How second pillar reform can affect the redistributive impact of public pension system transition

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Abstract
In order to increase participation to supplementary funds, the 2007 Italian Budget Law has introduced a "silent-assent" mechanism allocating new flows of TFR (yearly accumulation of employees' severance pay) to pension funds. This is often thought as a way to contrast the declining trend of average replacement rates brought about by the '90s reform process.
We use an updated version of CeRPSIM, a micro-simulation model developed by Borella and Coda Moscarola (2006) that illustrates the effects of the first pillar reforms occurred in Italy between 1992 and 2004. CeRPSIM is a dynamic micro-simulation model by cohorts, developed to capture in depth the effects of both normative and earning risks. Particular care has been devoted to model the legislative framework of the reform process phasing-in and to reproduce heterogeneity in individual income and labour force participation profiles.
We enriched the model with a specific module in order to calculate second pillar pension benefits. This enables us to compute a more comprehensive (in that it includes both public and private pension benefits) replacement rate for heterogeneous individuals belonging to different cohorts, according to pre- and post-reform rules.
Taking into account various scenarios concerning policy options and pension funds performance, we look at how the participation to pension funds affects the average level of retirement benefits as well as its redistributive impact, if any.

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Introduction

The motivation that led Italy to change deeply the structure of its pension system is a common one among many European countries: population ageing and decreased fertility put under stress public pension systems' sustainability and added to already accumulated social security debt. Hence, measures aiming at keeping social security expenditure under control became unavoidable in the nineties. These measures were oriented towards the implementation of actuarial fairness principles and the gradual introduction of a private funded pillar.
Alongside the sustainability motive, incentives to the development of pension funds lay on adequacy concerns as well. As public pensions' generosity will be inevitably reduced in future years, private pensions are expected to fill this adequacy gap.
Until recently individual adhesion to occupational pensions has been very limited, however the provisions of the 2007 Budget Law seem to be right occasion for a take-off of private pensions.

The objective of the paper is to assess the potentiality of the second pillar in offsetting the reduction in substitution rates implied by the nineties' reform process. In particular, we investigate the current scenario where the "silent-assent" mechanism shall allocate new flows of TFR (private employees' severance pay) to pension funds.
The implications of pension system's reforms are analyzed by means of CeRPSIM, a dynamic micro-simulation model by cohorts built to study the transition process from DB to NDC system. The model aims at replicating the individual income heterogeneity to fully capture the redistributive impact of the transition towards the new steady state equilibrium.
In order to analyze the ability of the public and private pillars to adequately provide resources for retirement we compute a comprehensive replacement rate by adding to the program a specific module for the computation of second pillar benefits. The role of the fiscal system is also accounted for by a newly added taxation module.
Redistribution implications of the various reforms are investigated by using money's worth measures and the Reynolds-Smolensky index.

Literature [to be done]

The reform pattern of the Italian pension system

The reform process started in the nineties is driven by the purpose of recovering financial sustainability of the public social security system (first pillar).
Before 1992, pension benefits were calculated according to a quite generous defined benefit rule. Seniority pension requirements were very easily achieved and the earnings' reference period for the computation of the benefits was very short (5 years for private employees, 1 year for public employees).

The 1992 Amato reform introduced a DB formula less generous than the previous one (the modified defined benefit formula, MBD). The requirements for the seniority pension were tightened and the reference period for the computation of the pensionable income was meant to be gradually lengthened till reaching the entire working life. Furthermore benefits were indexed only to inflation instead of wage growth.
The 1995 Dini reform shifted the system to a notional defined contribution one. Pensions are to be calculated on the sole base of the contributions paid. Conversion into annuity of the present value of contributions is done according to an actuarially fair rule. However, the transition towards the new steady state is very gradual and slow. The Dini formula will be applied to the entire flow of new pensions only in 2030 and to the whole stock of pensions only in 2050, notwithstanding the two reforms of 1997 and 2004 sped up the convergence process.
The reform process will inevitably imply a reduction in benefits, as actuarially fair principles reduce the generosity of the system. Therefore, concerns on the adequacy of individual resources for retirement were the leading motivation of the legislator's initiative of rising minimum pensions (2002 reform) and to promote the development of private pensions (second pillar).

