TFR vs Pension Funds. A Model for the Analysis of the Incentives to Adhere to the Second Pillar in Italy

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Abstract

In this paper we aim at explaining two major features of the 2007 reform of supplementary pensions in Italy for private sector employees: a) the low adhesion rates and b) the positive correlation between firms' size and adhesion rates. These outcomes are particularly worrying given that: a) the public Social Security pensions will hardly grant adequate standard of living for current generations of workers and b) almost 60% of Italian workers are employed in small-medium enterprises. In order to address these issues we first build up a theoretical framework in which we model the individual decision of adhering to supplementary pension funds, which is an irreversible choice. Differently from existing works, we allow individuals to explicitly take into account the effect of their decision to adhere to supplementary pension funds on the financial situation of the firm in which they are employed. We then carry out Montecarlo simulations in order to replicate the Italian data: our results seem to reveal that the above mentioned features of the reform are likely to be a consolidated rather than transitory phenomenon, thus casting some doubts on the long run effectiveness of the reform in enhancing the second pillar for the majority of Italian workers.

1 Introduction

The public Social Security System (SSS from now on) in Italy will hardly be able to grant adequate pension benefits to the current generations of young workers, in particular temporary workers: after the 1990's reforms that transformed the PAYG Italian SSS from a "defined benefit" into a "defined contribution" scheme,

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the replacement rate between pension and last wage of private sector employees

On the firms' size, Bardazzi and Pazienza (2005) carry out simulations aiming at estimating the cost of the reform for Italian firms. They conclude that such a cost would add up to 5% of total wages in ten years, and that, both taking into account the interest rate structure of loans and the size of the TFR stock currently held by the firms, such a cost is inversely related with the firms' size.

Calcagno et al. (2007) argue that the reform will reduce the aggregate investment by medium-small enterprises, since it will reduce the access to credit for some of them. Their analysis follows the evidence provided by Pazienza (1997) and Guiso (2003) according to which the size is a strong determinant of the success in obtaining credit from banks in Italy (see also Palermo and Valentini 2000 and Capitalia 2005 on the financial structure of Italian firms).

In the light of these results much concern persists on the effectiveness of the compensation measures conceived by the law for reducing the negative impact of the foregone TFR on the financial costs for firms (see Pammolli and Salerno 2006).

Although effective in highlighting the risk for SME's financial health brought about by the reform, the literature up to now has overlooked the role that such a factor will exert on the workers' incentives to adhere to CSS.

A partial exception is represented by Garibaldi and Pacelli (2008), in which they work out a model entailing a positive relationship between TFR withdrawals and the risk of being fired by the firm. According to their estimates, the authors argue that the 2007 reform will increase the probability of job termination by 10% in the first year for an individual adhering to CSS. Moreover, their data show that withdrawing is more likely the larger the firm employees work in. The paper, although interesting, does not take into account that such higher risk of unemployment is likely to be a key determinant in the choice of individuals as to whether adhering or not to CSS (the reason being that the above mentioned authors were focused on a different goal). However, in our opinion this aspect (the risk of unemployment) is likely to play a relevant role in the Italian economy, where the vast majority of firms (more than 90%) are concentrated in the 1-20 dimensional class and that neither the labour nor the financial market are perfectly competitive.

In our work we try to fill this gap in order to explain, on the one hand, the reasons for the partial failure of the reform and, on the other hand, the positive correlation between the firms' size and the adhesion rates. Finally, we aim at performing some forecasts on the possible future scenarios of the reform at the regime phase.

More precisely, we firstly model the decision problem faced by workers after the introduction of the TFR reform, by which they assess their incentives to remain in the old system or to permanently switch to CSS. As mentioned above, the key point of our work is that, upon taking this decision, the agent will trade off not only the advantages and disadvantages of higher but riskier returns provided by CSS relative to TFR, but also the "external effects" of his/her decision on the financial health of the firm in which he/she is employed in. Indeed, in our model firms, in case of need, can finance themselves through three different channels: (1) the TFR stock (if any) available inside the firm (2) the share (or the very entrepreneurs') capital and, finally, (3) the credit market. Given that we assume some imperfections in the capital markets and some frictions in the labour market, the choice of an individual to switch from TFR to CSS induces a damage to the financial solidity of the firm and thus, a higher risk of unemployment. Moreover, such an external effect (which we can interpret as a lack of coordination among workers) will turn out to be higher the lower the number of workers employed by the firm and, hence, will be almost negligible for workers employed in large firms.

The work is organized as follows: after presenting the institutional setting of the Italian CSS system and the 2007 reform, we then lay out the baseline theoretical framework in order to determine the economic incentives according to which individuals decide whether adhering or not to CSS. Next, we complicate the analysis to replicate the main features of the Italian economy and to explain the outcomes of the reform as well as to provide some future forecasts of them.

2 The situation of CSS in Italy after the recent reforms

2.1 The institutional framework

As anticipated, the size of the second pillar in Italy is very small. As Table A.2 in the appendix shows, the assets managed by CSS amounted to 3% of GDP in 2006 (almost 3.5% in 2008). Given the worrying perspectives of the state pension scheme, the Italian Parliament has voted in past years several measures aimed at enhancing supplementary pensions, measures which however have been scarcely effective. Thus, in 2004 the law 243, and the subsequent implementing decrees 252/2005 and 296/2006 have introduced a new reform for private sector employees, which entails the possibility of devolving future contributions for the severance fund (called "Trattamento di Fine Rapporto" -TFR) to the CSS.

The TFR is regulated by the article 2120 of the Civil law Code (Codice civile) which states that each firm has to put aside, for each tenured worker (hence, "atypical" workers are excluded), about 1/13th of gross salary per year. Since such contributions are capitalized at 1.5% per year plus 75% of the inflation rate, until now from the firms' point of view the TFR fund has represented a cheap source of financing (also considering that such a yield has been lower than the risk-free rate of Treasury bonds in most of the past years).

Moreover, employees have the possibility to partially withdraw from such a fund, although under very specific conditions: only once, after at least 8 years of employment, up to 70% of the stock and given that withdrawing employees in each year cannot exceed 10% of the entitled employees and 4% of the workers of the firm as a whole. These withdrawals are allowed, for example, for the purchase of a house (either by the worker or by the worker's children), for medical expenditures and so on. As for fiscal treatment, besides contributions being tax exempt for both firms and employees, the annual re-evaluation of the stock is taxed by 11% (lower than the 12.5% tax rate for the returns produced by other financial investments). Finally, upon worker's dismissal, either voluntary or involuntary, the worker has the right of obtaining the whole stock of the TFR: such an amount of money (net of already taxed returns) is taxed at a fixed, favourable rate (the average of last 5 years mean-tax rate on personal income, typically about 23%).

In order to make the switch from TFR to CSS less traumatic or, in any case, more attractive for workers, the reform has, on the one hand, allowed the possibility of withdrawing from the personal fund (either partially or, in some cases completely, for example after 4 years of unemployment), thus mimicking the regulation of TFR, more than once along the whole career, every 7 years and for specific reasons, similar to the ones applying to TFR. On the other hand, a particularly favourable fiscal treatment for CSS has been introduced: more precisely, while contributions continue to be tax-exempt and returns taxed at 11%, the cumulated value of the investment obtained upon retirement (at most 50% cash, while the other part must be converted into an annuity) is taxed at 15% rate, with a further 0.3% reduction per each year beyond the 15th of contribution to CSS (and the minimum rate being 9%, granted after 35 years of adhesion to CSS). Finally, the law explicitly allows for the possibility of receiving the "employer contribution", provided that the employee adds a voluntary contribution on top of the 6.91% (currently these contributions amount to 1.16% and 1.27% of gross wage respectively).

