); ρ = 2%.

V.3.1.2 The 1995 reform

The 1995 reform changed the Italian social security system into a defined-contributions system. Each year, paid contributions are capitalized up to the age of retirement using a capitalization rate equal to a five-year moving average of GDP growth in that year. Pension benefit flows are then computed by applying a conversion factor (the transformation rate) to the total amount of (capitalized) contributions.

We first define:

$$C\left[L,t+(L-a)\right]=c\cdot y\left[L,t+(L-a)\right] \quad (13)$$

$$y\left[L,t+(L-a)\right]=y(L,t)\cdot e^{(L-a)g} \quad (14)$$

where c is the contribution rate applicable to the individual.

(13) and (14) define the initial contribution for an individual whose current age a at year t is $a<L$ and start working at age L in year $t+(L-a)$.

Once that individual starts to work, he/she cumulates contributions by the following recursive formula:

$$C\left[\alpha+1,t+(\alpha-a+1)\right]=C\left[\alpha,t+(\alpha-a)\right]\left(1+g^{*}_{t+\alpha-a}\right)+c\cdot y\left[\alpha+1,t+(\alpha-a+1)\right] \quad (15)$$

and $g^{*}_{t+\alpha-a}=\frac{1}{5}\sum_{j=1}^{5}g_{t+\alpha-a-j}$

where $g_{t+\alpha-a-j}$ is the actual rate of growth of GDP in year $t+\alpha-a-j$.

Benefits at retirement age are then given by:

$$B=\lambda(\tau)C\left[\tau,t+(\tau-a)\right] \quad (16)$$

where $\lambda(\tau)$ is the conversion factor (or transformation rate) that transforms the accumulated contribution into an annual benefit amount taking into account the life expectancy of the beneficiary at the retirement age τ. This conversion factor is given in the form of a table for males and females at various ages of retirement. It is related to life expectancy and incorporates a discount rate of 1.5%.[46] Table V.5 shows the legal transformation coefficients as well as the life expectancy of the insured person and spouse at the age of retirement. The law states that the coefficients must be reviewed every 10 years and changed accordingly to the observed changes in mortality rates. The contribution rate, c, is currently 33% for employees, 20% for self-employed (who actually contribute 15%). In computing the social security wealth the rate of growth of pension benefits, g_p is set to be equal to 0, while τ can be between 57 and 65.

The individuals in our sample are assumed to be under the old (pre-95) regime, or partially or totally under the new social security regime according to the following rules:

- New regime: individuals who started to work after 1993 (post-1995 formula)
- Old regime: individuals with 18 or more years of contributions in 1995 (pre-1992 or 1992 formula)
- Partially in the new regime: individuals with fewer than years of contributions in 1995 (pre-1992 or 1992 formula for years of contributions up to 1995 and new post-1995 regime for years of contributions after 1995)

We also consider two aspects of the legal provisions that regulate the transition to the new regime. First, the minimum legal age of retirement evolves in the simulation according to Table V.6. Second, the contribution rate paid by the self-employed (on their declared income) is increased by 0.2 per year starting in 1999, from 15.8% to 19% in 2014. The rate used for the computation of pension benefits of the self-employed remains fixed at 20%.

V.3.2. The social security wealth of pensioners, survivor's pensions and aggregation by family members

Social security wealth for current pensioners in the sample is simply computed by keeping the current observed net pension constant in real terms for the remaining life expectancy of the pensioner.

The Italian social security system provides a pension for survivors. This is a fraction of the pension benefits of the deceased worker or pensioner, which is paid to the surviving

[46] Actually, the coefficient is expressed as the inverse of the factor of actualization inclusive of the hypothesis of the pension to the survivor, assuming a three-year difference in age between husband and wife and taking into account the probability of divorce.

partner in accordance with the law. In the simulation model the survivor is given a fraction that takes legal provisions into account.[47]

It should be noted that, ideally, the benefit paid to the survivor should enter the formula for the computation of the social security wealth of workers (equation 6 above), which would be augmented by the expected value of the future benefits left to the survivor. Hence for married couples a joint likelihood of death of the worker and survival of the partner should be computed for each future year, and social security wealth should incorporate the expected benefits of the survivors according to the legal provisions outlined above.[48] In the present version of the model we ignore this issue, which should be tackled in future developments of the model.

Finally, the family total social security wealth is simply defined as the sum of the social security wealth of the head of the household and the spouse.

V.3.3. Social security wealth before and after the reforms

In Table V.7 we show the level (at 1995 prices) of gross social security wealth, computed using the parameters indicated above, for different cohorts of workers using all the survey data from 1989 to 1995 (data re-proportioned to the National Accounts). The average per capita gross social security wealth of the Italian family sector amounted to 394 million lire (about 13.7 times the net labour earnings in our sample). After the reforms of 1993 and 1995 the amount was reduced to 324 million lire (about 11.2 times the average net labour earnings). This remarkable reduction was clearly unequally distributed among the different cohorts of workers: for older cohorts the impact was essentially due only to the abolition of the indexation of pensions to salary growth, while younger cohorts also suffered the effects of the change in the computation of benefits. The total loss of cohorts of workers born in the 1960s reaches almost 25%.

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[47] In particular, the survivor is granted 60% of the pension benefit of the deceased person (insured pensioner or worker). This fraction is incremented by a further 20% for each dependant child, up to a maximum of 100%. The benefit paid to the survivor is reduced by 25% if he/she receives an income that is more than three times the minimum pension benefit. This reduction increases to 40% or to 50% respectively if the income of the survivor is greater than four or five times the minimum pension.

[48] Venturini (1998) computes the social security wealth for individuals in the BSIW survey following this procedure.

V.4 The decision to retire

V.4.1 Introduction

The choice of retirement age of working individuals is a key variable in our model since it is crucial in determining individuals' lifetime income and pension benefit claims and therefore their saving behaviour throughout their life. In this section we will try to give an appropriate representation of this choice by determining demographic factors and economic incentives that affect the decision to retire.

Over the past few decades, in Italy there have been large differences in individual retirement decisions and an increasing disappearance of older people from the labour force. Participation rates dropped between 1958 and 1994 from 90% to 70% in the 50-60 age group and from 60% to 30% in the 60-64 age group. Recent studies document the close link between retirement decision and the economic incentives to retire provided by the various social security schemes.[49] First of all, the public social security schemes provide virtually all retirement income, since pension funds and private annuities play only a very marginal role in Italy. Second, replacement rates have been, on average, very high. Third, the existence of provisions for early retirement, with no actuarial penalty, greatly distort choices in favour of early retirement. Therefore, the reform of the social security system undertaken in recent years and summarized in the previous section is very likely to have considerable impact on individual choices. It is therefore crucial for our purposes to be able to quantify possible responses and endogenize retirement decisions in our model.

The issues outlined above can be explored in some detail by looking at the information contained in the micro data of the SHIW.

Information on the planned retirement age of workers in the labour force is available in the SHIW survey data for 1989 for all people in the labour force. In Table V.8 we tabulate the distribution of the planned retirement age for various groups of individuals. Several spikes in the distribution can be observed for all the groups considered: at age 55, at age 60, and at age 65.[50] The first peak corresponds to the normal retirement age for women (before 1992) in the private sector and to recipients of early-retirement provisions; the second spike

[49] See Brugiavini (1997) for a comprehensive discussion of this topic for Italy.

[50] It is noticeable that the planned retirement age for the various groups matches fairly closely the distribution of the retirement age observed from labour force statistics and is consistent with the hazard function of the labour force estimated from panel data (see Brugiavini, op cit.).

corresponds to the normal retirement age for males in the private sector. The last peak at age 65 occurs because, even when retirement is not mandatory, there is virtually no possibility for dependant workers to work beyond the age of 65. A large variance in planned individual decisions can also be observed. Women expect to work shorter years than men (they have more favourable early retirement provisions, as we saw in the previous paragraph); self-employed people and managers in the private sector expect to retire later than the other groups (there is a non-negligible proportion of self-employed people who plan to retire after the age of 65); public employees plan to retire relatively earlier than other workers.

In Table V.9 we tabulate the average planned age of retirement for different age groups and for different years. A clear pattern can be seen in the figures: individuals up to age 45 tend to raise their planned age of retirement after 1993, probably in response to the decrease in expected pension benefits because of the reform. Older workers (less affected by the reforms, as explained above) instead revise their plans downwards, possibly prompted by the fear of further future interventions affecting early-retirement provisions.

As a first measure of economic incentives for retirement induced by the social security system, in Table V.10 we compute the internal rate of return (IRR) of the social security system for different pension schemes. This is the rate that equalizes, in expected value terms, the flow of benefits and the flow of contributions paid. The IRR depends on all the institutional parameters of the different social security schemes described above, on the projected rate of growth of salaries in the various groups, and on the expected retirement age. Since before the reform the value of benefits was unrelated to the life expectancy of the individual, the IRR is also clearly a function of the age at which people started to work, with early starts enjoying larger benefits. We have computed the IRR for a fixed number of years of activity (37 years), assuming a productivity growth of 2% per annum. Clearly, a large variety of individual rates of return existed before the 1995 reform. After the 1995 reform the IRR tends to be equal to the rate of growth of GDP for everyone, as explained before. This, in turn, suggests that a likely effect of the reform is, *coeteris paribus*, to increase the age of retirement, since the IRRs of the previous schemes were, on average, well above any forecast rate of trend GDP growth (while also reducing the variance of individual choices).

A second measure of economic incentives is tabulated in Table V.11, in which replacement rates and the tax/subsidy rate of the social security system are reported for a typical worker in the private sector who started to work at the age of 20. The social security tax/subsidy rate is computed as the ratio of the absolute change in the present value (at the year of retirement) of net social security wealth from working one extra year and the net potential income (including social security contributions) from working one extra year. This measure can be interpreted as an implicit tax in terms of social security entitlement loss on an additional year of work via social security entitlements. Even if this is a rough computation (we are not considering benefits paid to the survivor or the personal income tax structure, and we are assuming that complete earning histories exist)[51] the loss, in terms of foregone benefits, of working any extra years above the required minimum is apparent.

V.4.2 Regression analysis of retirement decisions

We develop two possible alternative methods of modelling the retirement behaviour of individuals. A first solution uses a measure of the expected age of retirement available in our original survey data and estimates a behavioural equation calculated on the basis of the cross-sectional sample. The information on the expected age of retirement embodies individual preferences and can help to identify the relevant behavioural response. In calculating this reduced-form behavioural equation, we can take advantage of the large variability of individual situations existing in our data, both in a cross-section dimension (large number of different social security schemes) and across time (because of the reforms that have taken place in recent years, as described in the previous section).

We also report the preliminary results of an alternative approach based on the estimate of a hazard model of retirement (of the kind first used by Diamond and Hausmann, 1984) for older workers, using the panel dimension of our survey data. This method has the advantage that information affecting individual decisions can be updated in a natural way as time elapses.[52]

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[51] Brugiavini, op cit., presents a careful computation of the social security implicit tax/subsidy for the Italian private sector, taking into account, in a variety of different cases, the personal income tax structure and pensions paid to the survivor. The figures are close to those presented here.

[52] Stock and Wise (1988) show that the hazard model has a natural interpretation in terms of utility maximization and represents a particular (restricted) case of the more general option value model.

V.4.2.1 Estimates based on information on the expected age of retirement

The regression analysis is presented in Table V.12, where we show a number of alternative specifications of individual retirement decisions. The first column of the table presents a set of estimates of the (log of) planned retirement income against "age invariant" characteristics, in which we also include dummies for occupational status and sector of work.[53] Year dummies after 1992 (the year of the first reform) are negative, probably capturing an effect of anticipation of retirement by older workers driven by the fear of further restrictions to early-retirement provisions. Coefficients on cohort dummies present a hump-shaped pattern. This reflects the secular trend of a declining age of retirement in Italy up to the generation born in 1945-50; the reversal of the shape also captures the fact that the age at which people start to work has increased regularly for younger cohorts. Education is clearly important: a worker with a degree will retire, other things being equal, two years later than a worker with no degree. The self-employed tend to work longer, while workers in the public sector work fewer years.

The second column of the table introduces (the log of) the IRR in the regression as a measure of the economic incentives provided by the various schemes. There is a clear improvement in the fit of the equation. The estimated elasticity with respect to the IRR of 3.5 implies that a one-percentage-point reduction in the IRR (or GDP growth under the new regime) will induce, *coeteris paribus*, an increase in the retirement age of about 2.5 years in the sample average.

As an alternative measure of economic incentives, in the last column we use (the log of) the ratio of expected social security wealth of working up to age 60 to normal earnings, computed for each individual in our sample according to the rules described in the previous paragraph. Compared with the IRR, this measure has the advantage of being forward-looking, reflecting expectations of individuals about future earnings, future pension benefits and life expectancy. The coefficient turns out to be significant and with the expected negative sign.[54] The implied elasticity of the age 60 social security wealth is, however,

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[53] Implicitly, we are considering groups in the population to be exogenously determined so that membership of a group can be interpreted as an instrument (control). This assumption is not necessarily true, however.

[54] It is interesting to note that the coefficient of the self-employed dummy reverses its sign. This reflects the fact that although this group usually has a very high IRR, it also has a very low ratio of social security

somewhat smaller compared with that found using the IRR. A one-percentage-point reduction in the IRR implies, on average, a reduction in the ratio of social security wealth to normal earnings of slightly less than 20%, inducing an average increase in the planned retirement age of 0.8 years.[55]

In the simulation model we use this last specification to attribute the retirement age to all new entrants in the labour force.

It has to be recognized, however, that both economic incentives and personal characteristics can vary with age and can affect the decision to take retirement or induce people to revise their plans. For example, a sudden drop in (expected) income might reduce the economic incentive to work as opposed to the decision to retire. The latter decision is also likely to be a joint decision within the family if other family members (partners) are working; each member's decision will therefore be a function of the relevant variables affecting the others. Changes in family composition might also exert important effects. For example, the presence of young dependants in the family can lead the ageing head of the household to postpone his/her retirement. Table V.13 shows the existence in our sample of a clear positive correlation between the planned age of retirement and the number of young dependants present in the family. The correlation increases when we restrict our attention to adult young dependants (over 18 years of age). The presence of young dependants can, in fact, lead parents either to accumulate more wealth during their working life, to retire later, or both. Clearly, the response will rest more heavily on the retirement decision when the difference in age between parents and children is relatively high and the children were, at least partially, unexpected, or when unforeseen and uninsurable risk such as unemployment affects particularly young individuals (as in the case of Italy).

In order to allow people to revise their plans in our simulation model in response to changing economic and demographic conditions, we produce a second set of equations that include some of these age-variant characteristics, restricting our sample to people in the labour force aged over 50. The results are shown in Table V.14. We introduce in the

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wealth over income because a large part of self-employment income is not reported to the fiscal authorities as a result of tax evasion (see the Appendix). Therefore, social security wealth is relatively unimportant for this group.

[55] This sizeable difference in estimated elasticity might be attributable to the fact that the social security wealth measure is more uncertain, especially for young people; the difference tends to disappear when the sample is restricted to older people who are closer to retirement (see below).

regression the (log of) real family wealth, a dummy for marital status (1 = married), dummies for the number of young dependants in the family interacted with the age of the head of the household, dummies for the number of income earners (in addition to the head of the household) and an inverse Mill's ratio term (from a probit estimate of the probability of being in the labour force for this group) to correct for a self-selectivity bias. The real wealth of a family emerges with a significant (but quite small) negative coefficient. The sign is not clear a priori, as the variable is evidently endogenous because individuals who plan to retire early might very well accumulate greater wealth.[56] Dummies for the number of income earners in the family show the expected negative sign and are statistically significant. The presence of young dependants in the family appears to increase the planned retirement age and the effect is more marked the greater the difference in age between the head and the dependant, confirming the analysis of the raw data above even if the effect is somewhat smaller than might have been expected on that basis alone.

Measures of incentives provided by the social security system are significant and have the expected negative sign, as in the set of regressions above. It is to be noted that the ratio of expected social security wealth (at age 60) over income (see column 4 of Table V.14) now presents an elasticity of -0.16 (about three times that estimated across the whole sample), which is now comparable with that given by the IRR measure. In addition, the fit of the equation is clearly improved when using this measure of incentives, underlining the importance of introducing forward-looking variables into the specification. Finally, we have added, in the regression for husbands and wives, their respective expected social security wealth as a ratio of total family income among the arguments of their planned retirement age specification. While the coefficients emerge with the expected (negative) sign, their effect seems to be minor.

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[56] See the discussion in Diamond and Hausmann (1984) on this point. To account for the possible endogeneity of wealth we re-estimated the equation using an instrumental variable type of estimator. When this is done, the sign of the estimated coefficient turns positive, meaning that the estimation is capturing essentially the "reverse causation" from early retirement to higher saving and missing the effect of wealth on retirement. In addition, other coefficients of the regression pick up fairly unplausible values. This somewhat unsatisfactory result might, of course, be due to the well-known fact that it is very hard to find appropriate instruments for wealth accumulation.

In the simulation model we choose to use the specification in column 3 to allow people to revise their planned retirement age when they become older (over 50) and up to the minimum required retirement age (which will be 57 under the new system).

V.4.2.2 A hazard model of retirement estimated on panel data

The second alternative is to model the choice of retirement age using the framework of the continuous time hazard model.[57] In contrast to the regression analysis based on the expected age of retirement, in the hazard formulation we follow individuals as they age, using the panel dimension of our survey data, and observe their actual retirement behaviour. This framework allows information affecting the retirement decision to be updated as time passes. In particular, it allows the marginal incentive to retire provided by the social security system to be taken into account. Here we describe some preliminary results from this method.

Let the instantaneous hazard rate of retirement for an individual who has not yet retired, θ_t, be expressed as a function of age, a set of time varying variables be Z_t, and a set of variables that remain constant over time be X:

$$\theta_t = pt^{p-1} \cdot e^{X\beta} \cdot h(Z_t \alpha) \quad (17)$$

The hazard model of retirement is estimated on the panel of the SHIW for the years from 1989 to 1995. We select people in the labour force aged 50 or over. After some cleaning up of the data, the final sample contains 1,219 subjects (all observed over at least two consecutive years), of whom 351 actually retire in the period under observation. The time-varying vector Z_t in (17) contains economic variables aimed at capturing the economic incentive to start retirement: the ratio of social security wealth to permanent income (SSWY), the ratio of accumulated assets to permanent income (WY), and the value of postponing retirement by one year as a ratio of the next year's income (VWY). The numerator of this variable (borrowed from the option value model) represents the monetary value of postponing retirement by one year, were a person to work for an extra year and then retire (evaluated at the beginning of the period t):

57 See Hausmann and Wise (1985), Diamond and Wise (1984) and a large body of subsequent literature. Stock and Wise (1988) have shown that the hazard model has a natural interpretation in terms of utility maximization and represents a particular (restricted) case of the more general option value model.

$$VW_t = \beta \cdot S(a,t) \cdot y_t^f + k \cdot (SSW_{t+1} - SSW_t) \qquad (18)$$

where $\beta = (1/(1+\rho))$, *k* is a parameter indicating the relative weight given to earnings while working with respect to earnings while in retirement and other variables as defined above. The value of the expected change in social security wealth from age 50 to 68 for the average of the panel and for some specific categories of individuals is shown in Table V.15. The figures are comparable to those given by Brugiavini (1997) and suggest that the loss in social security benefits becomes substantial as people reach their late 50s.[58]

The results of the estimates of the hazard model of retirement are given in Table V.16. Age is expressed as age minus 49. All variables present the expected signs and are generally statistically significant. A higher ratio of social security wealth to permanent income increases the probability of retirement, while an increase in the gain from working an extra year prolongs work. The effect of the ratio of social security wealth to permanent income is substantial but less marked than that found using the previous method: a decline of 10% in the ratio would imply an increase in the expected age of retirement of approximately half a year at age 60.[59] However, the results imply that an increase of 10% in the value of postponing retirement would increase the expected age of retirement by only about one month. Other variables have qualitatively the same effects as found in the previous analysis based on the expected retirement age.

We estimate the hazard model using different values of *k*. The likelihood reaches a maximum for *k*=1.3, but is substantially flat in the range from 1 to 1.5.

V.5 The consumption and saving behaviour of households

V.5.1 Age pattern of the ratio of households' consumption to total resources

Before coming to our empirical specification of the rule of consumption behaviour, we need to see whether our reconstruction of total resources for the households in our sample is

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58 However, since the SHIW provides only the age of the start of the individuals' working life the estimates might overstate the average loss due to social security provisions, since they do not take account of the possibility of gaps in the working life of individuals.

59 The calculation is based on the fact that if $\theta_t = pt^{p-1} \cdot e^{X\beta}$ then the expected age of retirement τ is given by $ln(\tau) = (1/p) \cdot \beta X$.

plausible or not. For this purpose, we reconstruct the ratio of *C(a)/TR(a)* for each age and for various family-type definitions. The results are shown in Figures V.2 and V.3. An implication of the life-cycle hypothesis and of the solution of the problem presented in (1)-(4) at the beginning of this Section is that, on the basis of standard preference assumptions, this ratio should be smooth and well-behaved over age. As we can see from Figure V.2, this seems in fact to be the case for our reconstructed average ratio for all groups of families: it increases steadily up to about age 70 and increases rapidly thereafter. We can see that the value of the ratio seems to be large, just rising from below 0.2 at age 20 (when life expectancy is around 55) to 0.9 at age 80 (when life expectancy is around 10).

The pattern of the ratio of consumption to total resources over age is also reasonably well-behaved for different groups of families (Figure V.3), even if the use of cross-section data can be misleading in this respect, since a single household can belong to different groups of families over its lifetime. With this word of caution, some differences emerge in the pattern of different groups, particularly after age 55. A much lower value of the ratio is noticeable for non-nuclear families (both couples and single-head families), especially around age 50 to 65. This might be surprising as those families have, on average, a larger number of components than other families. After some investigation we can explain this fact by the presence of more income earners in those families compared with the other groups, and their concentration in families whose head is aged between 50 and 65. Because in our formulation young working children contribute with part of their lifetime income to the total resources available to the families, the total resources for these groups are relatively high, while the presence of economies of scales means that consumption is proportionally lower.[60]

Singles present a much steeper pattern of the ratio of consumption over total resources after age 50 than other families, probably reflecting the absence of economies of scale in consumption and/or the absence of incentives to accumulate wealth for inter-vivos transfers of bequests to children. Single-head families present the noisiest pattern, probably because of the large number of in and out movements for this group.

Another feature of the data worth noting is the pattern of the ratio of consumption over total resources for families in the same age group, along the distribution of total resources for

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[60] In the regression analysis below, we investigate further the issue of what is the relevant horizon for decisions in families where several generations coexist.

the same age group. As shown in Table V.17, the ratio clearly tends to decrease as we move towards the top of the distribution. This fact is very often found in micro data (but very often left unexplained). It might be due to a relative income effect of the Duesenberry (1952) type (or to a "catching up with the Jones' effect). Or more simply, it might reflect the fact that poorer households are on a kink in the optimal solution to their maximization problem and it is impossible for them to leave a bequest, while richer households can leave their planned bequests. We have investigated this matter and tried to quantify this effect in the estimation of our consumption rule.

