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# SOCIAL SECURITY AND SAVING RATES: A COHORT ANALYSIS USING ITALIAN DATA

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# Social Security and Saving Rates: a Cohort Analysis Using Italian Data (Preliminary Version)

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## 1. Introduction

The purpose of this study is to investigate the relationship between Social Security and saving rates.

The starting point is the fact that the series of aggregate private sector saving rates for Italy shows a significant drop in the last 15 years. A decline in aggregate saving rates is a common characteristics of many industrialized countries, such as the U.S., Japan, Germany, France and Italy (see Poterba (1994)).

Italy is characterized by two facts: 1) the private sector saving rate has been especially high until the mid 1970's and 2) its decline thereafter has been particularly remarkable.

One of the most cited cause of the decline in aggregate saving rate is the role of Social Security. The intuition for this explanation is quite simple. An increase in the net benefit from Social Security (defined as the difference between the present value of pension benefits minus the present value of social security contributions) should induce agents (individuals or representative agents) to decrease their need for private saving, which is substituted by forced public saving.

The studies that explicitly aimed at testing the causal relationship that links drops in saving rates and Social Security are Rossi and Visco (1994, 1995) Jappelli (1995) Attanasio and Brugiavini (1999) for Italy, Börsch-Supan (1995) for

Germany, and Gokhale et al. (1996), Parker (1999) and Gustman and Steinmeier (1998) for the U.S.

Among these, Rossi and Visco (1994, 1995) focus on National Account series, while the other studies used survey data, trying to link individual behavior and aggregate consequences.

Our study is close in spirit to the one by Attanasio and Brugiavini (1999) but differs from it because we specify a different consumption model which leads us to interpret our results in a way that is alternative to theirs (we also make more explicit the assumptions about the agent's information set).

Given that we want to find a rigorous way to link saving rates (or consumption rates) to Social Security, Italy is a good candidate for our analysis because it has experienced very high private sector saving rates and a pronounced drop in their values in the last twenty years. Moreover Italy has witnessed some relevant changes in the Social Security regimen that can be useful in identifying the relationship between saving rates and Social Security. These changes have not affected all individuals in the same way. Particularly relevant is that fact the Social Security benefits (and changes in those benefit) have been distributed unequally among individuals depending on their working age, and hence on their belonging to a particular cohort.

For instance, starting in 1952 Social Security funding has gradually moved from a Fully Funded system to a Pay as You Go system, which became the only one starting from 1969. More importantly, in 1992 (and 1995) there were two reforms that changed the way in which pension benefits are computed depending on the working age of the individual at the time of the reform.

We choose the cohort as our unit of analysis and we show that there is enough variation in cohort saving rates to justify our approach. Then we construct the candidate explanatory variables and show that there is enough variation across cohorts and finally we link the changes in cohort saving and consumption behavior with the changes in the explanatory variables. Our approach seems an obvious candidate to test empirically the explanations that relate the decline of saving rates or the rise on consumption rates with variables that are (potentially) truly cohort specific (and not age dependent). The variable that we choose to explain the variation in cohort saving rates is given by the ratio of Old Age Wealth to Young Age Wealth (OTYAWR, defined as the sum of present value of labor income received after age 60 and Social Security wealth divided by the present value of labor income received before age 60). This variable summarizes in one number the way in which wealth is distributed along the life-cycle. Different cohorts, having

performed differently on the labor market and having been affected differently by Social Security, experience different values of OTYAWR.

As we will show in our work, under certain conditions we can rewrite the consumption function in such a fashion that differences between cohorts in consumption behavior can be reduced to differences in the intercept of the consumption function. Our task is to explain those differences in terms of the (constructed) explanatory variables.

Our approach fits well with the data used for the estimation. We work with the Survey on Income and Wealth of Italian Households (SHIW) for the years 1984, 1986, 1987, 1989, 1991, 1993, 1995. This a repeated series of cross-sectional data (with a small panel component starting only from 1989). By conditioning on the proper set of variables we can generate observations relative to representative individuals (representative with respect to the conditioning variables) and follow this agent through time. The choice of the conditioning variable is driven by the identifying assumptions.

We choose to condition on the sector to which an individual pertains (private/public) since Italy experienced a reform of the public Social Security system that affected differently private and public sector employees. It would have been interesting to distinguish also between employees and autonomous workers, as others have done. We have chosen to exclude autonomous workers mainly for two reasons. The first one is based on the well know fact that individual income for this category of workers in under-reported. The second one relates to the difficulties of computing pension wealth, since the Italian legislative landscape is full of specific rules and funds governing the pensions of the various types of autonomous workers, while the data that we have do not allow us to identify clearly the"type" of each worker. We reckoned that the benefits of including this group were smaller than the costs and hence we excluded them. We also excluded retirees and individuals who had yet to enter the labor market in a stable way. It is important to stress this because by eliminating certain groups we lose the tight relationship between our data and the aggregate data, but we gain in clarity in terms of the model used for estimation.

Moreover, within each sector, we conditioned on the educational attainment of the various individuals (three education groups: Junior High School Graduates, High School Graduates and College Graduates).

In section 2 we briefly discuss the main literature on the relationship between Social Security and private wealth, focusing on those contributions that try to explain the drop in aggregate and individual saving rates with changes in Social

Security. We also present the data (section 3) and discuss the relationship between aggregate and micro data (section 4). We compare the series of aggregate saving rates with the behavior of the aggregate series constructed from the sub-sample of the Survey of Households Income and Wealth (SHIW) dataset form the Bank of Italy, adopting our cohort approach.

Then we present the results from a reduced form estimation (section 5), meant to provide evidence of systematic differences in saving rates behavior across the cohorts that are represented in our sub-sample.

In section 6 we present formally the model used for estimation while in section 7 we briefly describe the rules governing the Italian Social Security system.

In section 8 we proceed to the estimation stage, under different hypothesis about the information set shared by the various cohorts. We motivate the conclusion that under the assumption of perfect foresight our model can explain the observed behavior because rising cohort profiles for Old to Young Age wealth are positively correlated with the rise in (cohort fixed effects for) consumption rates. On the contrary, under the hypothesis that agents forecasted their pension wealth according to the regime in place prior to 1992 and that were completely surprised by that reform (section 9) we find that our model fails to explain the drop in cohort saving rates. This is due to the fact that the cohort profiles for the explanatory variable are quite flat or even negatively sloped while our estimated cohort fixed effects for consumption rates have a positive slope. This result corresponds to the fact that the pre 1992 Social Security system was not becoming increasingly generous for younger cohorts, whose saving rates were though still declining.

## 2. Survey of the Literature

As already mentioned in the previous section, Italy has experienced extremely high aggregate saving rates during the 1960's and 1970's and a very rapid decrease in those rates during the 1980's and 1990's.

Guiso, Jappelli and Terlizzese (1994) and Jappelli and Pagano (1998) document the time series of the Italian (Net of Depreciation) National, Government and private saving rate from 1950 to 1990[1]. The picture that emerges from their study is one of rapidly declining Government saving rate starting from 1960, slowly rising private saving rate for the period 1965-1978 followed by a rapid drop thereafter, and a declining series of net national saving rates starting from 1966 (with

[1] Jappelli and Pagano (1998) actually report the whole series starting from the 1862, the year after the birth of the National State.

the exception of the years from 1975 to 1978). One problem with this series is that it is not adjusted for the transfer of wealth from the private to the public sector caused by the reduction in the real value of nominal debt due to inflation. This problem was particularly evident in Italy during the 1970's and the 1980's. Once the series are adjusted for such a transfer (which leaves net national saving unaffected) they find that the drop in Government saving rate is less pronounced while the drop in net private saving started earlier and was more pronounced[2].

Comparing the Italian net national and private saving rate with those of the OECD or G10 and G7 countries, Guiso, Jappelli and Terlizzese (1994) and Jappelli and Pagano (1998) find that Italy has been characterized by higher than the average saving rates during all periods (but the deviation of Italy from the predicted values is bigger for the 1960's and the 1970's) and faster decline during the l980's, even after controlling for growth, government saving rates and per-capita GDP (which would be significant if preferences are not homothetic).

These results have been interpreted by Jappelli and Pagano as a sign that growth and fiscal policy alone cannot account for the "abnormal" behavior of the Italian private saving rate. In a different paper (Jappelli and Pagano (1984)) the same authors show that, in a two period OLG economy with an exogenous credit constraint in the first one , "for any given growth rate the presence of borrowing constraints produces a higher aggregate saving rate and it increase the sensitivity of the aggregate saving rate to changes in the growth rate".

There is enough evidence that Italy has been characterized by tight credit up to the mid 1980's. This is true with respect to the financing of consumer durables (mainly homes and cars) and non-durables (Guiso, Jappelli and Terlizzese (1994), Jappelli and Pagano (1998)). The same authors argue that the insurance market was not fully developed and that the banking sector was quite far from being competitive. All these aspects point towards reduced and expensive credit and hence higher saving rates.

This hypothesis that credit constrained households have a higher saving rate has been tested by various authors with respect to Italy. Jappelli and Pagano (1988), splitting the 1984 SHIW sample between those that are likely to be credit constrained and those that are not (based on an arbitrary threshold of a saving rate equal to 15%) find that the group composed by liquidity constrained households has a marginal propensity to save 10% higher than the control group (the

[2] Jappelli and Pagano (1998) find that the private sector saving rate for Italy is positively correlated with the growth rate of GDP. Moreover they cannot reject the hypothesis that variation in growth rates Granger-cause variation in saving rates.

result is clearly not independent from the sampling technique). Guiso, Jappelli and Terlizzese (1994) start from the simple intuition that mortgage market imperfections force Italian households to save more when young. By imposing the assumption that home owners are not credit constrained while renters are they conclude that renters would be accumulating assets at a faster rate than home owners. Hence they estimate the optimal consumption for home owners (using the 1989 SHIW dataset) and use the estimated coefficients on the sample of renters (after controlling for selection bias). They find that projected consumption of non-credit constrained renters would be higher than the observed one by a significant amount (around 14%). This approach suffers from the fact the home purchasing is an endogenous choice.

Mariger (1986, 1987) developed a model of intertemporal consumption in which binding credit constraints arise endogenously. The idea is that the consumer maximizes over its life-cycle but in each period there is a minimum value of assets below which is wealth cannot drop if he wants to have access to credit. Once the assets go below that minimum value, the life-cycle planning horizon is reduced to a single period problem. The advantage of such a procedure is that the point in which the consumption problem cease to be a multi period one and becomes a series of single period optimization problems is determined endogenously. Applying this procedure to Italy Maccan *et al.* (Maccan, Rossi and Visco (1994)) find that about 27% of Italian households experience single period planning horizons, which implies that, on average, 19% of total consumption is attributable to credit constrained households. They also find that the incidence of liquidity constraints is higher in the older portion of the population (over 75) compared to households in their thirties and forties. Moreover they find that the relationship between liquidity constraint and consumption rates is not monotonic. They also find that a relevant portions of households that suffer from credit constraint are forced to save more than it would be optimal. This is the case for tenants, given that their consumption profile must take into account the accumulation of wealth necessary to purchase a house.

The result obtained by Maccan, Rossi and Visco (1994) are important because they show a much richer interaction between liquidity constraints and saving rates. Moreover, while concluding that this is an important component in explaining the drop in saving rates experienced by Italy, their study casts some doubts on explanations that would be based on the intuition that in recent years the liberalization of insurance market and the increased availability of credit have benefited only young households.

Demographic change is another likely candidate for explaining the changes in aggregate saving rates. With reference to Italy the issue has been explored by Cannari (1994) and Jappelli and Pagano (1998). Both studies adopt a decomposition of the aggregate consumption rate as proposed by Bosworth, Burtless and Sabelhaus (1991) in which the aggregate variable is expressed as

$$\frac{C_t}{Y_t} = \sum_{i=1}^{i=G} w_{it} y_{it} cr_{it}$$

where $G$ indexes the groups among which the population has been divided, $w_{it}$ represents the proportion of households in group $i$ at time $t$ ($w_{it} = \frac{n_{it}}{n_t}$), $y_{it}$ is the ratio of average income in the i-th group compared to the overall average at time $t$ ($y_{it} = \frac{\overline{Y_{it}}}{\overline{Y_t}}$) and $cr_{it}$ is the average propensity to consume of the i-th group at time $t$. Cannari[3] considers two different SHIW surveys, the one of 1989 and the one of 1980. Then he imposes on $cr_{it}$ and $y_{it}$ for 1989 the weights $w_{it}$ observed in 1980 and obtains a counterfactual aggregate consumption rate that would have been observed in 1989 had the demographic structure of the population remained that of 1980. The demographic factors that he considers are: age, the size of the households and the number of children (each considered one at a time). He finds that the only change that can account for a small portion of the rise in aggregate consumption rates is the change in the age structure, but quantitatively it only has a small effect. He concludes that the rise in consumption rates has been fairly distributed across all groups and that consumption rates age profiles are fairly flat.

A similar exercise is conducted by Jappelli and Pagano (1998) using the SHIW dataset for the period 1984-1993. They allow for variation in all of the three components (but one at a time) able to explain the changes in the aggregate: the age composition, the propensity to consume of the various groups and their income share. They find that the changes in age composition cannot account for much of the variation, while changes in the other two variables are both relevant. About a third of the change in the aggregate series can be traced to changes in the distribution of income among groups. The greater part of the change is due to increase in group specific propensity to consume. By fixing the age and the income distribution prevailing in 1984 and allowing for the observed variation in the group specific saving rates they find that all of the observed change in

[3]The aggregate consumption rate refers to the aggregate that results from the two series and not the one that would correspond to national accounts.

aggregate saving rates (-6.4%) can be explained by the latter variable alone. We will come back later to this issue because it hides some relevant identification problem.

Several studies have explored the hypothesis that Social Security could be responsible for the drops in private saving rates.

From 1952 to 1968 the Italian Social Security System faced both an enlargement in terms of coverage of workers and a movement from Fully Funded to Pay as You Go. The system adopted the latter definitively in 1969. pension benefits in the private sector were made proportional to the average earnings of the last three years previous to retirement (the last year for public sector workers) and to the number of years of contribution. Pensions were indexed to the cost of living. In the following years the period over which the average had to be computed was extended to five and pension were indexed to the earnings of employed workers. The effects was a significant rise in the ratio of Social Security benefit to GDP. Retirement age in the private sector was 55 for females and 60 for males (65 for males and 60 for females in the public sector).

In 1992 a reform took place (Amato reform, from the Prime Minister in charge at that time). The purpose of the reform was to bring closer the regimes for the private and the public sector, reduce the generosity of pension benefits and increase retirement age in the private sector. Moreover indexation to the earnings of employed workers was abandoned in favor to indexation to the cost of living.

The reform did not affect all generations in the same way. Those who could count on 15 years of contribution at the time of the reform were much less affected by it than those who had less than 15 years of working experience.

The effects of such a reform on Social Security wealth (which we identify with pension wealth, given that private and corporate pension provision has not been very common in Italy up to very recent years) are quite obvious for public sector workers. Compared to what they would have obtained in the absence of the reform they suffered a reduction in pension benefits. As for the private sector, the effects are more complex because they are a function of the years of contribution under the previous regime. Moreover the rise in retirement age was to be obtained gradually, one year every two calendar years.

The best studies on the effects of Social Security on saving rates for Italy that uses aggregate data are Rossi and Visco (1994, 1995). In their work, the two scholars identify a steady state relationship between aggregate saving rates and the following variables: the real interest rate, the growth rate of real disposable income of the private sector, the non-human wealth (real and financial wealth)

to net disposable income ratio, the ratio of gross Social Security wealth to net disposable income and the social transfer to income ratio. Using a series from 1954 to 1992 (in Rossi and Visco (1994) the series extends to 1952 to 1990 and income is defined in a slightly different way) the authors[4] find that until 1962 the rise in aggregate saving rates is the result of rising non-human wealth to net disposable income ratio, with a negative effect coming from the rise in the ratio of gross Social Security wealth to net disposable income. The increasing generosity of the Social Security System that followed the 1960's becomes a major determinant of the behavior of the aggregate saving rate, and they find that for the period 1980-1992 "slightly less than half of the entire fall of the private equilibrium saving rate appears to be due to the increased gross social security wealth to income ratio". At the same time they find that this negative effect is "partially offset by the direct effects of pension expenditures on disposable income", so that the net effect of Social Security on equilibrium saving rate is greatly reduced.

Most of the studies that have investigated the relationship between Social Security, saving and wealth accumulation are based on some sort of life-cycle model.

Here we focus on those relevant for Italy, mentioning those that refer to other countries only when relevant for our explanation.

Brugiavini (1987) and Jappelli (1995) share the same hypothesis regarding the functional form that links accumulated assets and Social Security wealth. This relationship, used by King and Dicks-Mireaux (1982, 1984) and Hubbard (1986) originates from a simple life-cycle model. They define Total wealth ($TW$) as the sum of private wealth ($W$), Social Security wealth ($SW$) and private pension wealth ($PW$). They assume that Total wealth ($TW$) to permanent income ($Y$) ratio is a function of age and hence they can express $W/Y$ as a function of age, $SW/Y$ and $PW/Y$. The coefficient that relates $W/Y$ and $SW/Y$ measures the degree of substitution between private and Social Security wealth.

One problem with these studies is the construction of permanent income. This requires very strong assumptions regarding the shape of the age profiles. The problem arises from the fact that both King and Dicks-Mireaux (1982) and Brugiavini (1987) use just one cross section. This implies that the estimated age profile cannot be separated from a cohort profile, meaning that the differences in wage due to age cannot be separately identified from differences in wages due to cohort effects.

[4]Notice that they consider the period up to reform of 1992, for which a stable long run relationship could have been plausible.

The second problem is the construction of Social Security wealth. This is unobserved and hence has to be constructed, imposing assumptions regarding some basic questions like: the expected age of retirement, the expected replacement rate between the first pension and the last wage, the expected indexation mechanism and other aspects that might affect its value (which depend on the institutional framework). The previous task is particularly complex for Italy, because there numerous separate Funds and rules that govern the public pension of specific categories of autonomous workers. Moreover, even for private and public sector workers there are two types of Old Age pension. One that requires a certain number of years of contribution to the system (provided that retirement age has been reached) and another one that simply requires the individual to be above a given age.

Brugiavini (1987), estimating the previous model using the SHIW dataset for 1984, finds that an increase of one dollar in Social Security wealth induces a drop in private wealth of around 10 cents. This value is about one third of the one obtained by Hubbard (1986) for the U.S.and King and Dicks-Mireaux (1982) for Canada, using an almost identical procedure. We have to notice that in the SHIW dataset it is not possible to match precisely every individual to its specific public pension Fund and hence a good degree of approximation is present in the computation of Social Security wealth by Brugiavini.

Given that the SHIW surveys for 1989 and 1991 report a question on the expected replacement rate between the first pension and the last wage and one on the expected retirement age, Jappelli (1995) is able to avoid the second of the two above mentioned problems. By using the expected replacement rates and expected retirement age (which do not coincide with the actual values) the computation of Social Security wealth becomes easier. There is still the problem of estimating permanent income, and this is done by Jappelli pooling the dataset for 1989 and 1991 and estimating a reduced form wage equation. Jappelli estimates the relationship between private wealth and Social Security using an equation analogous to the one used by Brugiavini and King and Dicks-Mireaux and finds that an increase in Social Security wealth causes a decrease in private wealth by a percentage between 11 and 20% (depending on the specification used). Moreover he finds that the offset is higher for households with higher values of $PW/Y$. The implications for saving rates is that "the development of Social Security system in the 1970s and 1980s explains about one-fifth of the fall in the Italian private saving rate in the last three decades".