As far as firms' are concerned, in order to partially offset the potential harmfulness of the reform for the financial solidity of enterprises, the legislator has, first of all, provided tax exemptions for contributions transferred to CSS. Moreover, it has differentiated the regulation of contributions maintained inside the firm by the workers, according to the firm's size. In particular, for "small firms" (that is, with less than 50 workers) these contributions will in fact remain inside the firm, while for "large firms" (employing more than 50 workers) they will be transferred to a State fund ("Fondo di Tesoreria" of INPS, the Institution managing Italian Social Security) and, hence, will be lost in any case, no matter the decision of the employee.

The principle of "freedom of choice" explicitly stated by the law, has been safeguarded through the mechanism of silent or implied consent. However, while the choice of switching to PF is irreversible, the option of maintaining the contributions inside the firm can be reconsidered in any future period. Several authors argue that this asymmetry of treatment, together with other critical aspects (such as the non-full portability of the "employer's contribution"), are mostly responsible for the partial failure of the reform.

In fact, the adhesion rates, after two years, are clearly unsatisfactory. As shown by Table 1, from 2006 to 2007 the rate of subscription to CSS has increased from 16.28% to 25.11% and remained nearly stable in 2008.

The situation is even worse if we consider that the above data refer to workers that have adhered to any kind of PF. If we focus only on workers that transferred their TFR to CSS and if we exclude those that had adhered to a PF before 1993, we obtain lower figures (see table 2). The latter data are probably more suitable

	Adherents to any kind of pension funds
2008	3603000
2007	3402135
2006	2161455
	Potential adherents to pension funds
2008	13870000
2007	13548800
2006	13278100
	Aggregate adhesion rates (%)
2008	25.98
2007	25.11
2006	16.28

Table 1. Adhesion to PF for private sector employees (source: Covip 2006, 2007 and 2008)

	Adherents to pension funds that contribute with their TFR (excluding pre-1993 adherents)
2008	2403042
2007	2274285
2006	1163501
	Potential adherents to pension funds (excluding pre-1993 adherent)
2008	13386000
2007	13106800
2006	12861100
	Aggregate adhesion rates (%)
2008	17.95
2007	17.35
2006	9.05

Table 2. Adhesion to PF for private sector employees that contribute with their TFR (our elaboration from Covip data)

to describe the outcome of the 2007 reform which, as stated above, aimed at favouring the switch from TFR to CSS; hence we refer to these data in the rest of the paper. A second feature which is worth mentioning is that the adhesion rates are increasing with the size of the firm, as shown in the table below. In particular, the second column of table 3 shows how total adhesions are distribuited among firms of different size and reveals that the distribution of adhesions and employment are significantly different. Consequently, adhesion rates vary greatly across size, with larger firms having higher adhesion rates, as it is illustrated in the third column.

	Distribution of employees (%)	Distribution of adhesions (%)			Total adhesion rates (%)		
Size of the firm	2006	2006	2007	2008	2006	2007	2008
1-19	40	10.70	14.10	12.50	2.43	6.15	5.64
20-49	14	9.00	10.40	9.00	5.90	12.81	11.46
50-249	18	22.80	25.40	25.10	11.05	23,62	23.38
250+	28	57.50	50.10	53.40	18.76	31.36	33.42
Total	**100**	**100**	**100**	**100**	**9.05**	**17.35**	**17.95**

Table 3. Adhesion Rates by Firm Size

In the remainder of the paper we will try to shed light on these features of the outcomes of the 2007 reform.

3 Basic model

We imagine that the economy is populated by identical firms and infinitely living workers and, as in a standard job search setup[2], we write down the flow value of being an employed worker. We start from a worker which opted for the TFR scheme. In this case he/she receives a fraction $(1-\gamma)$ of the wage w immediately and a fraction γ is kept in the firm and given back to him/her at the end of career, revaluated by a yearly rate r_{TFR} (which we imagine to

[2]See Cahuc and Zylberg (2004), *Labor Economics*, pages 109-113.

be risk-free). We imagine that instant utility is a positive function of the wage and of the end of career payments, so that it is given by $u(w, r_{TFR})$. Then, we define $V_{E,T}$ as the present expected value of the lifetime utility of currently being employed, such that the flow utility is given by:

$$\beta V_{E,T} = u(w, r_{TFR}) + \lambda \left(V_{U,T} - V_{E,T}\right) \tag{1}$$

where $V_{U,T}$ is the present expected value of lifetime utility when being unemployed, β is the discount rate, λ is the probability of losing the job. The subscript T identifies a worker that opted for the TFR scheme. In practice, the flow value of being employed is given by the flow utility from income and the expected change in the asset expected value (from employment to unemployment with probability λ).

In a similar way we can write the asset flow for an unemployed worker that opted for the TFR scheme:

$$\beta V_{U,T} = u(bw) + \delta \left(V_{E,T} - V_{U,T}\right) \tag{2}$$

where $u\,(bw)$ is the instant utility from income he/she receives when unemployed (that is, an unemployed worker receives a share b of the wage as an unemployment benefit) and δ is the probability of finding another job. Combining (1) and (2) and rearranging we have

$$V_{E,T} = \frac{(\beta + \delta)\, u(w, r_{TFR}) + \lambda u(bw)}{\beta\,(\beta + \lambda + \delta)}. \tag{3}$$

Similarly we can derive $V_{E,F}$, the expected value of being employed for a worker who opted for the CSS: the main difference is that when employed he/she receives the fixed amount $(1-\gamma)\,w$ and an amount at the end of the career which is revalued in each period at the rate r^i_{CSS} which is drawn from a normal distribution with a positive mean r_{CSS} (with $r_{CSS} > r_{TFR}$) and variance σ^2. If we call $Eu(w, r_{CSS})$ the expected utility from this source of income we have:

$$V_{E,F} = \frac{(\beta + \delta)\, Eu(w, r_{CSS}) + \lambda u(bw)}{\beta\,(\beta + \lambda + \delta)}. \tag{3a}$$

Comparing equations (3) and ($3a$) we can note that $V_{E,F}$ is strictly higher than $V_{E,T}$ only if $Eu(w, r_{CSS})$ is greater than $u(w, r_{TFR})$. This is always true for risk neutral workers (as $r_{CSS} > r_{TFR}$) but may not be true for risk averse agents. In any case a situation where $u(w, r_{TFR}) > Eu(w, r_{CSS})$ is not interesting for us: in fact in this case all workers would simply opt for TFR with no further issue: hence, in the rest of this section, we rule out this possibility.

3.1 Firms survival and endogenous separation

We imagine now that the job separation rate (that is, the probability to lose the job) is endogenous and depends on the probability for a firm to go bankrupt. Suppose that each identical firm employs n workers (or filled positions, in search theory terminology), n_f of which have opted for the CSS. Total costs are then given by two components: the total wage bills nw and the remuneration of the capital: if we define h as the the ratio of own capital over wage and r_m the rate at which capital is remunerated, the latter component amounts to $nhwr_m$. Given the existence of the TFR mechanism, firms also have a stock of resources amounting to $nk\gamma(1-s_f)w$, where k is a measure of how many periods of TFR contributions are effectively kept inside the firm by each worker and s_f is the share of workers who opted for CSS. Note that remuneration of the that stock at the TFR could be a cost for the firm but, for simplicity and without loss of generality, we assume that the stock is kept in a bank deposit yielding the same remuneration as the TFR. All this said, profits are then given:

$$\pi = Y - nw(1+hr_m). \tag{4}$$

where Y is total production. We assume that Y/n (that is the average productivity in a given firm) is a stochastic variable drawn randomly[3] with mean $w(1+hr_m)$ (so that the expected profits are equal to zero) and with a cumulative distribution function $F(Y/n)$. At a given time firms may obtain negative profits but they do not go bankrupt unless the negative profits exceed a certain threshold. The exact amount of the threshold is determined by the financial structure to which the the firm is subject. In particular we are assuming that firms, in case of negative profits, are not strictly bound to remunerate the capital (which is subject to risk and so can receive no remuneration), that they can borrow from the credit market up to nhw (that is, due to financial market imperfection they can borrow up to an amount equal to the guaranties, in terms of own capital, it can offer) and that they can temporarily use the end of period TFR stock (which is due to the workers only at the end of their career in the firm) to compensate any further loss. Under these assumptions a firm goes bankrupt only if

$$\pi < -\left[nw\gamma k(1-s_f)(1+r_{TFR}) + nhw(1+r_m)\right] \tag{5}$$

and rearranging the above we have that the condition for bankruptcy is

$$\frac{Y}{n} < w\left[1-\gamma k(1-s_f)(1+r_{TFR}) - h\right]. \tag{6}$$

Whenever productivity is below this threshold a firm goes bankrupt and all its workers lose their job.

