Discussion Papers
Collana di
E-papers del Dipartimento di Scienze Economiche – Università di Pisa

Luca Spataro

Social Security And Retirement Decisions In Italy

Discussion Paper n. 1

2003

Discussion Paper n. 1, presentato: **Luglio 2003**

Indirizzo dell'Autore:
Dipartimento di scienze economiche, via Ridolfi 10, 56100 PISA – Italy
tel. (39 +) 050 2216 333
fax: (39 +) 050 598040
Email: l.spataro@ec.unipi.it
web site: http://www-dse.ec.unipi.it/spataro/

Acknowledgements
I am grateful to Orazio Attanasio, Jerome Adda, Carlo Bianchi, Stephen Jenkins, Franco Peracchi, the participants at the 2002 EABR Congress in Rothenburg (Germany) and an anonymous referee for helpful discussion and suggestion; Giovanni D'Alessio for providing me with the data. Financial support by MURST Funds "Progetti di interesse nazionale" is also acknowledged. The errors are my responsibility alone.

Si prega di citare così:
Spataro Luca (2003), "Social Security And Retirement Decisions In Italy", Discussion Papers del Dipartimento di Scienze Economiche – Università di Pisa, n. 1 (http://www-dse.ec.unipi.it/ricerca/discussion-papers.htm).

Discussion Paper
n. 1

Luca Spataro

Social Security And Retirement Decisions In Italy

Abstract

Social Security And Retirement Decisions In Italy

In this work I investigate the responsiveness of Italian workers to the early retirement incentives provided by the Social Security (SS) and try to shed light on the nature of the puzzling age-60-spike in the retirement hazards. The empirical analysis carried out on a sample drawn from the panel of the Bank of Italy Survey on Households' Income and Wealth (SHIW) shows that SS has very much to do with the high early exits rates from labor-force experienced by Italy during the last decade; yet, not all the SS incentive measures analyzed turn out to really matter to individuals: for example, the Replacement Ratio appears to fit the data fairly better than the Social Security Wealth, while both "one-year" and "lifetime" dynamic incentive measures fall short in explaining retirement behavior; in fact only two of the latter forward-looking parameters come out to significantly affect the probability of retiring. According to the estimations binding eligibility constraints are only partly responsible for the empirical age-60-spike of retirement hazards: in fact evidence of significant unexplained factors (possibly "social rules or "rules of thumb") is provided. Finally, I find evidence of spouses coordination and relevant family composition effects among Public Sector employees, while the achievement of adequate income and wealth levels appear to significantly delay the age of retirement of Private Sector workers.

Classificazione JEL: H55, J26
Keywords: Social Security, Retirement Decisions, Panel Data, Survival Analysis

Index

1. Introduction

Understanding how individuals decide the timing of retirement has become a crucial issue for Italy, where tightening reforms of the National Social Security (SS from now) system have already been introduced in early 90s and other reforms are likely to be implemented in the near future. Yet, studies assessing the determinants of retirement are very recent and results are still contradictory, so that very little can be said about the effectiveness of any reforms in improving activity rates. While there appears a general consensus on the generosity of the SS system to be the leading explanation of the sizeable early exits from labor force experienced by Italy during the last decades, there is still little evidence on the degree of workers' sensitivity to such SS-provided incentives. Clearly, shedding light on this point is preliminary and necessary to the implementation of whatever reform aiming at encouraging the postponement of retirement. Moreover, the pronounced spike of retirement hazards at the "normal age" (age 60) documented in previous works is still an empirical puzzle whose nature requires further investigation. Intuition suggests that the spike has much to do with retirement rules, that is with eligibility constraints, however to my knowledge no studies have explicitly dealt with this issue. In this work I propose an empirical analysis trying to bring new evidence on the determinants of retirement choices in Italy; more precisely I contrast the role played

by *forward looking* versus *short sight* incentives to retirement and by other socio-demographic factors. Furthermore, I discriminate between Private Sector and Public Sector employees in order to investigate whether the detected differences in the behavior of such categories are to be imputed to different SS rules or (also) to different underlying preferences.

On methodological grounds, the cornerstones of this works are two important lessons given by the recent literature on retirement. First, as several authors have pointed out, retirement is likely to be a decision made by rational, forward looking individuals who, in order to maximize their lifetime utility, typically contrast present SS wealth accumulation opportunities with those occurring at some time in the future. Starting from the work by Stock and Wise (1990) on the *Option Value* of retirement, many works have shared this assumption and assessed its relevance by both estimating structural forms (like Rust (1989), Gustman and Steinmeier (1986) and Rust and Phelan (1997), for Italy Spataro (2000)) and reduced forms of retirement decisions (Lumsdaine, Stock and Wise (1992) and, for Italy, Brugiavini and Peracchi (2001)). The reduced form approaches are most directly related to the methodology adopted in the present paper, in that I carry out a Survival analysis on Italian male employees. Second, recent works have highlighted the importance of the identification issue of the retirement incentive effects estimated by reduced forms (see Krueger and Pischke (1992) Coile and Gruber (2000) and Chan and Stevens (2001)). These authors recognize the difficulty to disentangle the role of earnings from that played by SS incentives, since the latter are a (non linear) function of the former and, in turn, the former are likely to be endogenous to unobserved tastes for retirement. Not accounting for this issue generally leads to biased estimates of the SS incentives effects. To address this point Coile and Gruber introduce a new measure, the *Peak Value,* which, by both discriminating between SS and pensions and isolating heterogeneity due to wage variation among individuals, provides an exogenous source of variation of SS wealth accumulation and, thus, they argue, allows unbiased estimations of SS incentive effects. Chan and Stevens share the same concerns about the correlation between Social Security (or private pension) incentives and underlying unobserved tastes for retirement, but go further by arguing that not even private pensions represent an exogenous instrument of identification; thus, by carrying out a panel data analysis, they allow

for fixed-effects estimations that explicitly account for unobserved heterogeneity (however, as for the dependent variable, the authors choose individuals' subjective probabilities of working beyond certain critical ages, which is not directly comparable with previous studies on actual retirement choices). In fact these authors find that significant bias of coefficients on SS incentive estimations is produced when omitted variables are not taken into consideration.

I draw on the insights of this literature, in that on one hand I use panel data and, on the other hand, I check for the validity of the exogeneity assumption upon SS incentives variability. However, I also depart from previous works in a number of aspects. First of all, I present a discrete-time Survival Analysis whereby I regress retirement hazards over a set of economic and socio-demographic covariates. Data comes from the Bank of Italy Surveys on Income and Wealth (SHIW) and in particular, as already mentioned, I focus on male employees retirement decisions occurred between year 1988 and 1995, that is prior to and after the introduction of the major reforms of early 90s; in this way I complement the analyses carried out for Italy so far, which have used either different sub-samples of the SHIW or completely different datasets (see the next section for a brief review). Second, I put an emphasis on binding eligibility constraints for explaining part of the variability of the data, which has been probably understated in previous studies. Another contribution I propose is the econometric test of some new forward looking measures which I have presented in the twin-paper: the first of them, which I call the *Marginal Cost of Retirement* (MCR) has two major properties: first, it unambiguously identifies and quantifies the main root of distortion of the retirement choice, that is the wedge over the gross wage brought about by the actuarial unfairness of the SS benefit formula; second, through a simple extension, it provides a forward-looking measure of SS incentives to early retirement (which I refer to as the *Minimum Cost Value (MCV))*. Finally, following the same criterion used for the latter measure, I develop and test a forward looking extension of the *Accrual,* which is referred to as the *Minimum Tax Value* (*MTV*).

The main findings can be summarized as follows: first, while unobserved heterogeneity is not of particular concern, there is evidence that SS-provided incentives play a crucial role in determining the shape of the retirement hazards in Italy; yet, the degree of perception or importance to individuals of such measures varies significantly: in fact, while static incentives do appear to

matter (and in particular Replacement Ratios more than Social Security Wealth) the contribution of "one-year" dynamic incentives (such as Accruals and MCR) turns out to be negligible; on the contrary, the forward-looking behavior hypothesis finds support, although not for the whole specifications adopted: in fact only the MTV measure and a previously estimated *Option Value* function, which incorporates a sizeable preference for leisure, high intertemporal discounting and risk aversion, come out to significantly affect the probability to retire. In the light of this it can be concluded that SS incentives, both static and, to some extent, forward-looking, do matter to male Italian employees. The third result is that, according to the model, the puzzling age-60-spike is mostly due to binding eligibility constraints, although associated with other unexplained factors (plausibly social rules or "rules of thumb"). Fourth, as for other socio-economic variables, on the one hand family composition is especially important for Public Sector workers: in particular, the negative impact on hazards of the age difference between spouses supports the hypothesis of coordination among couples about the timing of retirement. On the other hand, the achievement of eligibility and house ownership appear to be particularly compelling goals before retiring for Private Sector employees.