The first normative action instituting pensions funds dates back to 1993[2], but workers' adhesion remained quite low until now: only about 13% of private employees who potentially could enrol in occupational pension founds had done so in 2005 (Covip, 2006). Without going too much in detail on the legislation concerning pension funds, the major initiative encouraging workers to effectively accumulate a private pension is more recent. The main idea behind the latest reform is to use TFR as an additional resource to build a supplementary pension that will complement public pension benefits when these are likely to shrink. The TFR is a deferred wage that employers accumulate during a worker's career and then pay to empolyees upon job termination.
The Budget Law for 2007 decreed the starting from January 1st, 2007 of a "silent-assent" mechanism, by which private employees' TFR yearly flows will be automatically transferred from the employer to pensions funds as of June 1st 2007 unless workers explicitly express against this[3]. Public employees and self employed can contribute to the second pillar only on a voluntary base. Public employees are entitled to a severance pay similar to TFR but are excluded from the possibility of paying it to pension funds. The self-employed can contribute to second pillar pensions without restrictions but are not included in this automatism (as they have no TFR). They are expected to contribute substantially given their lower mandatory payroll tax rate for the first pillar
As a result, workers who opt for pension funds will receive a supplementary pension from the fund of their choice but will not be entitled to a severance pay any more.

[2] The D. Lgs. 194/93 creates pension funds in Italy and regulates the transfer of TFR flows to occupational pension funds on a voluntary base. Then the D. lgs. 299/99 introduced – for a limited period – the possibility to transform in bonds the TFR flows to be paid to pension funds (the so-called "*cartolarizzazione*").
[3] The same law introduced another mechanism whereby TFR funds not transferred to pension funds are paid to INPS, only for larger firms and supposedly only for a given period. However, this does not change substantially the normative setting on which the present paper is based.

The rules applying to current and future retirees

The actual public pension system distinguishes three groups of workers:
1 - Workers who had at least 18 years of service at the end of 1995 (and thus falling under a regime which we call modified defined benefit, MDB): their pension benefit is computed completely with the defined benefit formula, but pensionable earnings gained after 1992 are calculated averaging over a longer period, according to the MDB system set up by the 1992 reform. Eligibility requirements to claim seniority pensions have been progressively tightened with respect to the pre-1992 system by all the reforms including the 2004 one, as shown in table 1;
2 - Workers who entered the labour market before 1995 but had less than 18 years of service at that date (*pro-rata* regime, PR): their pension benefit is computed according to a *pro rata temporis* mechanism. The part of benefit referring to the pre-1995 contribution and is computed as for the MDB group. The second part – related to the post-1995 years of service – is computed with the NDC formula. Eligibility rules are the same as for the MDB group.
3 - Workers who entered the labour market since the beginning of 1996 (notional defined contribution, NDC): these are the workers to whom the notional defined contribution system will fully apply. Eligibility requirements, as set by the 2004 reform, are reported in table 2.

MDB and PR workers still benefit from minimum pensions (which can be claimed at retirement by low income pensioners), while NDC workers can only claim the means-tested old-age maintenance when they turn 65.

The introduction of the "silent-assent" mechanism allocating new flows of TFR to pension funds is considered the real occasion for the take-off of pension funds. Because of that, adhesion of private employees and self-employed will be simulated starting from 2007 on.