The probability λ of losing a job is then the probability of a random draw smaller than the above value:

$$\lambda = F\left\{w\left[1-\gamma k(1-s_f)(1+r_{TFR}) - h\right]\right\}. \tag{7}$$

[3]In practice we are assuming that productivity is firm-specific but not worker-specific or, at any rate, that it is not possible to observe the exact productivity of a given worker and fire him if his/her productivity is below the wage.

Note that the presence of the TFR stock reduces the probability of separation so that this probability depends positively on s_f : in this sense the disappearance of the TFR generates a damage to the firm.

In the theoretical model, given that we assume identical firms, we imagine that an equal share s_f of workers are assigned to each firm: therefore, each firm has the same probability of going bankrupt and each worker has the same probability of losing his/her job.

3.2 Endogenous choice

Consider a worker who is currently on the TFR scheme: his/her expected utility is given by (3). This worker could, at any time, opt to permanently adhere to CSS, obtaining a higher return from work but increasing the share of workers that, in his/her current firm, opted for a PF and, thus, increasing the probability for the firm to go bankrupt; the present value for a worker that makes this choice is then:

$$rV_{E,TF} = Eu(w, r_{CSS}) + \lambda_{TF}\left(V_{U,F} - V_{E,TF}\right) \tag{8}$$

where the subscript TF identifies a worker that moved from TFR to CSS and λ_{TF} is the probability of losing the current job, that is:

$$\lambda_{TF} = F\left\{w\left[1 - \gamma k\left(1 - s_f - 1/n\right)\left(1 + r_{TFR}\right) - h\right]\right\}. \tag{7a}$$

Equation (7) and (7a) are equal but for the fact that in the latter s_f has increased by $1/n$: it is then clear that their difference is greater the smaller is the dimension of firms.

The above equations tell us that the choice of switching to CSS implies a higher expected income when working (as long as $Eu(w, r_{CSS}) > u(w, r_{TFR})$) and a higher expected utility when unemployed (in fact $V_{U,F} > V_{U,T}$) but it comes at the cost of a higher probability of being fired ($\lambda_{TF} > \lambda$) from the firm where the worker is currently employed. It is important to stress that once he/she becomes unemployed for the first time after the switch, the worker is in all aspects identical to all the rest of unemployed workers that subscribed a PF plan and his/her expected utility is described simply by ($3a$).

Comparing (7) with (7a) we can also write

$$\lambda_{TF} = \lambda + \phi \tag{7b}$$

where ϕ is the 'damage' function of switching to CSS, with $\partial\phi/\partial n < 0$ and with $\lim_{n\to\infty} \lambda_{TF} = \lambda$.

We can obtain the expected value for a worker that switched to CSS combining equations (8) and ($7a$):

$$V_{E,TF} = \lambda_{TF}\frac{\left(\beta q + \beta\lambda + \delta\right)Eu(w, r_{CSS}) + \left(\beta + \lambda\right)u(bw)}{\beta\left(q + \lambda\right)\left(\beta + \lambda_{TF}\right)} \tag{9}$$

where $q = \beta + \delta$.

Given the above, a worker would switch from TFR to CSS only if $V_{E,TF} > V_{E,T}$, that is:

$$\lambda_{TF} \frac{(\beta q+\beta\lambda+\delta)Eu(w,r_{CSS})+(\beta+\lambda)u(bw)}{\beta(q+\lambda)(\beta+\lambda_{TF})} > \frac{qu(w,r_{TFR})+\lambda u(bw)}{\beta(q+\lambda)} \tag{10}$$

and, given the irreversibility of the choice, an equilibrium will be reached only if $V_{E,TF} \leq V_{E,T}$: in this case no workers will switch to CSS and hence the share of adhesion s_f will be stable. We can rearrange the above and obtain the incentive $I \equiv V_{E,TF} - V_{E,T}$:

$$I = \frac{Eu(w, r_{CSS}) - u(w, r_{TFR})}{\beta\,(q+\lambda)} q - \frac{Eu(w, r_{CSS}) - u(bw)}{q+\lambda} \frac{1}{\dfrac{\beta+\lambda}{\phi}+1}. \tag{10a}$$

The incentive is made up of two parts: the first one represents the financial gain of switching to CSS which is clearly related to the difference $Eu(w, r_{CSS}) - u(w, r_{TFR})$, while the second part can be considered the cost of switching which depends, among other things, on the loss during unemployment $Eu(w, r_{CSS}) - u(bw)$ weighted by the 'damage' ϕ.

Some properties of the incentives are easy to derive: first, since ϕ is the only parameter depending on n and $\partial\phi/\partial n < 0$ we have

$$\frac{\partial I}{\partial n} = -\frac{Eu(w, r_{CSS}) - u(bw)}{q+\lambda} \frac{1}{\left(\dfrac{\beta+\lambda}{\phi}+1\right)^2} \left(\frac{\beta+\lambda}{\phi^2}\right) \frac{\partial\phi}{\partial n} > 0 \tag{11}$$

and second

$$\lim_{n\to\infty} I = \frac{Eu(w, r_{CSS}) - u(w, r_{TFR})}{\beta\,(q+\lambda)} q > 0 \tag{11a}$$

The above results are extremely important: equation (11) tells us that the incentive increases as the size of firms grows while (11a) shows that for sufficiently large firms, the incentive is necessarily positive.

We can also see that

$$\frac{\partial I}{\partial\left[Eu(w, r_{CSS}) - u(w, r_{TFR})\right]} = \frac{q}{\beta\,(q+\lambda)} > 0 \tag{12}$$

$$\frac{\partial I}{\partial b} = \frac{\phi}{(q+\lambda)\,(\beta+\lambda+\phi)} \frac{\partial u(bw)}{\partial b} > 0 \tag{12a}$$

that is, when the direct gain in utility from being at the CSS increases or when the loss from being unemployed decreases, the incentive to switch becomes higher.

Both h and k affect negatively the probability of failure λ and hence the value of the incentive. However, their effect on the latter is ambiguous in that, as we can see from equation (10), a change in λ affects in the same direction both the 'financial gain' and the 'cost of switching', so that the final effect depends on the exact specification of λ and $u(.)$.

Through this section we have somehow given for granted a relevant point, that is, when considering the possible alternatives that a worker faces, we did not consider the possibility that he/she simply postpones the switching to a future period. Indeed this third possibility can be ruled out because it is always suboptimal as we demonstrate in Appendix B. This said, equation $(10a)$ represents the value of the incentive to switch from TFR to CSS: when that value is above zero workers find it convenient to switch to a PF. Depending on the exact functional forms of the instant utility and of the cumulative density function of the productivity shocks there could exist one or more values of s_f that make the incentive equal to zero, that is any worker indifferent between the choice of switching to CSS or not.