V.5.2 Empirical estimates of the consumption rule

We can now turn to the empirical specification of the consumption rule described in equation (5) in Section V.1. After some investigation we find that the specification that could satisfactorily describe the behaviour of all families in our sample is of the kind:

$$C_a / TR(i, F, a) = f_c(a) + \sum b(F) D_c(F) \qquad (19)$$

where $f_c(a)$ is an increasing function of age (which we approximate by a spline in age), $D_c(F)$ is a set of one-zero dummies indicating the presence or the absence of a characteristic represented by one component of F, and b(F) are coefficients.

The results of some alternative estimates of (19) are reported in Table V.18.

Overall, the explanatory power of the equations is satisfactory, with around 40% of the total variance explained by the regression. Coefficients generally have the expected sign and are significant. The constant (estimated at around 0.045) represents the ratio of consumption over total resources of a nuclear couple without children whose head is aged 20. The age spline fits the average pattern of the *C(a)/TR(a)* ratio over age fairly well (see Figure V.4), even if some of its terms are not statistically significant.

Some features of the estimated equation merit a more careful interpretation. Dummies for the number of children have the expected pattern for families whose head is relatively young (up to 45 years), with each extra child contributing a decreasing amount of additional consumption, indicating the presence of economies of scale in the number of children. However, surprisingly we find that this pattern is reversed as the head of the family becomes older (this feature is captured by interacting the dummies for the number of children with the age of the head; the resulting terms are strongly significant in the regression). A possible explanation, already mentioned, may be that after age 50 the heads of families with young children tend to expect to retire much later than people with no children or with relatively older children (this was confirmed by our estimations of the determinants of the retirement age). Delaying retirement owing to the presence of young children in families in which the head is relatively old tends, according to our estimates, to increase the total resources available to the family by more than the increase in consumption due to the presence of children, the net result being a decrease in the ratio of consumption over total resources. We believe that this effect, which might be due to the need to accumulate resources to invest in children's education (which is likely to increase as the children grow), is probably important in the current Italian context where younger generations have considerably postponed the start of reproductive life (see Section II).

The effect of the presence of additional adults in the family is twofold. On the one hand, they certainly make an important contribution to the total consumption of the family; on the other hand, they might also contribute in a significant manner to its total resources, tending, therefore, to reduce the *C(a)/TR(a)* ratio. We are able to separate these effects by introducing dummies for the number of income earners in the family along with dummies for the presence of adult members. Having done that, the effect of additional adults in the family looks very plausible.[61]

We introduce a set of additional dummies related to the family structure. We have already documented in Section II that, other things being equal, single persons living alone have a higher consumption-income ratio than similar individuals living with other families (e.g. parents); this feature is confirmed by our estimates. In addition, as we have already described, non-nuclear families (single-head or parent families) tend to have, *ceteris paribus*, a lower consumption over total resources ratio. As we have already argued, in addition to the combined effect of the presence of more income earners in these types of families and the effect of economies of scale on consumption, this result might very well be due to the fact

[61] The strong negative effect on the ratio of consumption to total resources exerted by each additional income earner might be related to the fact that families with more income earners are relatively richer; and thus related to the observation, clearly present in our data and documented in the introduction, that richer families tend to save more. This presumption is confirmed by the fact that when we introduce a variable capturing the distributional effect (the variable *dr* in the second column of Table V.18, which will be explained below) the negative effect produced by the number of income earner dummies is substantially reduced and implies a net reduction in the *C(a)/TR(a)* ratio of the family for any additional working adult.

that the time horizon for these kinds of families implicitly assumed so far (that is, that of the head of the family) is in fact incorrectly chosen. Their saving behaviour might simply reflect the fact that there are younger people accumulating wealth while living within the original family. Since, of course, in the data we cannot distinguish individual behaviours for consumption and wealth accumulation within a family, it is hard to give a definite answer to the problem. However, we perform a different set of estimates, in which we redefine the age of the head of the family as a weighted average of the ages of all income earners (using their relative incomes as weights). This modification does not appear to make any substantial improvement in the explanatory power of the equation.[62]

We perform a number of experiments to try to capture a "distributional effect" (rich families save more) in saving behaviour. We divide the sample by age group and compute for each observation in a given age group a spline of the form:

$dr(i,a) = 0 \text{ if } TR(i,a) <= TR_p(a)$

$dr(i,a) = (TR(i,a)-TR_p(a))/TR(i,a) \text{ if } TR(i,a) > TR_p(a)$

where $TR_p(a)$ is the value of the p^{th} percentile in the distribution of *TR* of the age class *a*.

We tried different percentiles as threshold values. In column 2 of Table V.18 the dummy *dr* is constructed using the 50[th] percentile as the threshold value. The coefficient is strongly significant and the improvement in the explanatory power of the equation is remarkable. The implied pattern of the propensity to consume (out of total resources) by total resource percentiles for households of various age groups is depicted in Figure V.5. It is noticeable that the estimated profile tends to become steeper for older (heads of) households.

Columns 3, 4 and 5 of Table V.18 report the results of estimates where the current disposable income of families is added to the basic equation as an explanatory variable, consistently with the literature on capital market imperfections and the presence of households with liquidity constraints. This has been shown to be important in Italy since

62 We also try to investigate the case in which we define the head of the household as the individual earning the highest income. In some cases this means making a substantial change to the age pattern of the ratio of consumption to total resources for non-nuclear families because in such families the younger people often earn more than their parents. Again, we do not find strong evidence of an improvement in the explanatory performance of our consumption equation. The problem might be due to the fact that households that are reclassified as younger usually have much higher income-wealth ratios than the average for their age groups, creating a potential problem in the opposite direction to the original one.

capital markets are less developed (especially for credit to consumption) compared with other developed countries.[63]

In column 3, the introduction of current disposable income (as a ratio of total resources) improves the fit of the equation; its size is extremely large (0.77), while the constant term (that is, the propensity to consume as a proportion of total resources becomes very small and not statistically significant). This result, however, might just reflect the possible endogeneity of current disposable income. In column 4 we use all the arguments present in the labour income equation plus variables relating to the value of houses owned used as instrumental variables for current disposable income (for renters we use the value of the rent). The equation now changes dramatically and the coefficient of disposable income assumes an implausible size (about 1.2), clearly an indication of the endogeneity of current income. In the last column we introduce the current disposable income variable only for those households that are most likely to be liquidity constrained, defined, quite arbitrarily, as households (with a head under 60 years of age) reporting a particularly low asset over current income ratio (we have tried different threshold values; the estimation reported is for households with a ratio of 0.15 or less).[64] The resulting estimate is quite satisfactory, with a coefficient on current income of 0.3.

However, given the uncertainty and the arbitrary assumption involved, we have decided not to use a specification of the consumption equation that includes the current income variable in the simulation set of the model presented here, which uses instead the specification in column 2 of Table V.18.

V.6 The evolution of total wealth

V.6.1 Families' saving and the next period initial wealth

The model is finally "closed" with the computation of families' saving and their next period initial wealth. Families' saving is computed as the difference between (predicted) disposable income and consumption. Disposable income is computed as the sum of labour income, transfers (pensions and unemployment benefits) and interest income (computed by

63 See Guiso, Jappelli and Terlizzese (1994) and Nicoletti-Altimari and Thomson (1995).

64 See Hayashi (1985) and Zeldes (1989).

applying a constant interest rate to total initial wealth). Finally, next period initial wealth is computed simply as the sum of the current period initial wealth and saving.

V.6.2 Transfers of wealth between households

Our demographic process gives rise to the creation of new households and to the dissolution of others, and this process necessarily entails a change in the net worth of the original and resulting households. While the main reason for changes in the net wealth of a given household in our model comes from the accumulation of assets resulting from savings as described in the previous section, we cannot avoid tackling the issue of the transfer of wealth between households that occurs after some demographic events. This is necessary both because we need to ensure consistency in the process governing the evolution of wealth for the society as a whole and because we want to maintain a plausible distribution of wealth by age and within the same age groups across households.

However, we must recognize that very little information exists, in the survey or in outside sources, on bequests and, even more, on *inter-vivos* transfers between households. While we admit that the whole issue deserves a much more careful analysis, for the time being we make use of simple rules of thumb, leaving a more rigorous strategy for future research. The simple rules given below represent parameters of the model that can be changed when new or better information becomes available.

The demographic events that give rise to a transfer of wealth in our model are: (a) the death of the head of the household (bequests); (b) marriage; (c) divorce; (d) young dependants becoming independent; (e) the merging of different households.

V.6.2.1 Bequests

Since our empirical consumption decision rule does not necessarily imply that people consume all their resources during their lifetime we must handle the issue of bequests from older to younger generations.

We conventionally attach the wealth of every family to the family head, so that we have to tackle the issue of bequest only after the death of the head. When this event occurs we distinguish two cases: there are other persons in the family or the deceased was alone.

In the first case, when a new head of the family can be identified we simply transfer the whole wealth to the new head; if no head is present, that is, there are only children under age 18, then we merge them with a different family (see Section III.4.4) and apply the rule governing transfers when different families merge, as explained below.

In the second case, if there are no other persons in the family, and since we do not know whether there are children living away from home or who they are in the original sample, we need to apply a more complex mechanism. We pool the wealth of all deceased individuals of a given age and redistribute it to other families according to the distribution of potential children that the female spouse could have had with the average risk of fertility during her childbearing years. That is, assuming average fertility for the female spouse (if the deceased was a male we infer the age of the potential spouse by applying the average age gap), we obtain the average number and the ages of potential children. We then allocate the bequests proportionally to all the heads of households in those age groups.

This method, and especially the first step where we do not recognize that, even if there are other persons in the family, there might be other relatives living away from home, clearly forces a more equal distribution of wealth within cohorts than that observed in the data and implies an asymmetric treatment of children who leave the household before the death of the head. To partially overcome this problem we assign a (quite substantial, as described below) proportion of wealth of the original family to individuals who leave the households to marry or to become independent. (Alternatively, we could have allocated part of the bequest outside the family in the first case, following the same method used in the second).[65]

V.6.2.2 Wealth transfers to marrying people

In the case of two singles living alone before marrying, the wealth of the resulting family will simply be the sum of the wealth of the two original families. When, however, one or both of them comes from another family we do not know what their wealth is (since in the survey wealth is assigned to the household and not to individual members). Moreover, we all

[65] Another interesting possibility would be to simulate the model for a long period, say 100 years, keeping track of all the relations among the families so as to be able to identify the children living away from home when somebody dies, and then apply legal provisions for bequest to allocate wealth. While this might be an important application of the model in order to study, for example, the distributive consequences of different schemes or legal provisions for bequest, it has the inconvenient feature that it would imply a modification of all the initial demographic conditions of the sample, which are crucial for the goals of the present study.

know from casual observation that there are substantial transfers of wealth from relatives (or friends) on occasions such as marriage. We then proceed as follows: we attribute a proportion equal to 1/3 of the original family's wealth to children and assign to the marrying person a part proportional to the number of children present in the family (that is, if there are, say, two children, the marrying children will receive 1/6 of the total wealth of the family). The wealth of the new family formed by marriage is simply the sum of the wealth of the two marrying individuals.

V.6.2.3 Wealth transfers to children leaving home

The formation of single households does not necessarily imply a transfer of wealth from the original family to the new one. However, when we observe the net worth of young individuals living alone we note that their holding of wealth is non-trivial even if their savings are quite low. This means that some degree of wealth transfer takes place at this stage (not necessarily in cash). We use here the same rule that we used for marriage (i.e., a proportion of the wealth of the original family equal to 1/3 times the inverse of the number of children). While this amount may appear relatively large, we adopt it to offset the asymmetric treatment of children who leave their family before the death of the head and who do not directly receive bequests from the original family.

V.6.2.4 Wealth transfers after divorce

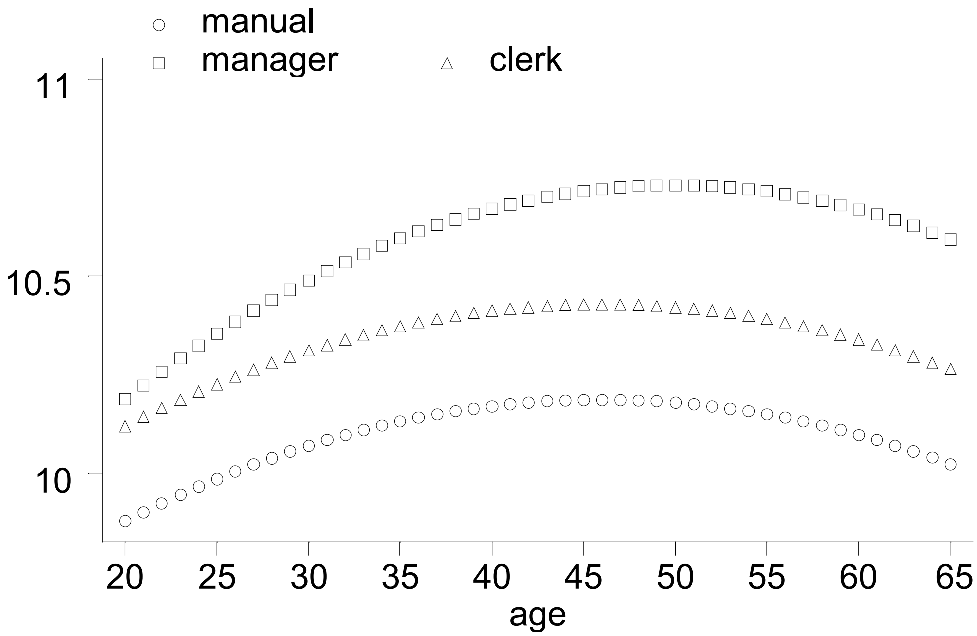
Here we distinguish between the case in which there are children present in the family and when there are none. If there are no children present, each spouse is assumed to keep 1/2 of the family wealth. If there are children present, two thirds of the wealth is given to the parent to whom the children are assigned, and the remaining 1/3 to the new single household.

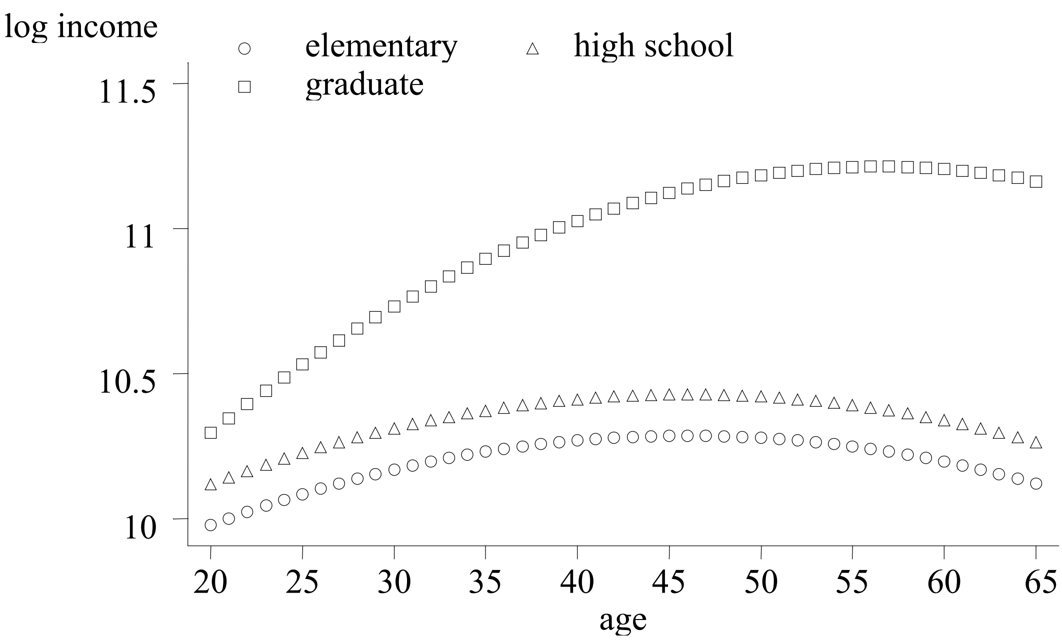
V.6.2.5 Wealth of merging households

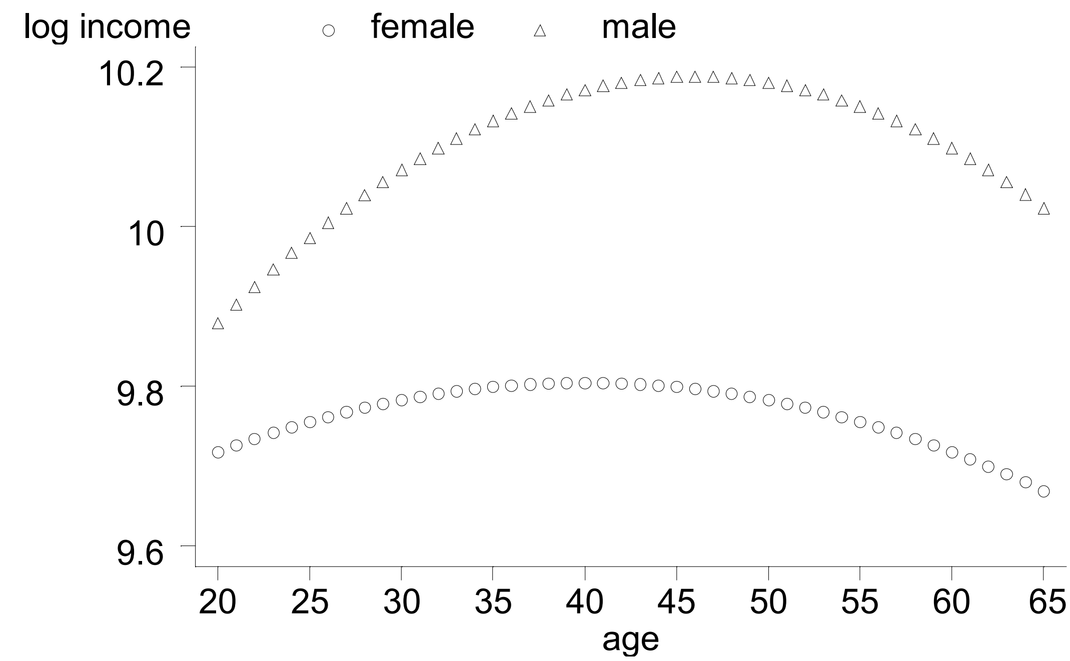
This is the case of old people merging with younger households or young unattached children merging with older households after their parents' death. The wealth of the new household thus formed is simply the sum of the wealth of the two original households.

Section V - Charts and Tables

Figure V.1: Income profiles by occupation, education, sex and sector






log income
female
male
10.2
10
9.8
9.6
20
25
30
35
40
45
50
55
60
65
age

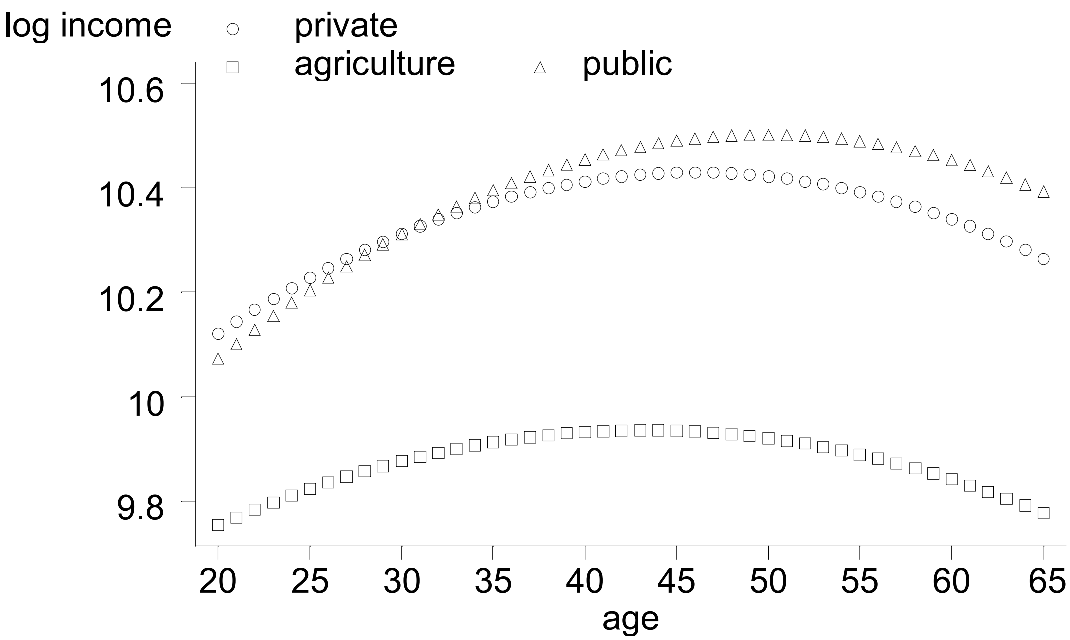

log income
private
agriculture
public
10.6
10.4
10.2
10
9.8
20
25
30
35
40
45
50
55
60
65
age