The paper is organized as follows: after sketching the main findings of the literature on retirement in Italy, I describe the data and illustrate the model adopted for the empirical analysis. Next, I present the econometric results, while concluding remarks will end the paper.

2. Previous related literature

As previously noted, so far the literature has produced puzzling answers on the determinants underlying retirement behavior in Italy. On the one hand, some works tend to support a positive answer as to whether SS incentives do really matter in retirement decisions: Brugiavini (1999), for example, analyzes early retirement incentives provided by the Italian legislation before the 1993 reform and enlightens their particular relevance; the author finds significant differences in labor force participation choices for individuals who have been differently affected by the reform: in

particular, retirement is postponed if pension wealth is lowered[1]. Similarly, Blondal and Scarpetta (1998) show that the low work force participation rates in Italy, if compared to the other OECD State members, can be explained by the generous incentives to early retirement provided by the SS system[2]. In a reform simulation the authors find that an actuarially fair system would raise the old-age male activity rate from 45% of 1995 to more than 70%.

On the other hand, several authors question these conclusions: Miniaci (1998), for example, finds a certain rigidity of retirement choices with respect to a 10% increase of the pension-to-last-wage ratio. Spataro (2000), adopting the *Option Value* framework for Italian male employees before 90s reforms, brings evidence of an empirical puzzle due to excess of retirement at age 60. In other words, he argues that the consideration of economic factors only partially explains the spike of retirees at that age, which, again, leads to suspect some rigidity of retirement behaviors. The author, however, does not explicitly discriminate between Private and Public Sector workers, thus failing to account for a likely important source of heterogeneity. Finally, Brugiavini e Peracchi (2001), using the National Social Security (INPS) dataset, obtain mixed results about the effects produced by some reforms for Private Sector employees, in that the changes in the retirement hazards do not imply any substantial improvement of the mean retirement age. In their estimations the authors use a mix of dummy variables for explaining the peaks of hazard rates at certain ages, which, although improving significantly the performance of the model, leaves the empirical puzzle of the age 60 spike substantially (and economically) unexplained.

All this considered, it can be said that the puzzling results of the recent works call for further investigation about the preferences underlying the retirement choices of Italian workers. In particular, *should the retirement behavior rigidity be confirmed, the same effectiveness of the reforms in enhancing the activity rates should be revised and new corrections considered (such as, for example,*

1 The author selects two groups: those who at 31/12/1992 had paid contributions for more and less than 15 years, respectively. The estimates, however, are probably distorted by the stop to "seniority pensions" imposed by the government in 1993 (on this point see section 5).

2 Blondal and Scarpetta (1998) perform a longitudinal, macroeconomic analysis using an OECD countries panel. However, the authors reckon that a relevant amount of the variance among countries is explained by the "fixed effect", that is by non-economic (and unspecified) elements.

tightening requirements for minimum retirement age and/or more effective incentives to work prosecution).

3. The econometric model and the Social Security incentives

In the empirical analysis I adopt a version of the Proportional Hazard framework which allows to deal with discrete-time (or yearly grouped) data[3]. In particular I focus on eligible individuals in order to assess the role played by eligibility rules, which, as already mentioned, has been accomplished in previous studies. As for the model, the first reason for such a choice relies on the presence of "left truncation" and "right censoring", affecting the data; by the former I mean that individuals can present "delayed entry" into the observation set (since the starting moment of becoming at risk of retirement is not necessarily observed for all individuals), while by "right censoring" I refer to the fact that, since agents are observed not necessarily up to "failure" (retirement), many observations happen to be censored.[4] Second, the model can accommodate time varying covariates, which in my model are represented (among others) by the SS incentive measures and are supposed to have a strong influence on the decision of exiting the labor force. Finally, since the SHIW does not provide the exact date of workers' retirement, but the year only, I choose a discrete-time hazard model: more precisely, the Cox's (1972) extension of the Proportional Hazard with a complementary log-log link for the hazard function[5], whereby the baseline hazard depends on a quadratic polynomial of age, the duration variable. In the section that follows I sketch the main features of the model adopted for the econometric estimations of the retirement hazards.

---

3 See Jenkins (1995) for a clear and extensive illustration of the model.

4 Thus, they are typically associated to a zero value (zero meaning "still working" and one "retired" by the current year, respectively) whether or not they are re-interviewed and whatever decision about retirement they will take in the future (see next subsection). For more detailed information about censored data analysis see Maddala (1983) and Kalbfleisch and Prentice (1980).

5 Also probit and logit regressions were tried out, but I do not present them here as the results were quite similar (and in general slightly worse) to those stemming from the model presented here.

3. 1. The hazard function in a discrete-time framework

Let us define the hazard at duration t, for individual *i* ($\lambda_i(t)$), as the conditional probability of retiring at that "time"[6], given that he has survived (at work) through that point:

$$\lambda_i(t) \equiv \lambda_{it} \equiv \Pr(T = t | T \geq t; X_{it}), \qquad [1]$$

where $T=(1,2...)$ is a discrete time variable (duration) with unspecified probability $f(t)=Pr(T=t)$ and X_{it} a set of covariates varying over time and across individuals *(i)*. If one then defines the survival function S_{it} as the probability that for individual *i* survival time *T* is at least *t,* so that:

$$S(t) = S_{it} = \Pr(T \geq t; X_{it}) = \sum_{z=t}^{\infty} f_{iz}\ , \qquad [2]$$

it can be shown that the following property holds:

$$S_{it} = \Pr(T > t) = \prod_{z=1}^{t-1}(1 - \lambda_{iz}), \qquad [2']$$

and, consequently, the unconditional probability of retiring in period t is:

$$\Pr(T = t) = \lambda_{it} S_{it} = \lambda_{it} \cdot \prod_{z=1}^{t-1}(1 - \lambda_{iz})^{7}. \qquad [3]$$

Thus, the Likelihood function of the sample can be written as:

$$L = \prod_{i=1}^{n} \cdot \left[\lambda_{it} \cdot \prod_{z=1}^{\tau_i - 1}(1 - \lambda_{iz}) \right]^{\eta_{it}} \cdot \left[\prod_{z=1}^{\tau_i} \cdot (1 - \lambda_{iz}) \right]^{1-\eta_{it}}, \qquad [4]$$

---

6 In this section time is equivalent to "duration", although calendar time does not coincide with duration time necessarily (see the following footnote). In any case in the current analysis the duration variable is age.

7 Actually, the same property applies in case of "delayed entry", in that individuals enter the observation set, say, in with duration $r>1$; in this case the new formulation of [3] would be $\Pr(T = t_j \,|\, T > r-1) = \lambda_j \cdot \prod_{z=r}^{t_j - 1}(1 - \lambda_z)$. The underlying assumption here is that hazard rates are not dependent on duration and that censoring is non-informative (see Jenkins (1995), p. 133).

where $i=1...n$ is the number of individuals observed in the whole sample, τ_i the last period of duration (or observation) for agent *i*, $\eta_{it}=1$ if by duration *t* individual *i* retires and *0* otherwise. Finally, after some manipulation, and expressing again the hazards as functions of the set of covariates X_{ji}, the equation above can be expressed in logarithmic terms:

$$LogL = \sum_{i=1}^{n} \sum_{z=1}^{\tau_i} \{[\eta_{iz} \log \lambda_{iz}(X_{iz})] + [(1-\eta_{iz}) \log(1-\lambda_{iz}(X_{iz}))]\}. \qquad [5]$$

By this formulation, the η can be interpreted as an independent Bernoulli observation with probability given by the hazard λ for individual i at duration t. The econometric formulation used for estimations depends on the particular function assigned to the hazards; in this work, as already mentioned, I adopt a Proportional Hazard function with complementary log-log link. This means that the hazard function has the following expression: $\lambda_{it} = 1 - \exp[-\lambda \exp(b(t))]$, where $\lambda = \exp(X'_{it}\beta)$ and $b(t)$ is the baseline hazard function. As a consequence, the complementary log-log function, $d(t) = \log\{-\log[1-\lambda_{it}]\}$ is a linear function of the covariates set. Finally, in order to take into account unobserved heterogeneity, in this framework one can add a random variable whose complementary log-log function is a normally distributed variable with zero mean and variance equal to one. I now turn to the explanation of the covariates (both static and time-varying) entering the set X_{it} and capturing the SS incentives faced by individuals. The other socio-economic variables are presented in the subsequent section.