The micro-simulation model

In order to assess the distributive implications of the progressive introduction of pension funds, we use CeRPSIM, a dynamic micro-simulation model by cohorts built by Borella and Coda Moscarola (2006) for the purpose of analysing the impact of first pillar reforms.
The program takes into account the effect of the social security normative changes (normative risk) on a population of heterogeneous individuals born in different cohorts and devotes particular attention in reconstructing the wage profiles of the individuals. Income process mechanisms have been derived from Borella (2004a).
Simulated cohorts are chosen in such a way as to belong to different pension regimes and then to be differently affected by the reform process.
The population module simulates gender, education and labour market participation and earnings of each individual in each cohort. **The pension module** calculates the retirement age and the amount of the benefits received according to the actual rules. A great effort is spent in catching the normative details concerning contribution rates, minimum and maximum contribution levels, ceilings, exit windows, etc…

A specific **second pillar module** has been introduced in order to calculate second pillar pension benefits for private employees and self-employed. The main underlining hypotheses in this module are the following:

- the contribution rate is constant over time and equal for all workers in each scheme (both private employees and self-employed);
- accumulation to the pension funds follows the career profiles of the individual and it is interrupted when he is unemployed;
- the annuity rate is actuarially neutral, i.e. it is based on the effective mortality tables (RG48 shifted according to cohort of birth, RGS, 2006);
- the annuity is indexed to inflation;
- the annuity is reversionary if the individual is married at the time of retirement.

This enables us to compute a more comprehensive (in that it includes both public and private pension benefits) replacement rate for heterogeneous individuals belonging to different cohorts, according to pre- and post-reform rules.

The analysis is complemented by measures of net pension benefits and net replacement rates, derived by applying income tax legislation on the gross simulated amounts, namely labour income and pension benefits from the first and second pillars. In the **tax module** deductibles refer to work and pension income. Dependent relatives deductibles are not accounted for due to the lack of information on household composition and spouse income. In the simulation by cohort approach the focus is on the individual and even if married, no information on spouse characteristics and family compositions are simulated. Independent taxation on second pillar benefits is fully accounted for.

Measures of redistribution

The redistributive impact of the reforms of public and private pillars is described graphically by plotting the present value ratio (PVR) on the permanent income (PY), and quantitatively by the Reynolds-Smolensky progressivity index.

The PVR is the ratio between the present value of the pension benefits to be received and the present value of payroll taxes paid, both valued at retirement. It measures the expected money's worth of participation to the public pension system with respect to the opportunity cost of a lost alternative exogenously fixed (represented by the discount rate used in the calculations)[4]. A PVR greater than one suggests that the individual is going to receive in terms of social security benefits more than he has actually paid in terms of payroll taxes.
We plot it against lifetime working income - defined as the present value of working income, valued at retirement - to see how convenience from participation to the public pension system differs across income levels. If the PVR is on average decreasing in lifetime working income, the expected money's worth of participation is higher for low income individuals, that is the system is progressive.

[4] We take an individual perspective in which we do not account for measures of total household income and for potential differential mortality rates among different socio-economic groups.

Graphical analysis highlights heterogeneity among individuals, whereas the Reynolds-Smolensky (1977) progressivity index quantifies the average redistributive impact.
This index is defined as the difference between the Gini coefficients of lifetime income under an hypothetical actuarially fair system and under the actual one. It measures how the actual pension system changes the concentration of the lifetime income. To compute the Reynolds-Smolensky index, we calculate lifetime income, defined as the sum of the present value of working income valued at retirement and of social security wealth (SSW), the last being the present value of benefits minus the present value of contributions. The higher the index, the greater the extent of redistribution from the rich to the poor induced by the pension system in place.

Results

We simulate the life of 12,000 individuals of six subsequent cohorts, starting from 1945 with a ten year gap. Workers belonging to the private sector automatically transfer their entire TFR flows to pension funds from 2007 on. Self-employed workers are assumed to participate also to the second pillar with a contribution rate that fills the gap between their first pillar contribution rates and the contribution rates of the private employees (32.7%+6.91%). We assume that public sector workers do not contribute to the second pillar. Macroeconomic variables are set to their historical values till 2003; from 2004 on GDP real growth is fixed at 1.5% and inflation rate at 2%. All amounts are expressed in euro 2000.

Baseline scenario. The normative setting chosen for the baseline scenario is that of the 2002 reform. The main framework is the one introduced by the 1995 Dini reform, with some minor modifications implemented in 1997 and 2002. A new reform was legislated in 2004 but as it has not yet come into force and as its repeal looks likely, we analyze it only as a variant of the base case.