The studies by Brugiavini (1987), Rossi and Visco (1995) and Jappelli (1995)

refer to a pre-reform period and for those years (and particularly for those who are focused on the years preceding the 90's) it is plausible that the rise in Social Security wealth could explain the drops in private saving rates. But they can hardly account for the fact (documented in the next paragraphs) that the drop in saving rates are common trough both older and younger cohorts of workers. Younger workers do not appear at a first pass to be particularly favored by the system when compared with 40 to 50 years old workers. Moreover the changes in the political climate of the 1980's which brought to the Amato reform of 1992 should have induced younger cohorts to save more (everything else constant). Alternatively, we should recognize that the dynamics sparkled by the Amato reform are slightly more complex than it is usually thought.

The Amato reform and its effects on consumption rates have been studied by Attanasio and Brugiavini (1999). Their paper is the closest to ours in the methodology followed. The authors start from the realization that a simple life-cycle model without uncertainty leads to individual saving rates that can be expressed as a function of age, individual (or household) characteristics, the ratio of future to current earnings and the ratio of pension wealth to current earnings and the interaction between the two latter variables with a polynomial in age. This interaction accounts for the intuition (that can be formally derived) that unexpected changes in pension wealth (like the one that follows from the Amato reform) affect individuals differently depending on their age. The authors also control for cohort effects (including cohort dummies) and time effects (including a year dummy). The estimation is then conducted in three ways. First using individual data and OLS, then using individual data and Instrumental Variables for the ratio of future to current earnings and for the ratio of pension wealth to current earnings and finally using a difference in difference approach. When they use OLS they find that pension wealth reduces private saving rates but the coefficient is quantitatively not very significant. When they use instrumental variables they find that the coefficient of pension wealth to current income ratio is actually positive.

The most interesting part of their paper is the one in which they apply the method of difference in difference estimation. What they do is basically a regression of the changes in average saving rates between 1993 and 1991 for the groups that they identify as relevant[5] on the changes in pension wealth, controlling for

[5] They choose to condition an characteristics like age and sector such that the effects of the Amato reform on pension wealth would be amplified. This is necessary to identify the relationship between changes in pension wealth and changes in saving rates.

other factors that might influence the result. Taking into account the fact that the changes in pension wealth should affect differently individuals at different stages in their lifetime they interact the difference in pension wealth with a polynomial in age. The result show that there is a negative average relationship between saving rates and pension wealth and that quantitatively this effect is larger than the one obtained with OLS. Moreover they show that the relationship between the two variables significantly depends on age. The age profile of the coefficient on the correlation between saving rates and pension wealth shows a positive value up to age thirty, then it becomes negative and keep dropping until the age of forty is reached. After that age its value rises and it becomes positive again at around sixty.

## 3. The Data

We use the Bank of Italy "Survey of Household Income and wealth" (SHIW). These data report information on individual and household variables. Of main concern for this work are data on individual labor and non labor income, wealth, consumption and savings. Data on labor income are net of taxes and contributions to the pension System. We also have informations on the number of components and the number of income recipients in the household. These data have been collected since 1965, but only for the period after 1984 we are able to have information on the age of individuals. Because of a mistake by a collecting agency, the age variable prior to 1984 has been recorded only in classes of ten year intervals. Since we want a measure of cohorts shorter than that, we are forced to use only the dataset from 1984, 1986, 1987, 1989, 1991 1993 and 1995. The data have been collected by different agencies in the different years and hence the sampling techniques and the definitions of the variables do not always coincide. We have tried as much as possible to create comparable variables when this was necessary[6].

When imputing to individuals the variables defined only at the household level (consumption, saving, wealth, total income, family composition) we allow for Equivalence Scales, and hence we divide household variables by the square root of the number of component as a satisfactory approximation to per-capita values.

Given the sample provided by the Bank of Italy we proceed in focusing on a

[6] For a description and analysis of the sampling procedure see Brandolini and Cannari (1994).

restricted sub-sample, formed by those who are dependent workers in the private and public sector[7]. Then we divide the sample by education groups. We create three education groups: (i) those with less then or completed Junior High School (the mandatory school level in Italy); (ii) those with completed High school; (iii) those with completed Ba's or postgraduate education. Finally we condition on sex.

Within the sub-sample we then proceed to create synthetic cohorts. When data refer to individuals we create age-sector-education-sex cells based on the characteristics of the individual. When dealing with variables defined only at the household level we use the age, sector, education and sex of the head of the household to assign the variables of interest. Notice that the head of the household is always a male, unless the female is a widow or single.

We then proceed to compute the average value for every relevant variable for each age-sector-education-sex cell. We focus only on agents (potentially) permanently attached to the labor market and hence only on agents that, in every given year, are older than 20 years if they have post-secondary education or less and 26 if they are college graduates, and younger that 60 if males and 55 if females. In order to obtain a sufficient number of observations we construct cohorts that have a five year interval. Hence we have 9 cohorts of College workers and 10 cohorts for the other two groups. The oldest ones are the two cohorts indexed by 1. They are: a) High and Junior High School Graduates that entered the labor market at age 20 in 1946 and b) College Graduates that entered the labor market at age 25 in 1951. When the highest bound of the interval on which the cohort is built is greater that 60 (or 55 if females) we drop the cohort.

When relevant we construct real variables using the CPI index, with base year 1990. We do not need to do so when evaluating ratios.

## 4. Aggregate facts and Micro data

The first problem that we face is the reconciliation of the data obtained from the SHIW and those of National Accounts. As documented by Jappelli and Pagano (1998) and Brandolini and Cannari (1984) the two dataset in general do not match perfectly. The difference are due (see Brandolini and Cannari 1994)) to under reporting (in the SHIW) of income from self-employment, pensions and financial assets. For the period that we focus on (1984, 1986, 1987, 1989, 1991, 1993, 1995)

[7] We exclude workers in the agricoltural sector.

the series of aggregate and "implied" aggregate data have a similar broad trend, but the timing of the changes do not match. In Fig.1 we have reported the series of aggregate saving rates coming from both National Accounts and OECD while in Fig.2 we have the series of "aggregate" data obtained from the sub-sample of the SHIW dataset previously described, using both total and labor income ($agsrti$ refers to saving rate in terms of total income while $agsrli$ is expressed in terms of labor income).

The differences between the "true" aggregate series and the "constructed" aggregate series are due to 1) sampling techniques for the SHIW; 2) our selection criteria in creating the quasi-panel; 3) the relative size of the various cohorts within our sub-sample. The series show a declining trend and hence that sub-sample of the SHIW dataset we focus on is informative with respect to our objective.

A "strong" way to reconcile the aggregate and the Micro data is the one followed by Gokhale *et al.* (1996). They match National Income and Product Account (NIPA) with Consumer Expenditure Surveys to derive measures of cohort specific consumption and resources. Then, by recognizing that with homothetic preferences each cohort's consumption is proportional to the present value of its remaining lifetime resources, they can perform counterfactual exercises by simply changing the amount of resources of the various cohorts (which include social security as well as the present value of Medicare and Medicaid services).

A similar procedure could be followed focusing just on the aggregate series resulting from survey data, avoiding the matching between the two types of datasets. In this case it would be necessary to compute cohort averages for all the relevant variables (consumption rates, present value of future resources etc..) and analogous counterfactual exercises could be performed.

This is the type of analysis conducted by Jappelli and Pagano (1998).

At the present stage we just want to shed some light on the correctness of this type of exercise.

Suppose that we focus on the aggregate data obtained from survey data that are representative of the whole population of a country (such as the SHIW). As already mentioned we can always decompose the aggregate saving rate in the following way

$$\frac{S_t}{Y_t} = \sum_{i=1}^{i=G} w_{it} y_{it} sr_{it} = 1 - \sum_{i=1}^{i=G} w_{it} y_{it} cr_{it}$$

where $G$ indexes the group over which we have taken the average consumption rate, $w_{it}$ represents the proportion of households in group $i$ at time $t$ ($w_{it} = \frac{n_{it}}{n_t}$),

$y_{it}$ is the ratio of average income in the i-th group compared to the overall average at time $t$ ($y_{it} = \frac{\overline{Y_{it}}}{\overline{Y_t}}$) and $sr_{it}$ ($cr_{it}$) is the average propensity to save (consume) out of disposable income of the i-th group at time $t$.

This decomposition is just an accounting exercise and as such should be used with care as far as policy conclusions are concerned. For instance, comparing the aggregate series of saving rates that would result from shifts in the age composition of the population (keeping constant the shares of income and the saving rates) is an acceptable exercise only as long as saving rates themselves are not a function of the age composition. Moreover this type of approach cannot help much when a causal relationship is looked for. For that we need to fully specify a consumption function.

A step toward a more "structural" approach can be obtained if we assume that preferences are homothetic. In that case we know that $cr_{it}$ is proportional to the present value of lifetime wealth. The latter can be expressed both in terms of normalized age zero values and in terms of the actual (average) age of group $i$ in year $t$. The second approach is followed by Gokhale, Kotlikoff and Sabelhaus (1996) where they evaluate what would have been the aggregate series had Social Security wealth (among other things) been different. The problem with this approach arises from the fact that the present value of lifetime resources as of time $t$ includes the value of accumulated assets, which is an endogenous variable and hence would respond to changes in pension wealth.

We prefer a different specification where consumption is expressed as a function of the present value of age zero lifetime wealth, which includes human wealth and pension wealth.

The previous decomposition can then be rewritten as

$$\frac{S_t}{Y_t} = 1 - \left( \sum_{i=1}^{i=G} w_{it} \alpha_{it} \frac{r_{it}(0)}{r_t(0)} \right) \frac{R_t(0)}{Y_t}$$

where $r_{it}(0)$ represents the average present value (as of age zero) lifetime wealth[8] for cohort $i$ at time $t$, $r_t(0)$ is the average present value (as of age zero) lifetime wealth at time $t$ ($r_t(0) = \frac{R_t(0)}{N_t}$, where $R_t(0)$ is the present value of total life time wealth (as of normalized age zero) at time $t$ and $N_t$ is the size of the sample at time $t$, $Y_t$ is the value of total income (resulting from the aggregation of sample data at time $t$), and $\alpha_{it}$ is the average propensity to consume out of lifetime wealth of cohort $i$ at time $t$.

[8]We have indexed this variable by $t$ because we allow for time variation, for instance due to unexpected shocks to human or pension wealth.

In Figs. 3 to 8 we have graphed the behavior of the average saving rate out of lifetime resources computed as of age zero $(1 - \alpha_{it})$ for each cohort (and each sector and education group) in the various years in which we observe it. As we can see the pattern is consistent: in all groups for which we have more than one observation we observe declining profiles (with the exception of cohort 10 for Junior High School Graduates in the public sector and cohort 9 for College Graduates in the private sector).

Still this picture is not sufficiently informative. First we have not written an explicit solution for the consumption function. If we do that, as in section 3, it will appear that (even in a simple no uncertainty case) $\alpha_{it}$ is a function of many parameters and variables: the intertemporal elasticity of substitution, age, the interest rate(s), the discount factor(s), household characteristics and possible interaction between those variables. What this means is that the behavior of $\alpha_{it}$ can be the result of age, cohort and time effects (besides their interaction) and household characteristics. Second, before we perform counterfactual exercises were for instance we compare the aggregate profiles obtained under two different values of pension wealth, we should verify that such a consumption model is actually appropriate.

In the next sections we specify a functional form for the consumption function, derive an equation for consumption rates that permits to separate age and cohort effects under the assumption that changes in pension wealth can be interpreted to affect only the levels of consumption rates of the various cohorts (and not the age profile) and finally verify the hypothesis that pension wealth can explain the variation in consumption rates observed across cohorts.

## 5. Evidence from reduced form estimation

The first step towards the analysis of a problem is to show that the problem actually exists and that you can measure it. The macro problem is the fall in aggregate saving rates. The tools to address it are theory and micro data. We have already shown that the aggregate series obtained from the SHIW dataset (after having conditioned on the appropriate variables) is not inconsistent with the behavior of the aggregate series from National Accounts or OECD. This just means that it is likely that the same forces that tend to drive down cohort saving rates would also affect the aggregate series. Still we have to motivate empirically the choice of a cohort framework or, put differently, we have to show that there are (statistically) significant differences between cohorts. This is done by regressing

pooling all the years and regressing the group-sex-cohort saving rates on a cubic in age, cohort dummies, interactions between the cohort dummies and age (when meaningful) and the deviation of the unemployment rate from its trend. The latter variable is used to capture the potential cyclical component.

We are not pretending that we can separately identify age, cohort and time effects. We simply assume that there is a common cyclical effect (that in the same year affects all the cohorts in the same way) and we interpret the cohort dummies as "Age Zero Saving Rates". We have conducted the estimation also allowing for age-cohort interaction.

The result that we find show (Tables 1 and 2) that there is significant evidence of declining Age Zero effect cohort profiles for High and Junior High School Graduates in the private sector and for Junior High School graduates in the public sector (we have some evidence also for High School Graduates within this sector).

In Figs. 9 and 10 we have graphed the cohort profiles for the estimated saving rates. It emerges that more recent cohorts have been saving a lower fraction of their income at every age.

The previous result shows that there is enough cohort variation in saving rates behavior to justify our approach and the attempt of constructing a more structural model.

## 6. The Theoretical Framework

### 6.1. The life-cycle model

In this section we will present the basic life-cycle model that will be used as the basis for the empirical analysis. It is a model that has been widely used in the literature, for studying both consumption and labor supply in a dynamic context. Our analysis differ from previous work not in the choice of the model but in the way we look at it and interpret it in a cohort framework.

The life-cycle model, in its deterministic framework, has been first fully developed by Modigliani and Brumberg in the 50's (Modigliani and Brumberg (1954)). It is mainly a model created to explain individual behavior. In its simplest form it assumes that agents have a finite lifetime and that they know all that there is to know about their future with certainty. There is no uncertainty about the states of the world. Moreover, the certainty assumption is often coupled with the perfectly competitive markets assumption. This is important because it means that there are no credit constraints and hence that the per-period budget constraints can

be summarized in a single life-time budget constraint where the present value of consumption is equal to the present value of the flow of future income plus initial wealth. If we introduced credit constraints, there would no longer be a unique budget constraint and, depending on the form of the imperfection in the capital market, we would have to specify the optimizing problem in a more complicated fashion. One of the reasons for such a widespread fortune of the deterministic approach with perfect capital markets is that, under homothetic preferences, consumption at a given age is a fraction of the present value of all the income stream that a person will receive in its life.

In subsequent years the model has been extended and developed in stochastic and infinite life environment, to study the behavior under uncertainty and/or the time series of aggregate data[9].

In our analysis we take the assumptions of finite lives, complete certainty and absence of credit constraints but we think of the model as applying to cohorts. Instead of thinking in terms of individuals we think in terms of a given statistic (the average) of individuals and hence we end up thinking in terms of representative individuals, where the relationship of representation is towards the group over which the average is taken.

In the next paragraph we present formally the model and discuss its implications for the analysis of saving rates.

### 6.2. The Consumption Function

We choose to present the solution to the agent's optimization problem in terms of consumption and not in terms of either assets or saving rates. Those can be immediately obtained once we have the solution for consumption.

Agents (cohorts belonging to the different groups) live T+1 periods, they face no liquidity constraints and have the following preferences

$$\sum_{0}^{T} \left( \frac{1}{1+\rho} \right)^{t} U(\gamma_{c,g}(t), C_{c,g}(t))$$

with

$$U(\gamma_{c,g}(t), C_{c,g}(t)) = \gamma_{c,g}(t) \frac{C_{c,g}^{\alpha}(t)}{\alpha}$$

[9] See Deaton (1992) for a detailed survey over consumption.

where $\alpha < 1$ and $\gamma_{c,g}(t)$ is an individual (cohort-group) specific taste shifter at time $t$.

The intertemporal budget constraint is given by

$$A_{c,g}(0) + \sum_{0}^{T} S_t Y_{c,g}(0) = \sum_{0}^{T} S_t C_{c,g}(t)$$

with

$S_t = 1/\left[(1+r_1)(1+r_2)\cdot\cdot\cdot\cdot(1+r_t)\right]$ and $A_{c,g}(0)$ represents initial assets. In terms of our problem, we can think of $Y_{c,g}(t)$ as being either labor or pension income. For instance, in a three period model, where agents work for the first two periods and retire in the third one, the lifetime budget constraint would be

$A_{c,g}(0) + Y_{c,g}(0) + S_1 Y_{c,g}(1) + S_2 P_{c,g}(2) = A_{c,g}(0) + HW_{c,g}(0) + PW_{c,g}(0)$

Clearly

$HW_{c,g}(0) = Y_{c,g}(0) + S_1 Y_{c,g}(1)$

$PW_{c,g}(0) = S_2 Y_{c,g}(2)$.

In general, allowing for income and social security taxes, the following will hold

$A_{c,g}(t+1) = A_{c,g}(t)[1+r(t)] + Y_{c,g}(t)[1-\vartheta(t)-\tau(t)] - C_{c,g}(t)$ for $t \leq R$

$A_{c,g}(t+1) = A_{c,g}(t)[1+r(t)] + P_{c,g}(t)[1-\tau(t)] - C_{c,g}(t)$ for $t > R$

where $R$ represents retirement. Note that we are using real values.

Notice that $HW_{c,g}(0) + PW_{c,g}(0) + A_{c,g}(0) = W_{c,g}(0)$ represents the Present Value of lifetime wealth as seen from age zero.

Given our assumptions we can solve the problem in more than one way. We could choose to characterize the solution in terms of Frisch Demand functions or we could just express it in term of all the explanatory variables, among which a fundamental role is held by the present value of lifetime wealth. The choice in general depends on the question asked. If we are interested in studying the profiles for consumption levels the Frish Demand function approach is more elegant, while the reverse is true if we are interested in studying consumption or saving rates.

Given our objective we choose to use the second approach. Still, this allows us to represent the solution at least in two ways[10].

- In terms of the Present Value of lifetime wealth as of age zero.

[10] From now on we will think of time as age and hence use $a$ instead of $t$ when indexing variables that have an age representation. Real interest rates will be still indexed by $t$ because they are common to everybody in the same year (they will affect differently individuals depending on their age)

The first order optimality condition for consumption at age $a_t$ in year $t$ is given by

$$\left(\frac{1}{1+\rho}\right)^{a_t} U'(C_{c,g}(a_t)) = \lambda_{c,g}(0) S_t$$

where $\lambda_{c,g}(0)$ represents the marginal utility of wealth as of age zero for cohort $c$ and group $g$ and is hence a function of parameters and of the factors affecting the present value of lifetime wealth. By the substitution of the first order conditions in the budget constraint we can express $C_{c,g}(a_t)$ as a function (besides other variables) of $W_{c,g}(0)$.

- In terms of the Present Value of lifetime wealth as of age $\omega$, where $\omega$ is the age individuals have when they optimize, for instance the first year for which we have data for a given cohort. The first order conditions are

$$\left(\frac{1}{1+\rho}\right)^{a_t-\omega_t} U'(C_{c,g}(a_t)) = \lambda_{c,g}(\omega_t) S_t$$

As in the previous case we could substitute the first order conditions into the lifetime budget constraint (expressed from age $a_t$ onwards) and we would have $C_{c,g}$ as a function (besides other variables) of $W_{c,g}(\omega_t)$, the present value of remaining lifetime wealth as seen from age $\omega_t$ (which would include accumulated assets).

Notice that, with constant real interest rate, we have the following relationship between $\lambda_{c,g}(0)$ and $\lambda_{c,g}(\omega_t)$ **for the same representative individual (**defined in terms of his cohort-group):

$$\lambda_{c,g}(\omega_t) = \left(\frac{1+\rho}{1+r}\right)^{\omega_t} \lambda_{c,g}(0)$$

The Lagrange multiplier as of age $s$ ($s = 0, \omega_t$) is a function of the assets existing at time $s$ and of all the future streams of income and benefits. The more an individual ages and the more 1) he/she faces a lower present value of human wealth (just because he has less working years) and 2) he/she faces higher values of net pension wealth (because he approaches retirement).