3. 2. The Social Security incentive measures

I now turn to the presentation of the SS incentive measures used in the analysis, starting from the one referred to as the *MCR*. Let us image an individual is assessing the possibility of leaving her job and, thus, retiring in the current year, the latter being also the first period in which eligibility is achieved. I assume that decisions (and wage or pension benefits) occur at the beginning of each year; the agent can decide whether working or not for one year more, but the amount of time on the job is given and normalized to 1. Thus,

by leaving in current year t, the agent gives up her current wage (net of pension payroll tax) and obtains a flow of pension benefits up to year *D* (when she dies) which is usually referred to as "SS wealth"[8]. Formally:

$$F_{L,t} = (1-\tau)\cdot W_{L+1,t} - \sum_{i=1}^{D-t} \frac{P_{L,t+i-1}}{(1+r)^{i-1}}, \qquad [6]$$

where $W_{L+1,t}$ is the wage of year *t* after *L+1* years of work, τ is the contribution tax rate, $P_{L,t+i-1}$ is the annual pension amount corresponding to the minimum number of contributions *(L)* needed for eligibility, r is the interest rate, supposed constant for simplicity.

On the other hand, In case she keeps on working another year, she "gains" the flow of benefits:

$$F_{L+1,t} = -\sum_{i=1}^{D-(t+1)} \frac{P'_{L+1,t+i}}{(1+r)^{i}}. \qquad [7]$$

By subtracting expression [7] from [6] we get the Marginal Cost of Retiring in year *t*, which is:

$$MCR_{L/L+1,t} = (1-\tau)\cdot W_{L+1,t} + \sum_{i=1}^{D-(t+1)} \frac{P'_{L+1,t+i}}{(1+r)^{i}} - \sum_{i=1}^{D-t} \frac{P_{L,t+i-1}}{(1+r)^{i-1}}. \qquad [8]$$

More generally, in each future year *t+j*, one has:

$$MCR_{L+j/L+1+j,t+j} = (1-\tau)\cdot W_{L+j+1,t+j} + \sum_{i=1}^{D-(t+j+1)} \frac{P'_{L+j+1,t+j+i}}{(1+r)^{i}} - \sum_{i=1}^{D-(t+j)} \frac{P_{L+j,t+j+i-1}}{(1+r)^{i-1}} \qquad [8']$$

with $j=0,1\ldots(\bar{L}-L)$, where $\bar{L}$ is the maximum number of working years fixed by the law[9]. Finally, by dividing expression [8'] by the current wage, we get the Rescaled *MCR*:

$$RMCR_{L+j/L+1+j,t+j} = \frac{MCR_{L+j/L+1+j,t+j}}{W_{L+j+1,t+j}}. \qquad [9]$$

---

8 For the sake of simplicity I abstract from survivor benefits and survival probabilities. The latter are however accounted for in the estimations of all parameters presented in the section Finally, I assume that individuals start paying contributions at the beginning of their working careers.

9 See Spataro (2000) for a more extensive analysis of the MCR and of its steady state properties for Italy.

Intuitively, should the benefit formula be actuarially fair (or pensions not provided at all), the cost of retiring would be the current wage, thus reproducing a well known result stemming from microeconomic theory on labor supply. In all other cases, being the cost either bigger or lower than the wage, a distortion of work/leisure choice and, consequently, welfare losses would be brought about[10]. Notice that the RMCR is quite close to the implicit tax/subsidy of postponing retirement used, among others, by Brugiavini (1999) and by Coile and Gruber (2000), which I indicate as $B_{L+j/L+1+j,\,t+j}$; it is defined as the ratio between the expected present value of future pension benefits accrual (with negative sign), obtained from postponing retirement by one year, and the current period wage. Formally:

$$B_{L+j/L+1+j,t+j} = -\frac{1}{W_{L+j+1,t+j}}\left[\sum_{i=1}^{D-(t+j+1)} \beta^i P'_{L+j+1,t+j+i} - \sum_{i=1}^{D-(t+j)} \beta^{i-1} P_{L+j,t+j+i-1}\right]$$
$$\equiv -\frac{ACCR_t}{W_{L+j+1,t+j}} \qquad [10]$$

where β is the intertemporal discount factor; now, supposing β and r equal to 1 and 0 respectively, for the sake of simplicity, the following relationship holds:

$$RMCR_{L+j/L+1+j,t+j} = \left[-B_{L+j/L+1+j,t+j} + (1-\tau)\right] \qquad [11]$$

Consequently, if the system is actuarially fair, so that $MCR_{L+j/L+1+j,t+j} = W_{L+j+1,t+j}$, (or RMCR=1) then $B_{L+j/L+1+j,t+j} = -\tau$. On the contrary, there is an incentive to early retirement if and only if

$$MCR_{L+j/L+1+j,t+j} < W_{L+j+1,t+j} \Leftrightarrow RMCR_{L+j/L+1+j,t+j} < 1 \Leftrightarrow B_{L+j/L+1+j,t+j} > -\tau. \qquad [12]$$

From the relationships above it can be said that the third inequality to hold, rather than the positive sign of *B* (that is a positive accrual) is a necessary and sufficient condition for the

10 The analysis of SS systems optimality was presented in the seminal work by Aaron (1966); the reconsideration of such conditions under endogeneity assumption of labor supply is provided by Hu (1979) and Breyer and Straub (1993). For a macroeconomic, static analysis of the links between employment and SS see also Casarosa (1996).

presence of early retirement incentives[11]. In this sense, the *(R)MCR* seems more coherent with the microeconomic theory on labor supply and gives an immediate and exact measure of the incentive to early retirement.

A straightforward extension of such parameter is what I call the Minimum Cost Value *(MCV)* of retirement, that is the difference between the minimum marginal cost of postponing retirement in the future and the current date marginal cost. Formally:

$$MCV_t = \min\left(MCR_{t+j} - MCR_t\right) \text{ with j=1}\ldots\left(\overline{L} - L\right). \qquad [13]$$

In other words, this parameter allows for possibility that individuals: i) face a longer time-horizon than a single year; ii) compare not just the difference between flows of benefits (like in the Peak Value case) or values (like in the Option Value) but the "marginal costs": in particular, in case the marginal cost reduces as at some older age, so that $MCV_t<0$, it is more convenient for individuals to postpone retirement. Again, were the SS system actuarially fair, (so that the *MCR* in each period would equal the current salary) the decision to retire would be completely led by the difference between future and present wages. Henceforth, in order to disentangle the effect of wage changes from the SS wealth variation, I will also use a rescaled measure of the *MCV*, that is the difference between the minimum expected future *RMCR* and the current one:

$$RMCV_t = \min\left(RMCR_{t+j}\right) - RMCR_t \quad with\ j=1\ldots\left(\overline{L} - L\right). \qquad [14]$$

Analogously, one can extend the same reasoning to the Accruals, and build-up the following measure, which I call the Minimum Tax Value *(MTV);* more precisely, I define such measure as the difference between the Maximum expected value of the Accruals (with reversed sign, which can be interpreted as the

11This is property does not hold in case the subjective discount rate (β) is different from the interest rate. A deeper discussion of this case is more complex and beyond the scope of this work; however, as an example, it can be shown that in a funded system and for reasonable values of the wage growth rate and the interest rate, the MCR will be greater than (lower or equal to) the current wage if and only if $\beta < (\geq) r$. (The formal demonstration of this proposition is available upon request to the author).

minimum tax levied upon the decision of anticipating retirement by one year) and the value (with reversed sign as well) associated to the current year. By calling the negative of the Accrual as the Absolute Tax *(ATAX),* we get:

$$MTV_t = \left(\min ATAX_{t+j}\right) - \left(ATAX_t\right) \quad \text{with j=1}\ldots\left(\overline{L} - L\right). \qquad [15]$$

Again, both (R)MCV and MTV measures indicate that the higher the difference between future and current costs (taxes) comprised in the decision of retirement, the more likely individuals will tend to postpone the year of retirement.