Table 3 shows the evolution of retirement age and of the average replacement rates (RR) provided by the first and second pillar of the Italian pension system to different cohorts and different schemes. In general retirement age depends on the age of entrance in the labour market, on career's continuity and on specific rules concerning retirement requirements (in many cases gender-specific). This is the reason for a considerable heterogeneity in retirement age between different types of workers. In particular, employees of the private sector enter relatively early in the labour market and have slightly discontinuous careers; civil servants enter later and have very stable working lives; self-employed are characterized by the highest degree of instability.
In general women have a lower retirement age than men, with the exception of cohorts falling entirely under the NDC system. In particular, private sector women under the NDC tend to retire later than men because they meet less often the minimum benefit requirement[5].

[5] Under the NDC regime, individuals can retire before 65 only if their pension benefit equals at least 1.2 times old-age social allowance.

Pension rules of the first pillar grant women a replacement rate generally higher than men, with the exception of the self-employed born from 1965 onward. Furthermore, public employees and self-employed show a replacement rate higher than private employees.
As reforms gradually phase in for younger cohorts, the average replacement rate of the first pillar decreases for all categories. The highest reduction is detected for self-employed. Their contribution rates are in fact still smaller than the one of the employees, while benefits are now linked to effective contribution.
The introduction of the second pillar obviously increases the total average replacement rates of interested categories both because of the flows of additional contributions and because of the higher rate of return granted by the pension funds with respect to public system (2% market rate versus 1.5% economic growth).
The gross replacement rate of a male private employee of 1945 cohort is on average 62 per cent, under the MDB regime, and it declines to 40 per cent for the 1995 cohort, completely under the NDC scheme. By adding the second pillar a slight increase in the replacement rate is achieved: a 6.91 per cent contribution to the pension funds during the whole working life increases the comprehensive replacement rate of about 8.5 percentage points.
The hypothesis of a total contribution rate for the self-employed equalizing the private employees' one allows the former to double on average the replacement rate they would earn with the sole first pillar. For instance, a self-employed male born in 1995 – who would have a substitution rate of 38% with the sole first pillar – can obtain a total replacement rate of 79%.
The interpretation of the results changes if we look at net replacement rates instead of gross ones. For instance, the gross first pillar replacement rate of male public employees born in 1995 is almost one half of those born in 1945, but the 70 per cent in net terms. Tax rules in addition favour participation to the second pillar in a way that rewards longer permanence in the fund. Net replacement rates of the second pillar are about 30-50 per cent higher than gross ones.

Maroni reform. In the second set of simulations we implement the 2004 reform. The main innovations with respect to the previous normative setting are the increase in the minimum retirement age, as in table 4, and the introduction of different old-age requisites for women and men (60 and 65 respectively, see table 2).
Irrespectively of the tightening of the age+seniority requirement, women tend to retire either with the seniority requirement (40 years) or with the pure old-age requisite (60 years of age). Together with the increase in average retirement age, also overall replacement rates improve.

Age shifting scenario. On the same hypotheses of the baseline, we insert an automatic shift of the minimum retirement age. Such a shift is in line with that of the mortality tables. The rationale is to maintain roughly constant the longevity risk as longevity increases. Pension benefits, even in a notional defined contribution regime, are inevitably based on projected life expectancies. As a consequence, the longer the retirement period, the higher the uncertainty for the insurance provider on such a prevision and the greater the risk of underestimating effective longevity gains.
This hypothetical reform achieves the same objectives of the 2004 one but it is fairer in intergenerational terms and it avoids the so-called "big step" in age requirements of the

Maroni reform. However, with respect to the Maroni scenario, retirement age are on average slightly lower for male while almost the same for females (see table 5).
It is interesting to note that mean retirement age for women increases – for younger cohorts – above the "threshold" of 60 years of age because in this scenario also old-age requirement is increased along with other requisites.