For us to be able to compare the intercept and the coefficient on the slopes of consumption rate profiles across cohorts in a meaningful way, we have to make a normalization of the **age** at which we operate such a comparison. Notice that $\lambda_{i,g}(\omega_t)$ and $\lambda_{j,g}(0)$ are not directly comparable across cohorts $i$ and $j$ (even within

the same group) and neither are $W_{i,g}(\omega_t)$ and $W_{j,g}(0)$, because they refer to lifetime wealth as seen from different ages by the various cohorts.

We choose to normalize everything as of age zero ($s = 0$), where age zero is defined in terms of entrance in the labor market.

By substitution of the first order conditions into the lifetime budget constraint we obtain the following expression for consumption by a representative individual belonging to cohort $c$ of group $g$ at age $a_t$.

$$C_{c,g}(a_t) = \left(\frac{\gamma_{c,g}(a_t)}{\gamma_{c,g}(0)}\right)^{\frac{1}{1-\alpha}} \left(\frac{1+r}{1+\rho}\right)^{\frac{a_t}{1-\alpha}} \Psi_{c,g}(0) W_{c,g}(0)$$

Notice that we have imposed the condition that all the cohorts share the same discount rate. While this is someway arbitrary, we have to remember that: 1) we cannot directly identify the discount factor from other cohort related effects and 2) the challenging economic problem is to be able to explain cohort differences in terms of observables. If everything else fails we can always go back and re-discover the role of discount factors (which play the role of preferences towards consumerism).

The variable $\Psi_{c,g}(0)$ is a function of the real interest rate, the discount rate, the parameter $\alpha$ affecting the curvature of the Utility function and the sequence $\left(\gamma_{c,g}(0).....\gamma_{c,g}(D)\right)$ where $D$ is the age of (expected) death.

The consumption rate is obtained dividing the left and the right sides of the equation by the value of income at age $a_t$. Given that we have chosen to express consumption and saving rates in terms of labor income $w_{c,g}(a_t)$ (in order to avoid the endogeneity problems correlated to the introduction of assets), after taking logs, we obtain

$$\ln\left(\frac{C_{c,g}(a_t)}{w_{c,g}(a_t)}\right) = \frac{1}{1-\alpha}\ln\left(\frac{\gamma_{c,g}(a_t)}{\gamma_{c,g}(0)}\right) + \left[\frac{1}{1-\alpha}\ln\left(\frac{1+r}{1+\rho}\right)\right] a_t + \ln\Psi_{c,g}(0) + \ln\frac{W_{c,g}(0)}{w_{c,g}(a_t)}$$

The main message from our simple theoretical model is that we can think of consumption as a function of age, of cohort dummies, of household characteristics and of interaction between age and household characteristics. We now look more thoroughly at the various elements of the previous expression.

- The term $\frac{1}{1-\alpha}\ln\left(\frac{\gamma_{c,g}(a_t)}{\gamma_{c,g}(0)}\right)$ refers to household characteristics at age $a_t$ (in year $t$) compared to them at age zero (we interpret this as normalized households characteristics). From this term we could be able to estimate the value of $\alpha$.

- The term $\left[\frac{1}{1-\alpha}\ln\left(\frac{1+r}{1+\rho}\right)\right]a_t$ picks up the linear contribution of age. Notice that once we know the estimated $\alpha$ and assuming a value for $r$ we could obtain an estimate for $\rho$.

- The term $\ln\Psi_{c,g}(0)$ is a function of $r, \alpha, \rho$ and the sequence $\left(\gamma_{c,g}(0).....\gamma_{c,g}(D)\right)$. Potentially this term hides cohort-age interaction if the relevant household characteristics we focus on show an age profile that is cohort dependent.

- The term $\ln\frac{W_{c,g}(0)}{w_{ca}}$ refers to the ratio of the present value of lifetime wealth to the value of labor income at age $a_t$. This term as well could exhibit cohort-age interaction, in the event that the age profiles observed in the labor market were cohort dependent.

The latter point is fundamental and it is worth spending some time to treat it more thoroughly.

Suppose that, focusing on a group at a time, we can write the wage process as a multiplicative function between an age function and a cohort effect (both specific for that group), analogously to[11]

$$w_{c,g}(a_t) = \mu_{c,g} * g_g(a_t)$$

where $\mu_{c,g}$ is a group specific cohort effect and $g_g(a_t)$ is a group specific polynomial in age. Then the value of human wealth for cohort $c$ belonging to group $g$ (as of age zero) $HW_{c,g}(0)$ (equal to the present value of lifetime wages under the assumption of a discount factor equal to zero), could be written as

$$HW_{c,g}(0) = \mu_{c,g} * \sum_{k=0}^{k=R} g_g(a_k)$$

where $R$ refers to retirement age.

As for pension wealth, we can always express the first pension benefit received after retirement as a function of the last wage prior to retirement and write

$$P_{c,g}(R+1) = \delta_{c,g} * w_g(R)$$

(where $\delta_{c,g}$ is the replacement rate). This approach is very natural when the law itself, in determining the pension benefits, refers to an average of past wages

[11] Analogous results hold if we adopt a functional form where the log of wages is regressed on cohort dummies and a polynomial in age. In both cases we are able to express Human Wealth as a combination of two separate age and cohort effects.

(as in the Pre Amato and Amato regimes). But it can be used also when the formula used to compute the pension benefit is based on past contributions. If we assume that retirement age does not change across both cohorts and groups, different cohorts of the same group will experience different values of $\delta_{c,g}$ either if the rules determining the pension benefit change or because the age profile for wages changes across cohorts. For instance, let's suppose that, within the same group, two different cohorts experience the same value for the wage cohort effect ($\mu_{c,g}$) but the younger one has higher age profile for the first four of the last five years before retirement (so that the two cohorts share the same final wage). If the pension benefit is based on an average of the last five years then the younger cohort will have a higher replacement rate that the older one. Symmetrically, if two cohorts (of the same group) share the same wage cohort effects and the same age profiles, but the younger one experience a more generous pension system, we would observe that the younger cohort has a higher replacement rate. What this means is that (within the same group) differences across cohorts in the values of $\delta_{c,g}$ can be traced directly to differences in pension legislation or indirectly to differences in the labor market performance.

From this discussion it should be clear that, when comparing across cohorts (and groups) the generosity of the Social Security system, it is very important to separate the effects coming from the labor market from those originating from changes in the rules governing the system. This separation is greatly simplified if we can show that in the labor market the cohorts' wage profiles can be separated into a cohort and an age effect.

Assuming that the last hypothesis is confirmed by the data[12], we can write pension wealth (as of age zero) as

$$PW_{c,g}(0) = \sum_{k=R+1}^{D} P_{c,g}(k_t) = \delta_{c,g} * \sum_{k=R+1}^{D} w_{c,g}(R) = \delta_{c,g} * \mu_{c,g} * (D-R) * g_g(R)$$

This expression summarizes the different forces affecting the value of pension wealth: the generosity of the system in computing the benefit, combined with the wage path, ($\delta_{c,g} * \mu_{c,g} * g_g(R)$) and the time interval between retirement and (expected) death ($D - R$).

We are now able to express total wealth (as of age zero) as

$$W_{c,g}(0) = HC_{c,g}(0) + PW_{c,g}(0) = \mu_{c,g} * \left[ \sum_{k=0}^{k=R} g_g(k) + \delta_{c,g} * (D-R) * g_g(R) \right]$$

[12] See Appendix B.

so that the total wealth to labor income ratio becomes

$$\frac{W_{c,g}(0)}{w_{c,g}(a_t)} = \frac{\left[\sum_{k=0}^{k=R} g_g(k) + \delta_{c,g} * (D-R) * g_g(R)\right]}{g_g(a_t)} = \frac{(A_g + B_{c,g})}{g(a_t)}$$

where

$$A_g = \sum_{k=0}^{k=R} g_g(k)$$

represents the age profile for human wealth (which is common across cohorts of the same group but differs across groups) and

$$B_{c,g} = \delta_{c,g} * (D-R) * g_g(R)$$

is the age profile for pension wealth (which differs both across cohorts and groups).

This result allows us to rewrite the natural log of consumption rates for cohort $c$ of group $g$, at age $a_t$ is year $t$ as

$$\ln\left(\frac{C_{c,g}(a_t)}{w_{c,g}(a_t)}\right) = \frac{1}{1-\alpha}\ln\left(\frac{\gamma_{c,g}(a_t)}{\gamma_{c,g}(0)}\right) + \left[\frac{1}{1-\alpha}\ln\left(\frac{1+r}{1+\rho}\right)\right] a_t +$$

$$+ \ln\Psi_{c,g}(0) + \ln A_g + \ln\left[1 + \frac{B_{c,g}}{A_g}\right] - \ln g_g(a_t)$$

This result is important because, under the assumption that we can separate out a cohort and an age profile for wages, we obtain that the effects of the pension System on consumption rates operate through the ratio of Old to Young Age Wealth ($\frac{B_{c,g}}{A_g}$). This is the ratio between pension wealth and human wealth, both computed as of age zero. We will explore more in depth in the next section the issue of comparison of this variable across groups and/or cohorts that experience different retirement ages, but the important result of our approach is that changes in the distribution of wealth along the life cycle affect (log) consumption rates only at the intercept. This result might appear very strong but is comes just from two the combination of two hypothesis: 1) that we can separate out a cohort and an age profile for wages and 2) that agents have a constant information set over the years for which the estimation is conducted.

The possibility of expressing in just one number the changes of life-cycle wealth is very appealing because we would have a multicollinearity problem in trying to separately estimate the marginal effects of human and pension wealth. The two

variables are in fact very highly correlated, due to the method used to compute the first pension (which is an average of past wages).

This result also implies that when we estimate the equation for consumption rates one group at a time, regressing the natural log of consumption rates on cohort dummies, an age profile, cohort-age interaction and household characteristics, we interpret the estimated coefficient on the cohort dummies as potentially explainable by the ratios of pension to human wealth.

Notice that by estimating the previous equation one group at a time we lose one source of variation but we gain in simplicity because we make the assumption that differences across cohorts should be explained by differences in the ratio of Old to Young Age Wealth ($\frac{B_{c,g}}{A_g}$).

At this stage we should think again on the assumption of the life-cycle model that we have presented. The model, per se, just implies absence of credit constraints and no uncertainty. It does not tell us how agents would react to a change in the environment. The underlying hypothesis that we make is that agents either have perfect foresight or they are completely myopic (and hence completely surprised by a change in Social Security). Under the perfect foresight hypothesis, agents, when choosing consumption, know (the means) of all the relevant variables, which in our case are: the wage profile, the pension profile, the structure of the household etc.[13]. Under the complete surprise assumption, agents (cohorts) just assume that whatever they observe will go on forever. If there is a change in the environment, they will adapt immediately their information set and assume once again that the new environment will go on forever. The relevance of those two approaches will become clear after we talk about the changes in pension legislation that were carried on in Italy in the early 1990's and that are useful in identifying the potential source of cohort differences in saving rates.

Notice that the choice of the reference age does not imply assuming that individuals choose all the path for consumption as of time zero and never change it thereafter. It is only a reference point and agents are allowed to re-optimize if new informations are delivered to them. We can always represent their choice from the standpoint of age zero or of any other age. What is important is that in the estimation we use only the dataset referring to the years where the information set is the same.

[13]We do not introduce general equilibrium conseguences of Social Security.

# 7. The Explanatory Variables: Pension Wealth and human wealth

## 7.1. Pension Legislation in Italy

Italy has recently witnessed some major changes in the rules governing the public pension System. In this section we will try to summarize the most important ones.

In general public pension systems can be organized according to two basic principle: Pay As You Go and Capitalization. According to the PAYG structure, an individual pays taxes when working and receives a benefit when retired, without any specified relationship between the two. pension benefits of retirees are funded by the social security taxes paid by current workers. It is the law that specifies the way in which pensions have to be computed. They can reflect past wages, past contributions or just basic needs. The choice of defining the functions of Pensions in a PAYG system is mainly political. In this sense it could be difficult to interpret in pure individualistic terms the effects of such a system. It is not obvious that workers would perceive social security taxes as forced saving, the returns of which (plus the capital) will be given back at the time of retirement. Workers know how much they are contributing and have certain expectations about how much they will receive at the time of retirement, but those expectations are expectations about the behavior of the Government. At the end it is the Government that guarantees the inter-generational contract implicit in a PAYG system.

Typically two kinds of rules have been followed by Governments when choosing the value of pensions.

The first is named "wage based method" (*metodo retributivo*) and the (first) pension is a function of past wages and years of contribution This rule stresses more the income smoothing function of social security. In this case the main function of pensions is to guarantee an income stream that is not too far away from the one experienced during working life.

The second (*metodo contributivo* or "contribution based method") stresses the insurance component of social security because links the benefits to contributions, which could be real or fictitious. It is not necessarily the case that the Present Value of benefits is equal to the capitalized value of all the social security taxes paid by the individual during his work-life, but there is a closer relationship between what is paid and what is received.

In both cases the total amount of resources to be transferred to the elderly are

given by the total amount of social security taxes collected from those who still work. Hence both suffer from adverse demographic or economic trends.

Conversely, in a system based on Capitalization, an individual is forced (if the system is compulsory) to save a certain fraction of its wage, which is administered by a fund and given back (principal plus returns) at the moment of retirement (it is normally spread along the years after retirement). The relationship between contribution and benefits is clear and perceived as such by individuals. Is also obvious that there is only one way to determine the value of (annual) pensions in this system. They are equal to the principal (past contributions to the system) plus interests, divided by the life expectancy at the time of retirement.

From 1968 to 1992 Italy was characterized by a Pay as You Go regime of the first type, that we call Pre-Amato. In 1992 the first reform was implemented (the Amato reform), changing slightly some rules governing retirement but still maintaining the basic Pay as You Go structure of the Italian public pension System. In 1995 a second reform, the so called Dini Reform was implemented. The Dini Reform changed the way in which pensions are computed, from a wage based method to a contribution based method, still maintaining the Pay As You Go framework. It also provides a temporary regime meant to regulate the retirement of those who started their working life under the previous regime. The logic governing the temporary regime is the following: the more an individual has been working under the previous system, the less his/her pension will be far away from the one he/she would have gotten under the old regime.

We will now review the basic rules governing retirement under the three regimes framework, **focusing exclusively on Old Age Pensions (*Pensione di Vecchiaia*)**.

Most private sector pensions are managed by the *Istituto Nazionale di Previdenza Sociale* (I.N.P.S.), and, within the latter, by a fund called *Fondo Pensioni Lavoratori Dipendenti (F.P.L.D.)*. There are some differences between sectors (pertaining more on the tax side) but the rule governing pensions are basically the same for the whole private sector.

As for public sector employees, there are two major differences. The pensions on the State employees age managed (and partly governed) by the Treasury, while those of the other employees (local public sector employees) are managed (and partly governed) by an autonomous Institute, the INPDAP. The rules governing pensions in the two funds are slightly different.

### 7.2. Summarizing the changes in pension legislation

Under the Pre-Amato regime retirement age was 60 for males in the private sector, 55 for females in the private sector, 65 for males and females in the public sector. The Amato reform raised the retirement age for workers in the private sector by one year every two calendar years starting from 1993. The Dini reform confirmed the raise but allowed flexibility between a minimum (57) and a maximum age (65). People retiring early would just be getting lower pensions.

The Pre-Amato regime guaranteed high replacement rates between the last wage and the first pension (with a maximum of 80% if a worker had contributed for 40 years). It also benefited workers that experienced steep wage profile at the end of their working life because of the way the average of past wages (the *Retribuzione Pensionabile)* was computed. This was obvious in the case of public sector workers. The *Retribuzione Pensionabile* was the last wage, augmented by 18%. But also for private sector workers the averaging, being only on the last five years before retirement, ended up favoring the steepest carriers. The tendency to a high *Retribuzione Pensionabile* was only partially offset by the fact that the coefficients to use to compute the first pension were decreasing in the value of the former.

As for indexation, the Pre-Amato regime guaranteed indexation to prices and to real growth in the manufacturing sector, but it protected more lower pensions than higher ones.

The Amato reform affected the value of the *Retribuzione Pensionabile* extending the number of years over which the average had to be taken. The change was stronger for younger workers (those who had less than 15 years of work experience as of 31/12/1992). It also limited indexation to inflation only.

The Dini reform confirmed the rules introduced by the Amato for the oldest generations (those who had more than 18 years of experience as of 31/12/1995). It also reduced the value of the pension for those who would start working in 1996. As for the middle generation, those who had already started working as of 31/12/1995 but had less than 18 years of experience, it introduced a mixed system that could actually end up benefiting those who would retire under the temporary regime. As we will soon see this is due to the absence of a upper limit on both contribution and the benefit.

# 8. Estimation under Perfect Foresight

## 8.1. The model

The starting point is the optimization process described in section. This allowed us to describe the natural logarithm of consumption rate for any given cohort $c$ belonging to group $g$ at age $a_t$ at time $t$ as a function of its age, the real interest rate, the cohort discount rate, age-zero fixed effects and other potentially relevant explanatory variables as

$$\ln\left(\frac{C_{c,g}(a_t)}{w_{c,g}(a_t)}\right) = \frac{1}{1-\alpha}\ln\left(\frac{\gamma_{c,g}(a_t)}{\gamma_{c,g}(0)}\right) + \left[\frac{1}{1-\alpha}\ln\left(\frac{1+r}{1+\rho}\right)\right] a_t + \ln\Psi_{c,g}(0) + \\ + \ln A_g + \ln\left[1+\frac{B_{c,g}}{A_g}\right] - \ln g_g(a_t)$$

where

$$A_g = \sum_{k=0}^{k=R} g_g(k)$$

represents the age profile for human wealth (which is common across cohorts of the same group but differs across groups) and

$$B_{c,g} = \delta_{c,g} * (D-R) * g_g(R)$$

is the age profile for pension wealth (which differs both across cohorts and groups).

The purpose of our analysis is to verify the effect of pension wealth on consumption rates. From the previous specification should be clear that pension wealth affects consumption and saving rates through the ratio $\frac{B_{c,g}}{A_g}$. This is the ratio between pension wealth and human wealth, both evaluated as of age zero. Our strategy is to regress (one sector at a time) cohort consumption rates on household characteristics, age, cohort dummies, an interaction between age and cohort effects and focus on the explanation of the coefficient estimated on the cohort dummies.

Before we can actually do that we have to make the values of the variables fully comparable across sectors. In fact, retirement age has been changing in the private sector, because the Amato Reform gradually extended it from 60 to 65 for males and from 55 to 60 for females, while it has remained constant in the public sector. This would make the values of $\frac{B_{c,g}}{A_g}$ non comparable across sectors.

Hence we need to create a **normalized retirement age** equal to 60 for males and to 55 for females. Then we create a variable called "**Old age Wealth**",

which is equal to the sum of the part of human wealth received after normalized retirement age and pension wealth. The intuition for this choice is that what matters in the determination of consumption and saving rates is the ratio of **Old age Wealth** to **Young age Wealth** (the human wealth profiles up to normalized retirement age), and not the form in which old age income is received. This is indeed a strong assumption because imposes the condition that future wages and future pensions are substitutable forms of wealth. The alternative (which we have tried) would be to treat the two variables separately. But then the above mentioned problems of multicollinearity emerge. We are not able to estimate the individual contribution of pension wealth and human wealth to consumption rates.