3.3 A simple case: uniformly distributed shocks

Suppose that Y/n is drawn from a continuous uniform distribution that ranges from 0 to 1, that is $F(x) = x$. In these circumstances equation (11) and the properties described by (12) and (12a) still hold and in addition we have that:

$$\lambda = [1 - \gamma k (1 - s_f) w (1 + r_{TFR}) - h] \tag{13}$$

and that

$$\phi = \gamma k (1/n) w (1 + r_{TFR}) \tag{13a}$$

which tell us that s_f only influences λ and not ϕ. Then, we examine how the incentive depends on the share of adhesion simply deriving equation (11) with respect to s_f:

$$\frac{\partial I}{\partial s_f} = \left[-I + \frac{Eu(w, r_{CSS}) - u(bw)}{(\beta + \lambda + \phi)^2} \phi \right] \frac{1}{(q + \lambda)} \frac{\partial \lambda}{\partial s_f}. \tag{14}$$

A few results follow from the above: first, for negative values of the incentive the derivative is always positive; second, when the incentive is positive the sign is undetermined and is defined by the sign of $\frac{Eu(w,r_{CSS})-u(bw)}{(\beta+\lambda+\phi)^2}\phi - I$; finally when n is large enough ϕ tends to zero and $I > 0$ and the derivative is necessarily negative.

In figure 1 we represent two possible shapes of the incentive function: in one the curve is always positive, in the other it crosses the horizontal line between 0 and 1.

We can now determine the value s_f^* for which the incentive is zero:

$$s_f^* = 1 - \frac{1 - h + \beta}{\gamma k w (1 + r_{TFR})} + \left[\frac{Eu(w, r_{CSS}) - u(bw)}{Eu(w, r_{CSS}) - u(w, r_{TFR})} \frac{\beta}{q} - 1 \right] (1/n)\,; \tag{15}$$

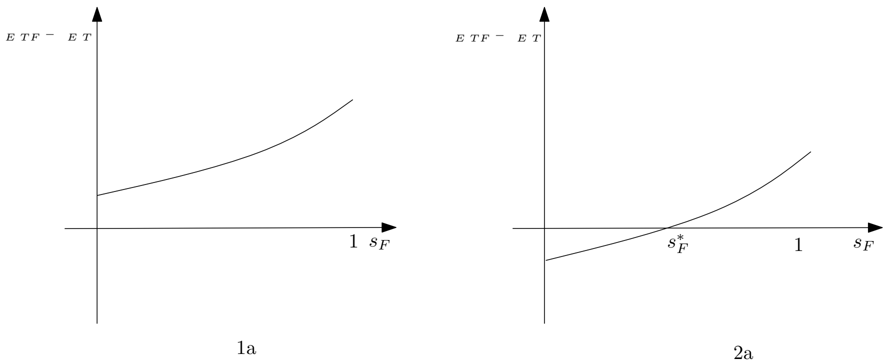


Figure 1: Shapes of the incentive function

given the properties of the derivative of I with respect to s_f we know that s^*_f cannot be a stable equilibrium (in fact the I curve cannot cut the horizontal axis from above); hence s^*_f is rather a threshold: when we are below that value no further adhesions occur and s_f stays constant at its current level, when above that value all workers find it convenient to switch and s_f eventually reaches one.

We can examine how this threshold changes when some of the parameters change:

$$\frac{\partial s^*_f}{\partial h} = \frac{1}{k\gamma w\left(1 + r_{TFR}\right)} > 0 \tag{16}$$

$$\frac{\partial s^*_f}{\partial k} = \frac{1 - h + \beta}{k^2\gamma w\left(1 + r_{TFR}\right)} > 0. \tag{16a}$$

The derivatives above indicate that the more financial robust are the firms, the higher is the threshold value. This result might be puzzling, but it is due to the fact the probability of bankruptcy is increased linearly by the adhesion of a worker. Under these circumstances workers find it more convenient to switch if the firms are already likely to go bankrupt because they know they would stay in the current firms only for few periods.

The last result we derive is

$$\frac{\partial s^*_f}{\partial n} = \left(\frac{\beta}{q}\frac{Eu(w,r_{CSS})-u(bw)}{Eu(w,r_{CSS})-u(w,r_{TFR})} - 1\right)\frac{1}{n^2} > 0 \quad \text{for } \frac{\beta}{q}\frac{Eu(w,r_{CSS})-u(bw)}{Eu(w,r_{CSS})-u(w,r_{TFR})} > 1. \tag{17}$$

The latter case is particularly interesting because it tells us that as long as $\frac{\beta}{\beta+\delta}\frac{Eu(w,r_{CSS})-u(bw)}{Eu(w,r_{CSS})-u(w,r_{TFR})}$ is above 1 larger firms should exhibit a lower threshold value of s_f (or possibly no positive value at all).

In truth equation (15) is positive in s_f and below 1 for most of the realistic values of the parameters. This means that, under the hypothesis of uniformly distributed shocks and without agents' heterogeneity there exists a threshold value of s_f which constitutes an unstable equilibrium. Above that value, and in the absence of frictions, all workers switch to CSS, while below that value no further worker does. It follows that the outcome in terms of participation rates is binary, either the initial level of s_f or 1. In addition, the variation of the conditions of the system affects the value of the threshold, determining the likelihood of ending in one of the two possible outcomes; for example, a higher size of firms decreases the values of the threshold and, hence, increases the probability that all workers switch to the CSS.

4 Simulation Strategy and Results

In order to enhance the degree of realism of our work, in this section we introduce more general assumptions on the distribution of shocks of firms' productivity and allow for heterogeneity of both individuals and firms. Needless to say, the cost of this gain will be the loss of closed form solutions, such that we have to resort to Montecarlo simulations to assess the outcomes of our model.

At this stage of the research, given the lack of information on some key parameters, we decided to adopt the following empirical strategy:

a) to use existing data when available, or to resort to proxies for all other variables;

b) to calibrate the model in order to replicate the data on aggregate adhesion rates and the shape of the relationship between the latter and the firms' size before the 2007 reform.

c) to use the parameters chosen under a) and b) to try to replicate the outcomes of the 2007 reform and to perform forecasts on the long run equilibria.

In fact, the reform of the second pillar introduced in 2007 represents a "natural experiment" by which it is possible to verify the sensitiveness of workers to variations of some key parameters underlying the decision of CSS subscription, such as taxation, rates of return, and so on and, hence, to test, although indirectly, the validity of our framework. In order to perform the simulation we have also to specify some further details, such as the utility functions, the tax regime and fiscal rebates, firms' contribution and so on.

4.1 Utility functions

We assume workers' preferences are represented by the following instant utility function:

$$u(c) = \frac{c^a}{a} \tag{18}$$

where c is the consumption in a given period and a is the risk aversion coefficient (with a below one the worker is averse to risk, with a above one, he/she is risk prone). Workers' income from employment comes in two forms: an amount $(1-\gamma)\,w$ which is immediately paid (and consumed) to the workers and an amount γw that will be given to him/her only at the end of career, revaluated at a certain rate. Since we are dealing with infinitely living individuals, de facto this latter part increases individual wealth so that we assume that in each period a worker, in order to pursue consumption smoothing, sells (and immediately consumes) this annuity to a bank, which in exchange anticipates money by applying a rate r_c. We call p_i the amount the worker gets from the sale of this annuity (the subscript i indicating either the TFR or the CSS) with p_i depending on the rate of return from the investment scheme as well as on the fiscal regime and fiscal rebates, on additional contributions from firms and on the age of retiring: the exact formula to compute p_i it is described in Appendix C. Note that the computation of p_{CSS} is based on the random variable r_{CSS} and so that p_{CSS} itself will be a random variable with a distribution that we compute numerically.