Figure V.2: Consumption over total resources ratio, by age: all households

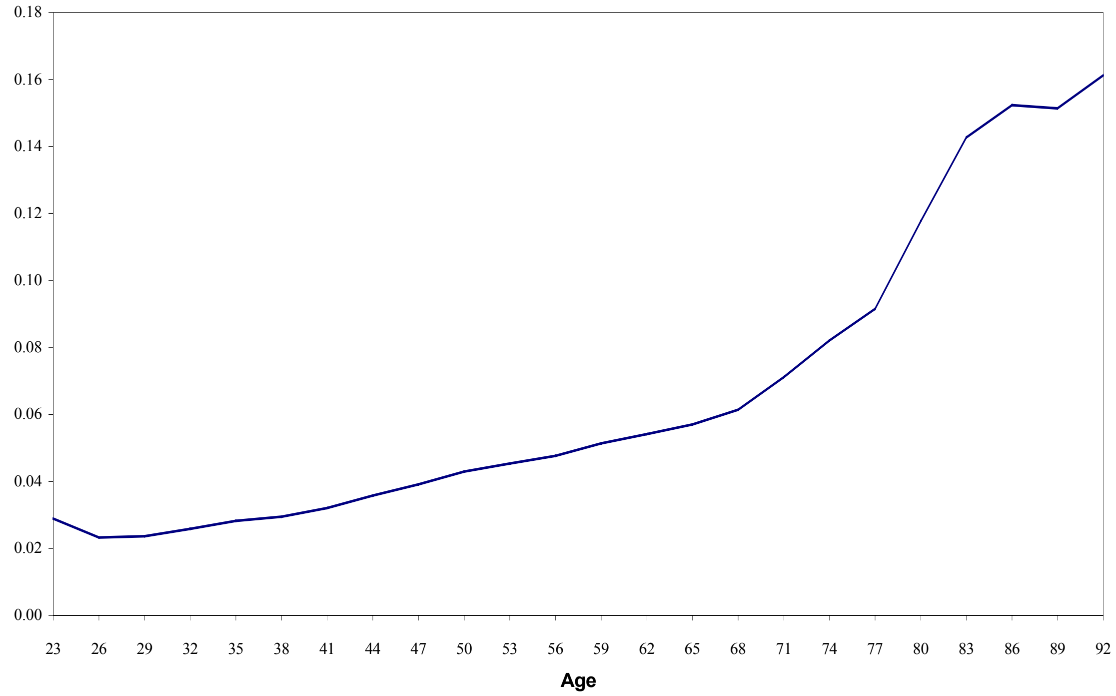


Figure V.3: Consumption over total resources ratio by age and family type

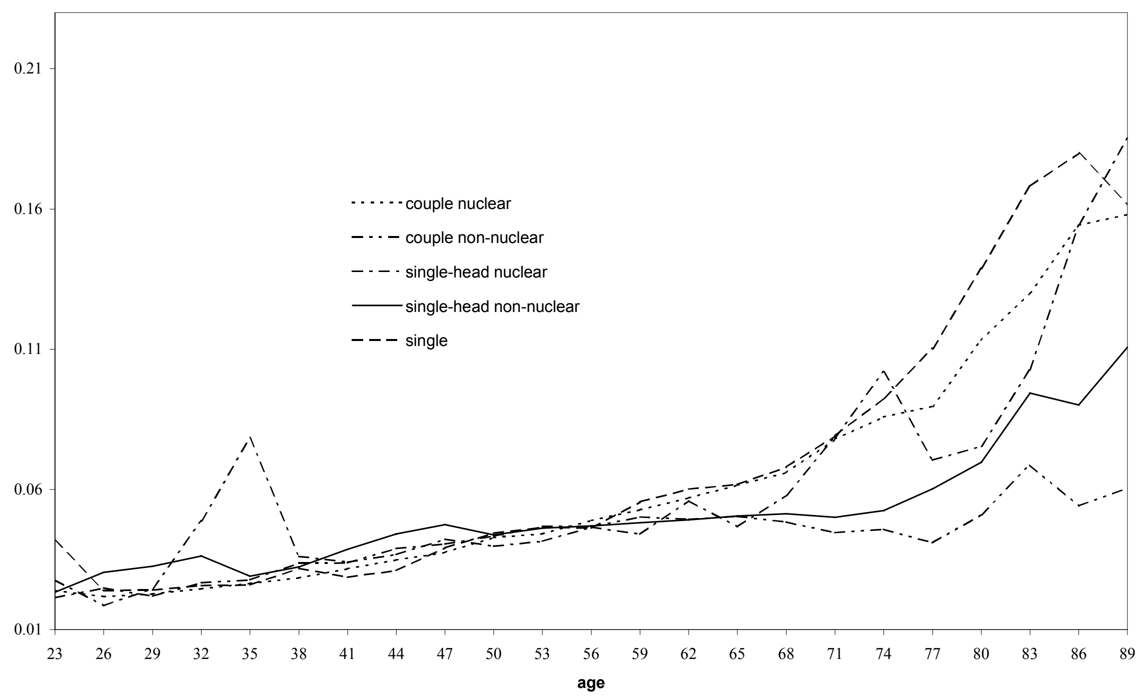


Figure V.4: Consumption over total resources ratio: actual and fitted values

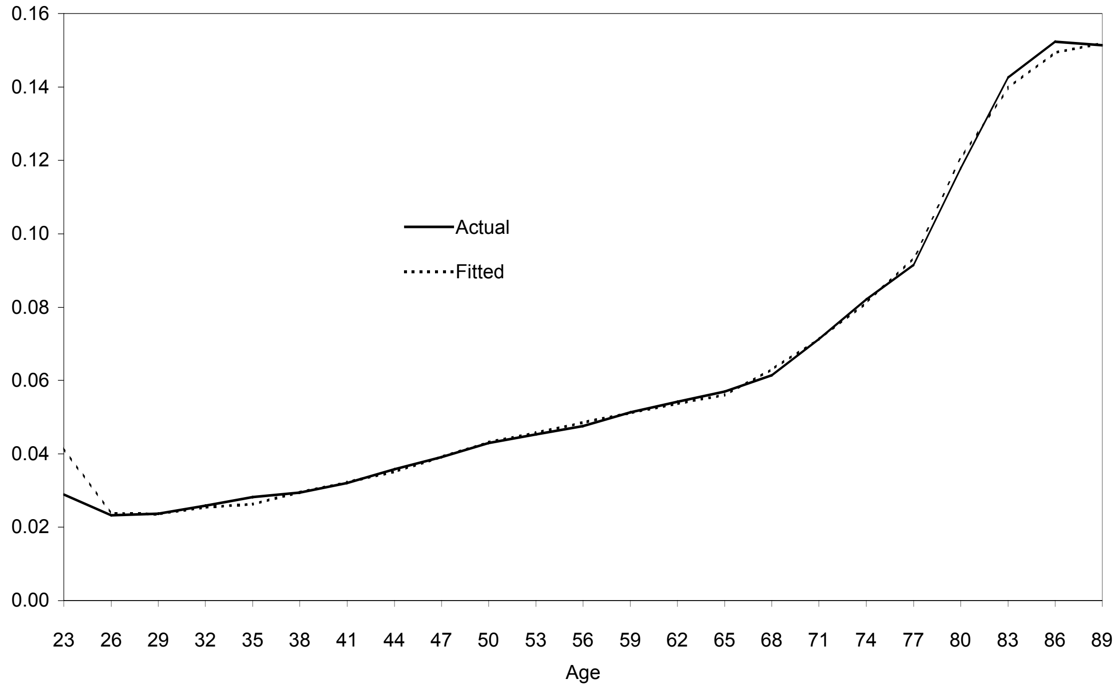


Figure V.5: Implied shape of C/TR ratio by TR percentiles at different ages

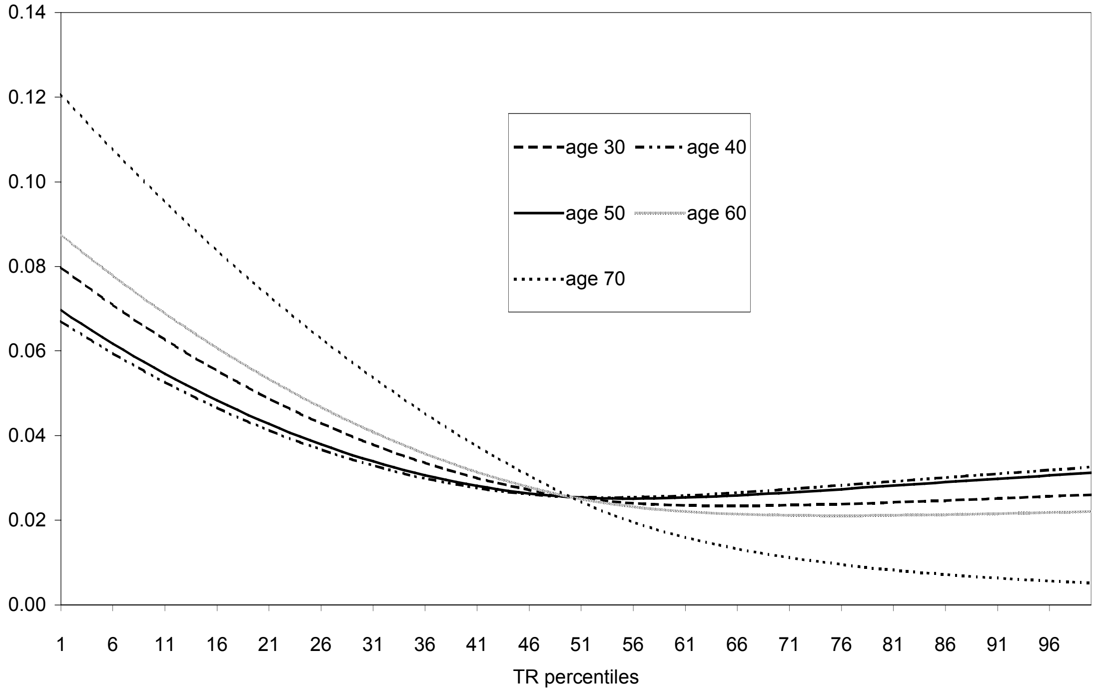


Table V.1: Probit equation for labour force participation
(1987-1989-1991-1993-1995 SHIW data)

Variable	Coefficient	Std. error
constant	-1.79	0.030
male	0.77	0.016
married	0.23	0.020
head	1.82	0.021
centre	0.49	0.018
north	0.66	0.015
no. earners: 2	1.52	0.017
no. earners: 3 or more	1.89	0.021
no. children: 1	0.18	0.021
no. children: 2	0.25	0.024
no. children: 3 or more	0.11	0.035
c1	0.27	0.025
c2	0.37	0.028
c3	0.39	0.030
c4	0.23	0.030
c5	0.01	0.030
c6	-0.3	0.031
c7	-0.52	0.033
c8	-0.78	0.040
c9	-0.52	0.065
d89	-0.19	0.022
d91	-0.24	0.022
d93	-0.54	0.022
d95	-0.54	0.022
No. of observations	67150	
Pseudo R2	0.46	

Notes: Variables are dummies set equal to 1 when the characteristic is satisfied.
c1-c9 are 5 years successive cohort dummies: c1: born between 1920 and 1924; c2: born between 1925 and 1929; etc.

Table V.2: Labour income forecast equation
(dependant variable: log of labour income)

(Cross-section estimates; robust standard errors)

Variable	w/o cohorts dummies		with cohort dummies				
	Coefficient	Std. error	Coefficient	Std. error	Variable	Coefficient	Std. error
d89	0.035	0.0077					
d91	0.132	0.0078	0.116	0.0049	c1	0.114	0.0169
d93	-0.001	0.0096	-0.002	0.006	c2	0.149	0.0207
d95	-0.073	0.0097	-0.054	0.0044	c3	0.161	0.0245
elementary	0.305	0.0273	0.307	0.0274	c4	0.182	0.0277
high school	0.466	0.0281	0.466	0.0282	c5	0.2	0.0301
university	-0.629	0.1905	-0.733	0.1926	c6	0.2	0.0324
clerk	0.184	0.0078	0.185	0.0078	c7	0.213	0.0354
manager	0.057	0.1601	0.032	0.1602	c8	0.243	0.0406
self-employed	0.562	0.1203	0.525	0.1212	c9	0.279	0.0508
private sector	0.058	0.1085	0.071	0.1092			
centre	0.144	0.0082	0.144	0.0082			
north	0.259	0.0075	0.26	0.0076			
male	-0.239	0.0951	-0.205	0.0959			
head	1.153	0.1018	0.939	0.1114			
part-time	-0.273	0.0239	-0.275	0.0238			
Mill's ratio	-0.049	0.0047	-0.05	0.0048			
age	0.052	0.0062	0.035	0.0073			
university (*)	0.049	0.0089	0.054	0.009			
manager (*)	0.013	0.0078	0.015	0.0078			
self-employed (*)	0.016	0.0059	0.018	0.006			
public (*)	0.013	0.002	0.013	0.002			
private sector (*)	0.011	0.0057	0.01	0.0058			
male (*)	0.026	0.0052	0.024	0.0052			
head (*)	-0.045	0.0054	-0.034	0.0059			
age squared	-0.001	0.0001	-0.0004	0.00009			
university (**)	-0.0004	0.0001	-0.0004	0.0001			
manager (**)	-0.0001	0.0001	-0.0001	0.00009			
self-employed (**)	-0.0001	0.0001	-0.0002	0.00007			
public (**)	-0.00005	0.00004	-0.0001	0.00004			
private sector (**)	-0.00007	0.00007	-0.0001	0.00007			
male (**)	-0.0002	0.00007	-0.0002	0.00007			
head (**)	0.0004	0.00007	0.0003	0.00007			
constant	8.012	0.1178	8.288	0.1329			
No. of observations	43412		43412				
R-squared	0.44		0.44				

(*) interacted with age; (**) interacted with age squared.

(^) years dummies are constrained to be orthogonal to a time trend.

Notes: Variables are dummies set equal to 1 when the characteristic is satisfied. c1-c9 are cohort dummies, see Table V.1.

Table V.3: Labour income forecast equation

(Panel regression; dependent variable: logarithm of labor income)

Variable	Coefficient	Standard error
Elementary	0.3326	0.0469
High school	0.4735	0.0482
College degree	-0.3220	0.2840
Clerk	0.1979	0.0159
Manager	0.4437	0.3073
Self employed	0.6029	0.1630
Private sector	-0.0996	0.1893
Center	0.1216	0.0152
North	0.1757	0.0124
Male	-0.2753	0.1553
Head of household	0.8236	0.1694
Partime	-0.3515	0.0382
Age	0.0241	0.0104
Interacted with age:		
College degree	0.0369	0.0132
Manager	-0.0057	0.0148
Self employed	0.0032	0.0080
Public sector	0.0122	0.0033
Private sector	0.0181	0.0095
Male	0.0268	0.0082
Head of household	-0.0319	0.0086
Age squared	-0.0002	0.0001
Interacted with age squared:		
College degree	-0.0003	0.0002
Manager	0.0001	0.0002
Self employed	-0.0001	0.0001
Public sector	-0.0001	0.0001
Private sector	-0.0002	0.0001
Male	-0.0003	0.0001
Head of household	0.0003	0.0001
Constant	8.6846	0.2096
Autoregressive term	0.6601	0.1262
SEE	0.45	
No of observations	13469	

Notes: Variables are dummies set equal to 1 when the characteristic is satisfied.

Table V.4: Minimum age of retirement or minimum years of contributions

	Old age		Years of contributions	
	M	F	M	F
Private employees	60	55	35	35
Public employees	65	65	20	20
Self-employed	65	60	35	35

Table V.5: Coefficients of transformation

Age	Life expectancy		Lambda
	Insured	Partner	%
57	20.76	28.28	4.72
58	19.97	27.41	4.86
59	19.19	26.52	5.006
60	18.42	25.64	5.163
61	17.68	24.76	5.334
62	16.94	23.88	5.514
63	16.22	23.01	5.706
64	15.52	22.13	5.901
65	14.84	21.27	6.136

Table V.6: Evolution of age and years of seniority for pension entitlement

Dependant workers			
	Age with 35 years of contributions		Years of seniority
Year	Private	Public	
1996	52	52	36
1997	53	53	36
1998	54	53	36
1999	55	53	37
2000	56	54	37
2001	57	55	37
2002	57	55	37
2003	57	56	37
2004	57	57	38
2005	57	57	38
2006	57	57	38
2007	57	57	39
2008	57	57	40
Self-employed			
From 1998	58		40

Table V.7: Average expected gross social security wealth by cohort
(estimates based on (source: 1987-1989-1991-1993-1995 SHIW data at 1995 prices)

	Old regime	New regime	
Year of birth:		(*)	(**)
pre-1922	215306	195167	195167
1923-1927	364685	323578	323578
1928-1932	352332	308367	308367
1933-1937	386984	334267	334256
1938-1942	411455	351795	351723
1943-1947	429143	364345	364016
1948-1952	431808	365946	363981
1953-1957	418030	354710	346051
1958-1962	407254	346497	322530
1963-1967	377644	321495	288588
1968-1972	351894	300103	269938
1973-1977	299923	256727	243015
pre-1922	100	90.65	90.65
1923-1927	100	88.73	88.73
1928-1932	100	87.52	87.52
1933-1937	100	86.38	86.37
1938-1942	100	85.50	85.48
1943-1947	100	84.90	84.82
1948-1952	100	84.75	84.29
1953-1957	100	84.85	82.78
1958-1962	100	85.08	79.20
1963-1967	100	85.13	76.42
1968-1972	100	85.28	76.71
1973-1977	100	85.60	81.03

(*) After the abolition of the indexation mechanism.
(**) Final effect of the reforms.
Notes: See text in Section V.3.

Table V.8: Distribution of planned age of retirement by various characteristics

(source: 1987-1989-1991-1993-1995 SHIW)

Planned age of retirement	Whole labour force			Males			Females		
	Obs.	Per cent	Cum. %	Obs.	Per cent	Cum. %	Obs.	Per cent	Cum. %
<40	154	0.43	0.43	39	0.17	0.17	115	0.91	0.91
41-45	267	0.75	1.19	107	0.47	0.64	160	1.26	2.17
46-50	1958	5.52	6.7	920	4.03	4.67	1038	8.2	10.37
51-53	1000	2.82	9.52	733	3.21	7.88	267	2.11	12.48
54-55	4665	13.14	22.66	2145	9.39	17.27	2520	19.91	32.39
56	519	1.46	24.12	326	1.43	18.7	193	1.52	33.91
57	734	2.07	26.19	380	1.66	20.36	354	2.8	36.71
58	866	2.44	28.63	471	2.06	22.42	395	3.12	39.83
59	561	1.58	30.21	352	1.54	23.96	209	1.65	41.48
60	12585	35.45	65.66	7652	33.5	57.46	4933	38.97	80.44
61	538	1.52	67.17	395	1.73	59.19	143	1.13	81.57
62	623	1.75	68.93	450	1.97	61.16	173	1.37	82.94
63	474	1.34	70.26	257	1.13	62.29	217	1.71	84.65
64	352	0.99	71.26	209	0.92	63.2	143	1.13	85.78
65	9155	25.79	97.05	7492	32.8	96.01	1663	13.14	98.92
66-68	496	1.4	98.44	442	1.94	97.94	54	0.43	99.34
69-71	513	1.45	99.89	437	1.91	99.86	76	0.6	99.94
72-75	40	0.11	100	33	0.14	100	7	0.06	100
Total	35500	100		22840	100		12660	100	

	Private sector								Public sector	
Planned age of retirement	Manual worker		Clerk		Manager		Self-employed			
	Obs.	Per cent	Obs.	Per cent	Obs.	Per cent	Obs.	Per cent	Obs.	Per cent
<40	29	0.27	51	0.79	6	0.32	24	0.26	44	0.61
41-45	33	0.31	72	1.11	10	0.54	35	0.38	117	1.63
46-50	695	6.48	406	6.26	81	4.39	297	3.21	479	6.65
51-53	480	4.48	174	2.68	43	2.33	116	1.26	187	2.6
54-55	1751	16.32	1132	17.46	238	12.89	625	6.76	918	12.75
56	156	1.45	109	1.68	27	1.46	52	0.56	175	2.43
57	215	2	160	2.47	52	2.82	97	1.05	210	2.92
58	271	2.53	184	2.84	45	2.44	114	1.23	252	3.5
59	205	1.91	107	1.65	36	1.95	97	1.05	116	1.61
60	4233	39.46	2433	37.53	625	33.84	2945	31.87	2348	32.62
61	140	1.31	54	0.83	22	1.19	235	2.54	87	1.21
62	106	0.99	61	0.94	28	1.52	302	3.27	126	1.75
63	40	0.37	22	0.34	13	0.7	326	3.53	73	1.01
64	13	0.12	14	0.22	2	0.11	285	3.08	38	0.53
65	2280	21.26	1442	22.24	577	31.24	2988	32.33	1866	25.92
66-68	21	0.2	26	0.4	6	0.32	385	4.17	58	0.81
69-71	57	0.53	36	0.56	35	1.89	287	3.11	98	1.36
72-75	1	0.01	0	0	1	0.05	32	0.35	6	0.08
Total	10726	100	6483	100	1847	100	9242	100	7198	100

Table V.9: Planned age of retirement by age and survey years

(source: 1987-1989-1991-1993-1995 SHIW)

Age class	Planned age of retirement			
	1989	1991	1993	1995
<20	59.05	59.62	60.13	60.89
21-25	59.06	59.92	59.92	61.08
26-30	59.27	59.85	59.74	60.64
31-35	59.31	59.68	59.73	60.69
36-40	59.29	59.58	59.14	60.01
41-45	59.02	59.38	59.23	59.27
46-50	59.65	59.60	58.90	58.92
51-55	60.50	60.85	60.55	59.71
56-60	62.08	62.54	61.86	61.40
61-65	64.61	64.83	64.80	63.46
66-70	63.79	63.74	65.88	65.48

Table V.10: Internal rate of return of the social security system

(after 37 years of activity assuming 2% productivity growth)

	Age of start of activity	Employees		Self-employed	
		Males	Females	Males	Females
before Amato reform	17	3.22	3.65	5.75	6.15
	20	2.91	3.35	5.55	5.92
	25	2.25	2.95	5.11	5.61
after Amato reform (*)	17	2.45	2.91	5.15	5.45
	20	2.15	2.75	4.95	5.25
	25	1.55	2.25	4.53	4.95
after Amato reform (**)	17	1.95	2.42	4.65	4.95
	20	1.65	2.15	4.42	4.75
	25	1.05	1.73	4.05	4.45

(*) with more than 18 years of SS contributions in 1993.

(**) with less than 18 years of SS contributions in 1993.

Notes: Our computation. The internal rate of return of the social security system is the rate that equalizes, in expected value terms, the flow of benefits and the flow of contribution paid. See text in Section V.3 and V.4.

Table V.11: Replacement rate and tax/subsidy ratios
(estimates for a typical worker starting at age 20 based on 1987-1989-1991-1993-1995 SHIW)

		MALES		FEMALES	
	Last year of work	Replace-ment rates (*)	Tax / subsidy	Replace-ment rates (*)	Tax / subsidy
pre - 1992	55	0.70	-	0.70	-
	56	0.72	0.362	0.72	0.262
	57	0.74	0.394	0.74	0.274
	58	0.76	0.433	0.76	0.309
	59	0.78	0.472	0.78	0.347
	60	0.80	0.625	0.80	0.381
	61	0.80	0.754	0.80	0.753
	62	0.80	0.814	0.80	0.768
	63	0.80	0.830	0.80	0.785
	64	0.80	0.842	0.80	0.796
	65	0.80	0.852	0.80	0.809
post - 1992	55	0.60	-	0.60	-
	56	0.62	0.317	0.62	0.026
	57	0.64	0.347	0.64	0.253
	58	0.65	0.376	0.65	0.280
	59	0.67	0.406	0.67	0.306
	60	0.68	0.594	0.68	0.330
	61	0.68	0.650	0.68	0.600
	62	0.68	0.667	0.68	0.614
	63	0.68	0.683	0.68	0.631
	64	0.68	0.693	0.68	0.641
	65	0.68	0.707	0.68	0.651

(*) Computed with respect to the last year of earnings.

Notes: See text in Section V.4.