If we define $R_1$ as our normalized retirement age and $R_{2c,g}$ as the true retirement age for cohort $c$ belonging to group $g$ (notice that for the oldest cohorts of private sector workers $R_1 = R_{2c,g}$), we can write

$$\begin{aligned} \frac{W_{c,g}(0)}{w_{c,g}(a_t)} &= \frac{\left[\sum_{k=0}^{k=R_1} g_g(k) + \sum_{k=R_1}^{k=R_{2c,g}} g_g(k) + \delta_{c,g} * (D - R_{2c,g}) * g_g(R_{2c})\right]}{g_g(a_t)} \\ &= \frac{(A_g + B_{1c,g} + B_{2c,g})}{g_g(a_t)} \end{aligned}$$

where

$$A_g = \sum_{k=0}^{k=R_1} g_g(k)$$

represents the age profile for human wealth up to normalized retirement age $R_1$ (which we have defined as "**Young age Wealth**"). $A_g$ is common within a group but changes across groups, while $R_1$ is common across cohorts and groups because it is a normalized retirement age common across cohorts and groups.

$$B_{1c,g} = \sum_{k=R_1}^{k=R_{2c,g}} g_g(k)$$

is the age profile for human wealth from normalized retirement age to the actual (as forecasted) retirement age (which potentially is cohort and group dependent) and

$$B_{2c,g} = \delta_{c,g} * (D - R_{2c,g}) * g_g(R_{2c})$$

is the age-cohort profile for pension wealth (again cohort and group dependent).

**Old Age Wealth** for cohort $c$ and group $g$ is defined as $B_{1c,g} + B_{2c,g}$.

It is worthwhile to remember that we are able to write our estimation equation in such a form because the age-cohort interaction terms observed in the labor market are not very significative. This means that, for each group, more recent cohorts enter the labor market with higher wages but have analogous age profiles, and this implies that consumption rates, ceteris paribus, should not differ across cohorts of the same group unless there are changes in the generosity of the Social Security system.

Hence we could rewrite the structural equation as

$$\begin{aligned}\ln\left(\frac{C_{c,g}(a_t)}{w_{c,g}(a_t)}\right) &= \frac{1}{1-\alpha}\ln\left(\frac{\gamma_{c,g}(a_t)}{\gamma_{c,g}(0)}\right) + \left[\frac{1}{1-\alpha}\ln\left(\frac{1+r}{1+\rho}\right)\right] a_t + \ln\Psi_{c,g}(0) + \ln A_g + \\ &\quad + \ln\left[1 + \frac{B_{1c,g} + B_{2c,g}}{A_g}\right] - \ln g_g(a_t)\end{aligned}$$

Notice the following:

- In the public sector the value of $R_{2c,g} - R_1$ does not change across cohorts of the same group, because retirement age remained fixed. This implies that, given our approach, the only within-group across cohort changes in the ratio $\frac{B_{1c,g}+B_{2c,g}}{A}$ for the public sector are due to changes in the parameter $\delta_{c,g}$, which we interpret as the measure of the generosity of the Italian Social Security system. This also means that from this group we are able to estimate the true effects of pension wealth on consumption and saving rates.

- In the private sector, within the same sector cohorts differ because the generosity of the Social Security system has changed and because mandatory retirement age has been raised. Hence we are not able to separately identify those two effects for this group. What we can identify is how changes in the ratio of old age income to young age income have affected consumption and saving rates.

- Across groups the value of ratio of Old to Young Age Wealth differ also because the age profiles for wages differ.

We hence proceed in the following way.

First we estimate the equation for cohort consumption rates using all the years to which the identification hypothesis apply and then we take the estimated cohort effects and we regress them on the ratio of old age to young age income, at different levels of aggregation (within each sector-education group separately, within each sector separately and pooling all the groups together)[14].

As for the construction of the dependent variable $\ln\left(\frac{C_{c,g}(a_t)}{w_{c,g}(a_t)}\right)$ we had to use different values according to the sample object of our study. When focusing on Males Head of Households, whatever their marital status (full sample) we construct Equivalent Scale consumption, given by the value of consumption divided by the square root of the number of components of the household, and $w_{c,g}(a_t)$ refers to the net labor income of the head. For the smaller sample (Households where the Head is married) we used household consumption and $w_{c,g}(a_t)$ refers to the total net labor income of the household. We then computed the natural log of these variables and thereafter the group average.

We estimate the following equation:

$$\ln\left(\frac{C_{c,g}(a_t)}{w_{c,g}(a_t)}\right) = m_g(a_t) + X'_{c,g,a_t} * \beta_g + \Phi' * \Psi_g + (\Omega_c * a_t) * \varphi_g + e_{c,g,t}$$

- where $m_g(a_t)$ is a cubic in age (potentially specific for group $g$), which captures the relationship between consumption rates and age coming from : (i) $\left[\frac{1}{1-\alpha}\ln\left(\frac{1+r}{1+\rho}\right)\right] a_t$ (the age profile for consumption) and (ii) $g_g(a_t)$ (the age profile for wages);

- $X'_{c,g,a_t}$ represents household/worker characteristics, which in the structural equation are represented by $\ln\left(\frac{\gamma_{c,g}(a_t)}{\gamma_{c,g}(0)}\right)$. The control variables are: a dummy for managers (for the group with college education) and a dummy for blue collar workers (for the other two groups), the number of income recipients in the household, the number of dependent children, a dummy if there is a wife in the household.

- $\Phi$ is a vector of cohort dummies, which captures both a common intercept (corresponding to the variable previously named $A_g$) and the differences in cohort values for $\frac{B_{1c,g}+B_{2c,g}}{A_g}$.

[14] This is analogous to treating the cohort effects as fixed effects estimated with a measurement error.

- $\Omega_c * a_t$ represents cohort-age interaction, meant to control for factors such as household characteristics that are age related which could be changing across cohorts. $\Omega_c$ is an index that identifies the various cohorts.

Estimation is then conducted separately for each education-sector group.

From each estimation we obtain a vector of estimated cohort effects $\widehat{\Psi_g}$, which represents the cohort effects that should be entirely explained by the differences in the ratio of Old to Young Age Wealth ($\frac{B_{1c,g}+B_{2c,g}}{A_g}$).

In a second stage we regress those estimated fixed effects on the explanatory variable $\frac{B_{1c,g}+B_{2c,g}}{A_g}$. Notice that this variables has two components: 1) $A_g$ (the age profile of labor income up to the reference retirement age) which is the same for all the cohorts pertaining to the same group (because we find that there is not significant evidence of cohort dependent age profiles in the labor market) but changes across groups (because the age profiles are allowed to differ between, say, college and blue collar workers); 2) $B_{1c,g} + B_{2c,g}$ which instead changes between cohorts of the same group (besides varying across groups).

When we pool the estimated fixed effects for all the groups and regress them on the explanatory variables we have to allow for differences in levels and slopes(related both to the sector to which the cohort pertains and to the education that they have achieved).

We also conduct the estimation at two lower levels of aggregation: 1) for each education-sector group; 2) for each sector, pooling all the education groups together. While we clearly loose in terms of significance we want to verify whether the results that we obtain for the larger sample are confirmed at the lower level of aggregation.

Finally, we have conducted the estimation for two different samples. The first one is composed of Males Heads of Households between the age of 20 (25 if College Graduate) and 60. The second one includes only Households of married couples (for the same age intervals defined for the head).

We chose to drop from the estimation procedure the most recent and the oldest cohorts, for each education group, due to the small number of observations that characterizes them. Hence we will focus on cohorts 2 to 8 for College Graduates and 2 to 9 for Junior High and High School Graduates.

### 8.2. Estimating the cohort fixed effects-Males Heads of Households

We have estimated the fixed effects using two different definitions of consumption rates: 1) equivalent scale consumption divided by individual net labor income;

2) household consumption divided by household labor income. The results are similar in the two cases. We will mostly focus on the results that are relative to the larger sample given that we prefer the individual as our unit of analysis (and we let Equivalent Scales take care of household's changes).

### 8.2.1. Summary of the results

- Public Sector (Table 3)

For College Graduates we do not find evidence of significant fixed effects, but for the most recent cohort (and only when we don't consider age-cohort interaction). As for the group of High School Graduates, we find evidence of significant cohort effects when we do not control for age-cohort interaction (and particularly for the most recent cohorts). When we control for the latter variable we lose some significancy on the individual coefficients but we gain some on the whole regression. Given that the cohort profiles are rising in both cases we feel quite confident in picking the results obtained under the specification that uses age-cohort interaction (so has to have full comparability with the other cases). As far as the group of Junior High School Graduates in the public sector we get some evidence of rising fixed effects, but this result is not robust to the various specifications.

- Private Sector (Table 4)

For the groups composed of College and High School Graduates in the private sector we find consistent and significant evidence of rising cohort profiles. The evidence for the group of Junior High School Graduates in the private sector is less clear-cut. When we do not control for age-cohort interaction we obtain very strong and significant cohort fixed effects. Instead, when we control for this interaction we get a higher Adjusted $R^2$ but all the coefficients on the cohort dummies and the one on the age-cohort interaction become not significant. What appears to happen is that there is some degree of collinearity between the variables. When we compare the fixed effects obtained including the age-cohort interaction with those obtained when this variable is excluded, we observe in both cases rising cohort profiles. This makes us quite confident in using the fixed effects obtained when we use age-cohort interaction. Notice that the coefficient on age-cohort interaction, when significant, is negative, indicating that the age profiles of younger cohorts are flatter.

### 8.3. Explaining Fixed effects-Perfect Foresight-Males Heads of Households

The purpose of this paragraph is to estimate the relationship between the estimated cohort fixed effects and the explanatory variables. This implies that we assume a functional form between the two variables and regress the fixed effects on the explanatory variables.

The first issue concerns the significancy of the estimated fixed effects. The general pattern that has emerged is one of rising cohort effects (see Fig.11 and 12). But, as we have previously discussed, we do not find results with the identical level of significancy for all the groups, neither in terms of individual coefficients nor in terms of overall significancy. To correct for this effect we will consider a specification in which the fixed effects are divided by their standard errors and verify whether the results that we obtain are robust with respect to this specification of the dependent variable.

The second issue concerns the relationship between the fixed effects and the explanatory variable. Here two issues are relevant. The first one concerns the choice of the independent variable. The second one is related to the choice of the functional form. With respect to both aspects theory might help.

Our theoretical model implies that human and pension wealth affect consumption rates in a very particular way, because, as discussed in the previous paragraph, after controlling for household characteristics and age, log consumption rates are just a function of the ratio between Old and Young Age wealth. In other words, our model implies that consumption rates at normalized age zero differ across cohorts of the same groups if their ratios of Old to Young Age wealth differ. Cohorts that expect higher values for $\frac{B_{1c,g}+B_{2c,g}}{A_g}$ should experience also higher values for their entry consumption rates. Our model imposes a very particular way in which (representative) individuals are affected by changes in pension wealth. It is worth remembering that this is the result of the hypothesis that we can separate an age an a cohort profile for wages and that the information set remains constant for the years used in the estimation.

As for the functional form, the theoretical model implies that the estimated fixed effects should be a function of the log of $\left[1+\frac{B_{1c,g}+B_{2c,g}}{A_g}\right]$. Besides this specification we have tried one where the cohort effects are a linear function of Old to Young Age wealth. The results do not depend on the specification of the explanatory variable since the two variables have very close values..

In Figs. 13 and 14 we report the graph of the values for OTYAWR under

the perfect foresight hypothesis, while in Fig. 15 we have plotted together the estimated fixed effects and the values for OTYAWR, one group at a time[15]. As we can see there is a general pattern of positive correlation within each group (with the exception of Group 2 for cohorts 4 and 5) but the relationship between the cohort effects and the log of one plus OTYAWR does not appear to be linear.

Given the variation across groups we have also estimated the relationship between the estimated cohort effects and OTYAWR at the education-sector and sector levels of aggregation.

For each specification that we have estimated the results show that at all levels of aggregation we get consistent results. The fixed effects are well explained by raising Old to Young age wealth, and, at the education-sector level of aggregation, the significancy of the explanatory variable tends to be higher for the groups where the fixed effects are more significant.

When we pool all the cohort effects and regress them on the log of OTYAWR we find that dividing the fixed effects by the standard errors affects the overall significance of the regression and the individual significance of the coefficient on the ratio of Old to Young age wealth.

When we use the (not corrected) fixed effects and we regress them on education dummies, sector dummies, interaction terms between education and sector and the log of $\left[1+\frac{B_{1c,g}+B_{2c,g}}{A_g}\right]$, we find the following results (see Table 5):

1) the Adjusted $R^2$ is quite high (0.76);

2) the log of one plus the ratio of Old to Young Age Wealth is very significant (t-statistics of 9) and enters with a positive coefficient (as suggested by the theory);

3) lower education groups have lower entry consumption rates (because if consumption is a function of permanent income and we are comparing at age zero, we expect College graduates to consume more of their entry wage because they expect a steeper wage profile).

When we use the estimated fixed effects divided by their standard errors we find that the Adjusted $R^2$ is lower (0.26) and so are the t-statistics on all the explanatory variables (which in any case remain significant), and the sign of the correlation between the dependent variable and the ratio of Old to Young age wealth remains positive.

Analogous results are obtained when we run the regression for the two sectors

[15] Group1 refers to Junior High School Graduates in the private sector, Group 2 to High School Graduates in the private sector, Group 3 to College Graduates in the private sector, Group 4 to Junior High School Graduates in the public sector, Group 5 to High School Graduates in the public sector and Group 6 to College Graduates in the public sector.

separately. In this case we also observe that, when going from the not corrected fixed effects to the corrected ones, the drop in overall significance of the regression is much smaller for the public sector.

Those results are common across the specifications that use the two definitions of consumption rates.

We believe that we have enough confidence in concluding that the rising fixed effects cohort profiles are well correlated with the rising ratios of Old to Young age wealth. In terms of our theoretical model this implies that: 1) we observe rising cohort profiles for entry consumption rates (and hence declining profiles for entry saving rates), after having controlled for a set of variables that affect the value of consumption rates observed for a given group in a given year; 2) those rising cohort profiles are "well explained" by the rising ratios of Old to Young age wealth.

When it gets to the point of identifying the marginal effect of pension wealth we have to combine the identification hypothesis (perfect foresight) with the institutional framework that is relevant for Italy. As previously explained, the Amato reform of 1992 had different effects on private and public sector workers. Summarizing, for private sector workers the reform gradually raised retirement age of younger cohorts, while reducing the generosity of the system. For public sector workers the reform kept retirement age constant but reduced the generosity of the system and this was more so for younger cohorts.

The implications of the previous conclusion is that using just observations from the private sector we are not able to identify the effects of pension wealth alone on consumption and saving rates. What we can instead identify is the effect of Old to Young Age Wealth on consumption rates. Within a groups the value of OTYAWR differs because both pension benefits and retirement age differ. Moreover, for private sector workers, the variation of these two components move in opposite directions. On the one hand the increase in retirement age raises the value of human wealth (everything else constant), while the reduction of retirement years and of the generosity of the system tend to decrease the value of pension wealth. Using our previous specification and focusing on a given group, $B_{1c,g} = \sum_{k=R_1}^{k=R_{2c,g}} g_g(k)$ is rising for the most recent cohorts (because $R_{2c,g}$ is rising) while $B_{2c,g} = \delta_{c,g} * (D - R_{2c,g}) * g_g(R_{2c})$ is declining, because both $D - R_{2c,g}$ and $\delta_{c,g}$ are declining for more recent cohorts. When we take the ratio of Old to Young Age Wealth (remembering that $A_g$ does not vary across cohorts of the same group), we can get rising cohort profiles for OTYAWR because for more recent cohorts the increase in wealth coming from having to work more years more than compensates

the decline in pension benefits.

The conclusion is different for the public sector. For this group the reform did not change retirement age. In term of our previous discussion this implies that $B_{1c,g} = \sum_{k=R_1}^{k=R_{2c,g}} g(k)$ is the same across cohorts for the same group (because of the assumption that we used to write this simplification is that there is no age-cohort interaction) while $B_{2c,g} = \delta_{c,g} * (D - R_{2c,g}) * g_g(R_{2c})$ is declining for the more recent cohorts.

When we go to the empirical counterpart of our theoretical model our previous conclusions are only partially confirmed.

In the private sector we observe rising cohort profiles for $\frac{B_{1c,g}+B_{2c,g}}{A_g}$ in the group of College Graduates. As for the other two we have a flat portion for the middle cohorts with overall raising profiles[16]. This results seem to explain quite well the rising fixed effects that we have estimated.

As for the public sector, theory predicts that, if we can separate cohort and age effects for the same group, we should observe declining profiles of Old to Young Age Wealth ratios. But when we look at the constructed values for the latter variables we find profiles that are flatter than those of their private sector counterparts, but they are still rising. This result is most likely due to some factor that we have not captured in our wage estimation. If this is the bad side of the story, the good one is that these mildly rising profiles for $\frac{B_{1c,g}+B_{2c,g}}{A_g}$ are quite well correlated with the rising profiles for the estimated fixed effects.

Hence what we find is that across all groups where the fixed effects show rising profiles so do the profiles for Old to Young Age wealth ratios.

Using the estimation coming from the public sector we are able to identify the effects of changes in pension wealth alone through its effects on the ratio of Old to Young Age Wealth.

Moreover, for workers in both sectors we are could construct the values for the consumption rates that would have been observed under a different Social Security regime (but under the same assumption about forecasting).

### 8.4. Implications for Aggregate Saving Rates

The main conclusion from the previous paragraph was that Old to Young Age Wealth Ratio could be a good explanatory candidate for the rise in cohort fixed

[16] For each group within the two sectors we have regressed the cohort profiles for 1 plus OTYAWR on an index for the various cohorts and we have found that more recent cohorts tend to have higher values for the ratio of Old to Young Age Wealth.

effects in consumption rates. For all the groups we have found a positive relationship between the fixed effects and the OTYAWR cohort profiles. This has been confirmed when we pooled all the data.

A different problem is to try to capture with high precision such a relationship. This is first an interesting question in itself, because we are interested in verifying whether there exist a common functional representation that links the fixed effects and the explanatory variable. It is also an interesting question for policy purposes. Given the rise in observed consumption rates (and hence decline in saving rates) we could be interested in answering the following question: what would have been the consumption rate profiles that we would have had observed if there had not been the Amato reform.

In order to obtain this counterfactual aggregate series we have estimated with FGLS our model of consumption rates including directly the log of 1 plus OTYAWR among the regressors[17] and imposing that the coefficient of the latter variables is the same across groups. We allow for age-cohort interaction and we let the log of 1 plus OTYAWR to enter with a quadratic term, finding evidence of a concave relationship between the log of consumption rates and the log of 1 plus OTYAWR (see Table 6 ).

Then, using the estimated coefficients from these regression we have computed both the predicted values for consumption rates (hence using the actual values for the log of 1 plus OTYAWR ) and the alternative values for consumption rates that we would have observed if the values of OTYAWR would have remained those implied by the Pre-Amato regime. From these we have then created (and compared) the corresponding aggregate series.

The aggregate series obtained form this exercise is graphed in Fig 16. We can see that in both cases the aggregate consumption rates that we would have observed had the Social Security Regime not changed, would have been lower than the one obtained from the predicted values of our estimation.

## 9. Estimation under Complete Surprise

The logic behind the complete surprise assumption is the following. Agents (individuals or households) did not expect the reforms of the pension system that took place in 1993. Hence they formed expectations regarding pension wealth

[17] Instead of estimating the cohort effects we have regressed the log of consumption rates on age, age squared, age cubed, huseholds characteristics, group dummies and the log of 1 plus OTYAWR.

and human wealth profiles according to the rules prevailing under the Pre-Amato regime which should be the relevant profiles to be used in the estimation. This is the approach followed by most of the literature on the Italian case (see Brugiavini (1987), Rossi and Visco (1994, 1995), Jappelli (1995)), which could be appropriate given that they focused on periods prior to 1992.