Finally, I will compare the above parameters with the existing Peak Value proposed by Coile and Gruber (2000), defined as the difference between the Maximum future expected SS Wealth and the current one, and the Option Value by Stock and Wise (1990) of delayed retirement, that is:

$$O_{t,h}(r_t^*) \equiv V_{t,h}(r_t^*) - V_{t,h}(t), \qquad [16]$$

with $O_{,h}\left(r_t^*\right)$ the Option Value, r_t^* the year of retirement which maximizes $V_{t,h}(r)$ from year *t* standpoint and

$$V_{t,h}(r) = E_{t,h}\left(\sum_{j=t}^{r-1} \beta^{j-t}\left(W_{j,h}\right)^a\right) + E_{t,h}\left(\sum_{j=r}^{D} \beta^{j-t}\left(kP_{j,h}(r)\right)^a\right), \qquad [17]$$

is the indirect lifetime utility attainable from working through year r. For the sake of comparability with previous estimates carried out by Brugiavini and Peracchi (2001), I assume an intertemporal discount rate factor β of 0.985, the marginal utility of leisure (k) equal to 1.25, a risk aversion parameter (a) equal to unity and r equal to 3%[12]; survival probabilities are taken from tables provided by ISTAT for the years considered, while future pensions (before reforms) are indexed by 1.5% per year. Finally, as for RR measure, its relatively simple formulation (in fact it is defined as the ratio of the first pension to the last wage) makes it immediate to consider such parameter a "short-sight" indicator; however one must bear in mind that the interpretation above is a simplification, in that the RR represents also the desired standard of living for the future and,

12 I have computed all incentives with different specifications of parameters (comprising also the case in which $\beta = 1 + r$), which however do not change the qualitative pattern of the incentives and conclusions.

thus, it probably comes out of some optimization process of smoothing consumption over time; more precisely, such measure is meant to grasp the "wealth effect" of retirement. In the remainder of the work I will refer to SSW and to RR as "static incentives" and to the others as "dynamic incentives". Among the latter, I will discriminate between "one-year dynamic" and "lifetime", including the (R)MCR, Accrual, Tax/Subsidy in the former subset and the Peak Value, (R)MCV, the OV and the MTV in the latter.

4. Data and Empirical Strategy

4.1 Data description

For the empirical analysis I use the Bank of Italy Survey on Income and Wealth of Italian Households (SHIW), by focusing on male dependent householders aged 48 to 64 and belonging to the partially rotating panel available from 1989 through 1995[13].

This is an interesting period in that two major SS reforms were introduced by the Italian Government; hence, such changes represent a "natural experiment" which provides the researcher with a unique exogenous source of variation of SS incentives. This, in turn, permits to draw more reliable inferences on individual preferences underlying the choice of retirement[14].

[13] See Spataro (2003) for a detailed explanation of the selection strategy adopted for the data

[14] Among the changes brought about by the reforms, perhaps the most relevant is the temporary halt to "seniority retirement" imposed by the Government in 1993 and 1995 in order to reduce the financial bleeding of the system. However also benefit cuts via changes of the pension formula and indexation, and the rise of SS payroll taxes were introduced. See Spataro (2002) and the references contained in that work for explanations of the reforms. In any case it is worth noting that, on the one hand, it is possible that individuals may have been surprised by (two consecutive) reforms, so that they were unable to react immediately; on the other hand, it is also likely that distortions of retirement choices may have occurred during the very first years since reforms introduction, due to the mentioned temporary restrictions on early retirement, the possible induced changes of expectations on future events (such as expected raise of payroll taxes, fear of further restrictions). As a consequence, the extension of the period analyzed after reforms should allow to avoid the risk of "noisy data", provide more reliable results. This is a interesting avenue for future research.

Since the Survey provides a lot of retrospective information (concerning, for example, the year of retirement, working status and so on) I build up a sample that, by means of imputations, seeks to exploit such information as much as possible. Note that at least two possible strategies might have been adopted. The former relies on current and retrospective information obtainable from the SHIW 1995 cross-section (the first wave in which questions on individual contribution payments to the SS Fund have been reported); the latter, implies the use of the 1989-1995 panel records. Both options imply the loss of some relevant information, which, *a priori*, does not make one approach superior to the other. However, trying to minimize such losses, to use panel information and to trace back individual specific "time varying" covariates (especially family composition), I work out the following strategy[15]:

1) I select panel householders with continuous working careers during the last years, belonging to the age 48-64 interval and still at work or just retired by the first interview;

2) Next, I replicate observations for the periods not covered by the Survey (i.e. even years from 1988 to 94) by exploiting retrospective information (on retirement year, family composition and working status changes and so on). However, in order to avoid the risk of imputing information too far in time since the interview, I transfer the original records backward and/or forward by one year only (and eliminate individuals as they retire or become older than age 64).

By following this strategy, starting from the 1065 original panel individuals and the 2129 original person-year records, I end up with 4283 person-year observations covering the whole 1988-1995 period. Before presenting results for the sample, I turn to highlight some "stylised facts" concerning retirement in Italy. For this purpose I present the Figures 1-6 in the Appendix related to the stock of retirees interviewed in 1995. Thus, looking at Figures 1 and 2, that two main persisting features in male employees retirement behavior may be recognized before the reform period (i.e. prior to year 1993): in fact, retirement mostly occurs:

At age 60;
With 35 years of contribution payment.

[15] See Coile and Gruber (2000) for a similar approach:

However, a deeper insight unveils a more complex scenario, in that Public Sector workers leave the labor force both at different ages (as the spikes at ages 55-60-65 depicted in Figure 3 show) and, on average, with lower contributions (see Figure 4); in fact, these characteristics are mainly due to different SS rules affecting each Sector, since State employees were generally subject to a more favorable legislation both on eligibility and on benefit computation grounds; however it also indicates a substantial heterogeneity that needs to be explained: in other words, it is worth verifying whether the variability of retirement choices between the two Sectors is statistically significant and, if this is the case, to what extent this stems from eligibility constraints or from different underlying preferences respectively.

Furthermore, by looking at Figures 3 and 5 it is possible to recognize the changes in the timing of retirement after the 1993-95 reforms, whereby the distributions of retirement ages become smoother and more dispersed: in fact, the modal value of frequencies in such years falls down and more spikes at lower ages occur: in particular, the spikes at age 56 and 59 in 1994, and at age 61 in year 1995 are noteworthy. Such changes are confirmed by the figures reported in Table 1, which relate to the sample used for estimations; on the one hand, the percentage of individuals that left the labor force in 1993 and 1995 decreased (with the exception of year 1994): however, this fact is likely to be the consequence of the already mentioned restrictions imposed to early retirement in those years; in fact, if we look at the pension-eligible individuals sub-sample, such percentages turn out to have increased dramatically: in fact more than 20% of the latter retired after 1993, against a mean of 14% of retirement flows for the whole period considered. Note that the relatively low exit rates from labor force occurred 1993 suggest that individuals have been "surprised" by the reform, so that only in the subsequent years they were able to react to the Government tightening policies.

The other main characteristics of sample obtained are summarized in Table 2: more precisely, individuals are evenly distributed between Public and Private Sector, although about 3/4th of the eligible workers are State employees, due to the more favorable rules the latter have been enjoying before reforms. About 94% of individuals were married and by 3.7 years older than their spouses. Among eligible workers, almost 10% and 31% happen to be within their first and third year of eligibility respectively.

Finally, house owners are about 73% of the sample, although percentages are different when considering Public and Private Sector employees separately (which I do not report in the table) 76% and 69% respectively.

4.2. Estimation strategy for Social Security incentive measures

The estimation strategy has to cope with some lack of relevant information, in that:

1) Wages reported in the Survey are net of taxes, while the formula of pension benefits requires pre-taxes wages;

2) Both retrospective and future wages are needed: the former are necessary for computing the "pensionable earnings" (a sort of accrued capital linked to years of contributions and to the last wages); the latter are needed to compute the life-time earnings and some of the forward looking variables;

3) Contributions paid to the National Fund are provided only in 1995 SHIW interviews, while the wage offered to the new retirees has to be completely imputed.

In order to overcome these problems:

1) I gross up wages by using information about tax rates and releases due to family composition; this is one of the decisions which drives me to drop non-panel observations in the imputation process: in fact family composition is a time-varying variable which is not recorded for years too far in the past.

2) I perform a two-stage estimation: precisely, I first impute both wages (past and future) and contributions to the sample and, secondly, I estimate the duration model on a set of covariates X_{ji}. In order to obtain independent samples for the two steps, I regress wages and contributions by using the 1989 to 1995 and 1995 cross sections, respectively.