Table V.12: Age of retirement equation: "age invariant" characteristics
(estimates based on 1987-1989-1991-1993-1995 SHIW)

	Col.1		Col. 2		Col. 3	
Variable	Coefficient	Std. error	Coefficient	Std. error	Coefficient	Std. error
d91	0.008	0.0009	0.008	0.0009	0.007	0.0009
d93	0.004	0.0009	-0.028	0.0014	-0.030	0.0014
d95	0.010	0.0009	-0.020	0.0014	-0.023	0.0014
c0	-0.012	0.0012	-0.011	0.0012	-0.011	0.0012
c1	-0.021	0.0012	-0.021	0.0013	-0.016	0.0013
c2	-0.028	0.0014	-0.026	0.0014	-0.018	0.0015
c3	-0.034	0.0015	-0.028	0.0015	-0.020	0.0016
c4	-0.037	0.0015	-0.030	0.0015	-0.023	0.0016
c5	-0.038	0.0016	-0.031	0.0016	-0.028	0.0016
c6	-0.024	0.0015	-0.017	0.0015	-0.020	0.0015
c7	-0.001	0.0016	0.004	0.0016	-0.005	0.0017
c8	0.027	0.0019	0.031	0.0019	0.015	0.0022
c9	0.046	0.0031	0.050	0.0031	0.032	0.0033
elementary	-0.001	0.0024	-0.002	0.0024	-0.002	0.0024
high school	0.019	0.0025	0.009	0.0025	0.009	0.0025
university	0.046	0.0027	0.028	0.0027	0.028	0.0027
clerk	-0.002	0.0009	-0.004	0.0009	-0.004	0.0009
manager	0.000	0.0016	-0.004	0.0015	-0.004	0.0015
self-employed	0.025	0.0009	0.111	0.0030	0.112	0.0030
public	-0.011	0.0018	-0.014	0.0018	-0.015	0.0018
private sector	0.002	0.0015	0.001	0.0015	0.000	0.0015
centre	-0.020	0.0009	-0.017	0.0008	-0.011	0.0009
north	-0.042	0.0007	-0.038	0.0007	-0.031	0.0008
male	0.036	0.0007	0.022	0.0009	0.030	0.0010
head	-0.008	0.0009	-0.007	0.0009	0.005	0.0012
TIR			-3.451	0.1148	-3.481	0.1147
ssw60						
Mill's ratio					-0.017	0.0011
constant	4.102	0.0029	4.216	0.0049	4.227	0.0049
No. of observations	41059		41059		41059	
R-squared	0.232		0.25		0.254	

Notes: Variables are dummies set equal to 1 when the characteristic is satisfied. c1-c9 are cohort dummies, see table V.1. TIR is the social security system internal rate of return for the individual considered; ssw60 is the expected social security wealth of the individual computed at age 60 (see text in Section V.4).

Table V.13: Retirement and the presence of young dependants in the household
(source: 1987-1989-1991-1993-1995 SHIW)

		Planned age of retirement			
	No. young deps.	1989	1991	1993	1995
All	0	60.91	61.02	60.00	59.83
	1	60.77	61.06	60.76	60.68
	2	60.35	62.67	62.05	61.92
	3>	63.08	64.11	62.17	61.85
North	0	60.27	60.13	58.77	58.72
	1	59.85	59.57	59.42	59.59
	2	59.85	59.57	59.42	59.59
	3>	65.00	62.53	56.00	59.71
Centre	0	61.39	61.21	60.19	60.37
	1	60.94	61.36	60.89	60.22
	2	60.71	62.86	60.62	61.55
	3>	59.91	65.00	63.12	64.52
South	0	62.05	62.42	62.15	61.42
	1	61.62	62.55	62.13	62.03
	2	61.99	62.87	62.67	62.75
	3>	63.47	64.15	63.06	61.59
		Percentage of pensioners			
	No. young deps.	1989	1991	1993	1995
All	0	39.84	42.38	45.71	43.31
	1	26.00	26.29	30.83	33.78
	2	22.15	28.06	29.06	28.48
	3>	27.80	32.37	20.27	33.81
North	0	42.25	44.17	50.96	47.49
	1	22.41	24.90	28.61	37.30
	2	9.43	21.78	29.56	29.13
	3>	0.00	0.00	0.00	22.55
Centre	0	34.87	39.27	37.18	40.90
	1	18.30	21.17	20.34	28.00
	2	16.48	40.09	20.86	21.42
	3>	19.30	0.00	0.00	0.00
South	0	37.79	41.52	40.50	36.33
	1	31.97	29.88	38.15	34.00
	2	29.53	27.68	31.29	30.78
	3>	29.03	34.45	25.41	39.45

Table V.14: Age of retirement equation: "age variant" characteristics
(estimates based on 1987-1989-1991-1993-1995 SHIW)

	Col.1		Col. 2 (*)		Col. 3		Col. 4	
Variable	Coefficient	Std. error	Coefficient	Std. error	Coefficient	Std. error	Coefficient	Std. error
d91	0.014	0.002	0.001	0.005	0.002	0.002	0.000	0.0031
d93	-0.011	0.003	-0.057	0.015	-0.019	0.003	-0.035	0.0047
d95	-0.006	0.004	-0.045	0.014	-0.017	0.004	-0.038	0.0060
c4	-0.094	0.013	-0.010	0.036	-0.085	0.014	-0.072	0.0238
c5	-0.085	0.012	-0.016	0.030	-0.075	0.013	-0.070	0.0212
c6	-0.060	0.010	-0.009	0.024	-0.049	0.011	-0.049	0.0187
c7	-0.029	0.009	0.004	0.018	-0.017	0.010	-0.020	0.0169
c8	0.005	0.008	0.025	0.015	0.020	0.008	0.014	0.0155
c9	0.028	0.008	0.034	0.014	0.039	0.008	0.035	0.0161
elementary	0.004	0.003	-0.023	0.011	-0.004	0.003	-0.006	0.0065
high school	0.018	0.004	-0.029	0.016	0.008	0.003	0.009	0.0069
university	0.035	0.005	-0.039	0.024	0.017	0.004	0.017	0.0072
clerk	-0.002	0.002	-0.032	0.010	-0.005	0.002	-0.009	0.0030
manager	0.006	0.003	-0.039	0.014	-0.002	0.002	-0.005	0.0039
self-employed	0.141	0.006	0.111	0.015	-0.075	0.004	-0.086	0.0066
public	0.011	0.003	0.030	0.008	0.006	0.003	0.000	0.0044
private sector	0.011	0.003	0.029	0.007	-0.002	0.002	-0.006	0.0037
centre	-0.012	0.002	-0.029	0.006	-0.013	0.002	-0.014	0.0027
north	-0.025	0.002	-0.051	0.008	-0.028	0.001	-0.030	0.0023
male	0.006	0.005	0.001	0.010	-0.032	0.005	-0.011	0.0073
head	-0.011	0.003	-0.002	0.007	-0.010	0.003	-0.033	0.0248
TIR	-3.706	0.249	-5.807	0.808				
ssw60					-0.157	0.005	-0.169	0.0086
log family wealth	-0.002	0.001	0.090	0.027	-0.001	0.000	-0.002	0.0008
married	-0.006	0.002	-0.016	0.005	-0.007	0.002	-0.013	0.0191
young dep.:1(*)	0.00002	0.00003	-0.00004	0.00006	0.00002	0.00003	0.00001	0.00007
young dep.:2(*)	0.00007	0.00004	0.00007	0.00008	0.00008	0.00004	0.00018	0.00010
young dep.:3(*)	0.00014	0.00006	0.00032	0.00013	0.00012	0.00005	0.00008	0.00015
young dep.:4(*)	0.00038	0.00009	0.00110	0.00029	0.00036	0.00009	0.00074	0.00024
no. of earners:1	-0.013	0.002	-0.008	0.005	-0.010	0.002	-0.019	0.0070
no. of earners:2	-0.014	0.003	0.008	0.009	-0.011	0.003	-0.021	0.0073
Mill's ratio	0.018	0.006	0.009	0.012	0.016	0.006	0.005	0.0090
ssw60 head							-0.001	0.0021
ssw60 wife							-0.004	0.0022
Constant	4.381	0.018	4.045	0.104	4.574	0.017	4.656	0.0314
No. of observations	11036		11036		10556		10566	
R-squared	0.298		.		0.343		0.347	

(*) Instrumental variable estimates.

Notes: Variables are dummies set equal to 1 when the characteristic is satisfied. c1-c9 are cohort dummies, see table V.1. TIR is the social security system internal rate of return for the individual considered; ssw60 is the expected social security wealth of the individual computed at age 60 (see text in Section V.4).

Table V.15: Increment in SS wealth by postponing retirement by one year

(estimates based on 1987-1989-1991-1993-1995 SHIW; thousands of 1995 lire)

Age	All	Males	Females	Non-self-empl.	Self-empl.
53	8298	8560	7577	8028	9037
54	4380	3902	5946	3359	7516
55	1184	-68	4480	-905	7480
56	596	248	2066	-1036	4743
57	-3476	-4393	-557	-5743	2401
58	-7175	-8168	-3022	-6464	-8541
59	-9153	-10963	-4406	-8402	-10765
60	-9594	-10893	-3936	-8685	-11287
61	-12371	-14736	-5736	-12182	-12636
62	-12485	-13867	-4562	-11438	-13896
63	-13231	-15482	-7135	-13629	-12786
64	-15522	-16114	-10113	-16754	-14021
65	-17296	-18703	-11668	-21617	-13950
66	-17522	-18006	-12555	-19290	-15500
67	-18273	-20241	-9840	-29772	-14014
68	-15123	-16505	-9596	-17712	-13829
No. of obs.	2698	2085	613	1826	872

Notes: See text in section V.4.

Table V.16: Hazard model of retirement

	Specification		
Variable	k=1	k=1.3	k=1.5
SS Wealth	1.62	1.59	1.59
	(0.14)	(0.14)	(0.15)
Dgain	-0.34	-0.24	-0.11
	(0.12)	(0.08)	(0.04)
Assets	0.13	0.12	0.13
	(0.05)	(0.05)	(0.05)
High school	-0.45	-0.44	-0.46
	(0.12)	(0.13)	(0.13)
College	-0.83	-0.82	-0.84
	(0.21)	(0.21)	(0.21)
Dependents	0.23	0.23	0.23
	(0.11)	(0.11)	(0.11)
Earners	-0.16	-0.16	-0.16
	(0.11)	(0.11)	(0.11)
Sex	0.20	0.18	0.20
	(0.17)	(0.17)	(0.17)
Head	-0.25	-0.24	-0.25
	(0.19)	(0.19)	(0.19)
Age parameter p	3.41	3.39	3.41
	(0.11)	(0.12)	(0.12)
Constant	-13.50	-13.38	-13.41
	(0.61)	(0.62)	(0.63)
Log likelihood	-413.02	-412.93	-414.05
No. of subjects	1219	1219	1219
No. of failures	351	351	351
No. of observations	2835	2835	2835

Notes: See text in sections V.4. Dgain: increment in SS wealth from postponing retirement by one year.

Table V.17: Consumption to total resources ratio by age and total resource percentiles

(source: 1987-1989-1991-1993-1995 SHIW)

Total resource percentiles	Age						
	<30	30-39	40-49	50-59	60-69	70-84	>84
0-20	0.039	0.038	0.047	0.059	0.082	0.181	0.292
20-40	0.025	0.029	0.041	0.050	0.068	0.111	0.163
40-60	0.022	0.027	0.036	0.048	0.059	0.086	0.111
60-80	0.021	0.026	0.035	0.044	0.050	0.066	0.077
80-100	0.021	0.024	0.036	0.043	0.039	0.043	0.054

Table V.18: Consumption equation

(estimates based on 1987-1989-1991-1993-1995 SHIW)

	Col. 1		Col. 2		Col. 3		Col. 4		Col. 5	
Variable	Coefficient	Std. error	Coefficient	Std. error	Coefficient	Std. error	Coefficient	Std. error	Coefficient	Std. error
constant	0.0550	0.0148	0.0315	0.0129	0.0236	0.0094	-0.0001	0.0063	0.0550	0.0148
age1	-0.0069	0.0034	-0.0044	0.0030	-0.0034	0.0022	0.0000	0.0001	-0.0071	0.0034
age1q	0.0004	0.0002	0.0003	0.0002	0.0002	0.0001	0.0000	0.0001	0.0004	0.0002
age2	0.0002	0.0003	-0.0001	0.0003	-0.0005	0.0002	-0.0011	0.0003	0.0001	0.0004
age2q	0.0001	0.0000	0.0001	0.0000	0.0001	0.0000	0.0001	0.0000	0.0001	0.0000
age3	0.0008	0.0002	0.0009	0.0002	0.0001	0.0002	-0.0005	0.0002	0.0008	0.0002
ag3q	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
age4	0.0015	0.0002	0.0008	0.0002	0.0004	0.0002	-0.0007	0.0002	0.0015	0.0002
age4q	-0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0001	0.0000
age5	0.0009	0.0003	0.0006	0.0002	0.0005	0.0002	0.0000	0.0002	0.0009	0.0003
age5q	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
age5	0.0035	0.0008	0.0021	0.0005	0.0012	0.0004	-0.0017	0.0004	0.0034	0.0007
age5q	0.0000	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
no. children: 1	0.0031	0.0006	0.0020	0.0005	0.0014	0.0004	-0.0003	0.0006	0.0030	0.0006
no. children: 2	0.0052	0.0006	0.0026	0.0006	0.0036	0.0004	0.0019	0.0006	0.0052	0.0006
no. children: 3	0.0058	0.0011	0.0018	0.0010	0.0035	0.0007	0.0014	0.0011	0.0058	0.0011
no. children: 4	0.0125	0.0029	0.0071	0.0025	0.0081	0.0017	0.0043	0.0014	0.0123	0.0029
no. children: 1 (*)	-0.0002	0.0000	-0.0001	0.0000	-0.0001	0.0000	0.0001	0.0000	-0.0002	0.0000
no. children: 2 (*)	-0.0003	0.0000	-0.0001	0.0000	-0.0001	0.0000	0.0001	0.0000	-0.0003	0.0000
no. children: 3 (*)	-0.0003	0.0001	-0.0001	0.0001	-0.0001	0.0000	0.0001	0.0001	-0.0003	0.0001
no. children: 4 (*)	-0.0009	0.0001	-0.0005	0.0001	-0.0003	0.0001	0.0002	0.0001	-0.0008	0.0001
nfert	-0.0025	0.0009	-0.0029	0.0008	-0.0016	0.0006	-0.0009	0.0008	-0.0023	0.0009
no. earners: 2	-0.0069	0.0003	-0.0015	0.0004	-0.0064	0.0002	-0.0059	0.0004	-0.0069	0.0003
no. earners: 3 or more	-0.0105	0.0006	-0.0025	0.0006	-0.0101	0.0004	-0.0098	0.0006	-0.0105	0.0006
no. of adults: 1	0.0018	0.0010	0.0064	0.0008	-0.0009	0.0006	-0.0034	0.0008	0.0018	0.0010
no. of adults: 2	-0.0001	0.0015	0.0106	0.0012	-0.0023	0.0009	-0.0039	0.0013	0.0000	0.0015
no. of adults: 3	0.0009	0.0017	0.0128	0.0014	-0.0030	0.0010	-0.0063	0.0015	0.0010	0.0017
no. of adults: 4	0.0008	0.0019	0.0135	0.0016	-0.0054	0.0014	-0.0106	0.0023	0.0003	0.0019
single	-0.0086	0.0018	0.0111	0.0015	-0.0044	0.0013	-0.0006	0.0016	-0.0081	0.0018
non-nucl. single-head	0.0251	0.0017	0.0053	0.0013	0.0085	0.0015	-0.0073	0.0019	0.0246	0.0017
non-nucl. couple	0.0284	0.0016	0.0004	0.0013	0.0123	0.0015	-0.0032	0.0019	0.0281	0.0016
single (**)	0.0003	0.0000	-0.0004	0.0000	0.0001	0.0000	-0.0001	0.0000	0.0003	0.0000
non-nucl. single-head (**)	-0.0007	0.0000	-0.0001	0.0000	-0.0002	0.0000	0.0002	0.0000	-0.0007	0.0000
non-nucl. couple (**)	-0.0007	0.0000	0.0000	0.0000	-0.0003	0.0000	0.0001	0.0000	-0.0007	0.0000
d89	-0.0027	0.0004	-0.0014	0.0004	0.0016	0.0004	0.0056	0.0005	-0.0024	0.0004
d91	-0.0019	0.0004	-0.0003	0.0004	0.0012	0.0003	0.0040	0.0005	-0.0016	0.0004
d93	-0.0004	0.0004	0.0008	0.0004	0.0038	0.0004	0.0078	0.0006	-0.0001	0.0004
d95	-0.0006	0.0004	-0.0001	0.0004	0.0045	0.0005	0.0094	0.0007	-0.0002	0.0004
dr1			-0.0360	0.0028						
dr1q			0.0336	0.0016						
dr1a			0.0023	0.0002						
dr1aq			-0.0001	0.0000						
ydc					0.7542	0.0471	1.4656	0.0650	0.3282	0.01533
No. of observations	40233		40222		40233		40573		40233	
R-squared	0.2945		0.5059		0.779		0.3397		0.3046	

Notes to Table V.18: Variables are dummies set equal to 1 when the characteristic is satisfied.

Age1-age5: spline in age constructed as follows:

defines age = age –19 and the vector a'= (11,19,31,45,57,81) corresponding to ages: 30,38,50,64 and 100). Then:

age1 = sage if sage ≤ a(1)

age1 = 0 if sage > a(1)

age2 = 0 if sage ≤ a(1)

age2 = sage-a(1) if a(2) ≤sage≤a(1)
age2 = a(2)-a(1) if sage>a(2)
…..
age6 = 0 if sage≤a(5)
age6 = sage-a(5) if sage>a(5)

age1q.. age6q are age1…age6 multiplied by age.

nfert: dummy equal to 1 if the spouse or the female head is of fertile age.

dr1, dr1a = distributional dummies; ydc: current disposable income: see text in Section V.5.

VI The simulation of the complete model

VI.1 Introduction

In this section we offer some examples of how the micro simulation model of the Italian household sector, as developed in the previous sections, can be used to analyze some important issues regarding the Italian economy. The examples focus on the effects of demographic developments, of changes in the rate of productivity growth and of changes in social security provisions on the evolution of the aggregate saving rate. By simulating the micro model under a number of alternative assumptions regarding the evolution of fertility and mortality rates, productivity growth and other parameters of the model, we can also gather useful insights into the properties of the micro model.

Quite obviously, we recognize that the results of the simulations have to be considered with caution because of the enormous uncertainty surrounding the many assumptions needed to simulate the micro model and because there is still ample room to improve some features of the model which are not completely satisfactory, as we discussed in the previous sections. Nevertheless, the exercise shows the usefulness of the model as a tool that allows the analysis to move from individual households' behaviour to the aggregate implications (and vice versa) and permits the study of a number of problems that could not possibly be analyzed in a framework of identical representative agents or by using standard macroeconomic models.

VI.2 The demographic evolution of the Italian population and the aggregate saving rate

We have performed a number of simulations of the complete model, all covering the period 1993-2100 to study the effects of changing demographic conditions on the evolution of the aggregate Italian households' saving rate. Our benchmark simulation assumes an evolution of fertility and mortality rates equal to the main variant of recent official forecasts, which predicts a substantial decline in the total population by 2050 and a dramatic decline thereafter, as well as a rate of growth of labour productivity of 2% per year, i.e., approximately equal to the average labour productivity growth in Italy over the past 30 years. We analyze the evolution of the aggregate saving rate generated by the model under these assumptions, disentangling the contribution made by the various groups (family types) composing the total population.

We find that according to the hypothesis adopted in this benchmark simulation the aggregate saving rate generated by the simulation model would remain at a relatively high level, and actually increase slightly in the course of the simulation, notwithstanding the substantial increase in the proportion of the elderly population. Various factors are behind this result. First, as we have seen and as known in the literature, a feature of the Italian data we use is that the pattern of the saving rate is quite flat at old ages. Second, the marked reduction in the number of children per household increases household savings according to our estimated consumption equation. Third, the (assumed) decline in the unemployment rate and the consequent increase in the number of adult dependants contributing to family income also impact positively on household savings. Finally (and especially) the gradual decline in expected social security wealth with respect to the disposable income of households as the effects of the 1995 reform start to come into play is compensated by an increased accumulation of private assets by households. We discuss in some detail the relative contributions of these factors and the reliability of the assumptions behind them. The results clearly depend on a number of assumptions that are subject to a great deal of uncertainty. We therefore carry out a number of alternative simulations using different assumptions on parameters governing the demographic development of the population and on a number of other key parameters of the model in order to assess the sensitivity of results and gain a better understanding of the interaction between the various features of the model.

VI.2.1 The benchmark simulation

VI.2.1.1 Basic assumptions

We start by looking at changes in the demographic structure of the Italian population between 1993 and 2100 in the benchmark simulation. The main hypothesis underlying the projections with respect to fertility and mortality are consistent with those of the Istat (1997) main variant middle-fertility scenario up to 2050. As in Istat's projections, we have kept mortality rates and fertility rates constant as from 2020. The set of assumptions regarding the demographic processes that we consider are briefly summarized below (see Section III for further details on other demographic parameters):

fertility: total fertility rate in 1995: 1.217

total fertility rate in 2020: 1.45

mortality: life expectancy at birth in 1995: males: 74.3; females: 80.7

life expectancy at birth in 2020: males: 78.3; females: 84.7

marriage, divorce, independent children and merging of households: observed probabilities by age in years 1991-1995

Other important assumptions for the benchmark simulation are as follows. The rate of labour productivity growth is set at 2% per year and the subjective discount rate is assumed to be to equal to the market interest rate at 3% per year. The aggregate unemployment rate is assumed to decline slowly, reaching about 8% of the labour force in 2003, from an actual 12% in 1995. Participation rates for all male age groups are kept constant. The female participation rate is assumed to increase somewhat over the simulation period, from about 48% in 1995 to about 52% in 2030 for females aged between 20 and 60, and remain approximately constant thereafter. Educational levels are assumed to evolve according to the process described in Section IV, which implies that the education of children is strongly correlated with that of their parents. Since at the start of the simulation period younger generations are, on average, better educated than older generations, the process implies that the overall educational level of the society rises over time. Transitional probabilities regarding the sector of occupation and the employment status are kept constant throughout the simulation period.

VI.2.1.2 The evolution of the main characteristics of the population

Since our demographic model has been calibrated to insure that the age and sex distribution conforms quite closely to the one generated by the projections of Istat (1996), this aspect of our results is not new and is summarized in Figure VI.1.

The total population is projected to reach its peak around the year 2005, thereafter slowly declining up to 2020 to about 55.5 million. The decline then accelerates during the following years: the total population falls to 48 million in 2050 and to 25 million by 2100, less than half of the population of a century earlier. The rate of decline reaches a maximum (around 1.4%) a little after 2050 and then recovers slightly to stabilize at about 1% at the end of the simulation period. Whether such a prolonged period of declining population is sustainable is, of course, questionable. However, as we have already mentioned, even the most optimistic projections of the Italian population indicate a prolonged period of decline in total population, so that it is instructive for analytical purposes to fully explore its consequences. We will analyze alternative scenarios in the following sections.

Quite naturally, the consequences of this pattern for the age structure of the population are fairly dramatic. They are summarized for broad age groups in Figure VI.2. The population aged less than 20 declines from 22.9% of the total in 1993 to 17.9% in 2050, while that aged between 20 and 64 declines from 62.1% to 49.6% during the same period. Correspondingly, those aged 65 or over rise from 15.0% in 1993 to 23.9% in 2020, reaching about one third of the total population by 2050. This pattern is slightly reversed at the end of the simulation period, as a response to the mild reduction in the rate of decline of the population after the overshooting around the middle of the century.

Details of the evolution of family structures are reported in Tables VI.1 to VI.4. Besides reflecting the assumptions with regard to fertility and mortality rates, the evolution of family types also reflects the assumptions adopted in the benchmark simulation with regard to the other major demographic processes (marriage, divorce, etc.). The most distinctive patterns are as follows. We observe a decline in the share of the population living in traditional (couple-headed) families, a strong decline in the number of young dependants, and an increase in the proportion of people living alone, especially in the extreme (very young and very old) age groups. Traditional families decrease from 55% of the total number of households in 1993 to 46% in 2050, while singles increase from about 13% to 24% during the same period. The main consequence of the decline in the number of dependants and of the increase in the proportion of the population living alone is the continuous shrinking of the average size of households, from about 2.9 members per family in 1994 to 2.5 in 2050.