We can then write the expected utility of an employed worker as

$$Eu(c_i) = \int_{-\infty}^{+\infty} f(p_i)\, a^{-1} \left[(1-\gamma) w + p_i\right]^a dp_i \tag{19}$$

where $f(p_i)$ is the probability density function of p_i (note that p_{TFR} has a degenerate distribution).

When unemployed the individual receives a fixed amount bw and we assume, without loss of generality, that he/she keeps contributing to a scheme equivalent to the previously chosen one, his/her expected utility being

$$Eu(c_{U,i}) = \int_{-\infty}^{+\infty} f(p_i)\, a^{-1} \left[(1-\gamma) bw + p_i\right]^a dp_i. \tag{20}$$

4.2 The mechanics of simulation

The simulation of the model works according to a simple mechanics. Each worker is generated drawing his/her specific parameters from a normal distribution and is then assigned to a firm whose parameters have been randomly drawn as well. We then compute the value of the incentive function for that worker and according to that value we determine whether he/she switches to CSS or not. However, we assume that a worker with positive incentive does not automatically switch; rather, we imagine that he/she has a probability α of doing it. This means that there are some frictions in the process of switching and we can imagine that these are due to misinformation, lack of financial literacy or a sort of aversion to changing: all these aspects are measured by the parameter α. We imagine that the information is shared among workers belonging to the same firms so that α will be the same for all workers of a given firm.

Once the incentives of all workers have been computed and the actual number of them that switched has been determined, a new period begins, where a new s_f is determined in each firm according to what happened in the previous periods. New values for the incentives are then computed and workers that were still at the TFR can opt to switch if their incentive is positive. This procedure goes on for several periods until the incentives of all workers are zero or negative: at that point an equilibrium is reached and the value of s_f becomes stable. In order for the simulations to be statistically significant, we perform the simulation with 4 millions firms (roughly 12 millions individuals).

Obviously, the outcome we obtain strictly depends on the values of the parameters of the model, parameters which represent the characteristics of the workers, of the firms and of the system as a whole.

In particular, each worker is defined by the degree of risk aversion and by the rate at which he/she discounts the future; moreover in order to allow heterogeneity among agents, these parameters vary and we assume they are drawn from normal distributions with means and standard errors described in the table below.

Workers Parameters		
	Mean	Standard Error
Discount rate	0.02	0.0066
Risk aversion coefficient	-2	1.5
Share of risk averse workers	95%	

Table 4. Workers' parameters

We set the risk aversion equal to 2 because there is a wide consensus in the literature that this can be a realistic value, for instance Schlechter (2007); its variance was chosen to deliver a reasonable share of risk averse population.

The financial structure of the firms are basically determined by two parameters: the amount of TFR payments that are kept within the firms (k) and the ratio of own capital over total wage bill (h), both measuring how much the firms can rely on these sources of credit before going bankrupt. Data from k were taken from Ministry of Labour and Social Policies (2002) and data for h were derived from Bardazzi and Pazienza (2005).

Each firm is also defined by the presence or absence of an agreement with a occupational PF: the probability of this occurrence was proxied to the ratio between potential adherents to occupational PFs over total private sector employees, so that it measures the probability that a worker can effectively subscribe to an occupational pension fund which grant the extra contribution from the employer. Finally, the value of the parameter representing the degree of information α (that we assume to be firm specific), in the absence of exact information, was chosen according to some proxies taken from two different surveys. More precisely, we set $\alpha = 0.5$ in the pre-reform, that is the percentage of workers interviewed in 2002 from Bank of Italy who declared either to be unable to predict their future pension or not to be in the need of a supplementary pension. As for the post reform, we could rely on a more precise proxy and we set $\alpha = 0.7$ because the ISAE (2005) survey showed that, at the end of 2005, 71% of workers were informed about the TFR reform and the possibility to switch to CSS. The values of the parameters for the firms are summarized in the table below.

Firms Parameters		
	Mean	Standard Deviation
Amounts of TFR payments kept within the firm	5.17	1.72
Capital Share over total wage bill	0.339	0.113
Degree of information (pre-reform)	0.5	0.16
Degree of information (post-reform)	0.7	0.23
Agreement probability (pre-reform)	0.69	
Agreement probability (post-reform)	0.78	
Ratio of Standard Error over Average Productivity	0.33	

Table 5. Firms' parameters

There are also several parameters that define and describe the economic system and therefore are common across all firms and workers. These parameters determine aspects of the labour market (the hiring rate and the replacement rate), of the credit markets (interest rates on loans to firms and interest rates on consumer credit), and of the CSS working (the contribution to TFR/CSS as a share of wage, the tax rate on the contributions and on the interests, the real returns on CSS and TFR). The data for the unemployment benefits were obtained as the average of the replacement wage that was fixed by law during the period we are examining. The values of expected return of PF are another key issue. For the simulation of the pre-reform phase we used historical data and we adopted the average rate of return of PF for the years 1999-2006, as given in Cesari et al. (2007). Things were more complicated for the post-reform simulation: first, long enough time series are not present and second, the 2008 financial crisis is likely to have induced lower expectations on the CSS returns. Hence, we decided to vary the pre-reform expectations using as a proxy the reduction of the returns on long terms government bonds (10 years BTP in our case) in the second part of 2008, according to the data provided by Bank of Italy.

Moreover, the reforms introduced some benefits for those workers opting for the CSS, in the form of better fiscal conditions: in the simulation we use those benefits to compute the annuity p_i as described in Appendix C. Finally, in our model average productivity is simply a numeraire on which wages are based. Therefore values of productivity and wages are simply chosen to be in scale with the rest of the variables. All values used in the benchmark simulation are summarized in Table 6.

System Parameters		
	Mean	Standard deviation
General Parameters		
Contribution to Tfr or PF as a share of wage	0.691	-
Contribution to PF from firm	0.0116	-
Voluntary contribution to PF from worker	0.0127	-
Hiring Rate	0.9	-
Consumer credit rate	0.05	-
Return rate of capital	0.05	-
Pre-Reform Parameters		
Pre-Reform Nominal Return of Pension Funds	0.045	0.02
Pre-Reform Inflation Rate (average 1996-2006)	0.025	-
Tax Rate on TFR contribution	0.23	-
Tax Rate on PF contribution	0.23	-
Replacement Rate from unemployment benefit	0.357	-
Post-Reform Parameters		
Post-Reform Nominal Return of Pension Funds	0.0427	0.02
Pre-Reform Inflation Rate (average 1998-2008)	0.0242	-
Tax Rate on TFR contribution	0.23	-
Tax Rate on PF contribution	0.09	-
Replacement Rate from unemployment benefit	0.55	-

Table 6. System parameters

4.3 Simulation Results

We present now the results of the simulations, starting from the benchmark case performed according to the strategy presented above.