An alternative way of obtaining the wages could have consisted, for employees, in applying a constant growth rate to present salaries and, for retirees, doing the same after inferring wages from reported values of the first *RR* attained as a retiree; however, I choose the first solution in order to keep enough heterogeneity in the SS incentives to be exploited in the estimation, since for the measures analyzed in this work the most relevant source of variation is not the *wage level* but, rather, the *wage growth rates*: in other words, the higher the variability of the latter,

the higher the heterogeneity of SS incentives and the more precise is the inference one can obtain from the data.

Furthermore, the choice of the covariates entering the hazard equation is constrained by the identification problem brought about by the adopted two-steps procedure (see Meghir and Arellano (1992) and Meghir and Whitehouse (1996)): in other words, identification restrictions about exogeneity of the instruments to be used both in wages and contributions estimations are needed. Hence, for the first step regression I use as identifying instruments cohort effects, number of years at work, sector of activity, working careers, regional residence, education, time dummies and interaction effects.[16]

Notice that the number of working years used as instrument would be endogenous to the model (since they depend on the decision to retire estimated in the second step); however, I tackle this issue by: a) using independent samples for the two steps; b): correcting the composition effect for wages by using Heckman's two-steps procedure: in other words, wages are "purged" from the "selectivity bias" by conditioning the wage equation on the probability of being at work; for contributions estimates such correction was not necessary since the latter distortion did not turn out to be significant under different specifications of the selection equation and both by using maximum likelihood or two-steps estimators[17]. Thus, as for the wages, I run a two-step OLS of log-wages over the pooled data belonging to years 1989-1995 interval. The estimation of contributions is run carried out by means of an OLS regression on the 1995 data only. Both variables are then imputed forward and backward to the panel sample. Finally, after the imputation process, I can estimate a Proportional Hazard model with complementary log-log link, using as duration variable the age and age squared and as covariates: family composition, average lifetime wages and number of income receivers in the household, working sector, house ownership and marital status; (pooled) regional unemployment rates are used as well in order to account

[16] This assumption can be interpreted by saying that such covariates do not enter directly the hazard function, but only via wages and contributions. Notice that years of contributions paid to the National Social Security Fund and life-time working years do not necessarily coincide, although they are highly correlated.

[17] See Greene (1999) and Maddala (1983) for Heckman's correction model. The exact regression specifications and results for contributions and wages are available under request to the author.

for business cycle effects. Besides this, I control for the occupational status of the spouse and the spouses' age difference; the latter variable is meant to detect the presence of coordination within couples upon the timing of retirement. Furthermore, I use a dummy for the years (1993 and 1995) in which reforms were phased in, and try several specifications by means of dummy variables to test the relevance of binding constraints and of other non-economic factors in determining the age-60-peak of retirement hazards. Finally, since some of the covariates are derived from the estimated wages and contributions, which have been previously estimated and enter non-linearly the latent equation, I correct the regression bias by bootstrapping the standard errors[18].

5. Results

As for SS incentive measure computations, in Table 3 I report only the mean values and standard deviations, expressed in 1992 ten thousand lira; a more detailed analysis of the age distribution and variance of such measures is provided in Spataro (2003). However, I present also the statistics of the *Option Value 2* measure, which is an OV function computed according to the econometric estimations carried out separately for such model and whose parameters are reported underneath Table 3. Next, I turn to explore the heterogeneity in SS incentives in order to assess the validity of such measures as means for identifying retirement behavior. For this purpose I run OLS regressions of SS incentives over age dummies, current and lifetime wages and working Sector. As shown by the R-squared reported in Table 3, although this set of covariates has some ability to explain the pattern of SS incentives, the overall explanatory power is relatively small. With the exception of SSW, which is in fact highly correlated with current and lifetime wages, the other SS incentives show a substantial amount of variation which is otherwise basically uncorrelated with retirement, so that one may be relatively confident about the

[18] Given that the asymptotic properties of the statistics are non-normal and likely to be non-standard as well, it seems sensible not to pose any parametric assumption on their distribution.

capability of econometric estimates to capture the "net" effect of SS incentive measures on retirement choices[19].

I now present the results of the hazard rates estimations (reported in Tables 4-5), which are carried out over the eligible workers sub-sample. Results of regressions explicitly accounting for omitted variables are not reported since after several trials there comes out no significant evidence of biased coefficients due to unobserved heterogeneity. As a consequence, individual-specific heterogeneity is only accounted for by clustering standard errors over individuals. I start by commenting the performance of SS incentive measures in explaining retirement behavior and next I focus on other socio-economic variables. The first finding which is worth mentioning is that the RR measure performs fairly better than SSW (either in absolute value or in terms of the current wage, see Table 4), although the latter are generally significant and with the expected positive sign. In fact this is not a completely unexpected result, given the high correlation of SSW with lifetime (and present) wages unveiled in the analysis of SS incentives heterogeneity (see Table 3). For this reason I use the RR in the next econometric specifications dealing with the dynamic SS incentive parameters.

As far as the one year dynamic incentive measures are concerned, results depicted in the last columns of Table 4 show that these parameters fall short in explaining the variability in the retirement hazards, since their coefficients are both not significantly different from zero and wrong signed (in fact the Accrual presents the correct sign only for Public Sector employees, but it is not significantly different from zero). Similarly, the coefficients associated to the first four SS lifetime measures in Table 5 are not significant, and only the OV coefficients (and the Private Sector RMCV coefficients) present the correct sign. However, both the MTV and the OV2 coefficients turn out to be significant and with

[19] A remark about the expected signs of the new SS incentive measure introduced in this analysis is worth making. First of all, by definition, I expect the MCR to negatively affect the probability of retiring by the current year. Secondly, if for an individual the minimum future cost (or tax) comprised in the choice of anticipating retirement by one-year is higher than the one resulting from the current year decision (i.e. the RMCV and the MTV are negative) one would expect such individual to exit labor force within the current year. In other words, the higher the difference between the future and present costs of retirement, the higher the probability to retire at the current age. As a consequence both the RMCV and MTV coefficients stemming from econometric estimations of the hazards should have positive signs.

the expected sign, both for Public and Private Sector employees. As for the MTV measure, an intuitive explanation of the findings above is that the time pattern of the Tax levied on retirement is relevant to individuals, so that they anticipate retirement when the differences in between future and present Taxes on is too high. As for the OV2, given the parameter specification adopted, it must be accepted that Italian individuals are particularly risk averse, highly discounting the future and leisure adamants.

Turning to the nature of the hazards spike occurring at age 60, I test three possible hypotheses: the first conjecture argues that age 60 is relevant per se (a sort of "rule of thumb" induced by social rules); according to the second explanation only eligibility constraints do matter, in the sense that a sizable fraction of individuals retire as soon as they are allowed to do so by the law. In this case age 60 is relevant inasmuch as it "happens" to be the age in which most binding eligibility constraints disappear. Finally, the third hypothesis is a mixture of the two. Tests are performed, respectively, by verifying the statistical significance of: i) a dummy variable for age 60; ii) a dummy variable activating when individuals are within their third year of eligibility[20]; iii) a dummy which is the interaction of the previous two. Results (the best of which are reported in the tables, i.e. those stemming from the last specification) show that the second hypothesis is never significant while the others are statistically different from zero and with the correct sign. However, the third specification appears to fit better the data, with a 4 points improvement of the Log likelihood on average if compared to the first. Thus, the evidence that eligibility arguments turn out to be relevant only when associated with the age 60 dummy, leads to concluding that some non-economic factor (such as "social rules") is likely to affect retirement decisions.

As for macroeconomic factors, while there is evidence that the years in which the reforms were introduced have experienced a delay of the retirement age (perhaps mainly due to the stop to early retirement imposed by the Government) the regional unemployment rates do not affect retirement substantially[21]. Among other socio-

[20] Since contributions are estimated, I preferred to use a broader measure instead of the very first year of eligibility.