It is important to observe the consequences of these patterns for the structure of the population by activity. Figure VI.3 shows that the proportions of the population in the labour force and of the non-active population decline steadily until the first half of the 21st century, while the proportion of pensioners rises from around 22% to about 32% of the total population during the same period. The participation rate by age over the simulation period is depicted in Figure VI.4. The total participation rate between the ages of 20 and 70 actually increases slightly (from about 58% in 1993 to 61% in 2050) mainly as a consequence of our assumption of an increase in the participation of the female population. The participation rate declines somewhat for young individuals because of the postponement of the age at which they start work caused by the increase in the number of people going to university, which, in turn, is a consequence of our modelling of the education process (a positive correlation between the education of parents and their children, see Section IV.3). However, there is a remarkable increase in the participation rate of people aged 51-60 and 61-70. The increase in the 51-60 age group is almost immediate and is mainly the consequence of the abolition of the early-retirement provisions that we discussed in Section V.3. The increase in the participation rate in the group aged 61-70 is more gradual and is related to the (estimated) behavioural response of workers to the social security system becoming less and less generous.

VI.2.1.3 The evolution of the aggregate saving rate: interpreting the results

Figure VI.5 shows the evolution of the aggregate saving rate over the entire simulation period in our benchmark simulation. The breakdown of the result by age groups and different family types is shown in Tables VI.5 to VI.8, while Table VI.9 reports the pattern of some selected aggregate variables over the simulation period. Figure VI.5 shows that the aggregate saving rate, from a level of about 10 per cent, initially increases quite significantly (by about 4 percentage points) up to around 2030. It then gradually declines by about 2 percentage points in the subsequent 20 years and thereafter remains basically stationary at around 12 per cent. Underlying this pattern are a number of factors, acting in different directions. We will enumerate the most important of them.

As shown in the detailed tables (from VI.5 to VI.8), with the notable exception of singles all family types contribute to the initial increase in the aggregate saving rate in the simulation. This is the result of different patterns across age groups. While in fact the saving rate of elderly households (over 60) is gradually reduced and the elderly groups increase their weight in the society because of the low birth rate, this process is more than compensated by a significant increase in the saving rate of younger households, in particular those in middle-age groups (40 to 60), whose weight, in terms of total resources, is substantial. The latter phenomenon mostly reflects the following three factors: (i) the marked reduction in the number of children per household; (ii) the decline in the unemployment rate (especially for young individuals) and the consequent increase in the number of adult dependants contributing to family income; and (iii) the gradual decline in expected social security wealth with respect to disposable income as the effects of the 1995 reform start to come into play.

The magnitude of the first effect (the reduction in the number of children per household) depends on the size of the estimated coefficients in the consumption equation used here and is, as we have already explained in Section V.5, larger for households that have children relatively early in life. The second effect (the decline in the unemployment rate) affects non-nuclear households (families or single-headed) in which different generations contribute to the total disposable income. For these households disposable income increases proportionally more than consumption when a young unemployed dependent starts to work and earn, according to our model. Admittedly, it might very well be that this effect is overestimated: first of all, it must be recalled that in the model young adult dependants contribute their full income to the current disposable income of the family, but they contribute to its expected lifetime resources only the (income of the) years during which they are expected to remain in the family. Therefore current disposable income rises proportionally more than households' total resources and therefore automatically the family's saving rate is increased (on this point, see the discussion in Section V.5). Second, it is likely that the decline in the unemployment rate of young individuals may increase the likelihood of the young leaving the family to form a new household (this potential effect is not taken into account in the current version of the model). This implies that we might underestimate the process of formation of households by young persons living alone (who do not save at all) and, therefore, overestimate the aggregate saving rate. We will tackle this issue in Section VI.2.4, where we report the results of different assumptions on the evolution of young single households.

Starting at around 2020, the third effect, i.e. the decline in the social security wealth, becomes gradually the dominant factor underlying the increase in the saving rate. An increasing share of the population falls under the new social security scheme and the faster decline in the population (reflected in a slower growth of aggregate income) starts to have a marked effect on the computation of future benefits. In order to clearly understand the mechanism involved, let us recall that under the new rules the system is basically a contribution-based pay-as-you-go system with a rate of return equal to the GDP rate of growth. Under this system, contributions are paid every year as a fixed percentage of earnings and then capitalized up to the retirement age using an interest rate equal to a five-year moving average of the GDP rate of growth.[66] At the age of retirement, therefore, the social security wealth of an individual with respect to his income will depend on the GDP rate of growth throughout the whole of his working life, and the ratio will be lower, the lower the GDP rate of growth. The latter is given, of course, by the sum of the rate of growth of per capita productivity (fixed at 2% per year in this benchmark simulation) and the rate of growth of the labour force. If we compare two different steady state rates of growth of the population, the ratio of social security wealth to income at retirement will differ only by a scale factor. If, however, the rate of decline in the population (and the labour force) increases, the ratio will keep decreasing. Moreover, since the effect is spread over the whole working life of each cohort of workers, every shock to the rate of growth of the population will exert its effect for a very long time. Figure VI.6 shows that the rate of growth of social security wealth is, from 2010, lower than that of the total disposable income for virtually the whole simulation period, only coming very close right at the end. As a consequence, the ratio of social security wealth over income falls dramatically from around 7 in 2020 to 5 around 2070, stabilizing at the end of the simulation period at slightly below 5 (see Figure VI.7). Our consumption and retirement decision rules, described in Section V, imply that families will partly compensate for this decline both by accumulating more wealth and partly by retiring later. The increase in the asset-to-income ratio over the simulation period from 6 to around 8 is therefore the consequence not only of the ageing of the population (increase in the weight of older people who hold more assets), but also of the increase in the accumulation of assets at younger ages in order to compensate for the decline in foreseen pension provisions.

To explore this intuition on the basis of the household consumption rule that we have adopted in this study (see Section V.5) we note that, abstracting from the influence of a number of household-specific factors, in essence this can be written as:

$$C_t = \alpha_y y_t + \alpha_a A_t + \alpha_s SSW_t \qquad (1)$$

where we have defined y_t as disposable income excluding social security benefits and contributions. It must also be true that for the aggregate:

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66 Computed starting with the year in which contributions are paid and including the four preceding years.

$$A_t - A_{t-1} = y_t + SSB_t - C_t \tag{2}$$

where $SSB_t = b \cdot SSW_t$ are gross benefits from social security (which can be defined as a fraction *b* of the total social security wealth to facilitate the analysis).

Combining (1) and (2) we can rewrite the accumulation rate for assets as:

$$\frac{A_t - A_{t-1}}{A_{t-1}} = g + (1-\alpha_y)\left[\frac{y_t}{A_{t-1}} - \frac{\alpha_a + g + (\alpha_s - b)\frac{SSW_{t-1}}{A_{t-1}}}{1-\alpha_y}\right] \tag{3}$$

where *g* is the rate of growth of the economy. Equation (3) implies that the rate of growth of assets can be split into a regular growth rate and a correction term for the deviation of the asset income ratio from its steady state value, indicated by the second term of the formula in the square brackets. Clearly, for individual households, not only does the rate of growth of income change over time as its members age, but also the relevant coefficients of the consumption rule will slowly change with age so that equation (3) must be viewed as a crude (and aggregate) approximation to families' accumulation behaviour. Nevertheless, this stylized characterization of consumption behaviour is indicative of the property that, for all households, the larger the net worth to income ratio, the lower the saving-income ratio.

If we further assume that $SSW_t = (1+g)\, SSW_{t-1}$ and that $\alpha_a = \alpha_s$ (as is indeed assumed in our empirical consumption rule) then we can rewrite (3) as:

$$\frac{A_t - A_{t-1} + SSW_t - SSW_{t-1}}{A_{t-1} + SSW_{t-1}} = g + (1-\alpha_y)\left[\frac{y_t + b' SSW_t}{A_{t-1} + SSW_{t-1}} - \frac{\alpha_a + g}{1-\alpha_y}\right] \tag{4}$$

where $b' = (b \cdot g)/(1-\alpha_y)$, implying that in the steady state:

$$\frac{A_t + SSW_t}{Y_t + b' SSW_t} = \frac{1-\alpha_y}{\alpha_a + g} \tag{5}$$

Equation (5) shows that in the steady state the ratio of total accrued savings – including accumulated assets and social security wealth – to disposable income (including labour income and social security benefits) is a constant independent of the level of assets or social security wealth. In other words, our consumption rule implies that any decline in the social security wealth as a ratio of disposable income will be offset by an increase in the ratio of accumulated assets to income, which is acquired by generating higher savings.

The results reported above depend heavily, therefore, on the evolution of households' social security wealth, which is, in turn, a consequence of the design of the social security system and of a number of assumptions that have an impact on it.

Figure VI.8 describes the rate of growth of aggregate contributions and pensions over the forecast horizon. Following the assumptions made with regard to the rate of growth of the population, productivity, the labour force and the evolution of aggregate employment and unemployment, the system generates relatively large fluctuations of the social security deficit. Clearly the government's attempt to offset these fluctuations by means of, say, changes in taxation applicable to the current labour force may affect households' disposable income and saving behaviour in different ways over the simulation period. We ignore these possible responses in the benchmark simulation. Moreover, the results depend crucially on our assumption that households perceived all of their estimated social security wealth as 'true wealth' in the period (early 1990s) over which we estimate our consumption equation. While this assumption is not rejected in the estimation, it is clear that a lot of uncertainty surrounds it, especially considering the significant changes that the Italian social security underwent in those years. Given the important impact of the evolution of the social security system on our results, the results of a set of simulations which are based on different assumptions are reported below in Section VI.2.4.3.

VI.2.2 Variant simulations

We perform a number of additional simulations under a variety of different assumptions. Tables VI.10 to VI.13 report some summary statistics of the aggregate results, which are discussed below.

VI.2.2.1 A high fertility scenario

In the high-fertility variant simulation, we follow Istat's (1997) high variant scenario assumes a gradual recovery of fertility rates up to 1.85 children per woman in 2020. In order to keep the distribution of the number of children per woman as close as possible to that of the Istat projections, we also increase marriage rates somewhat with respect to the benchmark simulation.[67]

Figure VI.10 shows the total population in the benchmark middle fertility scenario and in the high fertility scenario. The analysis of the detailed results for the high fertility scenario (not shown here to save space) reveals the following.

Increases in fertility rates do not have a very large effect in the medium run since the main demographic changes foreseen for Italy in the next 30 years are already under way and because the recovery in fertility rates is gradual. The aggregate saving rate (see Figure VI.11) remains just slightly under that generated in the benchmark simulation, primarily because the first effect of the rise in fertility is to increase the number of children per household, and this tends to increase consumption, other things being equal. The effect of the larger number of children is partly mitigated by the fact that we somewhat increase marriage rates in this simulation: this tends to increase the weight of nuclear households compared with singles in the young age classes, which has a positive effect on savings. Over a longer time horizon the increase in the weight of the working-age population relative to the benchmark case (see Figure V.12) leads to a higher saving rate, as expected. This effect is partly mitigated by the smaller decline in the social security wealth over income ratio in this case than in the benchmark case (shown in Figure VI.13), in turn a consequence of the higher rate of income growth in the high fertility scenario.

VI.2.2.2 The effects of changes in the rate of productivity growth

A productivity slowdown can exert dramatic effects on the aggregate saving rate. In the extreme case that we report in Table VI.11 the productivity growth is set so as to generate a rate of growth of total income close to zero. This case serves also to illustrate the internal consistency of the model, since it must be true that the saving rate approaches zero when the total income growth approaches zero (for a discussion of this feature, see Ando, 1996). In the simulation of our model the aggregate saving rate declines steadily, reaching about 3% at the end of the simulation horizon in 2100. The reduction in the aggregate saving rate is, however, very slow because the decline in social security wealth relative to income due to

[67] This reflects the fact that, as the model is set up at the moment, only married women can have children. It should be recalled that we make no distinction between marriage and cohabitation in our model.

the decline in income growth still induces a higher accumulation of wealth over the entire period. In terms of equation (3) above, this implies that the system is gradually approaching its steady state asset to income ratio (and the saving rate declining to zero) although the steady state value has not yet been reached, given the fact that social security wealth is still declining (relative to total assets) at the end of the simulation.

VI.2.2.3 The effects of alternative assumptions regarding the social security system

Since the effect produced by the social security system affects our results in such a significant manner, we perform another set of simulations to evaluate the sensitivity of results with respect to some key parameters that govern the response of individuals with respect to the social security system.

The uncertainty regarding both the measure of social security wealth (i.e., the actual measure perceived by households) and the parameters governing behavioural responses to it (that are estimated during a period of substantial changes in the system) lead us to perform a simulation in which parameters of the saving choices are re-estimated, assuming that households actually perceive only half of the estimated measure of social security wealth as real assets during the estimation period. That is, we impose a value of $\alpha_s=(1/2)*\alpha_a$ in equation (2) above. In this case, the counteracting effect on the saving rate produced by the social security system in the simulation that we describe above is far smaller than in the benchmark case. At the end of the simulation horizon, the aggregate saving rate is lower by 2 percentage points than in the benchmark as shown in Table VI.12. In terms of the analysis above, it can be shown that in this case the steady state solution (5) is modified as:

$$\frac{A_t + SSW_t}{Y_t + b'SSW_t} = \frac{1-\alpha_y}{\alpha_a + g + (1/2)\alpha_a \dfrac{SSW_t}{A_t + SSW_t}} \qquad (6)$$

That is, the steady state value for the total accumulated saving (including social security wealth) to disposable income is smaller than in the benchmark case (as can be seen easily by comparing equation (6) with equation (5) above), implying a lower (steady state) saving rate.

In a final simulation, we change the rules regulating retirement and the determination of benefits upon retirement. Firstly, we gradually increase the minimum age requirement from 57, as requested under the current rules, to 60 in 2003 and to 62 from 2020 onwards. Secondly, we eliminate the late retirement penalty that is still present in the social security system (for retirement after age 65) under the new rules.[68] In this case, two counteracting effects come into play in the model. On the one hand, since people work longer, the need to accumulate assets for retirement is reduced, which has a negative effect on savings. On the other hand, the share of the working population increases and this exerts a positive effect on saving. The net effect is that the saving rate throughout the simulation is only marginally lower than in the benchmark simulation (see Table VI.13).

[68] We simply compute the actuarially fair benefits for individuals that retire after age 65, using the same formulae adopted for retirement at earlier ages.

Section VI – Charts and Tables

Figure VI.1: Benchmark simulation: evolution of total population
(in thousands)

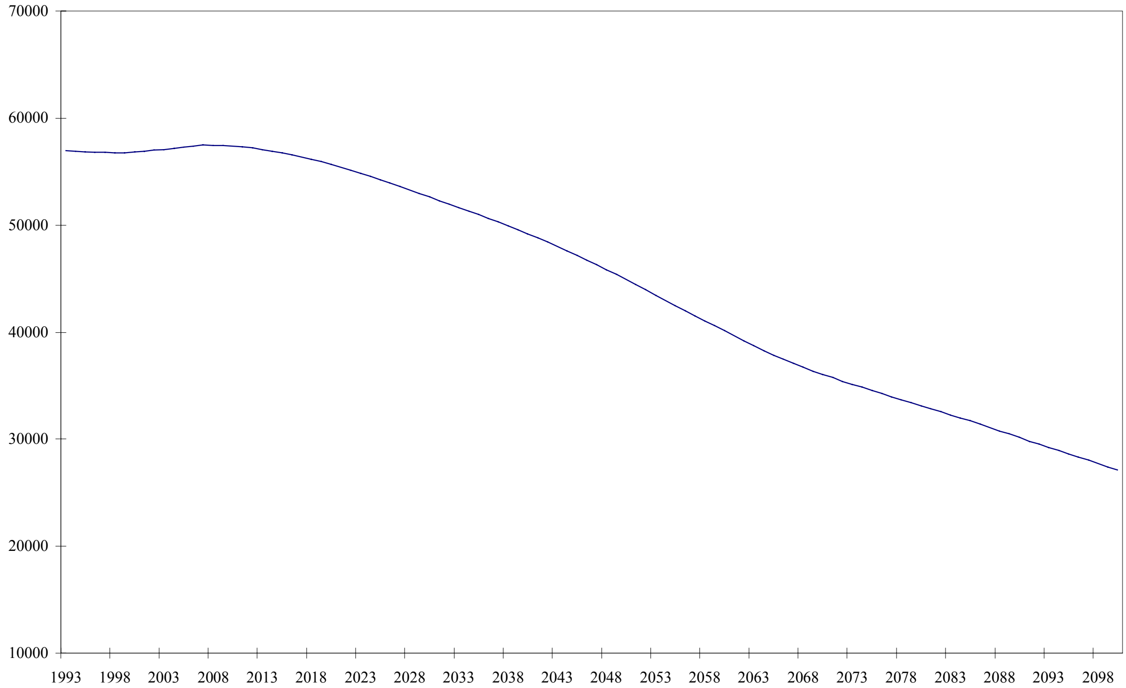

Figure VI.2: Benchmark simulation: age composition of the population
(fraction of total population)

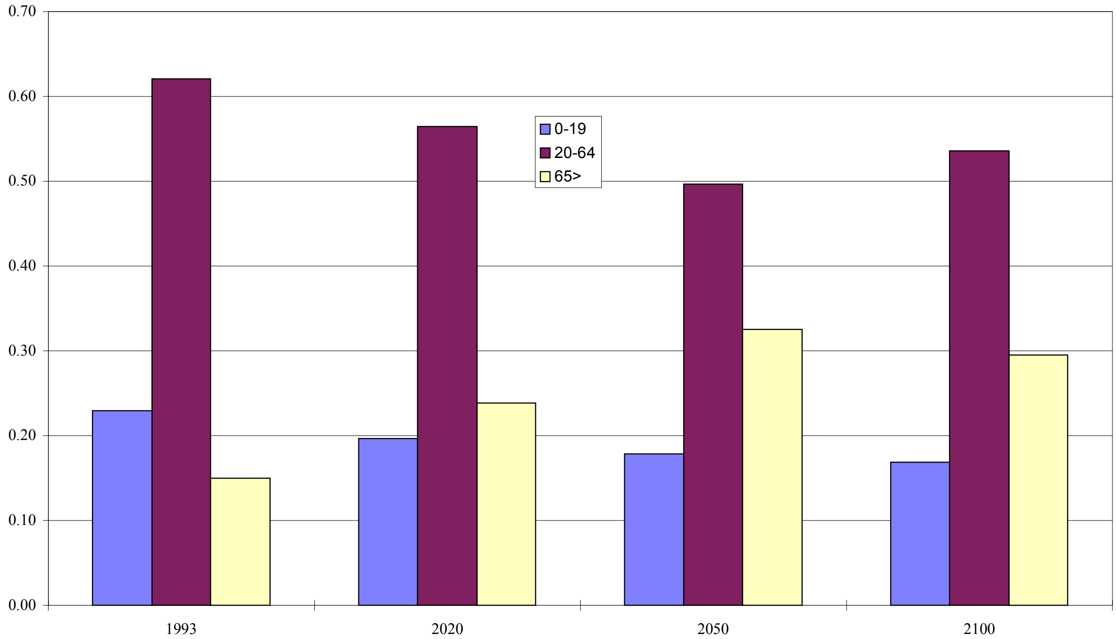

Figure VI.3: Benchmark simulation: composition of population by activity
(fraction of total population)

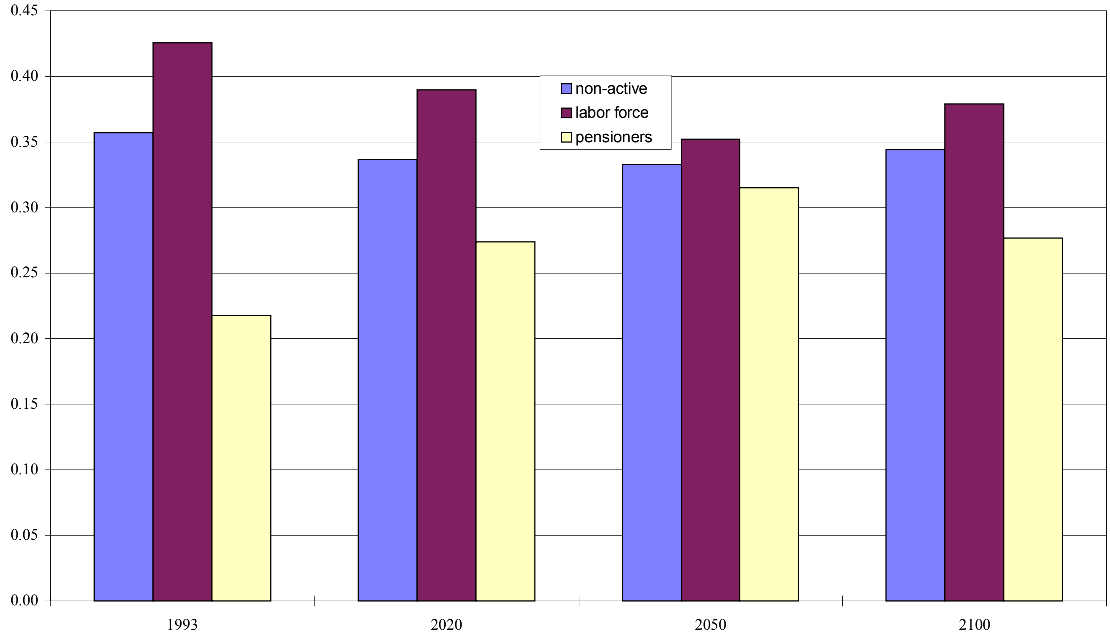

Figure VI.4: Benchmark simulation: labour force participation by age
(fraction of total population)

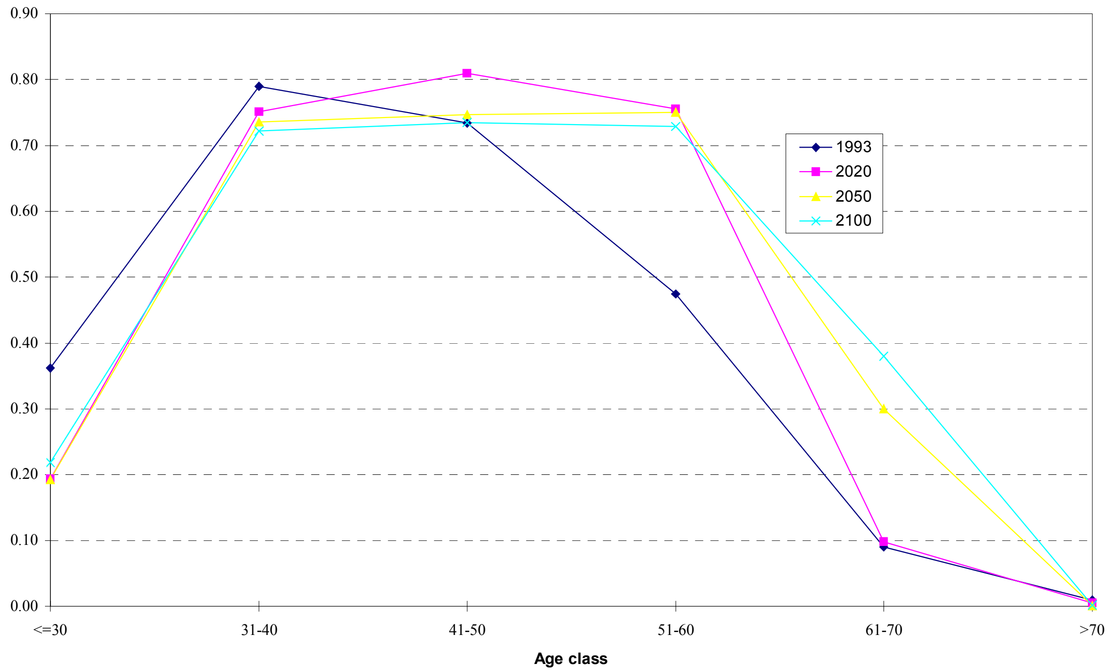

Figure VI.5: Benchmark simulation: evolution of the aggregate saving rate
(as a percentage of households' disposable income)