Two features of the results are worth mentioning. First, as it stands clear from Figure 2, the simulated participation rates neither stay at their starting level (0 at the beginning of the pre-reform period) nor reach 1, but lie somewhere in between. Second, the equilibrium value of s_f is significantly dependent on the size of the firms, with bigger firms displaying higher values of the adhesion rates. Tbl l276(92o0433749(f)-33ot54(e)774378(u)-0.575882(l)-0.382202(s)-33682202(a)0.43129

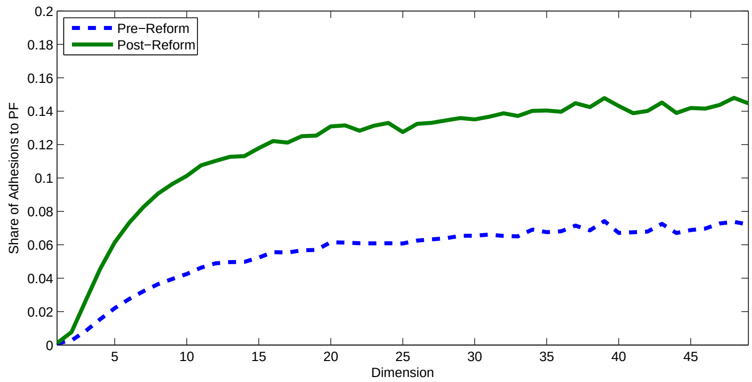


Figure 2: Adhesion rates before and after the reform

Adhesion Rates for Class Size (%)				
Class Size	**Real Value 2006**	**Simulated Value 2006**	**Real Value 2008**	**Simulated Value 2008**
1-19	2.43	2.19	5.64	5.35
20-49	5.90	6.49	11.47	13.52
1-50	3.32	3.16	7.16	7.16

Table 7. Simulation results: outcomes in terms of adhesion rates

rates almost double (or are halved in the case of variation of the standard deviation of the productivity shock), while in the case of changes of the share of firms' own capital the participation to CSS are even higher. However, if we focus on the interval $\pm 30\%$ around the benchmark values of the parameters under investigation, we can see that results are particularly sensitive to unemployment benefits, the returns to CSS and to the volatility of the productivity shocks.

On the contrary, neither the hiring probability nor the volatility of returns from the CSS appear to play a significant role. As for the former, this outcome may depend on the fact that, on the one hand, according to our model specification, unemployment lasts for no less than one period, and such a period is the one which accounts for a significant share of the loss in the life-time individual's welfare in case of firm's bankruptcy; hence, higher hiring probabilities cannot reduce the pain deriving from such an event; on the other hand, the increase of the hiring probability makes the individual better off in either states, i.e. employment or unemployment, which makes the net effect of such a change on the incentives to subscribe a pension scheme relatively small.

As for the volatility of productivity shocks, the reason for the relatively low sensitivity of the results stems from the fact that the weight of the "lottery" (i.e. the CSS returns) in the utility is rather small (according to our parameters, no

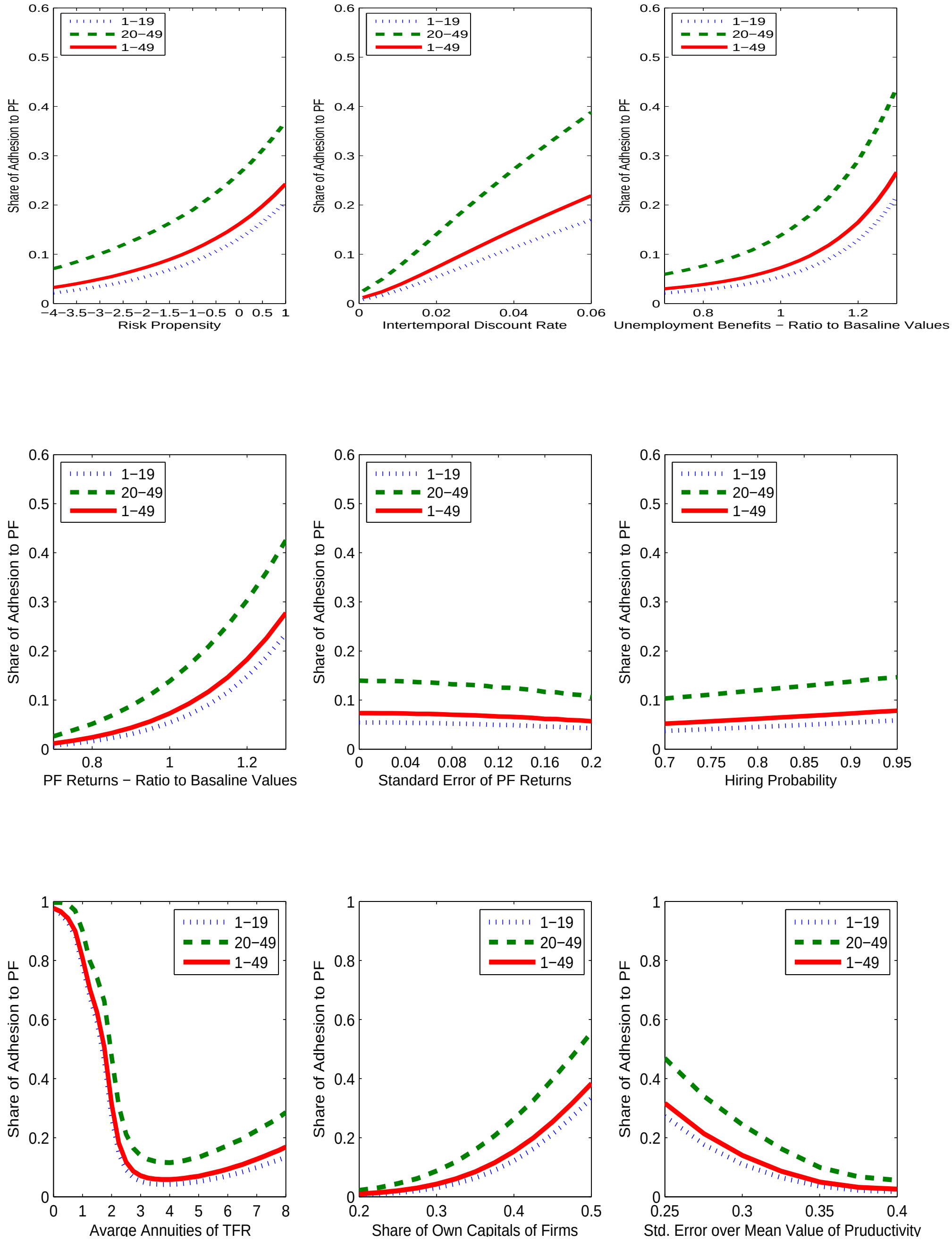


Figure 3: Sensitivity analysis for some key parameters

more than 1% of the gross wage, which is the "certain" component of the utility), such that higher losses or gains from the lottery cannot affect significantly the individual welfare. As a consequence, the decision to adhere to a PF seems to be driven mostly by the expected value of the gain rather than on its volatility, on the one hand, and on the loss of welfare in case of unemployment on the other hand.

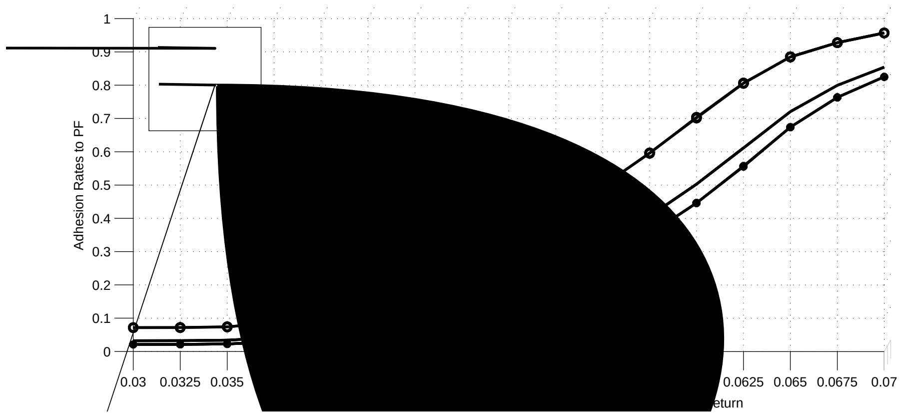
Finally, the role of k, the average number of yearly contributions to TFR set aside by the firms, is worth to be commented. As shown by the Figure, its effect on the adhesion rates is not monotonic and, more precisely, is U shaped. The reason is that, when k increases, two opposite forces are at work. On the one hand, such an increase enhances the robustness of the firm, given that the TFR is an internal cheap source of cash flow; on the other hand, it amplifies the damage that a worker's withdrawal of the TFR fund generates on the same financial solidity of the firm. According to our simulations it turns out that the latter effect tends to dominate the former for low levels of k, while it is offset for higher values of k.