In this section we will explore the performance of our model when we follow a similar assumption. This implies that we can both look at the relationship between consumption rates and OTYAWR both for the period 1984-1991 and for the period 1991-1993. In the first period we could assume that agents were forecasting according to the Pre-Amato regime. Considering the period 1991-1993 we would be able to estimate the effects of changes in OTYAWR (coming from the Amato reform) on changes in consumption rates (after controlling for other co-variates).

For workers in the private sector the reform had the effect of increasing retirement age, hence increasing the value of human wealth. This implies that, for given a cohort group, the human wealth profile under the assumption of complete surprise lies below the one obtained under the assumption of perfect foresight. In the public sector, given the absence of retirement age effects, the two profiles will coincide.

As for pension wealth, under the assumption that agents are completely surprised, we get cohort profiles that are rising and that have a shape very similar to the one of human wealth.

When we look at the profiles for Old to Young Age Wealth ratios (within each group at a time) we find that (see Figs. 17 and 18), in the public sector, the profiles obtained under the complete surprise hypothesis lie above the one obtained under the assumption of perfect foresight (due to the decrease of benefits for a constant retirement age). Moreover we notice that the profiles are either flat or downward sloping, which immediately casts some doubts about the chances of explaining rising cohort fixed effects for the private sector consumption rate profiles. As for the private sector, the relationship between the profiles obtained under the two hypothesis is more complex, because of the interplaying of the two conflicting above mentioned forces. The result is that (for the chosen discount rate) the profiles obtained under the assumption of perfect foresight lie above those obtained under the assumption of complete surprise (with the exception of the older cohorts of Junior High School Graduates) because the increase human wealth due to a higher retirement age more than compensates the decrease in

pension benefits[18].

We proceeded in much the same way as we have done in the previous paragraphs.

We estimated the fixed effects and then we regress the fixed effects on the ratio of Old to Young Age wealth, controlling for variation in the intercept and in the slope. The hypothesis of our exercise is that agents have not changed expectations between 1984 and 1991 and hence that we can estimate the relationship between the fixed effects and Old to Young Age wealth ratio for this period assuming that there have not been shocks[19].

Then we verify is there is any evidence that agents have reacted to the change in expectations (or simply have changed expectation at all). The theoretical model developed in section 6, under the assumption of complete surprise, implies that, for the same age-sector-education groups present both in 1991 and 1993, the change in consumption between the two years can be expressed by the following (structural) equation

$$\ln\left(\frac{C_{c,g}(a_{t+2})}{w_{c,g}(a_{t+2})}\right) - \ln\left(\frac{C_{c,g}(a_t)}{w_{c,g}(a_t)}\right) = \frac{1}{1-\alpha}\ln\left(\gamma_{c,g}(a_{t+2}) - \gamma_{c,g}(a_t)\right) +$$

$$+\left[\frac{1}{1-\alpha}\ln\left(\frac{1+r}{1+\rho}\right)\right](a_{t+2}-a_t) +$$

$$+\ln\left[1+\frac{\widetilde{B_{1c,g}}+\widetilde{B_{2c,g}}}{A_g}\right] - \ln\left[1+\frac{B_{1c,g}+B_{2c,g}}{A_g}\right] - (\ln g_g(a_{t+2}) - \ln g_g(a_t))$$

where $\frac{\widetilde{B_{1c,g}}+\widetilde{B_{2c,g}}}{A_g}$ represent the value for Old to Young Age wealth ratio as seen after the Amato reform has taken place, from the standpoint of a normalized age zero agent, and $\gamma_{c,g}(a_{t+2})-\gamma_{c,g}(a_t)$ represents the change in other control variables, between 1991 and 1993 (including age squared). If agents update their information set they will have non zero values for $\ln\left[1+\frac{\widetilde{B_{1c,g}}+\widetilde{B_{2c,g}}}{A_g}\right] - \ln\left[1+\frac{B_{1c,g}+B_{2c,g}}{A_g}\right]$.

At this stage we stress a final important point. The assumption of complete surprise implies two separate hypothesis that we are going to test. The first one, based on the fact that the environment was stable, says that the cohort fixed

[18]The fact that the opposite holds for older cohorts of Junior High School Graduates is due to the concavity of their age profiles. Extending retirement age means getting wages that are in real terms declining.

[19]Notice that, according to the assumptions about expectations, we estimate fixed effects using only the data from 1984 to 1991.

effects for the period 1984-1991 could be well explained by the cohort profiles for OTYAWR computed under the hypothesis of complete surprise. The second one says that the changes in consumption rates between 1991 and 1993, after controlling for the other co-variates should be positively correlated with the changes in OTYAWR.

The results that we have obtained show that the model under the Complete Surprise hypothesis is rejected.

To summarize the results of the first exercize (regressing the estimated consumption rates cohort effects on OTYAWR):

- in the private sector the fixed effects are rising for all groups while the Old to Young Age wealth ratio cohort profile is declining for the group of High School Graduates while for the other groups is quite flat. This implies that for this sector we get a negative relationship between the explanatory variable and the fixed effects;

- in at the public sector we find a positive relationship between the fixed effects and the cohort profiles for OTYAWR but the estimated coefficient on the log of Old to Young Age wealth Ratio is not statistically significant.

When we focus on the second exercize, regressing the changes in consumption rates on the changes inthe explanatory variables (among which we have the OTYAWR) we obtain that, after having controlled for age and household characteristics, we do not find evidence that the changes in consumption rates are positively correlated with the changes in OTYAWR.

## 10. Conclusions

In our work we have studied the relationship between saving rates and Social Security with reference to Italy.

In section 2 we have documented the existing literature on the explanation for the fall in aggregate saving rates, focusing mainly the one that relates to Italy. This literature, in its macro and micro approaches, finds evidence that a relevant role in the decline of aggregate (and individual, when relevant) saving rates is played by the increasing generosity of Social Security. Intuitively, this approach could be valid for the past but does not seem very convincing when we look at recent years. In the rest of the study we try to verify the appropriateness of our intuition.

We have then proposed an approach that interprets the aggregate series as the result of the behavior of representative individuals, defined in terms of sex, education, sector and year of birth (cohort). Using the Bank of Italy SHIW dataset for the years 1984, 1986, 1987, 1989, 1991, 1993, 1995 we have constructed a quasi-panel in which we have created representative individuals according to the above mentioned characteristics. Then we have focused on individuals between the age of 20 (25 if College Graduates) and 55 (50 if females), working in the private and the public sector and we have constructed the (sub)aggregate series for saving rates that would result from their (representative) behavior and we have shown that such a series shows a decline that, in trend, is not very different from the trend of the series from National Accounts for the same years.

Then we have shown that our choice of focusing on cohorts is worth the effort because we have a common pattern across different groups[20] that show that younger cohorts have lower levels of saving rates than the previous ones at each age of their life.

In section 6 we have presented a simple theoretical model that allows us to think of consumption rates across cohorts differences in terms of variation of a variable that we have named Old to Young Age Wealth Ratio. This is the ratio of pension and human wealth that is received after a normalized age (60 for males and 55 for females) to the value of human wealth prior to that age. It summarizes in one number how the distribution of wealth along the life cycle changes across cohorts (and groups). This step is fundamental given the collinearity that exists between human wealth and pension wealth (or between pension benefits and wages). We have also shown that such a ratio can be simplified if in the wage equation we can separate out an age and a cohort profile (for each group). Hence we have verified that this is the case for most groups.

In the Appendix we have also described how recent changes in the Italian Social Security regime could be used in constructing pension and human wealth. In fact, we have constructed the two variables under two different assumptions regarding the capability of agents of predicting the future legislation. Under the perfect foresight assumption we have constructed the cohort profiles for pension and human wealth imposing the condition that agents know the rule that would apply to them according to the Amato Reform of 1992. The effects of such a reform were to increase retirement age for the public sector and reduce pension benefits in the private and public sector, particularly for younger generations. We

[20] A group is defined in terms of education and sector. We consider three education levels and two sector.

have also computed pension and human wealth profiles under the hypothesis of complete surprise. In this case we assume that agents did not expect the changes brought about by the Amato Reform and were hence surprised by it.

Then, in sections 8 and 9, we have tested our model under both assumptions. In each case we have estimated the consumption equation (each group at a time) imposing that log consumption rates are a function of a polynomial in age, household characteristics, cohort dummies and age-cohort interaction. According to our model we have interpreted the estimated cohort effects as functions of the log of 1 plus OTYAWR and hence we have verified whether the estimated cohort effect profiles could be explained by the constructed cohort profiles for the log of 1 plus OTYAWR.

We have found that under the Perfect Foresight hypothesis the correlation between the cohort effects and the explanatory variable is positive and highly significant across all aggregations (groups, sectors, education, pooled dataset). This imply that Social Security is relevant in explaining falling cohort saving rates but only if we interpret Social Security in a wider sense, in which are included not only pension benefits but also retirement age provisions. Only under the assumption that agents forecasted an increase in retirement age we obtain positively sloped profiles for the log of 1 plus OTYAWR in the private sector.

When we perform the same exercise under the hypothesis of Complete Surprise, we find that the cohort effect profiles for all groups in the private sector are negatively correlated with the profiles for the log of 1 plus OTYAWR, while for the public sector we find a non-significant positive coefficient. This result goes contrary to the previous literature. Under the assumption of complete surprise (implicitly assumed by the literature that has focused on the Italian case) on one side we have rising cohort profiles for consumption rates and on the other one we have dropping (for the private sector) or rising (for the public sector) profiles for the explanatory variable. It is hence possible that an overall negative correlation could emerge when we pool all the data (and that is what happens). But the relevant point is that, when we focus on the private sector, in which the cohort effect are more significantly implying rising cohort profiles, we find always a negative correlation between the estimated fixed effects and the log of 1 plus OTYAWR.

We have also verified whether agents responded to the changes in pension and human wealth brought about by the Amato reform and we did not find evidence of such hypothesis. This in itself does not prove that the Complete Surprise hypothesis should be rejected. It only shows that agents did not react fast enough for our data to capture it.

We have also constructed counter-factual aggregate series of saving and consumption rates assuming that the Amato Reform did not take place[21]. These counter-factual exercises should be taken with care because, given our assumptions about the information set, what we can construct using the coefficients estimated under the Perfect Foresight hypothesis are the values of cohort saving and consumption rates that would have been observed for an environment in which expectations did not change for the period 1984-1995. We have performed such a task in various ways, assuming that the Pre-Amato Regime is the relevant alternative.

We find that in the absence of the Amato Reform aggregate saving rates would have been higher.

## A. Wage estimation: Age and Cohort Effects

Our discussion has been based largely on the possibility of separating age and cohort effects in the wage equation[22].

Hence we have tested this hypothesis using two sets of data. The first one is composed by the average wage of the various sex-education-sector-cohort cells. The second one collects individual observations. In both cases we controlled for cohort-age interaction. When we have individual data we can take into account characteristics over which we could not condition when we created representative individuals (due to an insufficient number of observations) like the area (North West, North East, Center, South and Islands ) and the type of job (white collar, blue collar, manager).

The results that we obtain when using group-cohort averages show signs of significant age-cohort interaction for males Junior High and High School Graduates in the public sector, for males Junior High Graduates in the private sector and for females Junior High and High School Graduates in the private sector.

When we use individual data we find significant evidence of age-cohort interaction only for males College Graduates in the public sector, for most cohorts of males Junior High School Graduates in the private sector, for very few cohorts of females Junior High and High School graduates in the private sector and for most cohorts of females College graduates in the private sector. The coefficient

[21] We could have taken any alternative scenario. We use the"No Amato Reform" one simply because it has been our main identification tool.

[22] Notice that we do not claim of separately identifying cohort, age and time. Our point is just to show that the age profiles within the various groups are not cohort specific.

on age-cohort interaction is negative in all cases but the one for females College Graduates in the private sector, for which the sign is positive[23].

We have also verified that when dropping the interaction term the explanatory power of the regressions is affected in only a minor way.

Given the previous conclusions we feel quite confident in concluding that, particularly when using individual data, there is not much evidence of cohort specific age profiles .

The following represents the estimating equation when we used individual data (excluding age-cohort interaction)

$$\ln w_{jt} = \delta_0 + D_j^{'} * \delta_1 + O_j * \delta_2 + A_j^{'} * \delta_3 + \beta_2 * a_{jt} + \beta_3 * a_{jt}^2 + \beta_4 * a_{jt}^3 + \beta_5 (D_j * a_{jt}) * \beta_6 * u_t + e_{jt}$$

where $D_j$ is a vector of cohort dummies (less one cohort), $O_j$ is a dummy that has a value 1 for blue-collar workers (or managers if the sample is constrained to include only College workers), $A_j^{'}$ is a vector of area dummies (less one), $a_{jt}$ is age of individual $j$ at time t and $u_t$ is a common time effect that captures cyclical effects.

The coefficient on the squared or cubic term for age is not significant for all groups and when it is not we drop it.

One important point concerns sample selection. We had do choose the age interval outside which we had to drop observations. We computed the average starting age for different sex and education groups and given that we wanted to restrict the sample to individuals attached to the labor market in stable way we chose to restrict the sample to those who, in each year, are above 20 if Junior High or High School graduates and 25 if College graduates. This values are slightly higher than the average starting age computed in the sample but we wanted to avoid including individuals that are only temporarily attached to the labor market.

Analogously, we had to choose the upper limit of the interval. We conducted various experiments. First we excluded individuals older than 60 if males and 55 if females (those were the two mandatory retirement ages for Old Age Pensions in the private sector). Then we excluded individuals older than 60 if males and 55 if females if they work in the public sector and individuals older than 55 (males) and 50 (females) in the private sector, hence dropping those who were closer than five years to the mandatory retirement age.

The results from log net wage estimation at the individual level are reported (only for males) in Tables 7 and 8.

[23] A negative coefficient means that for more recent cohorts an extra year of experience increases labor income by less.

## B. Construction of Pension Wealth and Human Wealth

The estimation of the present value of net labor income for each cohort requires knowledge of future and past wages for each representative agent and group. We have data for seven years and informations only on net wages at the individual level. To compute the *Retribuzione Pensionabile* we need gross (of income and social security taxes) wages. The amount of informations we have and the structure of our data direct our research. In the next paragraph we explain how we construct the entire life profile for (net and gross) wages, starting from the observed value for an individual in a given year. In a following paragraph we will explain how we went from net to gross wages.

It is important to notice that the results obtained at this stage will drive all the subsequent steps. The present value of net labor income and the present value of pension income can be obtained only if we know the age profile for wages (net and gross) for each individual agents (or cohort).

### B.1. Constructing Pension Wealth and Human Wealth Profiles

In the previous section we have described our wage estimation. To compute the present value of labor income and social security benefits we need the full (net and gross) wage life path for each individual. We have constructed such a path applying the estimated age coefficients to the individual observed wage, obtaining a foreward and bacward series. Once we have obtained the whole life-cycle profile for each individual (under the two different assumptions regarding retirement age), the task of computing the variable human wealth (as of age zero) is quite simple because we just take the present value of the whole series (for each individual) applying a discount rate equal to 10%.

The computation of pension wealth is a complex task. The first problem arises from the fact that the *Retribuzione Pensionabile* used to determine the first pension is based on gross wages, which are not available in our dataset. Hence we had to construct them doing a sort of reversed income tax computation. The problem is that the income tax schedule is not linear, but progressive. This implies that the average tax rate is not independent from the (observed) net wage[24].

To assign individuals to their true income tax bracket, for every year in the dataset and every individual, we started from the declared net wage and assigned

[24] If this were not the case than we would simply divide the observed net income by (1-average tax rate) and we would get gross income.

the individual to the tax bracket that would be appropriate if the net wage and the gross wage would coincide. Then, using the information on the household, we computed the resulting due tax and net income. If net income resulting from this computation was different from the observed net income we reassigned the individual to a higher tax bracket. This went on until the computed gross income was be consistent with the observed net income and the tax schedule. Then, to compute gross wages net of Social Security taxes we just divided the observed net wage by one minus the average income tax rate. Finally we took account of social security taxes and we obtained true gross wages. With these at hand we did the same as for net wages. We estimated an equation for log gross wages using individual and cohort data. Then we applied the coefficients on the "observed" gross wage coefficients and we obtained the whole (predicted) life path for each individual. This was then used to compute the first pension. Once we have the first pension we apply the indexation mechanisms and the rules that fix a maximum and a minimum to pension benefits and we get the whole series of pension benefits up to expected death. Then we take the present value of such a series using a discount rate of 10% per year and we obtain pension wealth (as of age zero).

The choice of doing these computations at the individual level rather than at the cohort level is due to the presence of non linearities in the formula used to compute pensions. Allowing the greatest amount of diversification among individuals can be useful in the identification process.

Once we have the individual value for pension and human wealth for each year we put together all the years in which a cohort appears and compute their average value for each age-sex-education-sector group (using sample weights).

The results of these computations are presented[25] in Figs. 19 to 22.

We discuss the results differentiating between private and public sector workers. We will focus only on the full sample (where we look just at males head of households and we do not distinguish between married and singles) because only by looking at them we can really understand the changes at the individual level following from the reform of the pension system.

[25] Note that in every graph it is better to disregard the first and the last cohort because the number of individuals used to compute the average is quite low (in general less than 15 observations).

### B.2. Private Sector Workers

#### B.2.1. Pension Wealth

Similarly to what we have done for wages, first we have computed the value of pension wealth at the individual level and than we have computed its average value for every age-sector-education group. We have taken the standpoint of a deterministic model and hence we have assigned to individuals the expected age of death as given by the Italian Statistic Institute (74 years for man and 80 years for women). We do not allow for differences across cohorts in expected life-span. This might slightly underestimate pension wealth for more recent cohorts, if their life will turn out to be longer.

We have computed pension wealth under different assumptions.

- **Identification Assumption: Individuals forecast according to the Perfect Foresight Hypothesis (which include the Amato regime for those who retire after 1993)**

Under this assumption we have estimated pension wealth for those who retired prior to 1992 according to the Pre-Amato regime while for those who retired after that year we have applied the temporary and permanent regimes introduced by the 1992 Amato reform. We do not consider the possibility that agents forecasted according to the second reform that took place in 1995 (the Dini reform), given that the last dataset was collected in the same year.

- **Identification Assumption: Individuals forecast on the basis of the existing regime: Pre Amato from 1984 to 1991 and Amato in 1993**.

The real issue is whether agents would be able in 1984, 1986, 1987, 1989, 1991 to forecast changes that occurred in 1992 and 1995. Hence we also estimated pension wealth as if there were no reform. This will be useful when estimating the model under the assumption of myopic behavior, which means that from 1984 to 1991 agents forecasted pension wealth according to the Pre-Amato regime and where completely surprised by the Amato reform of 1992. In this case we have to use only the years to which the identification assumption pertain: 1984-1991 for the Pre-Amato period, 1993 for the Amato reform. For now we just want to stress the differences between pension wealth as estimated according to the Pre-Amato regime (agents do not forecast the reform) and pension wealth as estimated

according to the combination of Pre-Amato and Amato regimes (agents forecast taking into account the reform).

Fig. 19 compares the cohort profiles for the present value of pension benefits obtained under the assumption of, respectively, Perfect Foresight and Complete Surprise.