Figure VI.6: Benchmark simulation: rate of growth of selected variables
(% annual)

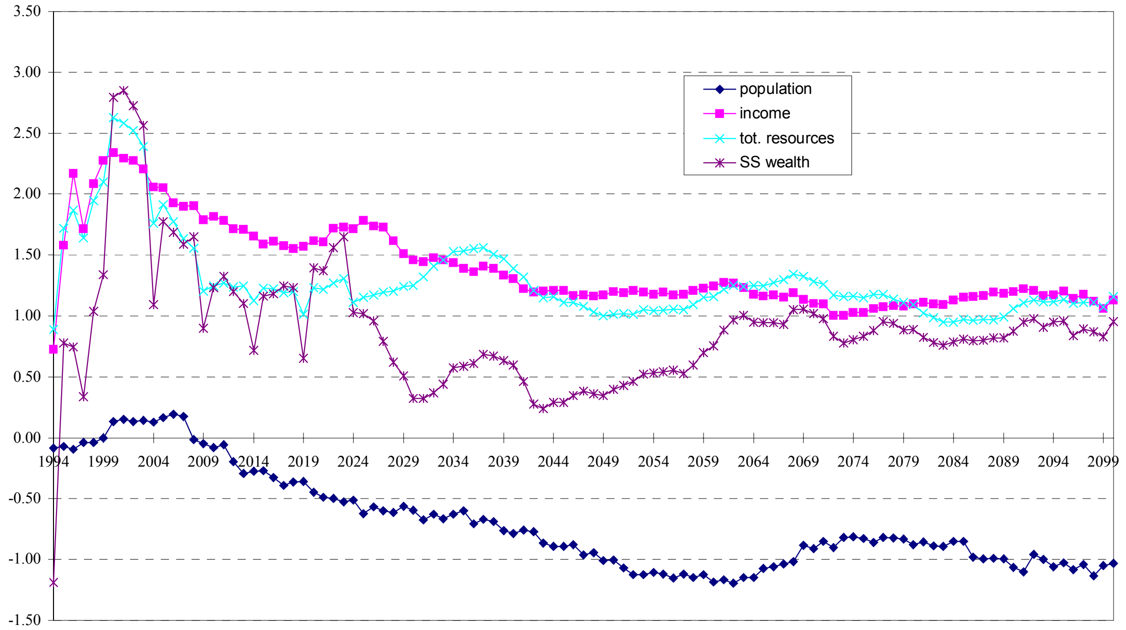

Figure VI.7: Benchmark simulation: net worth, SS wealth and total resources over disposable income ratio

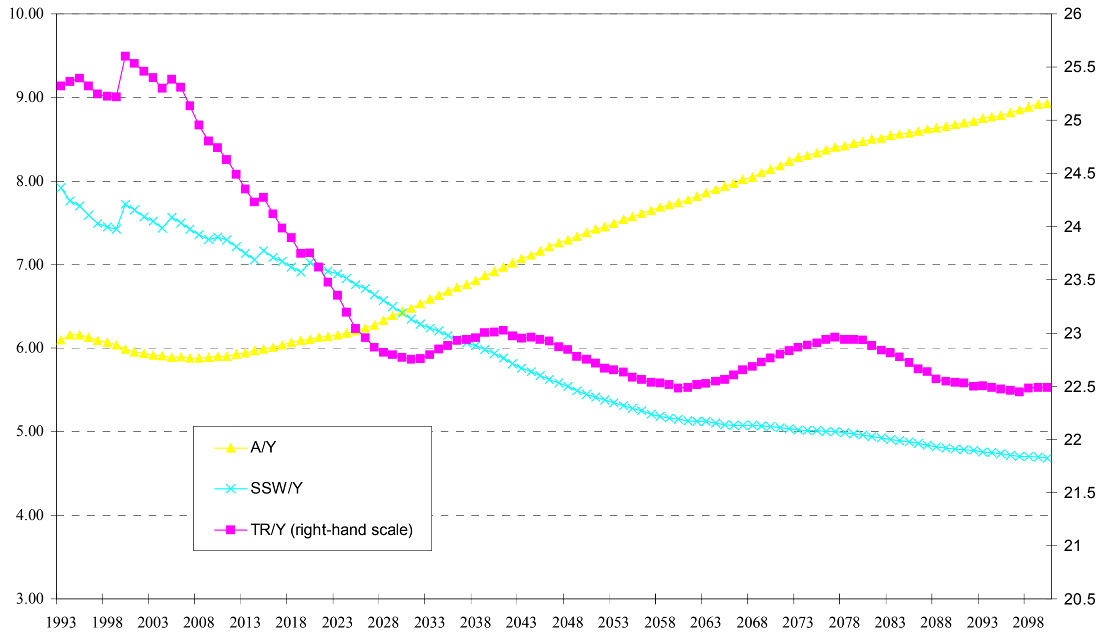

Figure VI.8: Benchmark simulation: rate of growth of SS contributions and pension benefits

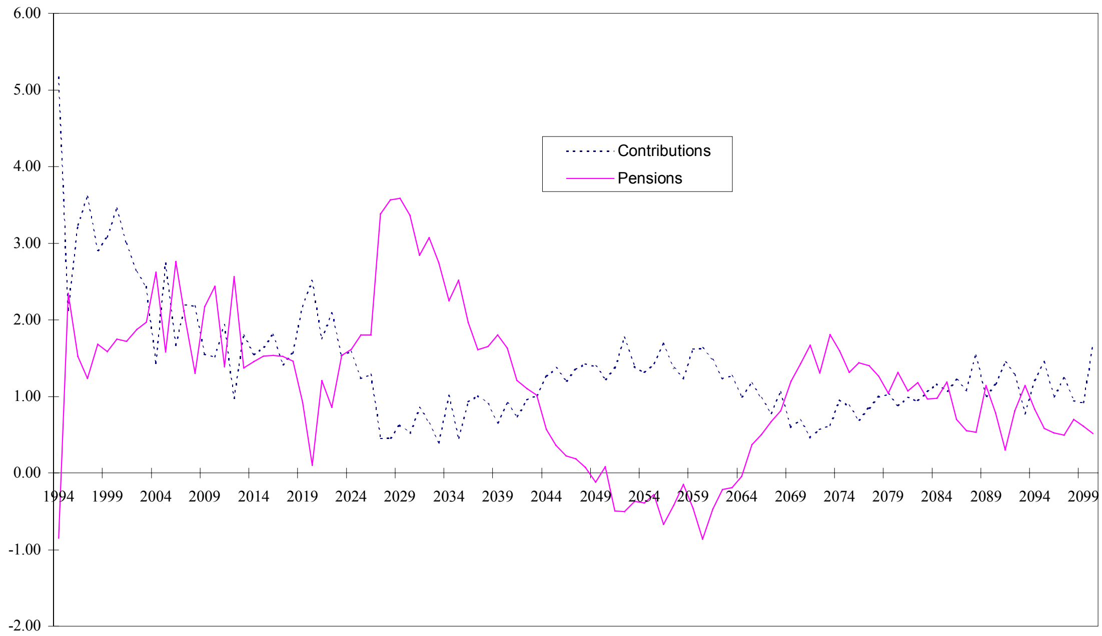

Figure VI.9: Total population in the benchmark and high fertility scenarios
(thousands)

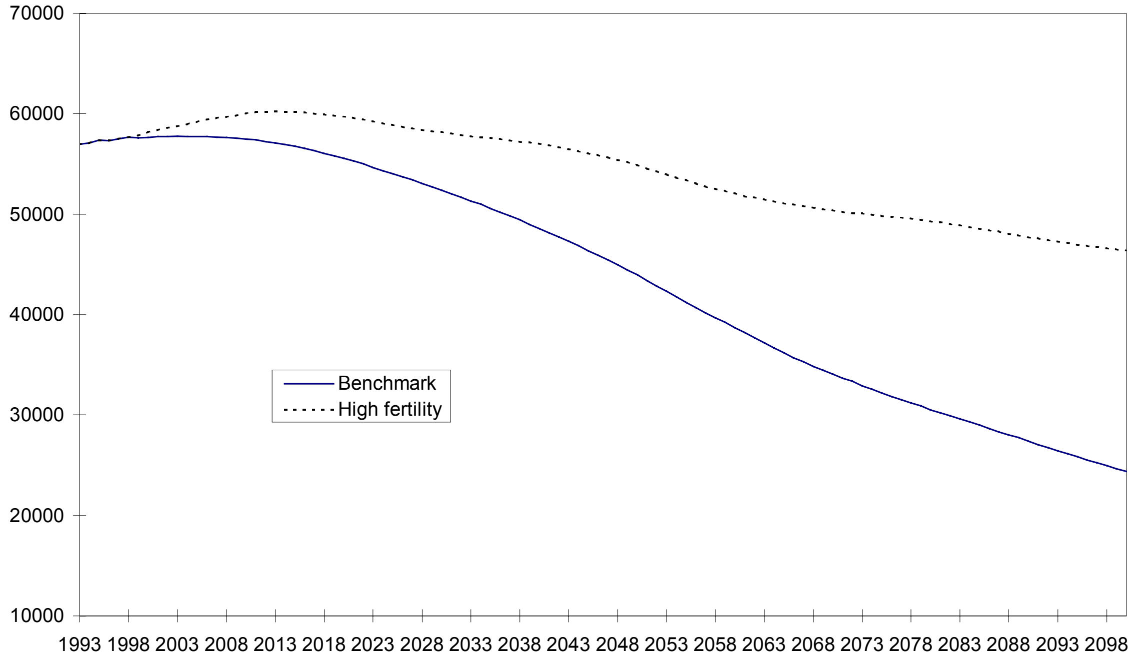

Figure VI.10: Aggregate saving rate in the benchmark and high fertility scenarios
(as a percentage of total disposable income)

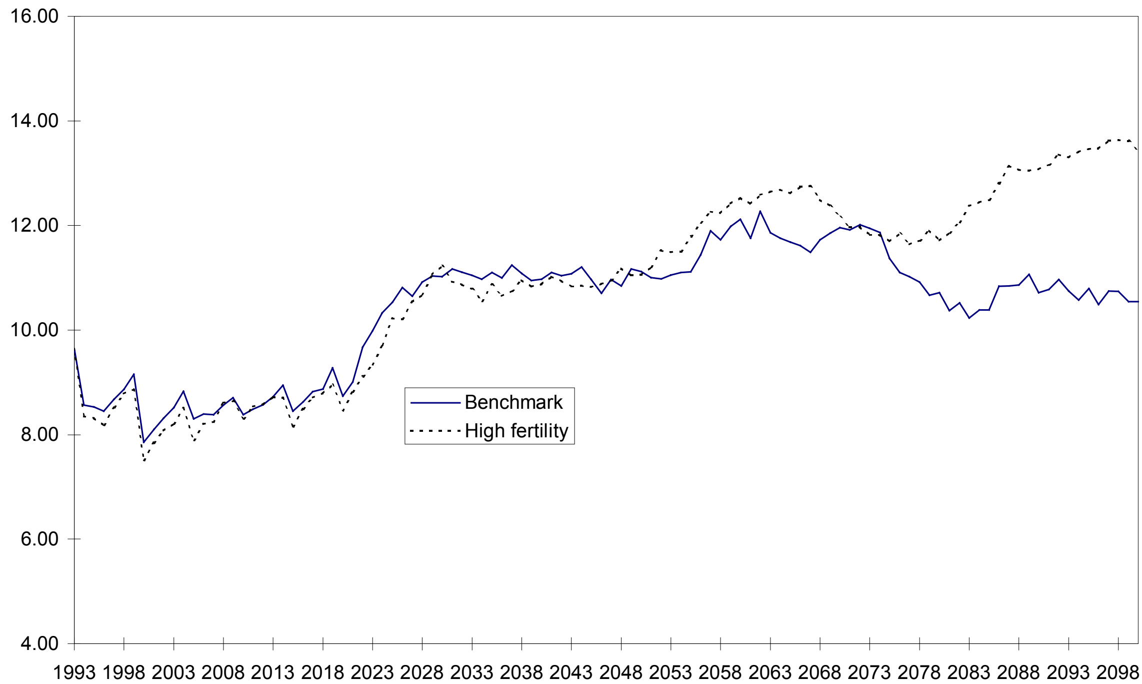

Figure VI.11: Age composition of the population in the benchmark and high fertility scenarios

(fraction of total population)

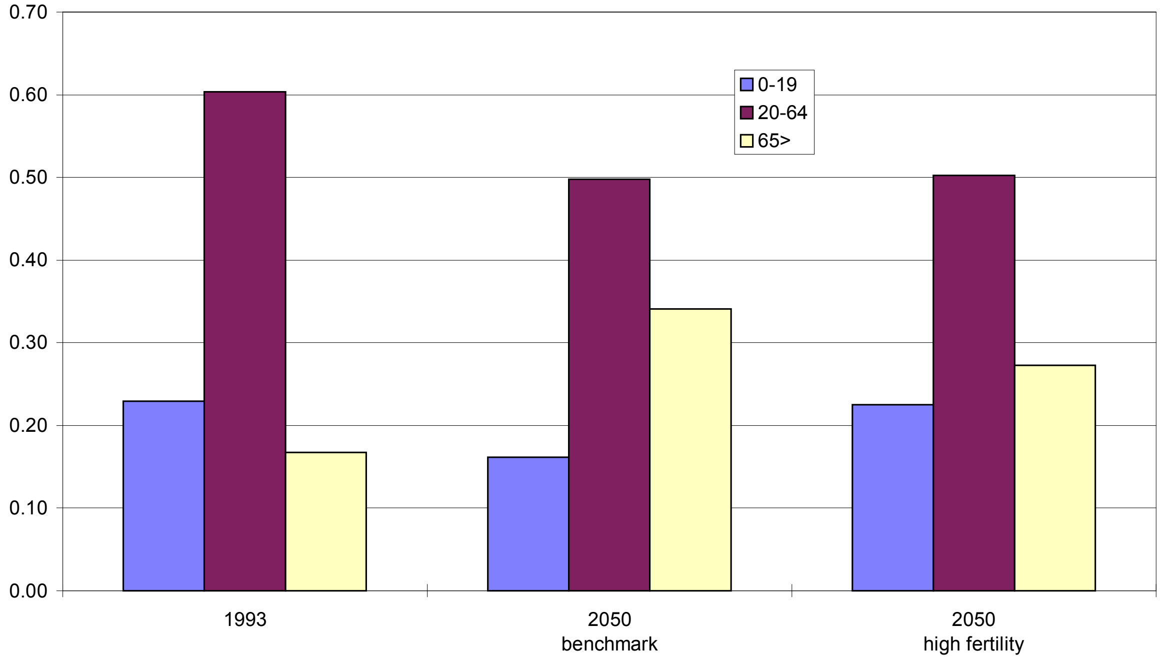

Figure VI.12: Net worth and SS wealth over income ratios in the benchmark and high fertility scenarios

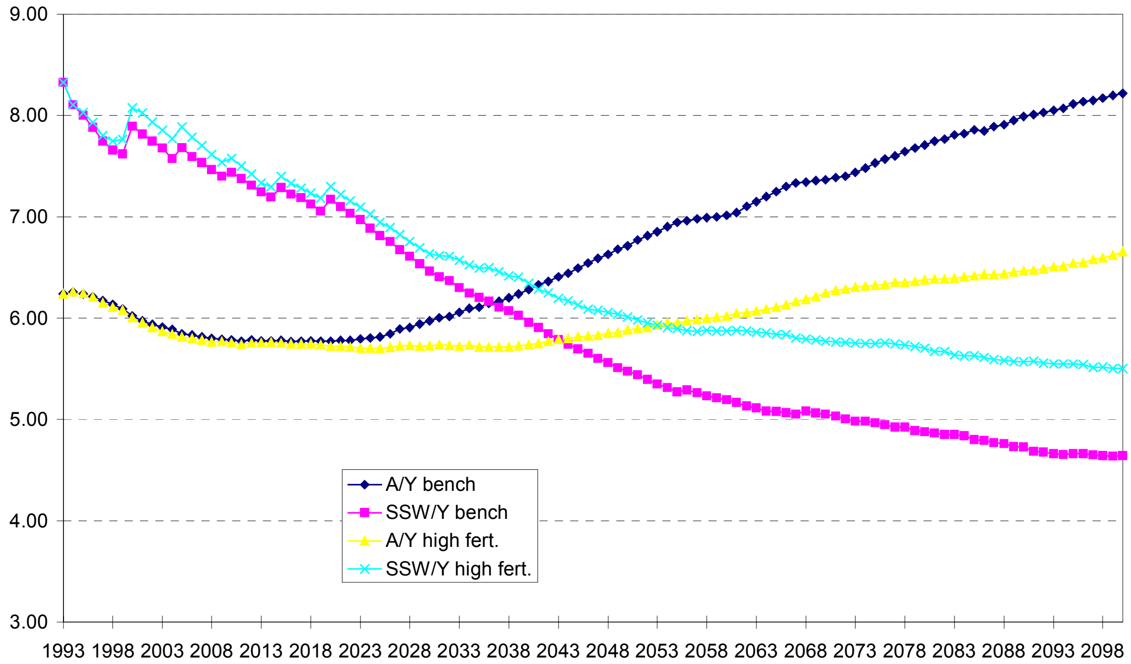

Table VI.1: Benchmark simulation: demographic structure by age and family type
(year: 1993 – actual)

MALES

Age class	Total Number [1]	Total Per cent [2]	Married [3] Nuclear	Married [3] Non-nuclear	Single-head [3] Nuclear	Single-head [3] Non-nuclear	Singles [3]	Dependant [3]
<31	11,698	(0.4251)	0.0612	0.0022	0.0000	0.0085	0.0070	0.9211
31-40	3,889	(0.1413)	0.7117	0.0374	0.0009	0.0283	0.0238	0.1978
41-50	3,723	(0.1353)	0.7139	0.1981	0.0034	0.0286	0.0107	0.0454
51-60	3,453	(0.1255)	0.4480	0.4416	0.0125	0.0365	0.0144	0.0470
61-70	2,836	(0.1031)	0.5005	0.3778	0.0024	0.0341	0.0256	0.0595
71-80	1,402	(0.0509)	0.5949	0.1505	0.0091	0.0636	0.0837	0.0982
>80	518	(0.0188)	0.6040	0.0327	0.0000	0.0107	0.0874	0.2653
Total	27,518	(1.0000)	0.3726	0.1357	0.0029	0.0230	0.0182	0.4477

FEMALES

Age class	Total Number [1]	Total Per cent [2]	Married [3] Nuclear	Married [3] Non-nuclear	Single-head [3] Nuclear	Single-head [3] Non-nuclear	Singles [3]	Dependant [3]
<31	11,411	(0.3876)	0.1361	0.0048	0.0011	0.0051	0.0041	0.8487
31-40	4,108	(0.1395)	0.7572	0.0630	0.0343	0.0208	0.0073	0.1173
41-50	3,931	(0.1335)	0.5554	0.2946	0.0383	0.0556	0.0142	0.0420
51-60	3,605	(0.1225)	0.3728	0.4199	0.0300	0.0844	0.0298	0.0630
61-70	3,321	(0.1128)	0.3984	0.1953	0.0262	0.0870	0.1826	0.1103
71-80	2,037	(0.0692)	0.3139	0.0436	0.0202	0.0601	0.3252	0.2370
>80	1,030	(0.0350)	0.0954	0.0092	0.0399	0.0377	0.3301	0.4877
Total	29,442	(1.0000)	0.3482	0.1268	0.0197	0.0379	0.0628	0.4045

(1) Thousands of individuals, scaled to match the population; (2) % of total male (female) population;
(3) Expressed as % of male (female) population in the age class.

Table VI.2: Benchmark simulation: demographic structure by age and family type
(year: 2020)

MALES

Age class	Total Number [1]	Total Per cent [2]	Married [3] Nuclear	Married [3] Non-nuclear	Single-head [3] Nuclear	Single-head [3] Non-nuclear	Singles [3]	Dependant [3]
<31	8,556	(0.3390)	0.0602	0.0002	0.0003	0.0003	0.0044	0.9347
31-40	2,758	(0.1093)	0.6156	0.0002	0.0025	0.0048	0.0705	0.3063
41-50	3,703	(0.1467)	0.6969	0.0315	0.0060	0.0124	0.0910	0.1623
51-60	3,604	(0.1428)	0.5137	0.1942	0.0085	0.0338	0.1127	0.1370
61-70	2,922	(0.1157)	0.5633	0.2404	0.0085	0.0425	0.0725	0.0730
71-80	2,396	(0.0949)	0.6138	0.1683	0.0101	0.0433	0.0919	0.0726
>80	1,303	(0.0516)	0.4592	0.1283	0.0196	0.0773	0.1664	0.1492
Total	25,242	(1.0000)	0.4104	0.0828	0.0054	0.0203	0.0643	0.4167

FEMALES

Age class	Total Number [1]	Total Per cent [2]	Married [3] Nuclear	Married [3] Non-nuclear	Single-head [3] Nuclear	Single-head [3] Non-nuclear	Singles [3]	Dependant [3]
<31	7,988	(0.2926)	0.1072	0.0002	0.0025	0.0003	0.0047	0.8851
31-40	2,586	(0.0947)	0.8262	0.0016	0.0259	0.0050	0.0420	0.0993
41-50	3,743	(0.1371)	0.6517	0.0679	0.0312	0.0204	0.0839	0.1450
51-60	3,973	(0.1455)	0.4442	0.2260	0.0295	0.0606	0.1077	0.1321
61-70	3,522	(0.1290)	0.4794	0.1570	0.0236	0.0879	0.1595	0.0925
71-80	3,101	(0.1136)	0.3741	0.0976	0.0293	0.1150	0.2225	0.1615
>80	2,385	(0.0874)	0.1313	0.0327	0.0540	0.1237	0.2973	0.3610
Total	27,297	(1.0000)	0.3795	0.0766	0.0228	0.0474	0.1044	0.3694

Notes: See notes to Table VI.1.