We conclude this section by investigating the steady state (or long run) results of the reform; in particular, by exploring different scenarios concerning the economic performances of the CSS and the speed of the adhesion of workers (for example, due to enhanced information campaigns) we aim at assessing whether the current worrying scarce results of the 2007 reform are temporary or permanent. For doing this we perform some simulations by assuming values for the inflation rate in line with the last decade values (2.25% and 4.5% respectively) and extend the simulation periods from 2 to 15 iterations, so that the reform has enough time to display its full effects: Figures 4 and 5 show the results of such an exercise.

As for the rate of return of the CSS, it can be seen that the adhesion rate become significatively sensitive to this parameter when the latter is above 5%, values which appear too optimistic given the historical data for Italy. Similar results emerge in the presence of higher values of the α parameter, that is the share of those workers that, having a positive incentive to switch from TFR to CSS, decide to do so. In particular, in the absence of frictions in the adhesion process (e.g. α equal to 1), the adhesion rates would be boosted up to 13%, which shows that results are rather insensitive to such a parameter.

Finally, as a mere numerical exercise, we present also the effects of a change in the fiscal treatment of both returns and accrued value of contributions to CSS (recall that the current values of the tax rates are 11% and 9% respectively). According to our simulations (see Figure 6) it emerges that, in order to boost adhesions to CSS, the most effective measure would be to reduce the tax rate burdening the returns from CSS: in fact, even increasing the tax on the accrued value (in order to offset at least partly the loss in total tax revenues), such a measure would deliver significantly higher rates of adhesion to the pension funds.

The reason for this outcome is that, although particularly favourable relative to TFR, the fiscal treatment of the CSS accrued capital will display its full effects only upon retirement, which can be very far in the future in workers' life and


Adhesion Rates to PF
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.03
0.0325
0.035
0.0625
0.065
0.0675
0.07

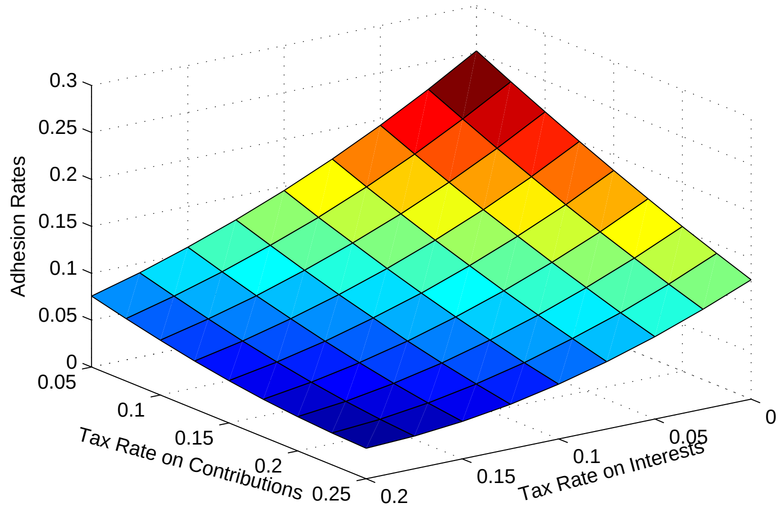


Figure 6: Adeshion rates for different levels of taxation

thus can be hardly perceived as relevant in the choice of subscribing a pension plan, especially by young workers; on the contrary the reduction of the interest rate on the CSS returns affects current flows of individuals' wealth accruals, thus making more attractive the adhesion to a pension fund. However, one has to keep in mind that such a policy (i.e. reduction of the interest rate tax and increase of the accrued capital tax) can be rather costly for the State, given that the increase of the latter tax rate would provide new resources only after several years, that is when individuals will start to retire or to withdraw from CSS (at least after 7 years, according to the reform). Indeed, such a cost could be partly offset by the increase in the adhesion rates to PFs, given that the returns from CSS and thus tax revenues, ceteris paribus, are higher than those from TFR. Anyway, the analysis of the exact cost for the State of such a policy change is beyond the scope of the present paper and is left for future research.

5 Conclusions

In this work we aim at providing a possible explanation for the results of the 2007 reform of complementary social security (CSS) for private sector employees in Italy. In particular, we build up a model in which each worker facing imperfections in the labour market, in order to take the decision of whether permanently adhering to CSS or not, has not only to trade off the direct economic advantages and disadvantages of adhering (consisting in higher but riskier returns), but also has to take into account the effects of this individual decision on the financial health of the firm in which he/she is employed in. In fact, the more workers switch to the CSS scheme, the more they indirectly induce the risk of default of the firm in which they work in, since they erode a (cheap) source of internal financing in the presence of imperfect financial markets. However, the higher the number of workers employed in a firm, the lower will be the effect of the individual decision to switch to a pension fund on the financial health of the firm.

In view of this setting, the adoption of the CSS scheme exposes workers to a twofold risk: the risk on the returns from the CSS scheme and the (increased) scenarios on the returns from CSS do not seem to overthrow the results, so that the expected adhesion rates in the regime phase of the reform will fail to reach high values. Finally, fiscal incentives have a relevant role on the adhesion rates, and in particular reductions of the tax rate on the interests are more effective than reductions in the tax rate on the final capital in increasing the long run adhesion rates.

Summing up, our results seem to grasp some basic features of the Italian experience, possibly shedding some light on the rationale and mechanisms behind it. In particular, the lack of efficacy of the reform may be due to: (a) the peculiarity of the Italian production system, populated by a large number of small and medium enterprises (SME), which have a fragile financial structure; (b) the institutional characteristics of the Italian labour market and the workers' preferences, opportunities and information sets.

A Data and Statistics

Tables is this section are taken from Covip (2008) and refers to the end of the years 2006 and 2007, unless otherwise specified.

Tab. A.1. *Gross Replacement rates between public pension and last wage for private sector employees and self-employed. Italian defined contribution scheme at the regime phase (%).*

	Before reforms	After reforms (regime phase)			
	35-40 years of contribution	Case 1: 35-40 years of contribution		Case 2: 35-40 years of contribution	
	Employees	Employees	Self-employed (or parasubordinati)	Employees	Self-employed (or parasubordinati)
60		58.46-66.82	35.43-40.49	54.18-61.47	32.83-37.25
62	70-80	62.23-71.11	37.71-43.09	57.76-65.53	35.00-39.71
65		69.85-79.83	42.33-48.38	64.86-73.59	39.30-44.6

Estimates obtained by using mortality tables of ISTAT 2004. Case 1: GDP rate of growth=1.5%, individual wages rate of growth=1.5%. Case 2: GDP rate of growth =1.3%, Individual wages rate of growth=1.6%. Contribution rates: 33% for employees and 20% for self-employed and "parasubordinati".