[21] In fact, the diverging signs of coefficients on such variable among sectors is likely to be due to different rules concerning the provision of a particular early retirement benefit, the so called "pre-pensionamenti", which have been often used by the government as "insurance" for older workers undergoing the

economic variables, mean future wages appear to affect negatively the probability of retirement (also specifications incorporating current wages were tried out, yet without producing relevant information): this clearly supports Coile and Gruber (2000) intuition about the relevance of such variable in affecting the probability of retirement: in fact, if the reward of the alternative option (i.e. employment) is high, individuals tend to go on working (this may also be interpreted in the sense that leisure is an inferior good or that for high-wage workers employment is a pleasure). Another relevant finding is that, similarly to Chan and Stevens's work, retirement is substantially affected by age, although with opposite sings: in the present analysis the coefficient on age is positive and significant and the squared term is negative and significant too; in any case the effect of age, given the values of parameters, keeps positive throughout the age interval under investigation, although its contribution decreases as individuals get older. Results concerning the other variables turn out to be substantially robust under several specifications: in particular, marital status and family composition are especially relevant for Public Sector employees: being married is likely to cause an anticipation of retirement, but the number of other individuals living in the household affects the hazards in the opposite way. Interestingly, among married individuals the magnitude of the age difference with the spouse lowers the probability of leaving the labor force, which brings some evidence of coordination among couples in the timing of retirement. On the other hand, for Private Sector workers results concerning marital status and family composition, although quite similar, are hardly ever significant. Moreover, the coefficients on the number of income receivers in the household and on house ownership present opposite signs for the two working categories. A plausible interpretation of such findings could be that Private Sector individuals are more constrained on income and wealth grounds (also due to less favorable benefits and eligibility rules), so that it takes more time to them to reach the desired standard of leaving for old age: in fact, contrary to State employees, house-ownership appears still a significant concern for such workers by the late years of their working careers.

---

risk of unemployment; in any case the negligible statistical relevance of parameters does not allow any robust interpretation of these coefficients.

6. Conclusions

In the present paper I investigate the role played by both Social Security (SS) incentives and other socio-economic variables in determining the retirement choices of Italian male employees in the late 80s-mid 90s. Such period is particularly interesting in that the 1993 and 1995 SS reforms, which have tightened eligibility rules and cut SS benefits, provide an exogenous source of variability in the SS incentive measures and, thus, help getting robust statistics on the effect of these parameters on retirement behavior. For this purpose I adopt a discrete-time Survival analysis framework whereby I can directly estimate retirement hazards. As for the data, I build-up a sample by exploiting the panel information provided by the Bank of Italy Survey on Wealth and Income of Italian households (SHIW).

As far as SS incentive measures to early retirement are concerned, I adopt and classify several measures according to whether they are static (Social Security Wealth, Replacement Ratio) or dynamic. Among the latter, I discriminate between short sight (or one-year measures: Accrual, Implicit Tax/Subsidy) and forward-looking (or lifetime) parameters (i.e. the Peak Value and the Option Value). Moreover, I introduce some new dynamic parameters: the Marginal Cost of Retirement (MCR), the Minimum Cost Value (MCV) and the Maximum Tax Value (MTV) and test their role in explaining the shape of older cohorts' exit rates from labor force. Due to missing crucial information, the empirical strategy is particularly cumbersome, in that, wages need to be grossed up and, the same as for contributions paid to the National Find, must be imputed: for this purpose I obtain them from regressions over workers belonging to the whole SHIW 1989-to-1995 cross-sections.

The main findings of the empirical analysis can be summarized as follows:

1) It is not the level of Social Security Wealth that matters in retirement choices, but, rather, the replacement ratio. Such parameter is by far the most important (in terms of Likelihood gains) among the whole set of SS incentive measures analyzed.

2) Neither short sight or almost the whole set of forward looking dynamic measures of SS incentives turn out to be significant in the original specification adopted for computations. In fact only the Option Value measure presents coefficients with

univocally correct signs; however, such coefficient are significant too when the OV function is computed according to previously estimated parameters. Also the MTV measure turns out to be relevant for both Public and Private Sector employees, so that, summarizing, at least for these measures the hypothesis of forward-looking behavior cannot be rejected.

3) Eligibility constraints appear to be one of the possible explanations of the age-60-peak of exit rates, although the presence of other unexplained factors associated to the choice of retiring by age 60 (such as "social rules" of "rules of thumb") is supported by the data.

4) As for other socio-economic factors, family composition and coordination in retirement choices within the household does seem to play a significant role for Public Sector employees only; on the other hand, Private Sector employees seem to be particularly concerned with the achievement of eligibility and of an adequate standard of living for the old age: in fact, for the latter category of workers, house-ownership before retirement seems to be an especially compelling goal.

5) Finally, on policy grounds, given the relevance both of the static and some forward-looking SS incentives, the present analysis would suggest that a reform to be effective should make the pension profile particularly steep with respect to age: more precisely, the reduction of the starting level of pensions obtainable upon eligibility achievement, and the provision of actuarially increasing benefits, would plausibly reduce retirement rates and, consequently, enhance the labor-force participation of older cohorts.