Table VI.3: Benchmark simulation: demographic structure by age and family type

(year: 2050)

MALES

Age class	Total Number [1]	Total Per cent [2]	Married [3] Nuclear	Married [3] Non-nuclear	Single-head [3] Nuclear	Single-head [3] Non-nuclear	Singles [3]	Dependant [3]
<31	6,334	(0.3269)	0.0623	0.0006	0.0000	0.0003	0.0036	0.9331
31-40	2,277	(0.1175)	0.6017	0.0041	0.0028	0.0048	0.0739	0.3127
41-50	2,507	(0.1294)	0.6747	0.0370	0.0047	0.0192	0.0968	0.1677
51-60	1,731	(0.0893)	0.4569	0.1902	0.0056	0.0587	0.1254	0.1632
61-70	2,028	(0.1047)	0.4834	0.1942	0.0075	0.0471	0.1345	0.1333
71-80	2,714	(0.1401)	0.5309	0.1256	0.0167	0.0237	0.1558	0.1473
>80	1,784	(0.0921)	0.4064	0.0638	0.0331	0.0465	0.2187	0.2315
Total	19,376	(1.0000)	0.3816	0.0663	0.0076	0.0209	0.0896	0.4340

FEMALES

Age class	Total Number [1]	Total Per cent [2]	Married [3] Nuclear	Married [3] Non-nuclear	Single-head [3] Nuclear	Single-head [3] Non-nuclear	Singles [3]	Dependant [3]
<31	6,011	(0.2839)	0.1099	0.0015	0.0024	0.0006	0.0066	0.8790
31-40	2,124	(0.1003)	0.7703	0.0043	0.0253	0.0057	0.0664	0.1279
41-50	2,386	(0.1127)	0.6070	0.0589	0.0300	0.0285	0.1080	0.1676
51-60	1,704	(0.0804)	0.4350	0.2447	0.0297	0.0912	0.1103	0.0891
61-70	2,356	(0.1112)	0.5055	0.1683	0.0213	0.0919	0.1475	0.0655
71-80	3,421	(0.1616)	0.3664	0.0732	0.0335	0.0667	0.2698	0.1905
>80	3,175	(0.1499)	0.1460	0.0194	0.0569	0.0688	0.3354	0.3735
Total	21,176	(1.0000)	0.3492	0.0606	0.0253	0.0426	0.1399	0.3824

Notes: See notes to Table VI.1.

Table VI.4: Benchmark simulation: demographic structure by age and family type

(year: 2100)

MALES

Age class	Total Number [1]	Total Per cent [2]	Married [3] Nuclear	Married [3] Non-nuclear	Single-head [3] Nuclear	Single-head [3] Non-nuclear	Singles [3]	Dependant [3]
<31	3,970	(0.3380)	0.0686	0.0010	0.0003	0.0002	0.0061	0.9237
31-40	1,303	(0.1109)	0.5617	0.0111	0.0013	0.0066	0.0799	0.3394
41-50	1,264	(0.1077)	0.6496	0.0487	0.0046	0.0151	0.1014	0.1805
51-60	1,404	(0.1195)	0.4679	0.2116	0.0085	0.0419	0.1186	0.1515
61-70	1,514	(0.1289)	0.4581	0.2229	0.0090	0.0429	0.1463	0.1208
71-80	1,276	(0.1087)	0.5125	0.1248	0.0167	0.0270	0.1761	0.1429
>80	1,013	(0.0863)	0.3769	0.0737	0.0260	0.0457	0.2347	0.2429
Total	11,744	(1.0000)	0.3586	0.0808	0.0070	0.0199	0.0943	0.4395

FEMALES

Age class	Total Number [1]	Total Per cent [2]	Married [3] Nuclear	Married [3] Non-nuclear	Single-head [3] Nuclear	Single-head [3] Non-nuclear	Singles [3]	Dependant [3]
<31	3,683	(0.2889)	0.1160	0.0020	0.0028	0.0006	0.0121	0.8665
31-40	1,286	(0.1009)	0.6438	0.0123	0.0233	0.0101	0.0826	0.2278
41-50	1,222	(0.0958)	0.6504	0.0847	0.0311	0.0236	0.1131	0.0970
51-60	1,508	(0.1183)	0.4103	0.2480	0.0300	0.0665	0.1414	0.1038
61-70	1,732	(0.1359)	0.3949	0.1607	0.0244	0.0875	0.2128	0.1197
71-80	1,532	(0.1202)	0.3954	0.0808	0.0295	0.0676	0.2706	0.1561
>80	1,785	(0.1400)	0.1418	0.0257	0.0679	0.0927	0.3355	0.3364
Total	12,749	(1.0000)	0.3304	0.0744	0.0261	0.0443	0.1478	0.3770

Notes: See notes to Table VI.1.

Table VI.5: Consumption and net worth income ratio for detailed demographic groups

(benchmark simulation: middle fertility; 2% productivity growth; year 1993 – actual)

Category		Weight (*)	Income (**)	Cons / Inc	Assets/Inc	Lflabour/Inc	Ssw/Inc	Trf/Inc
All people		18,744,647	61,047.6	0.903	6.003	11.403	7.914	25.320
Nuclear families, totals		0.5470	62,844.6	0.938	6.018	13.203	8.230	27.451
by age groups:	<31	0.7038	50,014.0	1.064	3.031	35.278	8.784	47.093
	31-40	0.8193	62,745.7	1.010	4.582	22.690	8.241	35.513
	41-50	0.6569	72,149.0	0.950	5.562	12.309	8.181	26.052
	51-60	0.4061	74,327.4	0.843	7.268	5.950	7.964	21.182
	61-70	0.3935	55,902.7	0.877	8.175	1.792	9.056	19.023
	71-80	0.4014	42,844.3	0.890	8.769	0.344	7.815	16.929
	>80	0.3617	44,336.8	0.769	9.316	0.065	5.372	14.753
Non-nuclear families, totals		0.1992	84,269.1	0.819	5.761	9.067	6.784	21.612
by age groups:	<31	0.0295	59,774.3	0.892	4.665	22.522	9.815	37.002
	31-40	0.0448	63,965.9	0.964	4.172	19.646	10.433	34.252
	41-50	0.1953	74,551.3	0.916	4.721	11.978	7.709	24.407
	51-60	0.4008	92,283.3	0.818	5.564	8.091	6.292	19.948
	61-70	0.2861	81,655.1	0.779	6.878	7.566	6.562	21.007
	71-80	0.0917	95,393.2	0.615	6.422	7.643	6.310	20.375
	>80	0.0250	69,061.9	0.721	4.917	4.276	8.457	17.650
Nuclear single-head, totals		0.0352	32,746.8	1.092	7.458	10.365	11.993	29.816
by age groups:	<31	0.0109	33,934.5	1.259	4.405	35.795	9.087	49.286
	31-40	0.0424	21,813.7	1.557	3.605	25.500	14.983	44.088
	41-50	0.0413	37,972.1	1.060	4.800	10.799	11.551	27.150
	51-60	0.0396	39,434.6	1.104	9.013	5.488	12.009	26.510
	61-70	0.0260	31,322.4	0.921	15.497	7.828	12.018	35.343
	71-80	0.0261	30,317.0	0.827	7.722	3.813	11.422	22.958
	>80	0.0535	31,857.4	0.728	4.727	0.000	8.394	13.121
Non-nuclear single-head, totals		0.0933	57,651.4	0.835	5.628	10.811	8.135	24.574
by age groups:	<31	0.1404	84,376.3	0.745	6.452	13.221	7.695	27.368
	31-40	0.0575	62,247.8	0.934	5.205	21.055	9.019	35.280
	41-50	0.0823	51,495.8	0.876	4.196	11.687	8.909	24.792
	51-60	0.1124	59,365.7	0.846	5.233	7.181	7.455	19.869
	61-70	0.1066	51,686.0	0.846	5.317	8.369	8.379	22.065
	71-80	0.1026	52,721.6	0.753	8.152	9.448	8.158	25.757
	>80	0.0579	46,363.6	0.701	8.676	3.580	5.409	17.665
Single, totals		0.1253	26,780.4	0.999	7.161	5.941	8.580	21.681
by age groups:	<31	0.1154	34,705.1	1.069	8.182	34.552	7.044	49.778
	31-40	0.0360	46,276.4	1.177	4.312	26.303	7.259	37.873
	41-50	0.0242	37,183.4	1.019	5.345	15.010	9.746	30.102
	51-60	0.0411	37,901.8	0.940	7.393	2.271	10.832	20.496
	61-70	0.1878	23,529.2	1.029	7.067	0.139	11.625	18.831
	71-80	0.3782	24,154.7	0.940	7.737	0.013	7.646	15.396
	>80	0.5020	21,845.5	0.954	8.031	0.000	4.511	12.542

(*) Total number of families. Numbers for family types are expressed as fractions of the total. Numbers for age groups within family type are expressed as fractions of the total number of families for the age group in question in the population. (**) In 1995 thousand lire.

Table VI.6: Consumption and net worth income ratio for detailed demographic groups

(benchmark simulation: middle fertility; 2% productivity growth; year 2020)

Category		Weight (*)	Income (**)	Cons / Inc	Assets/Inc	Lflabour/Inc	Ssw/Inc	Trf/Inc
All people		20,916,511	89,301.7	0.883	5.984	10.747	7.023	23.753
Nuclear families, totals		0.5119	88,633.7	0.921	4.717	13.174	7.258	25.148
by age groups:	<31	0.8201	78,030.5	1.092	2.909	37.846	7.651	48.406
	31-40	0.7726	93,592.2	0.990	2.429	26.209	6.696	35.333
	41-50	0.6769	110,366.8	0.857	2.841	14.712	6.372	23.925
	51-60	0.4414	113,535.6	0.769	4.753	8.154	7.285	20.192
	61-70	0.4240	70,867.4	0.951	8.047	1.627	9.988	19.661
	71-80	0.4319	50,166.6	1.247	11.129	0.408	8.358	19.895
	>80	0.2605	45,356.8	1.149	10.833	0.202	4.798	15.832
Non-nuclear families, totals		0.1658	135,879.6	0.798	5.828	9.524	6.491	21.843
by age groups:	<31	0.0434	150,802.3	0.744	6.205	22.348	7.198	35.750
	31-40	0.0810	133,191.9	0.904	6.702	17.343	8.399	32.444
	41-50	0.1295	128,130.5	0.902	5.001	12.335	7.703	25.039
	51-60	0.2715	153,492.8	0.781	4.857	8.596	5.834	19.287
	61-70	0.2421	122,508.2	0.799	6.379	8.646	6.765	21.790
	71-80	0.1261	126,198.6	0.680	7.171	7.995	6.108	21.273
	>80	0.0738	135,354.9	0.796	9.133	5.550	5.443	20.126
Nuclear single-head, totals		0.0363	55,087.3	0.976	9.357	7.536	9.282	26.174
by age groups:	<31	0.0325	47,586.6	1.097	2.822	30.403	7.003	40.227
	31-40	0.0317	46,205.8	0.958	2.981	20.267	7.687	30.935
	41-50	0.0346	60,827.5	0.941	4.376	11.100	9.460	24.936
	51-60	0.0337	64,083.9	1.023	7.010	6.939	10.506	24.455
	61-70	0.0275	47,852.7	0.833	13.911	4.141	13.349	31.401
	71-80	0.0342	49,888.0	1.032	14.179	3.601	9.000	26.781
	>80	0.0696	55,551.5	0.998	14.241	1.471	6.404	22.116
Non-nuclear single-head, totals		0.0863	106,136.2	0.756	8.555	7.332	6.711	22.598
by age groups:	<31	0.0069	125,391.1	0.662	6.858	15.712	7.262	29.832
	31-40	0.0113	98,484.2	0.768	7.330	14.328	8.433	30.090
	41-50	0.0304	92,293.0	0.864	6.950	10.014	8.100	25.064
	51-60	0.0826	108,101.4	0.869	7.391	8.062	6.454	21.906
	61-70	0.1106	95,364.7	0.845	8.704	7.830	7.611	24.145
	71-80	0.1370	100,694.9	0.700	8.854	7.977	7.359	24.190
	>80	0.1786	127,017.3	0.624	9.506	4.697	5.168	19.370
Single, totals		0.1996	51,293.6	0.993	8.982	6.365	6.986	22.334
by age groups:	<31	0.0970	42,485.2	1.219	3.360	40.771	8.588	52.719
	31-40	0.1032	65,468.0	1.193	1.721	25.941	6.191	33.852
	41-50	0.1286	65,411.0	0.876	3.864	13.930	6.308	24.102
	51-60	0.1707	71,033.5	0.905	7.233	6.715	6.862	20.811
	61-70	0.1957	46,840.7	0.978	12.512	0.322	10.443	23.278
	71-80	0.2708	40,972.2	1.095	12.172	0.001	7.849	20.023
	>80	0.4176	38,228.5	1.036	13.232	0.015	3.626	16.873

(*) Total number of families. Numbers for family types are expressed as fractions of the total. Numbers for age groups within family type are expressed as fractions of the total number of families for the age group in question in the population. (**) In 1995 thousand lire.

Table VI.7: Consumption and net worth income ratio for detailed demographic groups

(benchmark simulation: middle fertility; 2% productivity growth; year 2050)

Category		Weight (*)	Income (**)	Cons / Inc	Assets/Inc	Lflabour/Inc	Ssw/Inc	Trf/Inc
All people		17,310,800	163,315.6	0.874	7.254	10.049	5.450	22.753
Nuclear families, totals		0.4585	159,463.6	0.922	5.518	13.203	5.708	24.429
by age groups:	<31	0.8420	149,121.0	1.033	3.154	35.845	6.374	45.373
	31-40	0.7666	177,895.5	0.944	3.043	24.992	5.473	33.508
	41-50	0.6126	209,771.6	0.825	3.514	14.657	4.821	22.992
	51-60	0.3303	208,876.6	0.768	5.323	9.025	5.182	19.530
	61-70	0.3783	159,954.4	0.857	8.140	2.407	6.881	17.429
	71-80	0.4185	95,046.8	1.248	11.422	0.491	7.722	19.635
	>80	0.2608	79,318.1	1.177	10.877	0.245	5.021	16.144
Non-nuclear families, totals		0.1835	265,056.1	0.787	7.082	8.978	5.095	21.154
by age groups:	<31	0.0408	303,750.8	0.662	6.934	19.737	5.485	32.156
	31-40	0.0817	272,632.6	0.844	7.070	16.537	6.112	29.719
	41-50	0.1951	251,798.4	0.894	6.963	11.553	5.837	24.352
	51-60	0.4187	293,906.5	0.793	6.569	8.170	4.560	19.299
	61-70	0.2940	252,611.9	0.746	7.478	7.204	5.203	19.885
	71-80	0.1084	233,917.7	0.673	7.571	8.171	5.200	20.942
	>80	0.0406	239,817.4	0.781	9.024	6.305	4.436	19.765
Nuclear single-head, totals		0.0395	97,610.3	0.977	12.171	5.638	6.706	24.516
by age groups:	<31	0.0286	69,924.1	1.082	4.081	28.783	6.262	39.126
	31-40	0.0309	88,472.8	0.951	3.874	19.479	6.692	30.044
	41-50	0.0280	98,790.1	0.949	5.475	11.742	7.281	24.498
	51-60	0.0234	112,298.7	1.073	9.162	7.599	8.215	24.976
	61-70	0.0233	94,539.5	0.815	14.301	5.494	9.494	29.290
	71-80	0.0439	98,006.0	0.963	15.865	2.390	7.369	25.624
	>80	0.0849	98,111.9	1.012	14.597	0.976	4.920	20.492
Non-nuclear single-head, totals		0.0755	205,742.2	0.732	9.438	7.197	5.172	21.807
by age groups:	<31	0.0106	253,340.4	0.593	6.801	13.531	4.387	24.719
	31-40	0.0118	206,408.1	0.701	8.214	12.595	6.278	27.086
	41-50	0.0390	177,869.1	0.846	9.604	8.879	6.244	24.727
	51-60	0.0997	204,074.9	0.872	9.310	6.949	5.129	21.388
	61-70	0.1110	193,919.3	0.808	9.466	7.561	5.539	22.566
	71-80	0.0803	198,414.0	0.674	9.118	9.136	5.936	24.190
	>80	0.1067	236,313.8	0.584	9.855	4.518	3.901	18.274
Single, totals		0.2430	91,227.7	0.989	10.970	4.766	5.356	21.092
by age groups:	<31	0.0779	77,592.5	1.188	4.555	37.578	7.668	49.802
	31-40	0.1090	120,783.9	1.138	2.352	24.703	5.237	32.292
	41-50	0.1254	128,171.6	0.823	4.886	13.731	4.439	23.057
	51-60	0.1280	137,644.1	0.901	8.330	7.473	4.424	20.228
	61-70	0.1934	106,222.6	0.896	12.203	1.359	7.203	20.765
	71-80	0.3490	79,054.8	1.070	14.838	0.005	6.782	21.625
	>80	0.5071	72,035.7	1.032	12.833	0.000	3.726	16.559

(*) Total number of families. Numbers for family types are expressed as fractions of the total. Numbers for age groups within family type are expressed as fractions of the total number of families for the age group in question in the population. (**) In 1995 thousand lire.

Table VI.8: Consumption and net worth income ratio for detailed demographic groups

(benchmark simulation: middle fertility; 2% productivity growth; year 2100)

Category		Weight (*)	Income (**)	Cons / Inc	Assets/Inc	Lflabour/Inc	Ssw/Inc	Trf/Inc
All people		10,451,872	479,137.7	0.873	8.800	9.002	4.687	22.489
Nuclear families, totals		0.4513	470,399.7	0.902	7.078	11.524	4.937	23.539
by age groups:	<31	0.8243	405,401.4	0.951	4.181	32.166	5.543	41.890
	31-40	0.7196	505,428.1	0.889	4.317	22.581	4.800	31.698
	41-50	0.6153	600,104.8	0.798	4.786	12.999	4.305	22.090
	51-60	0.3916	585,027.1	0.760	6.511	8.331	4.456	19.298
	61-70	0.3634	507,090.7	0.837	9.121	2.674	5.593	17.389
	71-80	0.4186	284,791.8	1.384	15.218	0.388	6.542	22.148
	>80	0.2461	205,518.3	1.439	13.818	0.369	4.315	18.503
Non-nuclear families, totals		0.1911	761,701.5	0.781	8.210	8.537	4.335	21.082
by age groups:	<31	0.0421	808,018.5	0.623	7.409	17.398	5.044	29.851
	31-40	0.1205	761,524.9	0.832	8.593	15.110	5.359	29.062
	41-50	0.2104	709,246.9	0.912	9.375	10.271	5.135	24.781
	51-60	0.3498	811,130.5	0.774	6.934	8.198	3.780	18.912
	61-70	0.2739	761,157.1	0.737	8.230	7.095	4.396	19.721
	71-80	0.1169	705,148.5	0.700	10.202	6.955	4.343	21.500
	>80	0.0445	687,555.3	0.836	10.348	5.717	3.849	19.914
Nuclear single-head, totals		0.0396	271,539.0	1.039	14.008	5.311	6.065	25.384
by age groups:	<31	0.0300	200,115.4	1.081	6.160	27.340	5.551	39.052
	31-40	0.0276	258,952.6	0.889	5.393	19.974	4.989	30.356
	41-50	0.0294	301,385.9	0.967	7.550	9.655	7.045	24.251
	51-60	0.0301	288,743.2	1.118	11.477	6.328	7.513	25.318
	61-70	0.0260	298,655.7	0.782	16.740	3.423	7.627	27.790
	71-80	0.0388	298,811.7	1.017	19.830	1.918	5.961	27.708
	>80	0.0893	241,799.9	1.192	15.537	1.201	4.642	21.380
Non-nuclear single-head, totals		0.0763	597,134.0	0.748	11.291	6.244	4.332	21.867
by age groups:	<31	0.0079	662,832.4	0.566	10.233	9.805	4.323	24.360
	31-40	0.0189	570,302.2	0.741	10.867	11.309	5.667	27.844
	41-50	0.0322	510,796.6	0.856	12.341	7.912	5.690	25.943
	51-60	0.0836	572,506.8	0.874	10.218	7.379	4.164	21.761
	61-70	0.1008	561,046.0	0.814	11.716	6.186	4.645	22.547
	71-80	0.0803	563,132.2	0.720	12.286	7.638	4.824	24.748
	>80	0.1281	696,040.4	0.617	10.954	4.104	3.583	18.641
Single, totals		0.2417	268,824.6	1.045	13.137	4.353	4.679	22.169
by age groups:	<31	0.0957	207,981.6	1.107	3.580	36.494	6.692	46.767
	31-40	0.1134	340,715.8	1.072	3.761	21.808	4.592	30.162
	41-50	0.1128	371,087.0	0.831	6.346	12.653	4.060	23.059
	51-60	0.1449	380,627.5	0.891	10.013	6.458	4.001	20.472
	61-70	0.2359	314,894.1	0.893	14.707	1.480	5.660	21.846
	71-80	0.3454	243,888.8	1.178	18.546	0.009	5.696	24.251
	>80	0.4921	190,570.0	1.255	14.482	0.000	3.353	17.836

(*) Total number of families. Numbers for family types are expressed as fractions of the total. Numbers for age groups within family type are expressed as fractions of the total number of families for the age group in question in the population. (**) In 1995 thousand lire.

Table VI.9: Benchmark simulation: aggregate results

(benchmark simulation: middle fertility; 2% productivity growth)

Year	Weight (*)	Consumption / income ratio	Assets / income ratio	Life time labour income / income ratio	Social security wealth / income ratio	Total resources / income ratio	% Growth of aggregate income
1993	18,744,647	0.903	6.003	11.403	7.914	25.320	
1994	18,911,179	0.900	6.056	11.540	7.764	25.360	1.382
2000	19,876,236	0.905	5.893	11.983	7.723	25.599	2.664
2020	20,916,511	0.883	5.984	10.747	7.023	23.753	1.808
2050	17,310,800	0.874	7.254	10.049	5.450	22.753	1.166
2070	13,879,948	0.871	8.012	9.689	5.062	22.764	1.375
2090	11,547,102	0.876	8.550	9.192	4.795	22.536	0.991
2100	10,451,872	0.873	8.800	9.002	4.687	22.489	1.168

(*) Total number of families.

Table VI.10: High fertility scenario: aggregate results

(2% productivity growth)

Year	Weight (*)	Consumption / income ratio	Assets / income ratio	Life time labour income / income ratio	Social security wealth / income ratio	Total resources / income ratio	% Growth of aggregate income
1993	18,744,647	0.903	6.003	11.401	7.915	25.318	
2020	21,321,741	0.886	5.963	11.021	7.140	24.124	1.860
2050	19,411,333	0.880	6.419	11.073	5.917	23.409	1.733
2100	16,124,254	0.858	7.033	10.348	5.511	22.892	1.775

(*) Total number of families.

Table VI.11: Zero growth rate scenario: aggregate results

(middle fertility; zero growth rate of aggregate income)

Year	Weight (*)	Consumption / income ratio	Assets / income ratio	Life time labour income / income ratio	Social security wealth / income ratio	Total resources / income ratio	% Growth of aggregate income
1993	18,744,647	0.903	6.003	11.188	7.999	25.190	
2020	20,877,931	0.925	7.475	9.846	6.932	24.252	0.018
2050	17,462,622	0.939	9.144	9.598	5.296	24.038	0.195
2100	10,574,273	0.967	11.118	8.963	4.559	24.640	0.031

(*) Total number of families.