For the private sector, pension wealth, as computed according to the Pre-Amato regime (corresponding to the complete surprise hypothesis), is always higher than pension wealth computed according to the combination of Pre-Amato and Amato (corresponding to the perfect foresight assumption). This is due to various factors: 1) for the private sector retirement age is higher under the Amato regime and hence the number of years during which a person receives the pension is lower[26]. The effect is higher for the younger cohorts because they are the one that will retire at 65; 2) the formula used to compute the "*Retribuzione Pensionabile*" is more generous under the Pre-Amato regime. Then, within the Amato regime, it is more generous for older cohorts (more than 15 years of working experience as of 31/12/1992); 3) indexation is more generous under the Pre-Amato regime. The fact that retirement age in the private sector is increased by the reforms and that the "*Retribuzione Pensionabile*" is lowered also explain the declining portion of the cohort profile when we assume perfect foresight. Under both assumptions we see that after the profile has reached the bottom, it starts increasing again. This is due to the fact that for more recent cohorts retirement age has reached the upper limit and -keeping this constant- younger cohorts are more productive than older ones.

The gain in productivity is quite evident when we observe the cohort profile under the Pre-Amato regime for the Junior High Graduates group, in both sectors. Pension wealth raises constantly and, given that there are no changes in legislation, this is due to higher productivity which is then translated into higher wages and hence higher pensions.

For workers in the private sector that have completed High School we can observe that the cohort profile under the Pre-Amato regime is not constantly rising. Particularly we can see that cohort 4, 5 and 6 show a very small decline in pension wealth (compared to previous cohorts).

As for College workers, we have more variability, still with an overall raise of the cohort profiles under the Pre-Amato regime. The wider variability in this case is mostly due to the lower number of observations in each year.

[26] Note that the Amato reform increased retirement age by one year every two calendar years starting from 1995.

### B.2.2. Human Wealth

We have constructed the values of this variable according to the same identification assumptions used for pension wealth: "perfect foresight" and "complete surprise". In Fig 20 we compare the two profiles and we observe that the human wealth cohort profiles under the complete surprise assumption are below the profiles obtained under perfect foresight, for every cohort (but the first one, which is not touched by the Amato reform) and every educational group.

Particularly for the Junior High School and College Graduate groups we can see the importance of raising cohort effects.

## B.3. Public Sector Workers

For public sector workers the Amato reform did not affect retirement age, which remained constant at 65 for both males and females. It is true that in this sector there have been incentives and ways to obtain early retirement, but we choose to stick to the general rule for Old Age Pension. The absence of a retirement age effect is such that, at the individual level, the stream of pension benefits tend to follow closely the life path for wages. And this is particularly true for the oldest cohorts because the Pre-Amato regime based the computation of the first pension on just the last wage.

### B.3.1. Pension Wealth

When we compare the profiles obtained under perfect foresight with those corresponding to myopic expectations Pre-Amato scenario (Fig.21), we find that the Amato reform had the effect of lowering the value of pension wealth for all the cohorts to which it applied. For a constant retirement age, all cohorts would have been better off under the Pre-Amato regime. The spread between the two is a function of the steepness of the wage age-profile. The steeper is the latter and the more effective is the drop coming from having to use an average of past wages as opposed to just the last wage. Within each education group the effect is stronger for more recent cohorts because for them the average is taken over a longer period[27].

[27] This seems to be contradicted by the graph for Junior High School, where for recent cohorts the spread is reduced. But this is due to year effect and not to the reform. We have to remember that the two series are used using different years. For the perfect foresight case we used all the years in the dataset. For the complete surprise case we used only the years from 1984 to 1991,

Taking into account all this, we can conclude that under both scenarios we have a clear pattern of raising pension wealth, for every education group.

### B.3.2. Human wealth

Given that retirement age does not change and that we think in terms of partial equilibrium, the human wealth profiles are not affected by the reforms (Fig. 22).

Human wealth cohort profiles are raising for the lowest education groups. The only cohorts that do not seem to be doing better than the immediately preceding ones are cohort 9 for Junior High, and cohort 2 and 5 for High School. These results for Junior High Graduates confirm those obtained from the estimation of net wages, but for cohort 10, which has a lower "Entry Wage" than cohort 9 but experiences a higher value for human wealth. As for High School Graduates, the evidence of cohort effects from net wages is less decisive. None of the cohorts has significant "Entry Wage" effects and this is probably reflected in the flatter portion of the human wealth profile. The cohorts for which is stronger the evidence of significant "Entry Wage" effects (cohort 7 and 8) are also the one for which the human wealth profile shows an increase in steepness.

We notice two things that are important in our identification strategy.

- Under perfect foresight the path of pension wealth for public sector workers has a shape that resembles very much the shape of the human wealth profile. This would cause collinearity and would make extremely difficult to disentangle the effects of the two variables on the cohort effects. For private sector workers (combined with the assumption of perfect foresight) the Amato Reform affects the two variables in opposite ways, reducing pension wealth and increasing human wealth.

- Under complete surprise, for public sector workers, the only effect of the Amato reform is to decrease the value of pension wealth. This could help in explaining the variation of age zero cohort fixed effects between 1991 and 1993 (before and after the reform).

given that the Amato reform was implemented in 1992.

# Tables

**Table 1: Males Public Sector-Saving Rates**

| | College Graduates | High School Graduates | Junior High School Graduates |
|---|---|---|---|
| Age | -.016855<br>(.0401485) | .0064563<br>(.0242149) | .0387736<br>(.0199238) |
| Age Square | .0004716<br>(.0024614) | -.0009574<br>(.0013101) | -.0017989<br>(.001121) |
| Age Cube | -5.43e-06<br>(.000044) | .0000148<br>(.0000206) | .0000183<br>(.0000181) |
| Cohort3 | -.1028095<br>(.0987873) | -.0884633<br>(.0714232) | .0729315<br>(.0691963) |
| Cohort4 | -.0493048<br>(.1198336) | -.2576866<br>(.0865554) | -.0671068<br>(.0838508) |
| Cohort5 | -.0641521<br>(.1434428) | -.2804531<br>(.1022818) | -.1606418<br>(.099001) |
| Cohort6 | .0198227<br>(.168036) | -.3152613<br>(.1189687) | -.2619685<br>(.114877) |
| Cohort7 | -.1543298<br>(.1873116) | -.3081918<br>(.1348407) | -.2837126<br>(.1303987) |
| Cohort8 | -.3769796<br>(.204716) | -.4130473<br>(.1472314) | -.2286282<br>(.1424933) |
| Cohort 9 | n.a. | -.449918<br>(.1588751) | -.2951421<br>(.1538569) |
| U.rate | -.0183412<br>(0.527943) | -.1417412<br>(.0353265) | -.0022934<br>(.033847) |
| Intercept | 1.407606<br>(.2598238) | 1.579383<br>(.1912375) | 1.11494<br>(.1725366) |
| Adj-R2 | 0.098 | 0.3483 | 0.2178 |
| Number of Obs. | 43 | 50 | 51 |
| Dependent Variable | Saving rate | Saving rate | Saving rate |

Note: Standard Errors are in parenthesis.

**Table 2: Males Private Sector-Saving Rates**

| | College Graduates | High School Graduates | Junior High School Graduates |
|---|---|---|---|
| Age | .0125321<br>(.032276) | .0222383<br>(.0167272) | -.0111934<br>(.0103773) |
| Age Square | -.0011884<br>(.00207) | -.0018225<br>(.0009411) | .0004378<br>(.0005839) |
| Age Cube | .0000213<br>(.0000381) | .0000273<br>(.0000152) | -9.32e-06<br>(9.41e-06) |
| Cohort3 | .1183549<br>(.0965175) | -.087025<br>(.0580944) | -.0866492<br>(.0360409) |
| Cohort4 | .0619545<br>(.1170725) | -.1354546<br>(.0703978) | -.1561929<br>(.0436737) |
| Cohort5 | .1425127<br>(.1397272) | -.2165198<br>(.0831173) | -.2351573<br>(.0515647) |
| Cohort6 | .082121<br>(.1636175) | -.2973639<br>(.0964468) | -.2529834<br>(.0598341) |
| Cohort7 | .0431078<br>(.182939) | -.3101313<br>(.1094776) | -.2747509<br>(.0679182) |
| Cohort8 | .0025584<br>(.1998202) | -.3624817<br>(.1196317) | -.3319552<br>(.0742177) |
| Cohort 9 | n.a. | -.527473<br>(.1291721) | -.4035976<br>(.0801364) |
| U.rate | -.10506<br>(.0509847) | -.044379<br>(.0284166) | -.0314608<br>(.0176292) |
| Intercept | 1.115322<br>(.2302557) | 1.472744<br>(.1448549) | 1.458928<br>(.0898658) |
| Adj-R2 | 0.0922 | 0.3054 | 0.4475 |
| Number of Obs. | 44 | 51 | 51 |
| Dependent Variable | Saving Rate | Saving Rate | Saving Rate |

Note: Standard Errors are in parenthesis.

**Table 3: Males Public Sector-Estimation of Cohort Effects-Perfect Foresight**

| | College Graduates | High School Graduates | Junior High School Graduates |
|---|---|---|---|
| Age | -.0137799<br>(.1342298) | .2148233<br>(.1401807) | -.0102323<br>(.1715791) |
| Age Square | .0010749<br>(.0024045) | -.0021884<br>(.0020671) | .0024621<br>(.0020255) |
| Age Cube | -.0000187<br>(.0000338) | 1.82e-06<br>(.0000213) | -.0000443<br>(.0000163) |
| Number of Income Recipients | -.0281357<br>(.1017541) | .2514866<br>(.1194263) | .2182892<br>(.1648066) |
| Manager | -.3776298<br>(.1600997) | n.a. | n.a. |
| Blue Collar | n.a. | .1361075<br>(.2000657) | -.1622856<br>(.0995685) |
| Number of Dependent Children | -.0885093<br>(.0714412) | -.16958<br>(.0798001) | -.1580736<br>(.0756723) |
| Wife | .20403<br>(.1450886) | .07524<br>(.1626617) | -.0578584<br>(.1978417) |
| Cohort3 | .0070837<br>(.4765535) | .9177184<br>(.5050928) | .027544<br>(.6376658) |
| Cohort4 | -.0046536<br>(.869795) | 1.667858<br>(.9289057) | .2465062<br>(1.197487) |
| Cohort5 | .0213822<br>(1.182573) | 2.240083<br>(1.284939) | .4214961<br>(1.664349) |
| Cohort6 | .0097383<br>(1.425459) | 2.687619<br>(1.569966) | .5783557<br>(2.048441) |
| Cohort7 | .1069087<br>(1.588674) | 3.031092<br>(1.797728) | .6763941<br>(2.342853) |
| Cohort8 | .3351706<br>(1.676726) | 3.348966<br>(1.951537) | .6687586<br>(2.546385) |
| Cohort 9 | n.a. | 3.525547<br>(2.04854) | .8083667<br>(2.656702) |
| Age*Cohort Index | .0015607<br>(.0149607) | -.0211419<br>(.0137408) | -.0042265<br>(.0177766) |
| Intercept | -.3628732<br>(1.691386) | -4.136206<br>(2.083966) | -.9251452<br>(2.780017) |
| Adj-R2 | 0.4209 | 0.3901 | 0.5554 |
| Number of Obs. | 43 | 50 | 51 |
| Dependent Variable | Log of Equivalent Scale Consumption Rate | Log of Equivalent Scale Consumption Rate | Log of Equivalent Scale Consumption Rate |

Note: Standard Errors are in parenthesis.

**Table 4: Males Private Sector-Estimation of Cohort Effects-Perfect Foresight**

| | College Graduates | High School Graduates | Junior High School Graduates |
|---|---|---|---|
| Age | .3784848<br>(.1557862) | .3588774<br>(.1305717) | .080799<br>(.0823528) |
| Age Square | -.0036898<br>(.0026235) | -.0026864<br>(.001754) | -.0007736<br>(.0010757) |
| Age Cube | -7.26e-06<br>(.0000353) | -.0000123<br>(.0000151) | 6.09e-07<br>(.000014) |
| Number of Income Recipients | .187352<br>(.1928099) | -.1036367<br>(.1153408) | .230429<br>(.1672609) |
| Manager | -.0648741<br>(.1734559) | n.a. | n.a. |
| Blue Collar | n.a. | .0532012<br>(.1630107) | .2475024<br>(.1917865) |
| Number of Dependent Children | -.1522795<br>(.0833563) | -.1998496<br>(.0562979) | -.1768672<br>(.0808785) |
| Wife | -.117388<br>(.1811127) | .5934118<br>(.1658481) | -.1660683<br>(.2826839) |
| Cohort3 | 1.433037<br>(.5373463) | 1.487054<br>(.4614822) | .299038<br>(.3181817) |
| Cohort4 | 2.668564<br>(.9904699) | 2.721787<br>(.8717885) | .597427<br>(591906) |
| Cohort5 | 3.663719<br>(1.354677) | 3.788401<br>(1.21103) | .8823623<br>(.8121058) |
| Cohort6 | 4.459949<br>(1.634488) | 4.661533<br>(1.475266) | 1.078969<br>(.9956339) |
| Cohort7 | 4.970748<br>(1.82371) | 5.301921<br>(1.674989) | 1.291859<br>(1.130895) |
| Cohort8 | 5.310649<br>(1.931977) | 5.76243<br>(1.81034) | 1.431303<br>(1.224324) |
| Cohort 9 | n.a. | 6.167683<br>(1.888165) | 1.516727<br>(1.265327) |
| Age*Cohort Index | -.0445732<br>(.0171802) | -.0385558<br>(.0129429) | -.0070288<br>(.0088038) |
| Intercept | -5.614822<br>(1.955441) | -6.244198<br>(1.920865) | -2.206852<br>(1.321492) |
| Adj-R2 | 0.4146 | 0.8070 | 0.8017 |
| Number of Obs. | 44 | 51 | 51 |
| Dependent Variable | Log of Equivalent Scale Consumption Rate | Log of Equivalent Scale Consumption Rate | Log of Equivalent Scale Consumption Rate |

Note: Standard Errors are in parenthesis.

**Table 5: Males All Groups - Cohort Effects on Explanatory Variables - Perfect Foresight**

| | All Groups | All Groups |
|---|---|---|
| Log OTY AWR | 355.4616<br>(37.57649) | 317.5171<br>(95.34503) |
| Public Sector | -.4129868<br>(.3916159) | .4093774<br>(.99367) |
| High School Graduates | -9.202129<br>(.9241126) | -7.962547<br>(2.344805) |
| College Graduates | -12.57544<br>(1.273878) | -10.70283<br>(3.232284) |
| Public Sector*High School Graduates | 7.549035<br>(.9779985) | 6.329615<br>(2.481533) |
| Public Sector*College Graduates | 4.2592<br>(.6254016) | 3.173115<br>(1.586868) |
| Intercept | -9.631858<br>(.9166567) | -9.317001<br>(2.325887) |
| Adj-R2 | 0.7641 | 0.262 |
| Number of Obs. | 46 | 46 |
| Dependent Variable | Cohort Fixed Effects | Weighted (by the standard errors) Cohort Fixed Effects |

Note: Standard Errors are in parenthesis.

**Table 6: Males All Groups**

| | All Groups |
|---|---|
| Age | -.0413833<br>(.0067631) |
| Age Square | .0016582<br>(.0002992) |
| Age Cube | -.0000912<br>(4.48e-06) |
| Number of Income Recipients | .0524853<br>(.0344054) |
| Manager | -.3286594<br>(.0695649) |
| Number of Dependent Children | -.1631774<br>(.0196815) |
| Wife | .2170913<br>(.0515192) |
| Group 2 | -.1078889<br>(.0765867) |
| Group 3 | .0307062<br>(.1076985) |
| Group 4 | .0480771<br>(.0502571) |
| Group 5 | -.0755592<br>(.0546496) |
| Group 6 | -.1179224<br>(.0946688) |
| Log OTYAWR | 37.042222<br>(9.607323) |
| Square Log OTYAWR | -.4189556<br>(1.093206) |
| Age*Cohort Index | .0025246<br>(.0003367) |
| Age*Cohort Index*Group 2 | -.0011107<br>(.000508) |
| Age*Cohort Index*Group 3 | -.0007924<br>(.0006662) |
| Age*Cohort Index*Group 4 | -.0013388<br>(.0004924) |
| Age*Cohort Index*Group 5 | .0002049<br>(.0005474) |
| Age*Cohort Index*Group 6 | .0006814<br>(.0007586) |
| Intercept | -.9223552<br>(.2056122) |
| Log likelihood | 319508.7 |
| Number of Obs. | 290 |
| Dependent Variable | Log of (Equivalent Scale) Consumption Rate |

Note: Standard Errors are in parenthesis.

**Table 7: Males Public Sector-Log of Net Wages**

| | College Graduates | High School Graduates | Junior High School Graduates |
|---|---|---|---|
| Age | .0192163<br>(.0035619) | .0381413<br>(.0094727) | .0350246<br>(.0069282) |
| Age Square | n.a. | -.0005177<br>(.0001977) | -.0004682<br>(.0001338) |
| Age Cube | n.a. | n.a. | n.a. |
| Area2 | -.0414541<br>(.0523965) | -.0473714<br>(.030259) | -.0020835<br>(.0270569) |
| Area3 | -.0327131<br>(.0552004) | -.0296818<br>(.0320878) | -.0188404<br>(.0278986) |
| Area4 | -.1143948<br>(.0515868) | -.1225811<br>(.0306461) | -.0817291<br>(.0280146) |
| Area5 | -.0979358<br>(.0567903) | -.1379989<br>(.0352548) | -.1156504<br>(.0347057) |
| Manager | .4101354<br>(.048886) | n.a. | n.a. |
| Blue Collar | n.a. | -.1169717<br>(.037672) | -.1931744<br>(.0175172) |
| Cohort 2 | -.0193609<br>(.1051049) | .0392605<br>(.0801883) | -.047521<br>(.0659337) |
| Cohort 3 | -.0276743<br>(.1065959) | .0800477<br>(.0799971) | -.0062095<br>(.0566664) |
| Cohort 4 | .0973573<br>(.1121068) | .1044831<br>(.0900114) | .0363369<br>(.0589897) |
| Cohort 5 | .1469033<br>(.1258947) | .0699301<br>(.0945699) | .1163352<br>(.0638088) |
| Cohort 6 | .1867857<br>(.1290033) | .1094805<br>(.0973197) | .1657013<br>(.06746) |
| Cohort 7 | .1640385<br>(.1406776) | .1908446<br>(.1009273) | .2311799<br>(.0717285) |
| Cohort 8 | .1064572<br>(.1501808) | .1981194<br>(.1104519) | .2915384<br>(.0810963) |
| Cohort 9 | -.1489575<br>(.2511085) | .1538456<br>(.1151937) | .3078689<br>(.0963593) |
| Cohort 10 | n.a. | .1279997<br>(.1533168) | .2326103<br>(.1537603) |
| U.rate | .0705033<br>(.041878) | -.0155403<br>(.0235684) | -.0275824<br>(.0180156) |
| Intercept | 9.658632<br>(.1716403) | 9.341286<br>(.1357741) | 9.322329<br>(.1078318) |
| Adj-R2 | 0.30 | 0.1573 | 0.1574 |
| Number of Obs. | 1063 | 2271 | 2405 |
| Dependent Variable | Log of Real Net (Annual) Wage | Log of Real Net (Annual) Wage | Log of Real Net (Annual) Wage |

Note: Standard Errors are in parenthesis.