Appendix A: Figures and Tables

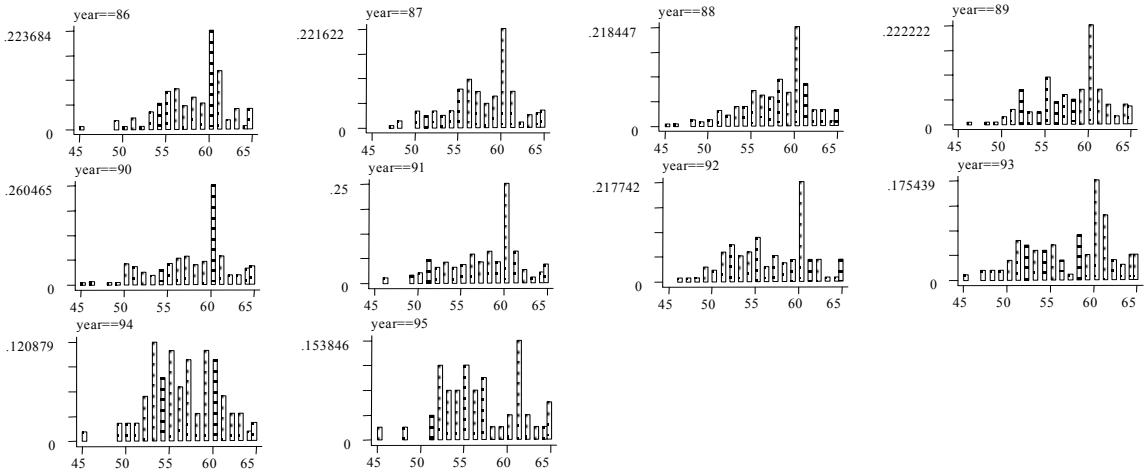

Figure 1. Private Sector employees: age at retirement

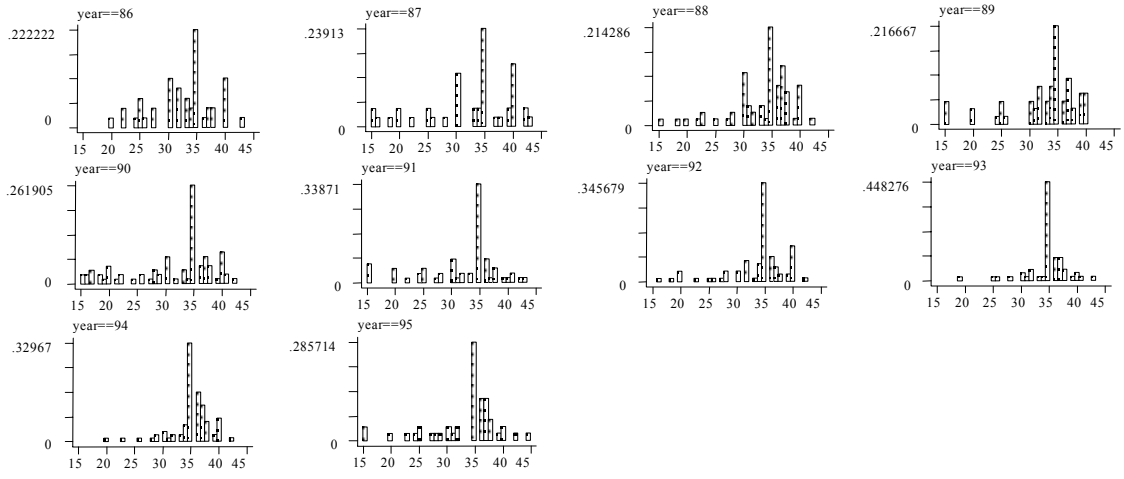

Figure 2. Private Sector employees: contributions at retirement

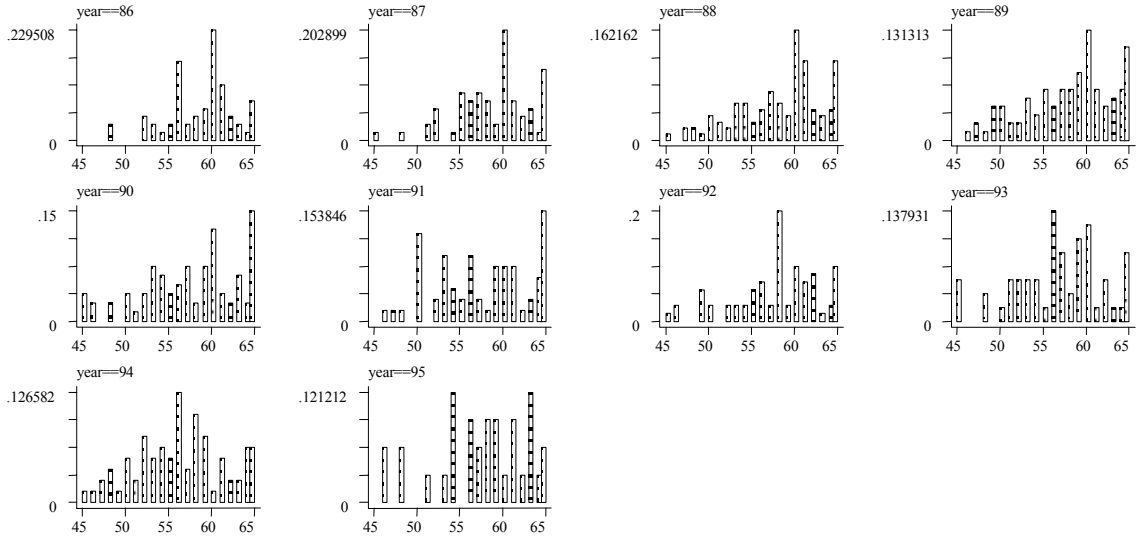

Figure 3. Public Sector employees: age at retirement

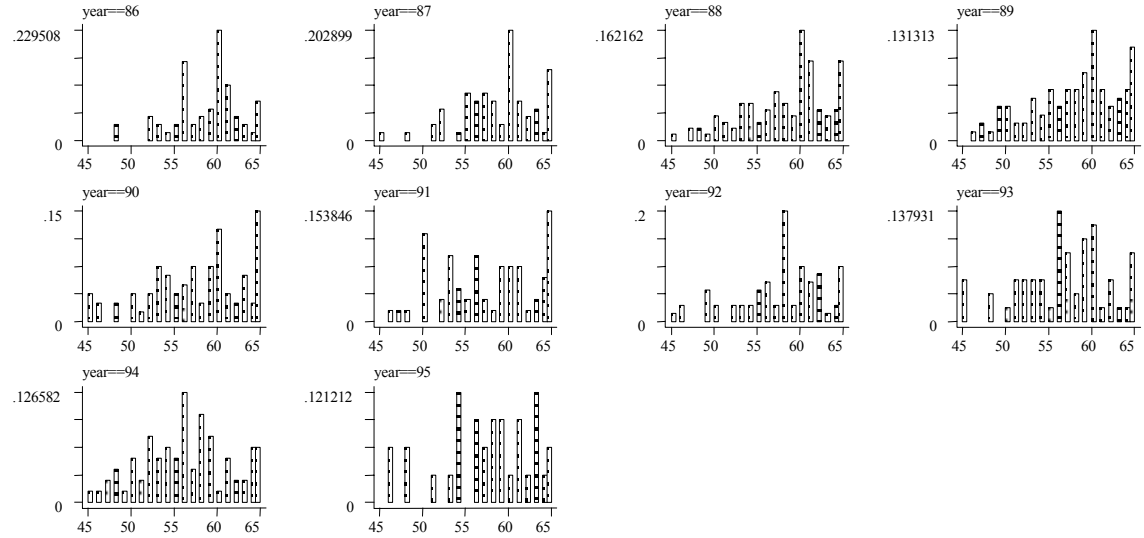

Table 1

Data description. Retirement flows in Italy out of householders belonging to the labor force: 48-64 age interval (percentages in parentheses)

Year	Whole sample		Eligible individuals	
	Retired	Obs	Retired	Obs
88	34 (10.49)	324	21 (11.29)	186
89	34 (10.79)	315	29 (15.34)	189
90	55 (8.23)	668	16 (9.09)	176
91	55 (8.10)	679	51 (11.83)	431
92	58 (8.94)	649	43 (12.95)	332
93	43 (6.66)	646	30 (15.96)	188
94	76 (14.81)	513	74 (21.20)	349
95	34 (6.95)	489	26 (20.31)	128
Total	389 (9.08)	4283	290 (14.65)	1979

(Source: own sample from Bank of Italy SHIW panel)

Table 2

Data description: mean values (std. dev. in parentheses)

Variables	Whole sample		Eligible workers	
Retired	.0908242	(.2873925)	.1465387	(.3537348)
Age	53.52977	(4.039649)	54.82719	(4.337092)
Married	.9434975	(.2309164)	.9484588	(.2211547)
Age difference with the spouse	3.750876	(4.225686)	3.848914	(4.257856)
# of Family Components	3.80014	(1.193251)	3.811521	(1.217229)
# of income recipients	1.924352	(.8983209)	1.939363	(.9063096)
House owner	.7286948	(.4446851)	.7367357	(.4405159)
Wife Without income (if married)	.5785664	(.4938464)	.5745326	(.4945386)
Public sector worker	.5052533	(.5000308)	.7326933	(.4426656)
First Eligibility Year	.0537007	(.2254524)	.0990399	(.2987911)
Within three years from eligibility	.3191688	(.466209)	.3112683	(.4631293)
Lifetime mean gross wage*	2.746767	(1.34243)	2.927936	(1.297603)
SS Contributions paid	30.88373	(5.092422)	32.75442	(4.784362)
Regional unempl. rates	8.733365	(5.023914)	8.780697	(5.013184)

** (1992 lira divided by 10000, and after age 47)*

Table 3

SS incentives: mean values (std. dev. in parentheses)

Variables	Whole sample			Eligible workers		
	Means	**Std. Dev**	**R^2*** **	**Means**	**Std. Dev**	**R^2*** **
SS wealth*	29.81579	(26.55597)	0.37	49.107	(21.9043)	0.78
RR	.3177619	(.3501008)	0.29	.6877081	(.103917)	0.24
Accrual*	1.808744	(9.893276)	0.046	-.7432019	(4.08748)	0.037
Implicit Tax/Subsidy	-.584031	(2.952204)	0.048	.2520136	(1.34699)	0.046
RMCR	1.555253	(3.463674)	0.026	.2774141	(1.22011)	0.048
Peak Value*	14.16625	(19.74688)	0.31	.683178	(6.06542)	0.086
OV	25.76937	(30.24325)	0.33	5.53279	(13.1773)	0.42
OV2**	.0018883	(.0030865)	0.18	-.000222	(.000437)	0.09
RMCV	-2.06011	(3.306035)	0.12	-1.08578	(1.66899)	0.27
MTV	-10.5449	(21.56007)	0.16	-2.43476	(7.46146)	0.10

**year 1992 10000 It. lira;*

***OV2 (Option Value 2) computations: risk aversion parameter:0.2; marginal utility of leisure: 1.61 (1.71) if age higher than 59 and 1.82(2.21) otherwise, for Public (Private) Sector employee; intertemporal discount factor: 0.74 (0.70) if Public (Private) Sector employee.*

****R-squared resulting from regressing the SS incentive over Current Earnings and Average Life Time Earnings polynomials, age dummies and Working Sector*

Table 4.