Table VI.12: Reduced perceived social security wealth: aggregate results

(middle fertility; 2% productivity growth)

Year	Weight (*)	Consumption / income ratio	Assets / income ratio	Life time labour income / income ratio	Social security wealth / income ratio	Total resources / income ratio	% Growth of aggregate income
1993	18,744,647	0.903	6.003	11.401	7.914	25.317	
2020	20,864,608	0.887	2.243	10.817	7.057	20.118	1.806
2050	17,335,780	0.889	4.135	10.094	5.525	19.754	1.376
2100	10,462,141	0.893	5.551	9.292	4.831	19.675	1.114

(*) Total number of families.

Table VI.13: Late retirement: aggregate results

(middle fertility; 2% productivity growth)

Year	Weight (*)	Consumption / income ratio	Assets / income ratio	Life time labour income / income ratio	Social security wealth / income ratio	Total resources / income ratio	% Growth of aggregate income
1993	18,744,647	0.903	6.003	11.401	7.915	25.318	
2020	20,844,902	0.885	5.972	10.799	7.052	23.823	1.830
2050	17,423,209	0.874	7.134	10.036	5.561	22.731	1.424
2100	10,521,260	0.875	8.661	9.106	4.847	22.613	1.160

(*) Total number of families.

Appendix

A.1 The Bank of Italy Survey of Households' Income and Wealth

The basic source of data for this work is represented by the Survey of Household Income and Wealth (SHIW), which is a household survey sponsored by the Bank of Italy. Its main purpose is to collect information concerning the economic behaviour of Italian households at the micro economic level. In particular, data on households' composition, consumption, income and wealth are collected.[69] The SHIW has been run on a yearly basis from 1965 to 1987 and every other year since 1987 until now. Up to 1987, the number of participant households in a typical year was around 4000. The number was doubled starting in 1987 when a number of other improvements has made the survey more reliable and rich in information.

A.1.1 The survey unit

The unit of observation is the family, which is defined to include all persons residing in the same dwelling who are related by blood, marriage or affection. Persons living in nursing homes, prisons or military installations are not included. On the basis of this definition only one unit is recorded when two or more nuclear families, as registered at the registry offices, are linked by family ties and live together. This explains why the survey-based estimate of average family size tends to exceed the estimate based on official records.

A.1.2 The sampling procedure

Sampling is carried out in two stages: the first consists in the selection of municipalities and the second in selecting the families. Up to 1986 the number of participant

[69] In particular, the SHIW is basically the only reliable source for the analysis of household income and wealth in Italy, data on which are not available in the Italian survey of consumer expenditure run by Istat, the Italian public statistical agency. The latter, however, does provide more detailed statistics on household consumption expenditures.

households in a typical year was around 4000 and was selected from the Electoral Register.[70] The sampling procedure was entirely revised in 1986 and brought into line with that used by Istat in its survey of the labour force. Municipalities are now divided into 51 strata, defined by 17 regions and 3 classes of population size: over 40,000 thousands, 20,000-40,000 thousands, less than 20,000 inhabitants. The number of families was doubled and the selection made from the General Registry Office's lists.[71] The average number of participant households is about 8,000. Starting in 1989 a small panel was introduced (about 15 per cent of the total number of families). The panel was gradually increased to 40 per cent in subsequent years.

A.1.3 The realization of the survey, response rate and processing of results

The survey is contracted out to a private company which provides professionally trained interviewers. Data are collected in personal interviews in the first months of a year and refer to family budgets of the previous calendar years. Questions concerning the whole family are answered by the head of the family, identified as the person who is mainly responsible for economic decisions in the family, while questions on individuals' incomes are answered by each member, if present. For both responding and non-responding families interviewers are asked to complete a section of the questionnaire on the family's characteristics. Non-responding families are replaced with other families with similar characteristics.

The response rate is around 50 per cent in a typical year (there was a large drop in the 1989 survey when the response rate fell to 23.3 per cent). On the basis of the characteristics of all families contacted it seems that the response rate is inversely correlated with income and wealth (Cannari and D'Alessio, 1992), leading probably to an underestimation of the mean and dispersion of incomes.

Questionnaires go through several checking procedures. These include re-contacting the interviewers incomplete or wrong questionnaires and automatic controls to eliminate coding and computation errors. Typically, about 95 per cent of the questionnaires are used.

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70 As noted by Brandolini and Cannari (1994), the sample design implied an oversampling of large families. Also, up to 1984 the first stage-stage sample was not random but selected on the basis of convenience in the collection of data (availability of professional interviewers in the area).

71 This is the registry office's list maintained by municipalities.

A.1.4 The information collected

The survey collects data on all the important social and demographic characteristics of household members: sex, age, relationship to the head of the family are collected for each member, while education, professional status and economic sector of activity are collected for all income recipients.

The information on incomes of family members is very detailed. The revision of the survey structure carried out in 1986 made the definitions closer to those used to compile the national accounts by introducing the distinction between receipts in income account and transfers in capital accounts (such as inheritances, lottery wins, etc.), by recording receipts and disbursements in the year they are due, and by distinguishing income from private non-corporate enterprises and that from quasi-corporate enterprises, including imputed rent, in the definition of income. All income is recorded net of taxes and social security contributions and no information on taxation is collected. Net income receipts are collected for each income earner of the family, divided by type of income (dependent work, self-employment, pension benefits and other transfers, interest income, property income).

Consumer expenditure is divided into durable and non-durable components: further disaggregation is not available. Expenditures on non-durable consumption include food, entertainment, education, clothes, medical expenses, housing repairs and rent (imputed for home-owners). Durable consumption is the sum of expenditures on vehicles, furniture, appliances and art objects.

Data on holdings of financial assets have been collected in a systematic way only starting with the 1987 survey. Detailed information on households' real estate and on mortgages is available in each survey.

A.2 The comparison of the SHIW with the National Accounts

A careful comparison of the survey data with the National Accounts data on income and consumption for the Households and Individual Firms sector was performed [72] to assess

[72] This is the institutional sector that most closely matches the sort of data collected in the surveys. Individual firms are defined as firms employing less than 15 people.

the comparability between the two sources of data for each survey from 1987 to 1995.[73] Below we give the details of the methodology used.

A.2.1 The sampling weights

The computation of average families' income and consumption has been carried out using the sampling weights of the SHIW historical archive data set (D'Alessio and Gallo, 1998). These are reconstructed starting from the original survey weights with iterative methods in order to match the distributions of some social and demographic characteristics of the population as recorded in official statistics. In particular, the distribution by age, sex, regional residence, dimension of municipalities of residence and economic activity of the population has been brought into line with the corresponding distribution obtained by Istat in its current population surveys and labour force statistics. This choice was made mainly because the proportion of self-employed individuals is severely underestimated by original survey data with respect to labour force statistics. Also, the new weights should enhance the comparability of survey data over time.

A.2.2 The total population and the number of families

An important source of difficulties in making the comparison between the survey data and the National Accounts is the uncertainty regarding the size and the distribution of the Italian population. The survey does not provide an independent measure of the total population because the basic unit is a *de facto* family, which might differ from the unit recorded at the registry offices (see above). To compute the total number of families we have divided the total resident population by the average family size estimated by the survey. The total resident population is taken from Istat official statistics, except for the years 1987 and 1989 for which we have used a revised series of the Bank of Italy.[74] Estimates of the total number of Italian families are reported in Table A.1.

[73] A similar exercise for the SHIW was carried out by Brandolini (1993) and Brandolini and Cannari (1994) for the SHIW up to 1989. Even if the methodologies differ in some respects, the results for the 1987 and 1989 surveys are qualitatively very similar to those obtained here.

[74] This is because official statistics present a negative jump of 1 million persons in 1991 (when the last Census was taken), due probably to the inaccuracy of the measures of the current population surveys carried out between the two censuses. The Bank of Italy measure simply re-scales the official series by smoothly subtracting this one million persons in the period 1981-1991.

A.2.3 The construction of gross income

The original SHIW data only report net after-tax incomes received by households and their members. For a number of important tasks in our model, however, we need to estimate gross income and to dispose of a fairly detailed description of the structure of personal taxes for the Italian household sector. Moreover, an estimate of gross income (and personal taxes) is needed to perform a comparison of the survey data with the National Accounts as the latter only provides gross pre-tax incomes and personal taxes are not broken down by income categories.

We have therefore reconstructed gross incomes of all labour income recipients in the surveys (dependent workers, pensioners and self-employed incomes), starting from the net incomes given by the survey and applying the legal provisions prevailing during each survey year and taking into account tax credits and deductions by job status and family composition.[75]

Given the structure of the Italian personal income tax schedule – a progressive levy with several income brackets – the pre-tax or taxable income for each taxpayer can be recovered from:

$$Y = \frac{1}{1-t_j}\left[YN + A_j - C\right] \tag{A.1}$$

where t_j is the tax rate of the j-th income bracket, YN is net of tax income given by the survey respondent, C is the amount of tax credits and

$$A_j = \sum_{i=1}^{J-1} t_i (S_{i+1} - S_i) - t_j S_j \tag{A.2}$$

where S_j is the lower bound of the j-th income bracket.

By initially deducting tax credits from the net income declared by the survey unit we implicitly assume that tax credits are not distinguished from wages and salaries by the respondent when answering the survey questionnaire.

We have considered two types of tax credit: tax credits for work-related expenses and tax credits for dependent relatives. The former is actually a fixed amount (unrelated to work expenses) that is scaled according to the effective working period. The latter are credits granted to the dependent relative (spouse or child) of the taxpayer. To qualify as a dependent the relative has to have an income below a prescribed ceiling. Credits have been computed differentiating for family structures (married couple and single parents)

We have not considered, for the time being, family allowances, that is the cash transfers to the families of employees and pensioners that vary directly with the number of members in the family and inversely with gross household income. We will consider this type of tax credit in future extensions of the model as it introduces some extra computational burden. Admittedly, its exclusion might imply some upward bias in the computation of personal taxes.

It should be noted that, according to the law, tax credits cannot be greater than gross tax liabilities. When this happens, tax credits are put at a level which results in net tax liabilities equal to zero.

Finally, we have also reconstructed gross interest incomes by applying the relevant tax rates on the different sources of interest (public bonds, deposits, etc.), applying the tax rates prevailing in each survey year.

The implicit average tax rates that we get for the various sources of income are quite plausible: considering, for example, the 1995 Survey, we have an average tax rate of 19% for dependent workers, 16.7% for pensioners, 22% for interest incomes, 24% for self-employed. As we shall explain below, in the final data used for the model we have adjusted the net, gross incomes and taxes of the original survey data to match the corresponding aggregates given by the National Accounts. This implies an estimate and the attribution of tax evasion. As a result of this procedure, the effective average tax rate on self-employment income is substantially reduced.

The taxable labour income Y in equation (1) represents the basis on which the social security contribution rates for employees (both those paid by the employee and by the employer) and self-employed have been applied in order to compute the gross labour incomes and contribution receipts necessary to model the Italian social security system.

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[75] The methodology adopted here follows closely, but with less detail, Di Biase et al. (1995) "ITAXMOD: A Microsimulation Model of the Italian Personal Income Tax and of Social Security

A.2.4 The imputation of direct personal taxes to different sources of income

As already mentioned in the National Accounts gross incomes and direct taxes are not broken down by type of income. Therefore, some arbitrary criterion of imputation of taxes has to be adopted to be able to compare the NA data with the survey data broken down by income categories. One possibility (followed, for example, in Brandolini and Cannari, 1993) is to simply assign each type of income a proportional share of direct taxes. We have followed a different procedure, which is described below.

We have first estimated the aggregate direct taxes for the total of the population implied by the survey data using the procedure described in the previous section to compute taxes on the income of payroll workers, self-employed, transfers and interests receipts. However, the estimate of aggregate direct taxes for these income sources largely overestimates the total amount of direct taxes given in the National Accounts aggregates,[76] even if we are not yet considering any taxes on the other income sources: capital and rent. This is in some sense natural since the average tax rate, according to National Accounts figures, on the total gross income of families is only about 13%, well below the average tax rates estimated by applying legal provisions on the survey observations. The main problem here, besides measurement errors, is clearly tax evasion, a particularly significant phenomenon in Italy.

In the light of these findings and in the absence of further information we have decided to proceed in the following way.[77] Firstly, we have kept unchanged the average tax rates estimated on survey data for payroll workers, pensioners, and interest receipts (not for self-employed income). Secondly, we have applied the estimated average tax rates for the above income types on the corresponding gross figures of the National Accounts and computed the total tax revenues from these incomes and the corresponding net figures. By subtracting the tax revenues computed in this way from the total amount of personal taxes in the National Accounts we get an estimate of taxes to be split among self-employed income, rent and capital. This procedure therefore amounts to assuming that tax evasion is concentrated in these sources of income. We then split this total amount of residual taxes proportionally for

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Contributions", ISPE Documenti di Lavoro No. 16.

[76] For 1995 the overestimation is of the order of 60 trillion lire.

[77] For a thorough analysis and for alternative methodologies for quantifying tax evasion in Italy, see Cannari, Ceriani and D'Alessio (1997).

the three sources of income. The resulting average tax rate is pretty small: 6.8% in 1995 and it varies (quite randomly) in the range from 3% to 10% in the surveys from 1987 to 1995.

Table A.2 shows the results from this procedure. Column 2 represents, for 1995 income types recognized in the NA Household Sector, net of social security contributions, depreciation and transfers in kind, that is the income base on which personal taxes are collected. Column 3 represents the effective average rate of personal income tax implied by statutory provisions using the size distribution and the characteristics of families as reported in the SHIW. As already mentioned, we accept this calculation for payroll workers' income, transfer payments and for interest income, but not for other types of income. Since the NA report that the ratio of total personal income tax on all income to the income base is 13.8, our procedure implies that for any incomes other than those of payroll workers, transfer payments and interest, the effective average rate is only 6.8%.

A.2.5 The definition of variables

Besides the problem stemming from direct taxes one has to consider the additional complication that definitions of variables in the survey do not always coincide with those used to compile the National Accounts. It is therefore necessary to make some adjustment so that the two sources become comparable. Below we report the National Accounts income definitions used and indicate the variables from survey data to which they have been compared. Definitions for the latter variables and their exact relation to the questions contained in the questionnaire of the survey are provided in Banca d'Italia (1995), Supplementi al Bollettino Statistico, "I bilanci delle famiglie Italiane nell'anno 1993", p. 28. Definitions refer to pre-tax incomes while the comparison has been made by netting each of the following aggregates by imputed direct taxes to each type of income computed as explained above.

Wages and salaries: compensation of employees minus actual and net imputed social security contributions (contributions paid by the self-employed are deducted from actual contributions); compared with survey variable: YL.

Self-employment income: gross operating surplus of sole proprietorships with fewer than 20 employees, net of depreciation of physical assets and interest payments on loans, minus contributions paid by the self-employed (for this last variable, source: R.G.S.E.P., various issues); compared with survey variable: YM

Rents: rents from land and royalties plus operating surplus of consumer households (which is essentially an estimate of imputed rents for owner-occupied houses). Compared with survey variable: YCR2+YCR3

Capital income: dividends and other receipts from corporate enterprises plus withdrawals from corporate and quasi-corporate enterprises (by construction net of consumption of net fixed capital); compared with survey variable: YCR1.

Interest: interest on bank deposit, post-office deposits and government bonds, minus interests on mortgages; compared with survey variable: YCF

Transfers: social security and assistance benefits net of benefits in kind (for this last variable, source: R.G.S.E.P.); compared with survey variable YT.

A.2.6 The results of the comparison

Using the definitions above, average household (gross and net) incomes and taxes (for the six different categories) and average household consumption were multiplied by the total number of Italian families.

Table A.3 shows the result of our comparison for net income and consumption. We find that NA income is underestimated by 25 to 33 per cent by survey data (depending on the survey) while the underestimation of consumption expenditures ranges between 35 and 40 per cent. The larger underestimation of consumption with respect to disposable income is probably to be expected, since the survey questionnaires are very detailed in recording income while questions on consumption expenditures refer only to broad aggregates.[78] All income types are underestimated, the only exception being rents. The underestimation of income is particularly severe in some categories, particularly for the income of self-employed workers, interest receipts and capital income. One can also notice a tendency towards an increase in underestimation over the years for all categories except transfers. As reported by Brandolini and Cannari (1994), the evidence conforms to the experience of other countries,

[78] Part of the underestimation, however, might be due to differences in definitions that have not been corrected: consumption from own production, which is not recorded in the SHIW; and consumption of valuables which is included in savings in the SHIW and in consumption in the NA.

both in terms of the level of the overall underestimation and in terms of categories of income for which the discrepancies are largest.

A.3 Re-proportioning to the National Accounts

A.3.1 Income, consumption and savings

Since the main purpose of our analysis is to give a description of the behaviour of families so to gain insights into the aggregate behaviour of the Italian household sector, we have decided to take the extreme position of re-proportioning the survey data on income and consumption to exactly match the corresponding NA figures for the household sector. We have therefore re-proportioned the survey data (wages and salaries, self-employed income, capital income, rent, interest and transfers) gross, net incomes and taxes for all types of income considered above to the corresponding NA figures. This has been done simply by multiplying, for all individuals in the survey, the income of each type by its re-proportioning coefficient (in the case of net incomes: the reciprocal of coefficients given in Table A.3 divided by 100).

Since we wanted to maintain the distribution of saving rates across households as close as possible to that observed in the original survey, the consumption expenditures of each family have been re-proportioned to the NA figure taking into account the coefficient used for re-proportioning the income of that family. That is, defining $\theta_i = yd_i^* / yd_i$, where yd_i is the i-th family's disposable income from the original survey data and yd_i^* is its disposable income re-proportioned to the NA, we have computed θ_T using:

$$C = \theta_T \sum_i \theta_i c_i \qquad \text{(A.3)}$$

where C is aggregate household consumption expenditure as reported in the National Accounts and c_i is the consumption expenditure of family i. The re-proportioned consumption of each family is then simply computed as

$$c^*_i = \theta_T \, \theta_i \, c_I \qquad \text{(A.4)}$$

A.3.2 Other adjustments

No strictly comparable data exist for real wealth in the official National Accounts. Table A.4. presents the comparison between the survey real estate wealth estimate and an estimate of housing wealth obtained at the Bank of Italy on the basis of National Accounts data and various other sources (see Brandolini, 1996). The survey estimate ranges between 85% and 100% of the national aggregate figure. However, since some information in constructing the national aggregate is in fact taken from the SHIW itself (houses prices per square meter) this cannot be considered an independent measure. Given the uncertainty surrounding this area, we have made no adjustments for the level of reported real wealth.

We have adopted the adjustment for the level of financial wealth of the SHIW, which severely underestimates the corresponding figures of Flow of Funds tables drawn up by Cannari and D'Alessio (1993). This is a non-proportional adjustment obtained by matching the survey data, for a series of defining characteristics of households, to data on clients of the banking system. The data were first corrected to impute financial assets to households reporting only the holding and not the amount. They were then adjusted for non-reporting and under-reporting by comparing the SHIW figures with the estimates derived from a survey carried out by Banca Nazionale del Lavoro (BNL) on a sample of its customers. This sample is not representative of the Italian population but provides more reliable information, probably owing to the greater trust that customers are likely to place in their own bank. The adjustment brings the total value of financial wealth held by the households in the survey to between 70 and 90 per cent (depending on the survey years) of the corresponding figures of the Flow of Funds of the financial National Accounts. The comparison is shown in Table A.5. Using this reconstructed level of financial assets we have corrected disposable income for the effect of inflation ("Hicksian correction").

A.3.3 The age profile of the average propensity to consume after re-proportioning

The final effect on the average propensity to consume of all the adjustments adopted can be gathered in Table A.6, where we have pooled all the surveys between 1987 and 1995. The adjustment to the National Accounts increases the average propensity to consume by 9 percentage points (because consumption is more underestimated than income, as we have seen), while the adjustment for inflation increases it by 6.3 points. It is important to note that with the adjustment for inflation to disposable income the saving rate across age becomes more hump-shaped: since older households have more financial assets the inflation adjustment is larger for them.

Appendix – Charts and Tables

Table A.1. Estimate of the total number of Italian families
(source: Istat and SHIW, various years)

	1987	1989	1991	1993	1995
Total population	56,049	56,012	56,778	56,960	57,333
Average family size	3.004	2.89	2.895	2.899	2.882
Number of families	18,658	19,381	19,612	19,648	19,893

Table A.2. Imputation of direct taxes to the different sources of income
(million lire; year 1995)

Income category:	Gross income (*)	Tax rate	Tax
Wages and salaries	456215	19.0	86658.0
Interest	157733	18.8	29672.0
Transfers	318777	15.7	50134.0
Self-employed	368943	6.8	24954.0
Capital	26872	6.8	1818.0
Rent	148210	6.8	10024.0
Total	1476750	13.8	203260.0

(*) As reported by the NA total Households Sector with the adjustments described in the text.

Table A.3. Comparison of SHIW and National Accounts: income and consumption
(percentage ratio of survey to NA figures)

	1987	1989	1991	1993	1995
Consumption	66.1	65.9	62.8	60.6	60.0
Disposable income	75.2	75.5	68.5	68.1	67.3
of which:					
Wages and salaries	90.0	92.0	85.4	87.2	89.2
Self-employed	56.3	57.3	48.4	43.7	35.2
Rent	118.7	122.6	110.9	116.0	109.1
Capital	28.1	13.3	3.2	14.4	9.5
Interest	65.6	42.5	25.6	21.7	22.3
Transfers	68.0	71.1	71.6	70.2	79.0

Table A.4. Comparison of SHIW and National Accounts: (*) real estate and financial wealth

(percentage ratio of survey to NA figures)

	1987	1989	1991	1993	1995
WF	86.2	84.3	83.6	89.5	100
AF	39.4	27.4	20.3	21.1	22.5
AFN	41.9	50.1	41.5	44.5	48.9
AFNN	64.8	74.2	79.4	81.7	88.2

(*) Survey estimate of households' real estates is compared with the Bank of Italy estimate of households holdings of houses and land based on official Istat data.

WF: real estate wealth.

AF : financial assets as reported in the survey.

AFN: financial assets adjusted for non-reporting.

AFNN: financial assets adjusted for non-reporting and under-reporting.

Table A.5. Comparison between original survey data and survey data adjusted to NA

(1987-1989-1991-1993-1995 BI survey data at 1995 prices)

	Original survey data	Adjusted to NA			
	C/Y	C/Y	C/Y*	A/Y*	W/Y*
Totals:	0.742	0.834	0.898	1.776	5.191
by age groups:					
<30	0.816	0.996	1.023	0.628	3.461
31-40	0.785	0.947	0.980	0.813	3.670
41-50	0.756	0.880	0.926	1.200	4.675
51-60	0.716	0.803	0.863	1.727	5.457
61-70	0.702	0.732	0.822	2.842	6.496
71-80	0.723	0.726	0.838	3.558	7.076
>80	0.733	0.690	0.820	4.358	7.500

Legend: C: total consumption expenditures.

Y: total disposable income.

Y*: inflation-adjusted total disposable income.

A: total financial assets (adj. for non-reporting and under-reporting).

W: total assets (adj. for non-reporting and under-reporting).

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