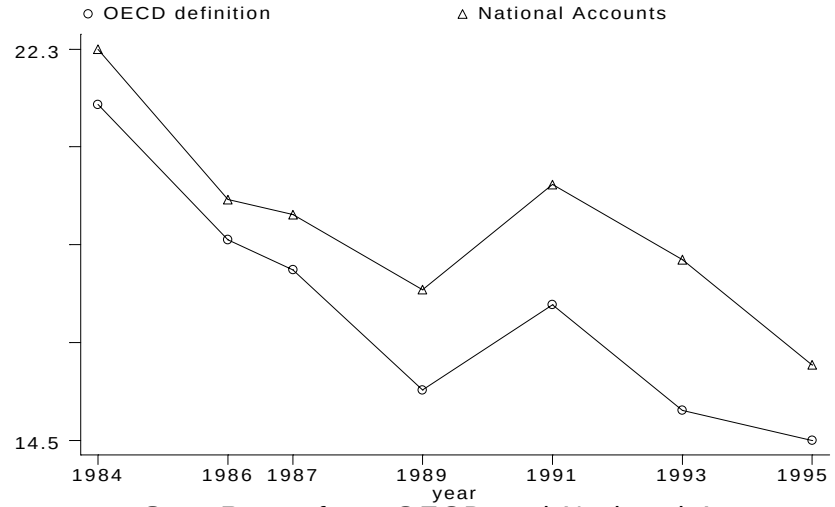
**Table 8: Males Private Sector-Log of Net Wages**

| | College Graduates | High School Graduates | Junior High School Graduates |
|---|---|---|---|
| Age | .0698378<br>(.0143096) | .1273706<br>(.016626) | .0437679<br>(.0051614) |
| Age Square | -.0009615<br>(.0004107) | -.005386<br>(.0009499) | -.0007767<br>(.0001115) |
| Age Cube | n.a. | .000081<br>(.0000162) | n.a. |
| Area 2 | -.1529305<br>(.046489) | -.1049044<br>(.0211169) | -.0772598<br>(.013293) |
| Area 3 | -.0485079<br>(.0465332) | -.0907516<br>(.0186196) | -.0812546<br>(.0136341) |
| Area 4 | -.2055662<br>(.0526701) | -.2247091<br>(.0209553) | -.2626822<br>(.0153364) |
| Area 5 | -.1677483<br>(.0543115) | -.1990446<br>(.0303049) | -.2877594<br>(.0378549) |
| Manager | .3393984<br>(.0401782) | n.a. | n.a. |
| Blue Collar | n.a. | -.2315021<br>(.0208529) | -.2521247<br>(.0119992) |
| Cohort 3 | .0812977<br>(.091329) | .1172824<br>(.0735897) | .0586685<br>(.0353676) |
| Cohort 4 | .0394465<br>(.099985) | .168034<br>(.073306) | .0823853<br>(.0354324) |
| Cohort 5 | .2220611<br>(.1175306) | .1484543<br>(.081954) | .1082699<br>(.0391641) |
| Cohort 6 | .2961728<br>(.1318556) | .1337141<br>(.0849453) | .1205971<br>(.0445875) |
| Cohort 7 | .4663878<br>(.1515685) | .1288794<br>(.0873331) | .1200127<br>(.0454348) |
| Cohort 8 | .4878311<br>(.1563043) | .1587496<br>(.0903066) | .1323545<br>(.0497624) |
| Cohort 9 | .3742283<br>(.1750775) | .2032076<br>(.0940309) | .1649659<br>(.0631724) |
| Cohort 10 | n.a. | .1525304<br>(.1054093) | .1530174<br>(.0625451) |
| U.rate | .0781055<br>(.0292808) | .0334454<br>(.0137141) | .0011863<br>(.0102913) |
| Intercept | 9.198364<br>(.1841171) | 9.015619<br>(.1288134) | 9.434808<br>(.0711671) |
| Adj-R2 | 0.34 | 0.35 | 0.214 |
| Number of Obs. | 1256 | 5978 | 10782 |
| Dependent Variable | Log of Real Net (Annual) Wage | Log of Real Net (Annual) Wage | Log of Real Net (Annual) Wage |

Note: for the Private Sector we cut the sample at the age of 55 and hence cohort 2 is the oldest one.

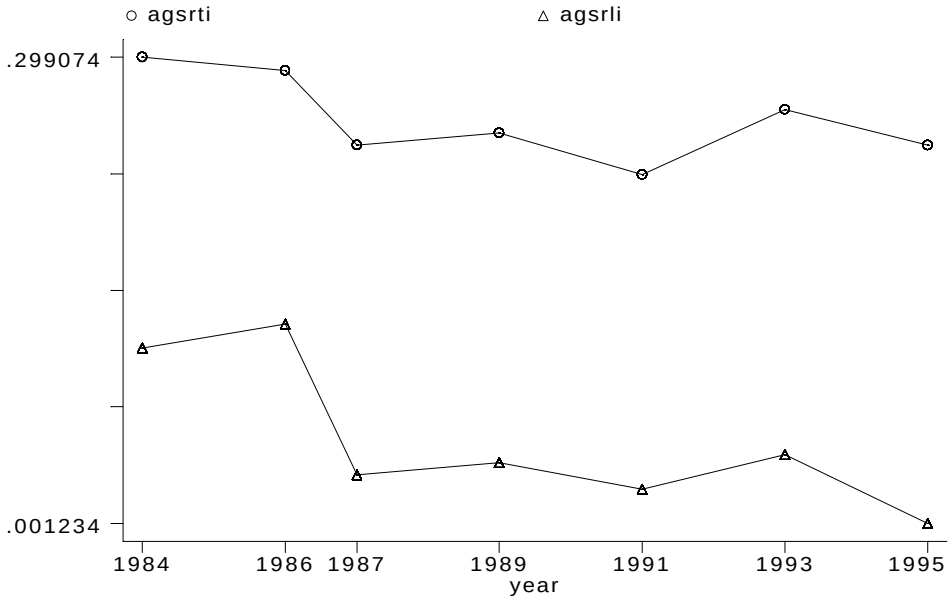
Note: Standard Errors are in parenthesis.

# Figures




Aggregate Sav. Rates from OECD and National Accounts

Fig.1: Aggretate Saving Rates from Aggregate Series




.2: Aggr.Sav. Rates for SHIW-using Total and Labor Incom

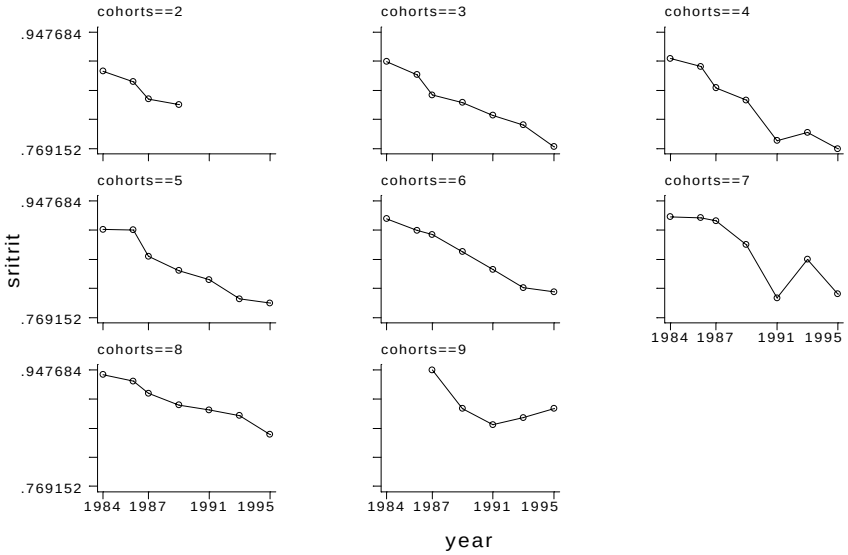



Fig.3-Sav.rates-Jun.High School Grad.-Public Sector

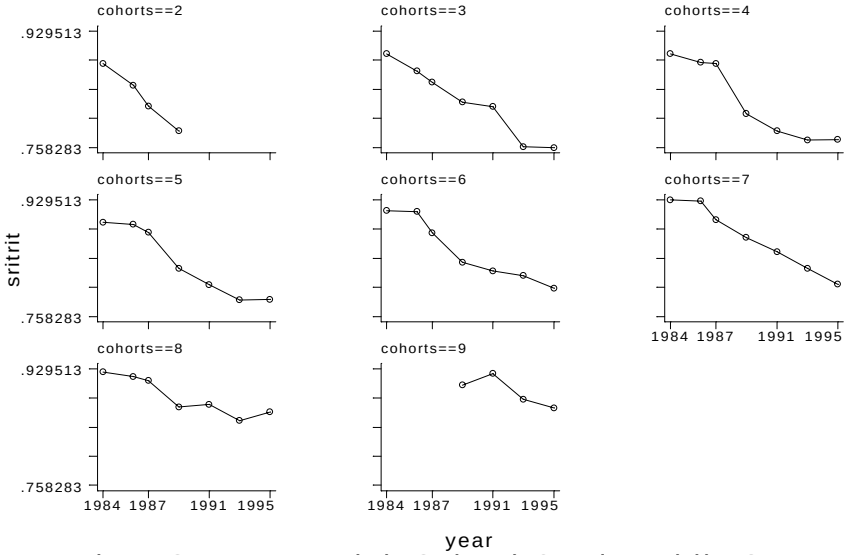



Fig.4-Sav.rates-High School Grad.-Public Sector

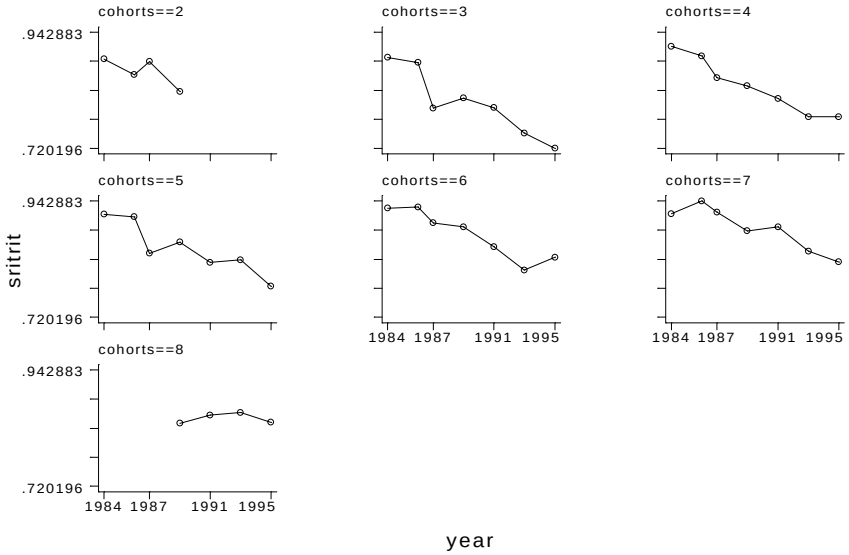



Fig.5-Sav.rates-College Grad.-Public Sector

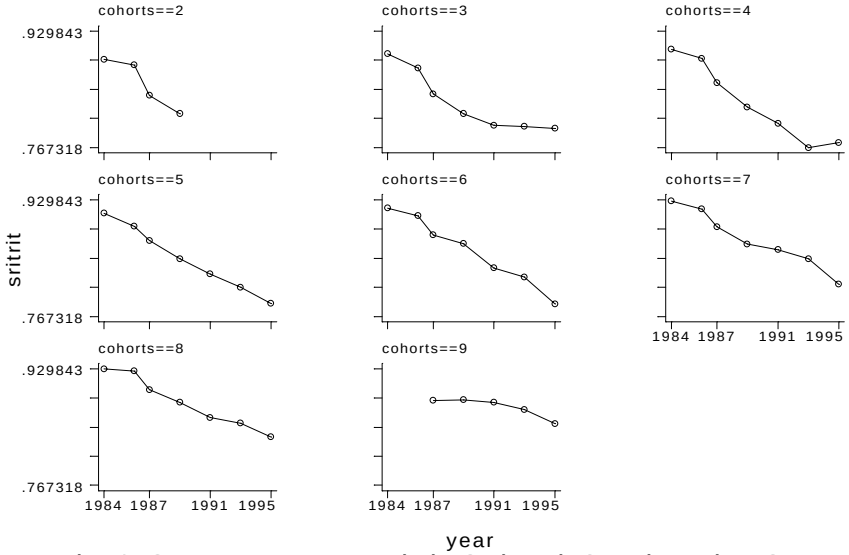



Fig.6-Sav.rates-Jun.High School Grad.-Priv. Sector

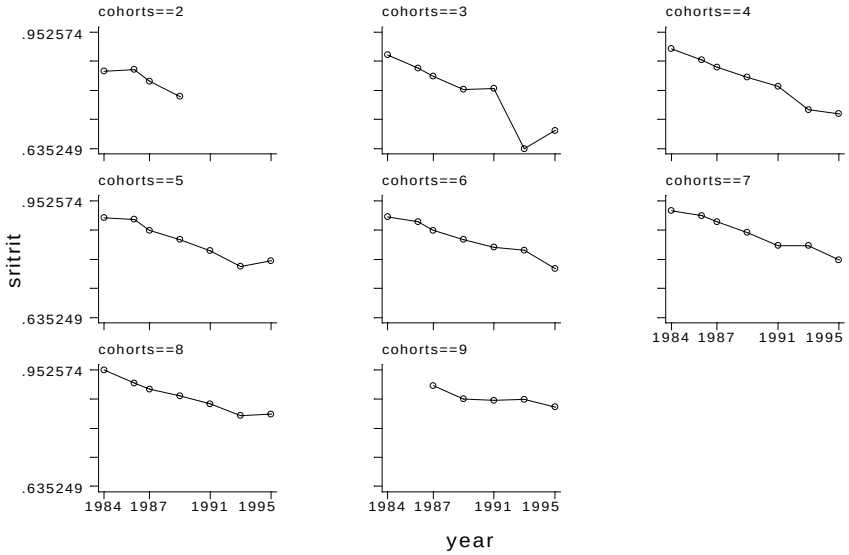



Fig.7-Sav.rates-High School Grad.-Private Sector

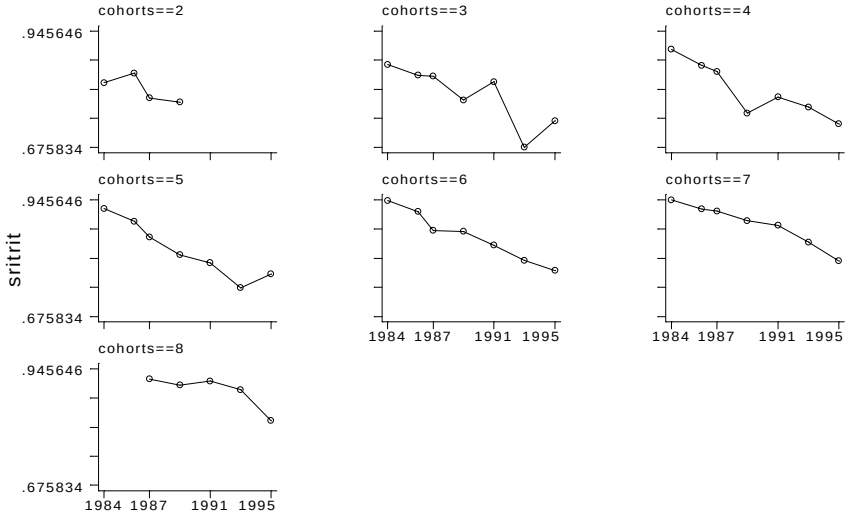



Fig.8-Sav.rates-College Grad.-Private Sector

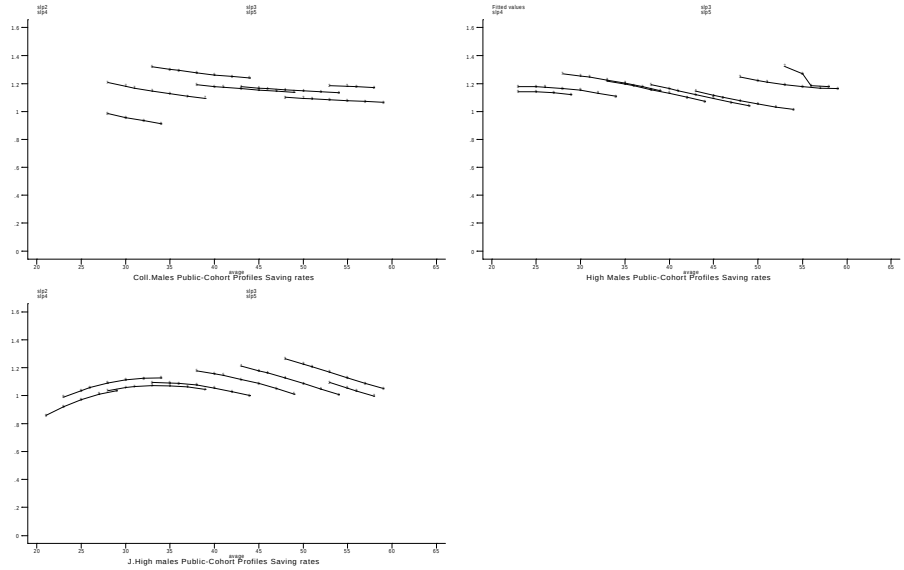



Fig.9:Males Public Employees-Sav.Rates-Cohort Profiles-Redu.Form Est.

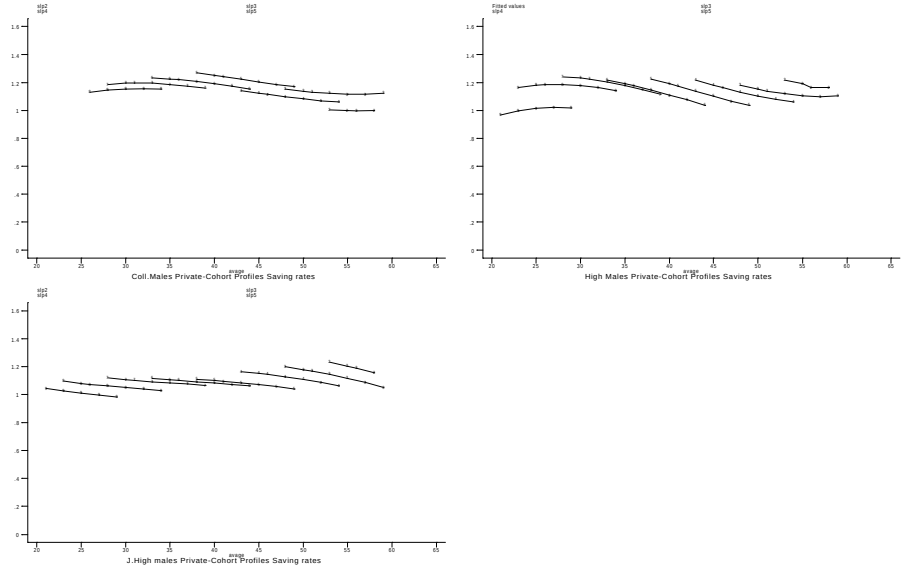



Fig.10:Males Private Employees-Sav.Rates-Cohort Profiles-Red.Form Est.

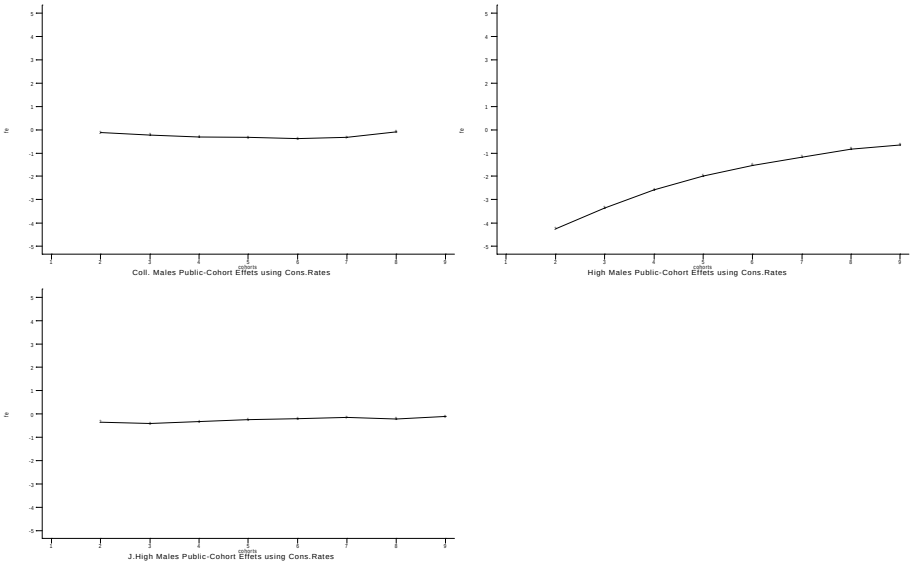



Fig.11:Males Public-Fixed Effect from Consumption Rates, P.F.