Estimation Results of Proportional Hazard: static and one year dynamic SS incentives (Std. Errors in parentheses)

Variables	SSW		SSW/Current Wage				RR		Accrual		Tax/Subsidy		RMCR
P*SS Incentive	.0191	(.01078)	.06100	(.0298)	2.7800	(1.1077)	.07402	(.0436)	-.1328	(.0590)	.07111	(.0296)	
S* SS Incentive	.0320	(.00721)	.12675	(.0306)	9.6763	(1.2559)	-.00425	(.0955)	-.07062	(.077)	.02179	(.0190)	
P*RR							3.5488	(1.204)	4.2334	(1.359)	4.0180	(1.32)	
S*RR							9.6878	(1.279)	9.8678	(1.262)	9.8452	(1.26)	
Log likelihood	-683		-684		-647		-643		-642		-644		

P and S stand for Private and State Sector respectively. The full set of covariates is presented in Table 5

Table 5

Estimation Results of Proportional hazard rates: lifetime dynamic SS incentives

Variables	Peak Value		Option Value		RMCV		MTV		OV2	
P*SS incentive	.028898	(.0254443)	-.018195	(.0157375)	-.0685847	(.0447537)	.0956853	(.0409302)	-373.329	(164.736)
S*SS incentive	.0009209	(.0160344)	-.017819	(.0121516)	.0059525	(.0716014)	.0324798	(.0154792)	-702.928	(187.0885)
P*RR	3.355857	(1.243627)	2.184026	(1.234818)	3.368727	(1.155161)	4.323734	(1.46417)	2.595789	(1.161785)
S*RR	9.706606	(1.260318)	9.182236	(1.303635)	9.654844	(1.251047)	9.931017	(1.272826)	8.99923	(1.294169)
Age	1.612886	(.4335554)	1.655964	(.4311158)	1.702166	(.4347904)	1.627731	(.4311832)	1.649414	(.4264595)
Age^2	-.0132325	(.0038062)	-.013688	(.0037858)	-.014033	(.0038061)	-.0133382	(.003786)	-.013491	(.0037367)
Age 60*less than 3 years eligibility	1.130501	(.3150052)	1.111531	(.3139347)	1.13177	(.3151704)	1.023694	(3367197)	1.106311	(.3127289)
P*Average Lifetime wage	-.2790031	(.094042)	-.194453	(.102796)	-.2347657	(.0912919)	-.2262169	(.0908709)	-.243135	(.0909594)
S* Average Lifetime wage	-.2875893	(.084707)	-.260291	(.0847669)	-.2871798	(.0853041)	-.2839439	(.0877007)	-.259078	(.0807278)
P* Age difference	-.0056957	(.0218853)	-.009046	(.0221325)	-.0048414	(.021887)	-.0032582	(.0222785)	-.006383	(.0226936)
S*Age difference	-.0441155	(.0194226)	-.044457	(.0192866)	-.0440379	(.0194409)	-.0407456	(.0194204)	-.045872	(.0187589)
P*# of Family Components	-.0793264	(.1685865)	-.043029	(.1672961)	-.0747478	(.1664197)	-.0952665	(.1704352)	-.329744	(.1755467)
S*# of Family Components	-.3115991	(.176571)	-.327163	(.1758107)	-.3118053	(.174915)	-.2665991	(.1777467)	-.070559	(.1712171)
P*# Income Receivers	-.5048636	(.2006619)	-.491494	(.1979498)	-.4897972	(.1984859)	-.5129043	(.2017797)	-.486701	(.2046239)
S*# Income Receivers	.4823656	(.2088974)	.4813873	(.2073939)	.4788943	(.2078674)	.4569078	(.2072597)	.4539724	(.2136846)
P*House ownership	.3989706	(.1736764)	.4388515	(.1783688)	.3927669	(.1738756)	.3752279	(.1755808)	.423138	(.1813062)
S*House ownership	-.0726231	(.2183329)	-.066001	(.2192663)	-.0712763	(.2193147)	-.0776056	(.2173917)	-.080088	(.2162879)
P*Married	.1717173	(.2503888)	.1813662	(.2543102)	.217356	(.2419168)	.2422657	(.2483077)	.211822	(.2599546)
S*Married	.6788764	(3726572)	.7613892	(.373067)	.6820309	(.3703152)	.6359079	(.3837093)	.80362	(.3803824)
P*Non-working wife	-.5145038	(.2071521)	-.541265	(.2024544)	-.5436805	(.2051818)	-.5515289	(.2101843)	-.496189	(.2080084)
S*Non-working wife	.0331619	(.2204979)	.045431	(.2205893)	.0323568	(.2205035)	.0367455	(.2218121)	.0287934	(.2149079)
Public Sector	-7.30877	(1.412222)	-7.48041	(1.440726)	-6.985513	(1.432)	-6.719407	(1.512429)	-7.29149	(1.454269)
Reform years (93 and 95)	-.6839789	(.1668494)	-.524285	(.1581349)	-.6384229	(.1531758)	-.8497533	(.1814993)	-.405557	(.1574022)
P*Regional unemp. rate	.0008215	(.0188821)	.0034487	(.0192886)	.007046	(.0194756)	.0041699	(.0194814)	-.001486	(.0194988)
S*Regional unemp. rate	-.014366	(.0206669)	-.011744	(.0208032)	-.0139436	(.0205338)	-.0205928	(.0211174)	-.011821	(.0209809)
constant	-50.27312	(12.24481)	-50.8235	(12.19454)	-53.03792	(12.39953)	-51.42048	(12.13724)	-51.3710	(12.12276)
Log-likelihood	-645		-643		-645		-639		-636	

P and S stand for Private and State Sector respectively; RMCV is the difference between the minimum future RMCR, and the current RMC

References

Arellano M. and Meghir C. (1992) “Female Labour Supply and On-the Job Search: An Empirical Model Estimated Using Complementary Data Sets”, *Review of Economic Studies* 59: 537-557.

Banca d'Italia: *I Bilanci delle Famiglie Italiane negli Anni 1977-199*5. Supplementi al Bollettino Statistico (Note Metodologiche ed Informazioni Statistiche), several years

Blondal S. and Scarpetta S. (1998) “The Retirement decision in OECD Countries”, AWP 1.4, OECD, Paris.

Brugiavini A. (1999) “Social Security and Retirement in Italy”, in Gruber J e Wise D (edited by): *Social security and retirement around the world*. NBER Conference Report series. Chicago and London: University of Chicago Press.

Brugiavini A. and Peracchi F. (2001) “Micro Modeling of Retirement Behavior in Italy”, prepared for the Workshop: "Socio-demographic factors and the future of the welfare state in Italy", March, Frascati (Rome), mimeo.

Chan S. and Stevens A. (2001) “Retirement Incentives and Expectations,” NBER Working Paper No. 8082,

Coile C. and Gruber J. (2000) “Social Security and Retirement”, *NBER WP*. No. 7830.

Cox D.R. (1972) “Regression models and life-tables (with discussion), *Journal of Royal Statistical Society*, Series B 34: 187-220.

Greene W.H. (1999) *Econometric analysis*, IV edition, New York, Prentice Hall.

Gustman A.L. and Steinmeier T.L. (1986) “A structural Retirement Model”, *Econometrica*, 54(3): 555-584.

Jenkins S. (1995) “Easy Estimation Methods for Discrete Time Duration Models”, *Oxford Bulletin of Economics and Statistics*, 57(1): 129-137.

Kalbfleisch J.D. and Prentice R.L. (1980) *The statistical analysis of failure time data*, John Wiley and Sons, New York, N.Y.

Meghir C. and Whitehouse E. (1996) "The Evolution of Wages in the United Kingdom: Evidence from Micro Data", *Journal of Labor Economics* 14(1): 1-25.

Miniaci R. (1998) "Microeconometric Analysis of the Retirement Decision: Italy". *OECD Economics Department W.P*. No. 205, Paris.

OECD (1995) "The Labour Market and the Older Workers", Social Policies Studies, n. 17, Paris.

Maddala G.S. (1983) *Limited dependent and qualitative variables in econometrics*, Cambridge University Press.

Samwick A. (1998) "New evidence on Pensions, Social Security, and the Timing of Retirement, NBER WP No. 6534.

Spataro L. (2000) "Le scelte di pensionamento in Italia: un'applicazione (ed estensione) del modello *Option Value*"; *Studi Economici, 72:* 25-54.

Spataro L. (2002) "New tools in micromodeling retirement decisions: overview and applications to the Italian case", *CeRP Working Papers*, n. 28/02.

Spataro L. (2003) "Social Security Incentives for Retirement in Italy", *International Business and Economics Research Journal*, n. 3, pp. 77-91.

Discussion Papers – Collana del Dipartimento di Scienze Economiche – Università di Pisa

1 - Luca Spataro, Social Security And Retirement Decisions In Italy
2 - Andrea Mario Lavezzi, Complex Dynamics in a Simple Model of Economic Specialization
3 - Nicola Meccheri, Performance-related-pay nel pubblico impiego: un'analisi economica
4 - Paolo Mariti, The BC and AC Economics of the Firm
5 - Pompeo Della Posta, Vecchie e nuove teorie delle aree *monetarie* ottimali