Redistributive impact of reforms

The redistributive impact of the first pillar pension system has been gradually reduced by the nineties' reforms.
The MDB rules were redistributing along many directions: both from the rich to the poor and vice versa. On average the PVR for older cohorts appears to be well above one and in particular, low permanent-income self-employed were granted the highest PVR (in orange in graph 1). However, the Reynolds-Smolensky index shows that the redistributive flows almost compensated each other so that the average impact on the income concentration is small (see table 7).
As reforms were gradually introduced, PVR decreased for all the categories along with dispersion. For the NDC cohorts it converges around one[6], at the actuarial fairness level.
The introduction of the second pillar from 2007 for all the cohorts of private employees and self-employed also contributes to the reduction in the average PVR level, since the second pillar is calculated according to a perfectly actuarially fair rule. However, the effect of the second pillar on the PVR is rather small as can be seen by comparing graphs 1 and 2.
The Reynolds-Smolensky index - as a synthetic measure of intra-generational redistribution – highlights the small impact of the pension system in reducing income concentration. The implementation of the various reforms of the first pillar and the rising of the minimum age requirements do not change this result substantially and the latest reforms even increase concentration slightly. Analogously, the introduction of the second pillar does not alter the income concentration in gross terms with respect to the public pillar alone. This result is robust to alternative policy options (age shifting and Maroni scenarios) as in table 7.

Sensitivity Analysis [to be completed]

We perform a sensitivity analysis by simulating the baseline scenario with a real return of 4% on private pensions. The results in table 6 show no change in retirement age and public replacement rates, whereas second pillar replacement rates increase roughly proportionally to the increase in interest rate.

[6] First pillar is granting an internal rate of return slightly lower than the market rate used for PVR computation.

Agenda

Further steps in model development will:

- Implement sensitivity analysis on contribution rates to the second pillar (by the employee and/or the employer)
- Model stochastic rates of return differentiated by occupational funds and individual schemes
- Compute Reynolds-Smolensky index on net income in order to account for the redistributive impact of tax system

Conclusions [to be done]

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Tables

Table 1 – Age requirements to claim a seniority pension (with 35 years of service) during the transition and after the 2004 reform (men and women)

	Employees	Self-employed
… - 2007	57	58
2008 - 2009	60	61
2010 - 2013	61	62
2014 - …	62	63

Table 2 – Eligibility requirements in the NDC regime after the 2004 reform

	Men	Women
Old-age	Age 65, no further requirement	Age 60, benefit greater than 1.2 times the yearly income support for the elderly
Seniority 40 years	No further requirement	No further requirement
Seniority 35 years	Age 62/63 if employee/self-employed, benefit greater than 1.2 times the yearly income support for the elderly	Age 62/63 if employee/self-employed, benefit greater than 1.2 times the yearly income support for the elderly

Table 3 - Baseline: 2002 reform 2 % real rate of return for pension funds- no age shift