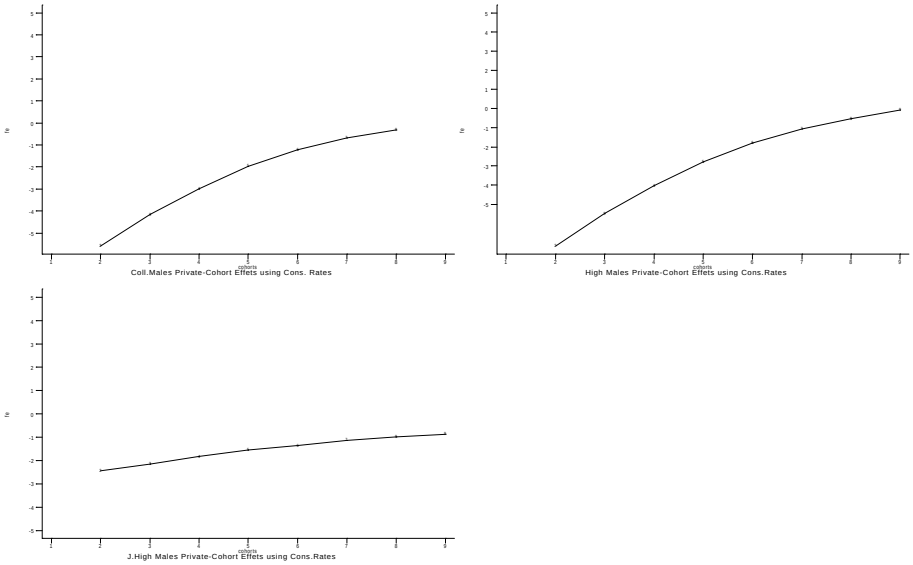



Fig.12:Males Private-Fixed Effect from Consumption Rates, P.F.

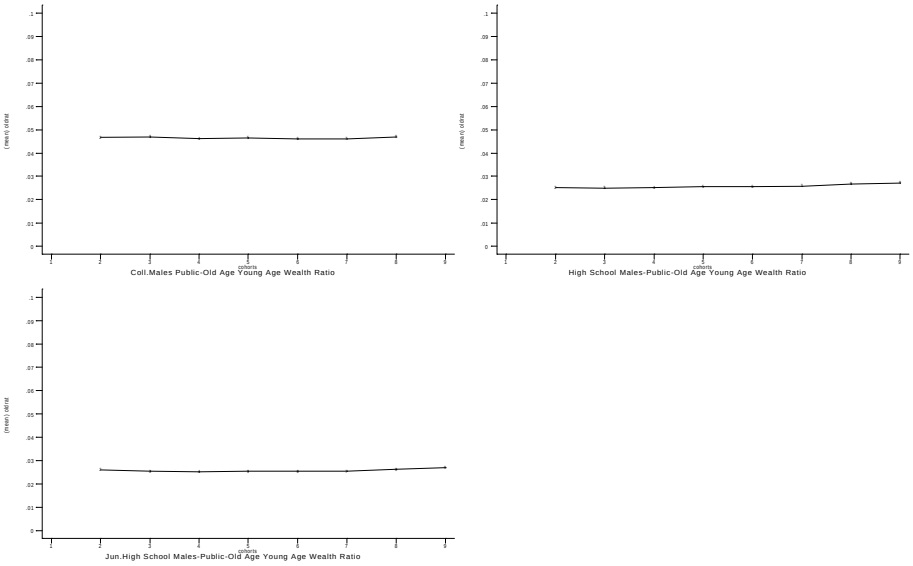



Fig.13:Males Public-Old Age to Young Age Wealth Ratio, P.F.

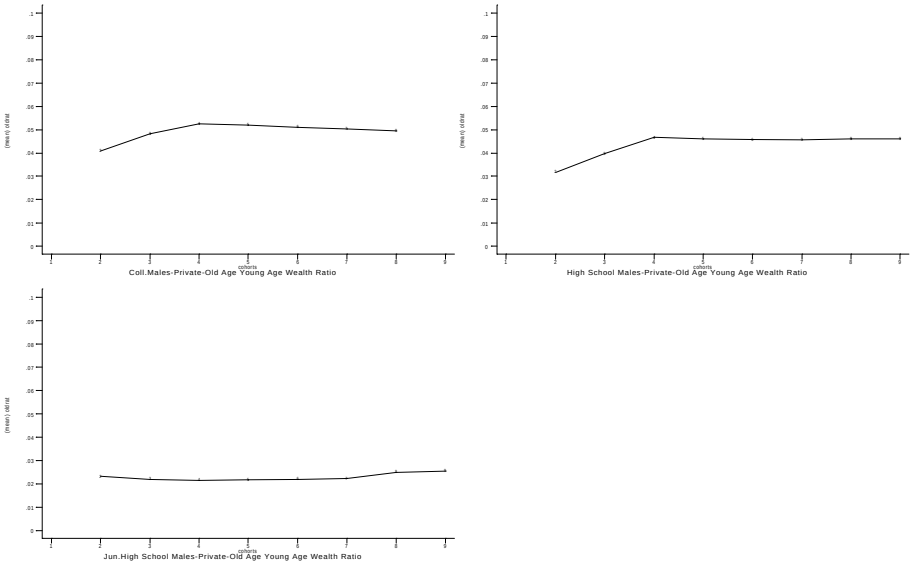



Fig.14:Males Private-Old Age to Young Age Wealth Ratio, P.F.

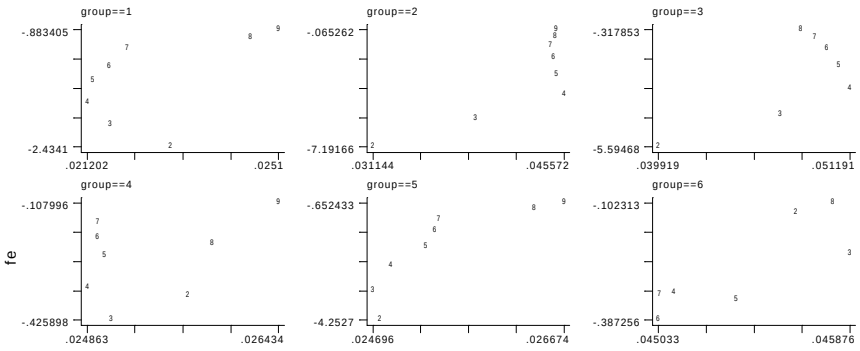



Fig.15: Plot of FE against lnoldrat, by group

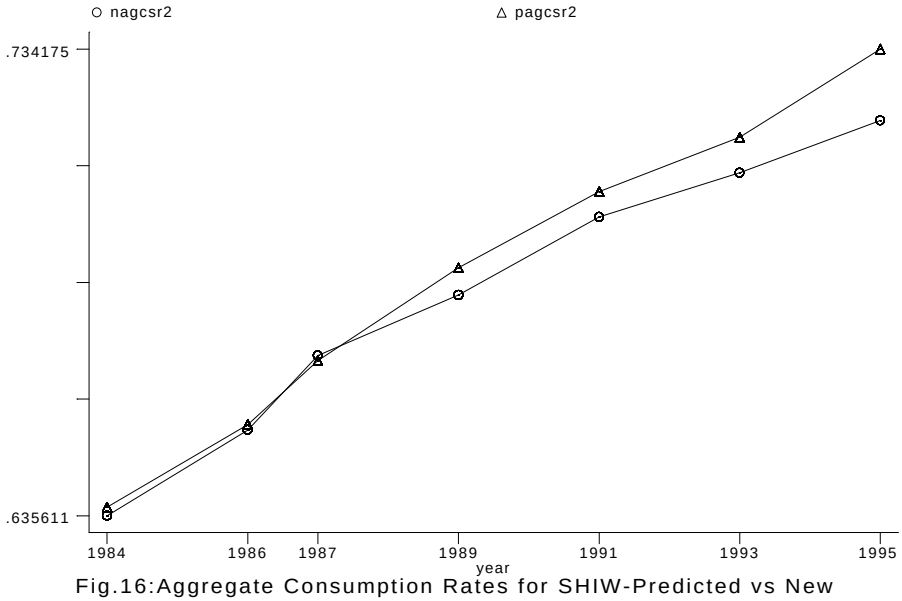



Fig.16:Aggregate Consumption Rates for SHIW-Predicted vs New

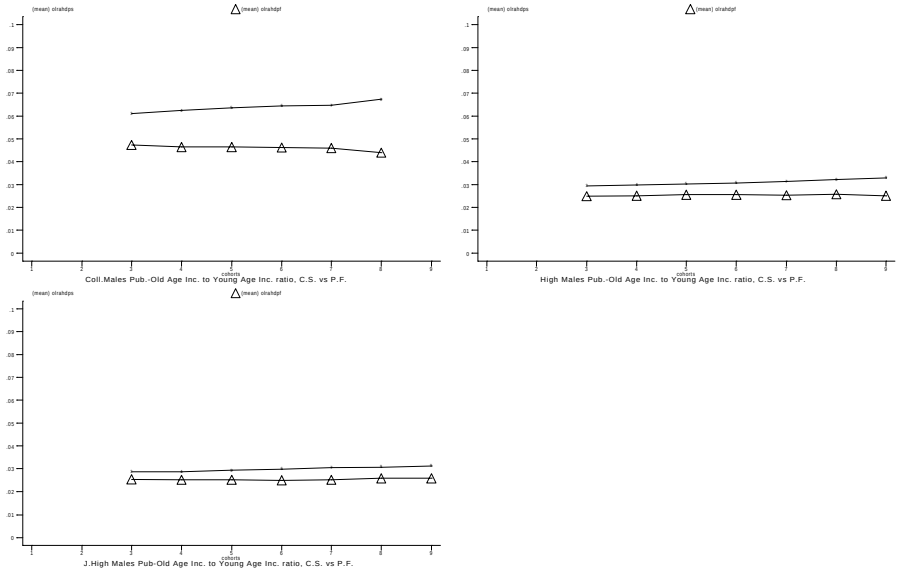



Fig.17:Males Public-Old Age to Young Age Wealth Ratio, C.S. vs P.F.

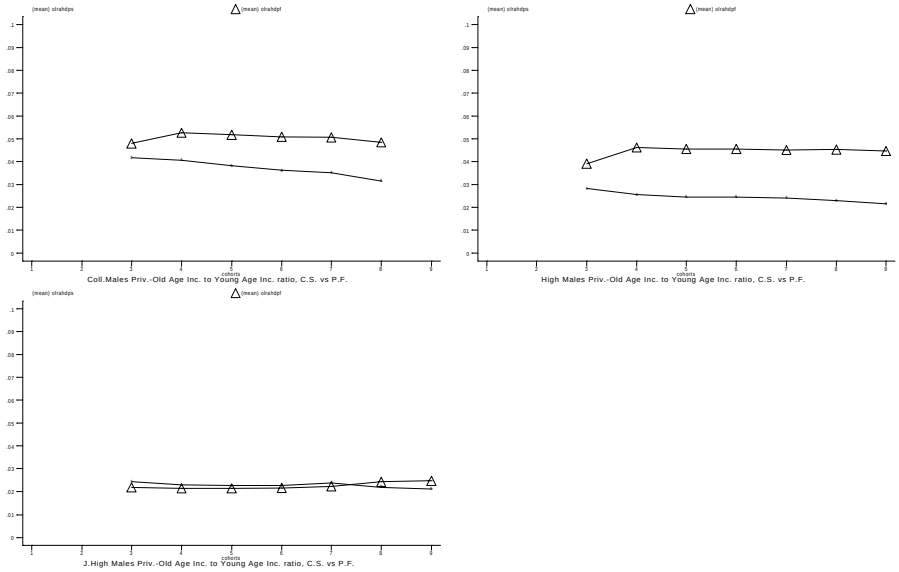



Fig.18:Males Private-Old Age to Young Age Wealth Ratio, C.S. vs P.F.

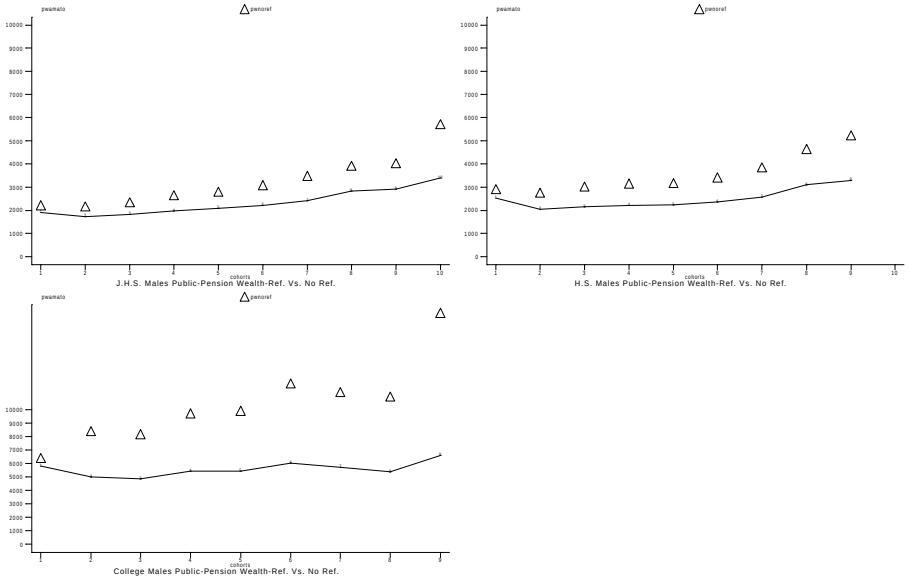



Fig.19: Males Public Employees-Pension Wealth-Reform Vs.No Reform

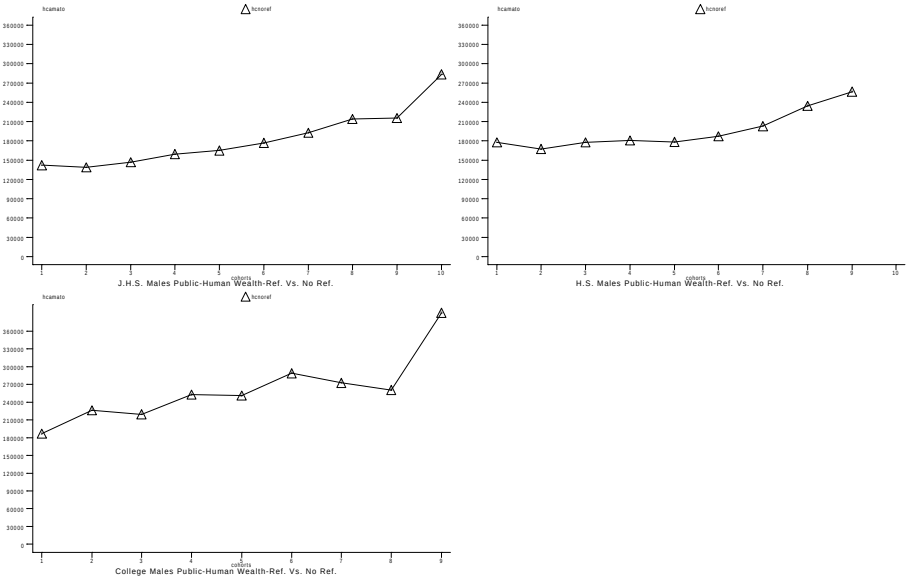



Fig.20: Males Public Employees-Human Wealth-Reform Vs.No Reform

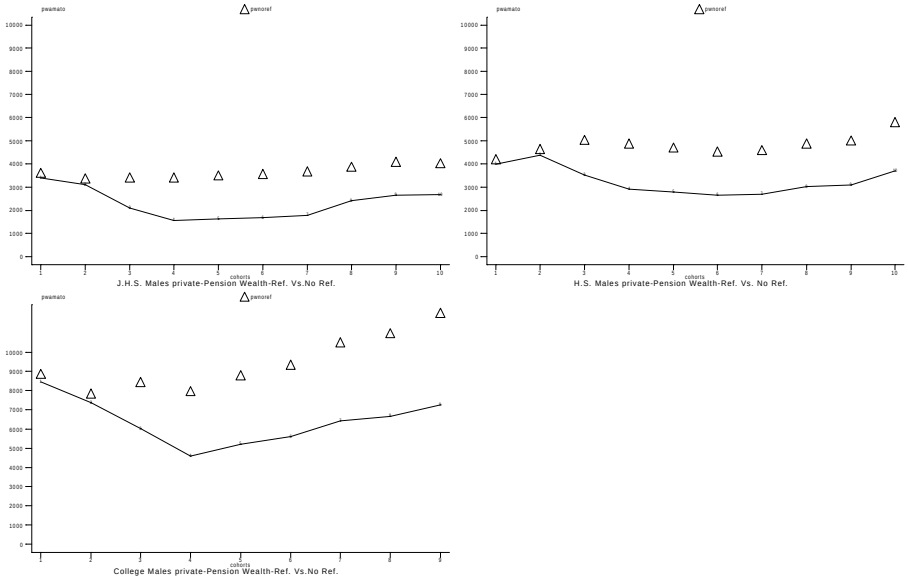



Fig.21:Males Private Employees-Pension Wealth-Reform Vs. No Reform

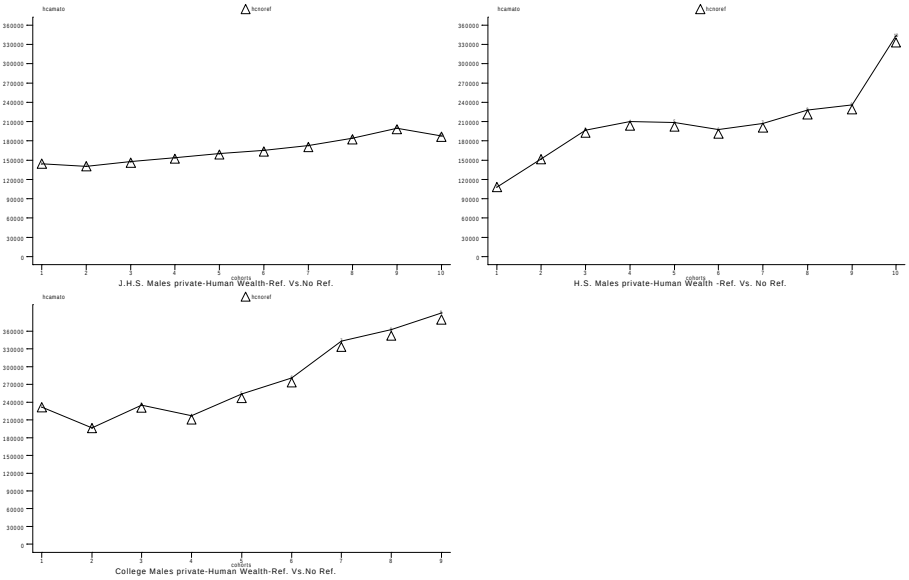



Fig.22:Males Private Employees-Human Wealth-Reform Vs. No Reform

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