Tab. A.2. *PF in some OECD countries.*[(1) (2)]*Value of assets as a percentage of GDP.*

Paesi	**2002**	**2003**	**2004**	**2005**	**2006**
Australia	56.4	54.2	76.4	85.1	94.3
Austria	3.8	4.1	4.4	4.8	4.8
Belgium	4.9	3.9	4.0	4.5	4.3
Canada	48.5	47.3	48.1	50.3	53.4
Czech Republic	2.7	3.1	3.6	4.2	4.6
Denmark	26.0	28.5	30.9	33.6	32.4
Finland	49.2	53.9	61.8	68.7	71.3
France	..	1.3	1.2	1.2	1.1
Germany	3.5	3.6	3.8	4.0	4.2
Hungary	4.5	5.2	6.8	8.4	9.7
Iceland	84.3	98.5	106.9	120.1	132.7
Ireland	34.5	39.9	42.2	48.3	49.9
Italy	2.3	2.4	2.6	2.8	3.0
Japan	17.1	19.7			

sion.

We want to prove that $V^0_{E,TF} > V_{E,T} \Leftrightarrow V^T_{E,TF} > V^{T+k}_{E,TF}\ \forall\, T, \forall\, k$.

We start showing that $V^0_{E,TF} > V_{E,T} \Leftrightarrow V^T_{E,TF} > V^{T+1}_{E,TF}$

Consider the choice of switching at the Teth possible occasion and the related $V^T_{E,TF}$. An individual does not know exactly after how many periods the Teth occasion occurs, however we can call p_i the probability that the Teth occasion occurs after i periods (obviously $p_i = 0$ for $i < T$). The value of $V^T_{E,TF}$ is then given by the sum of the expected utility in the case in which the occasion (and thus the switching) occurs after exactly i periods, multiplied for the probability of that occurrence: we can then write

$$V^T_{E,TF} = \sum_{i=0}^{+\infty} p_i V^{T,i}_{E,TF} \tag{a}$$

where $V^{T,i}_{E,TF}$ is the utility an individual gets if the Teth occasion occurs after exactly i periods. The utility $V^{T,i}_{E,TF}$ is made of 2 parts: the utility the individual gets until he/she switches plus the utility he/she gets after the switch. If we call M_i the former, we have:

$$V^{T,i}_{E,TF} = M_i + \frac{V^0_{E,TF}}{(1+\beta)^i} \tag{b}$$

and then we have

$$V^T_{E,TF} = \sum_{i=0}^{+\infty} p_i M_i + \sum_{i=0}^{+\infty} \frac{p_i V^0_{E,TF}}{(1+\beta)^i}. \tag{c}$$

Note that we do not need to exactly specify neither p_i nor M_i: for the rest of the demonstration this is not necessary.

Analogously, we can write

$$V^{T+1}_{E,TF} = \sum_{i=0}^{+\infty} p_i M_i + \sum_{i=0}^{+\infty} \frac{p_i V^1_{E,TF}}{(1+\beta)^i} \tag{d}$$

where $V^1_{E,TFP}$ is the expected utility from postponing the switching until the following possible occasion.

Combining the two we have

$$V^T_{E,TF} > V^{T+1}_{E,TF} \Leftrightarrow \sum_{i=0}^{+\infty} p_i M_i + \sum_{i=0}^{+\infty} \frac{p_i V^0_{E,TF}}{(1+\beta)^i} > \sum_{i=0}^{+\infty} p_i M_i + \sum_{i=0}^{+\infty} \frac{p_i V^1_{E,TF}}{(1+\beta)^i} \Leftrightarrow V^0_{E,TF} > V^1_{E,TF} \tag{e}$$

We can reformulate $V^1_{E,TFP}$ as

$$V^1_{E,TF} = \frac{u(w) + (1-\lambda) V_{E,TF} + \lambda V^1_{U,TF}}{1+\beta} \tag{f}$$

where $V^1_{U,TF}$ is the expected utility of a worker currently unemployed but that will switch to Pension Funds as soon as he gets a job, that is:

$$V^1_{U,TF} = \frac{u(bw) + \delta V_{E,TF} + (1-\delta) V^1_{U,TF}}{1+\beta} \tag{g}$$

which can be rearranged

$$V^1_{U,TF} = \frac{u(bw) + \delta V^0_{E,TF}}{(\beta+\delta)}. \tag{g1}$$

Inserting $(g1)$ in (f), we have

$$V^1_{E,TF} = \frac{u(w)}{1+\beta} + \frac{(1-\lambda) V^0_{E,TF} + \lambda \dfrac{u(bw) + \delta V^0_{TF}}{(\beta+\delta)}}{1+\beta}. \tag{h}$$

We can now determine the condition that guarantees $V^T_{E,TF} > V^{T+1}_{E,TF}$, from (d) we write

$$V^T_{E,TF} > V^{T+1}_{E,TF} \Leftrightarrow V^0_{E,TF} > \frac{u(w)}{1+\beta} + \frac{(1-\lambda) V_{E,TF} + \lambda \dfrac{u(bw) + \delta V^0_{E,TF}}{(\beta+\delta)}}{1+\beta} = V^1_{E,TF} \tag{i}$$

which is if verified for

$$V^0_{E,TF} > \frac{(\beta+\delta) u(w) + \lambda u(bw)}{\lambda+\beta+\delta} = V_{E,TF}. \tag{j}$$

The above condition allows us to state that

$$V^0_{E,TF} > V_{E,TF} \Leftrightarrow V^T_{E,TF} > V^{T+1}_{E,TF} \ \forall T. \tag{k}$$

In addition it is easy to see that $V^T_{E,TF} > V^{T+1}_{E,TF} \ \forall T \Leftrightarrow V^T_{E,TF} > V^{T+k}_{E,TF}$ $\forall T, \forall k$ so that condition (g) necessarily implies:

$$V^0_{E,TF} > V_{E,TF} \Leftrightarrow V^T_{E,TF} > V^{T+k}_{E,TF} \ \forall T, \forall k. \tag{l}$$

Condition (h) implies that whenever $V^0_{E,TF} > V_{E,T}$ we must have $V^{T-N}_{E,TF} > ... > V^{T-1}_{E,TF} > V^T_{E,TF}$ so that $V^0_{E,TF} > V_{E,T} \Rightarrow V^0_{E,TF} > V^T_{E,TF}$.

C Determination of the pension annuities

The economic incentives comprised in the choice of adhering to CSS were approximated as follows:

First, we define the accrued value of contributions AV_y:

$$AV_y = w\gamma_y \sum_{t=0}^{T-1} (1 - c_y)(1 + r_y)^{T-1-i} \ , \ y = TFR, CSS$$

where T is the number of years of contributions to TFR or CSS (35 years in the benchmark simulation), $\gamma_y = 6.91\%$ in case of of TFR or $6.91\% + \gamma_w + \gamma_e$ in case of CSS adhesion, that is the sum of the mandatory rate (6.91%) and the voluntary share by the worker $-\gamma_w$- and by the employer $- \gamma_e$; such values were set equal to the Italian average levels provided by COVIP (2008): 1.16% and 1.22% respectively; c_{CSS} is the administrative cost of CSS, set equal to 0.44% per year, according to the estimates provided by COVIP (2008); r_y is the real rate of return of either TFR or CSS.

Second, we compute the accrued value of the (gross of tax) annuity ($\overline{p}_y$) the individual obtains by selling on the market, in each period, the accrued value of his/her contributions AVP_y:

$$AVP_y = \overline{p}_y \sum_{t=0}^{T-1} (1 + r_m)^{T-1-i}$$

where r_m is the real interest rate in the financial market.

By imposing the equality $AV_y = AVP_y$ and solving for $\overline{p}_y$ we get the expression for the annuity. Finally, we compute the net of tax annuity:

$$p_y = \overline{p}_y q_y \left(1 - \tau_y^c\right) + \overline{p}_y \left(1 - \tau^r\right)$$

where q_y and $1 - q_y$ are the shares of contributions and of interests of the accrued 63572(164Td (w)Tj /R209.96264Tf 6.575882(v)27.4316(e)-0.4607065.9626Tf 11.06990Td [( )-0.8

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