		Men			Women		
		FPLD	**INPDAP**	**Self-empl**	**FPLD**	**INPDAP**	**Self-empl**
1945	*Ret Age (mean)*	58.8	56.4	57.7	55.8	56.0	56.6
	RR 1	62.24	79.85	76.76	64.10	80.96	78.69
	RR 2	0.07	0.00	0.21	0.00	0.00	0.00
	RR 1 Net	77.80	95.63	91.06	73.94	95.69	91.77
	RR 2 Net	0.09	0.00	0.25	0.00	0.00	0.00
1955	*Ret Age (mean)*	59.2	56.8	58.9	55.8	56.4	58.0
	RR 1	61.68	79.88	75.76	63.30	82.07	77.05
	RR 2	2.12	0.00	7.91	1.05	0.00	6.30
	RR 1 Net	77.75	97.36	90.56	80.98	99.40	92.17
	RR 2 Net	2.80	0.00	9.41	1.31	0.00	7.50
1965	*Ret Age (mean)*	60.3	57.6	60.2	56.3	57.5	59.2
	RR 1	52.20	60.98	47.97	49.58	64.10	46.83
	RR 2	5.45	0.00	20.64	3.73	0.00	17.22
	RR 1 Net	67.69	77.74	62.22	66.48	80.20	60.34
	RR 2 Net	7.50	0.00	24.96	4.74	0.00	20.81
1975	*Ret Age (mean)*	58.2	57.5	60.4	57.1	57.5	59.5
	RR 1	42.40	42.42	38.55	48.43	49.56	36.23
	RR 2	6.95	0.00	31.04	6.57	0.00	25.52
	RR 1 Net	56.43	56.90	53.04	66.06	64.00	49.76
	RR 2 Net	9.76	0.00	39.28	8.58	0.00	32.54
1985	*Ret Age (mean)*	57.6	57.5	60.5	58.3	57.7	59.9
	RR 1	40.18	42.34	37.74	48.76	49.76	35.53
	RR 2	8.58	0.00	39.74	9.59	0.00	34.42
	RR 1 Net	53.86	56.75	52.86	66.31	64.23	49.90
	RR 2 Net	12.31	0.00	51.18	12.88	0.00	44.71
1995	*Ret Age (mean)*	57.6	57.5	60.6	58.3	57.7	59.9
	RR 1	39.81	41.84	37.88	48.74	49.78	36.59
	RR 2	8.53	0.00	39.77	9.88	0.00	36.11
	RR 1 Net	53.36	56.12	52.94	66.27	64.28	51.11
	RR 2 Net	12.22	0.00	51.21	13.27	0.00	46.71

Table 4 – 2004 reform (2%)

		Men			Women		
		FPLD	**INPDAP**	**Self-empl**	**FPLD**	**INPDAP**	**Self-empl**
1945	*Ret Age (mean)*	58.8	56.4	57.7	55.8	56.0	56.6
	RR 1	62.35	79.86	76.20	64.10	80.96	78.69
	RR 2	0.07	0.00	0.19	0.00	0.00	0.00
	RR 1 Net	77.92	95.63	90.40	73.94	95.69	91.77
	RR 2 Net	0.10	0.00	0.23	0.00	0.00	0.00
1955	*Ret Age (mean)*	61.1	58.2	61.3	55.8	57.2	59.3
	RR 1	64.71	83.00	81.79	63.57	83.42	80.20
	RR 2	2.83	0.00	11.53	1.08	0.00	7.71
	RR 1 Net	81.03	100.56	97.02	81.39	100.64	95.75
	RR 2 Net	3.70	0.00	13.66	1.34	0.00	9.16
1965	*Ret Age (mean)*	61.8	60.5	63.4	56.5	59.3	60.5
	RR 1	56.22	67.10	56.57	49.91	66.18	47.71
	RR 2	6.15	0.00	27.11	3.79	0.00	18.34
	RR 1 Net	72.15	84.06	69.53	66.85	82.53	61.47
	RR 2 Net	8.50	0.00	32.99	4.82	0.00	22.31
1975	*Ret Age (mean)*	62.7	60.5	63.4	58.3	59.3	61.1
	RR 1	56.75	50.79	49.58	51.98	52.49	40.61
	RR 2	9.57	0.00	40.56	7.13	0.00	29.12
	RR 1 Net	72.81	66.41	63.36	69.43	67.09	53.66
	RR 2 Net	13.58	0.00	51.42	9.37	0.00	37.20
1985	*Ret Age (mean)*	63.4	60.5	63.4	61.3	59.3	62.0
	RR 1	57.37	49.70	44.70	57.54	53.75	39.71
	RR 2	12.12	0.00	46.98	11.21	0.00	38.18
	RR 1 Net	73.41	65.05	58.33	74.89	68.41	52.50
	RR 2 Net	17.28	0.00	60.33	15.09	0.00	49.63
1995	*Ret Age (mean)*	63.4	60.5	63.4	61.3	59.3	62.0
	RR 1	56.55	48.88	45.40	57.53	53.70	39.75
	RR 2	11.91	0.00	47.38	11.50	0.00	38.36
	RR 1 Net	72.44	64.15	59.20	74.87	68.36	52.48
	RR2 Net	16.93	0.00	60.69	15.47	0.00	49.87

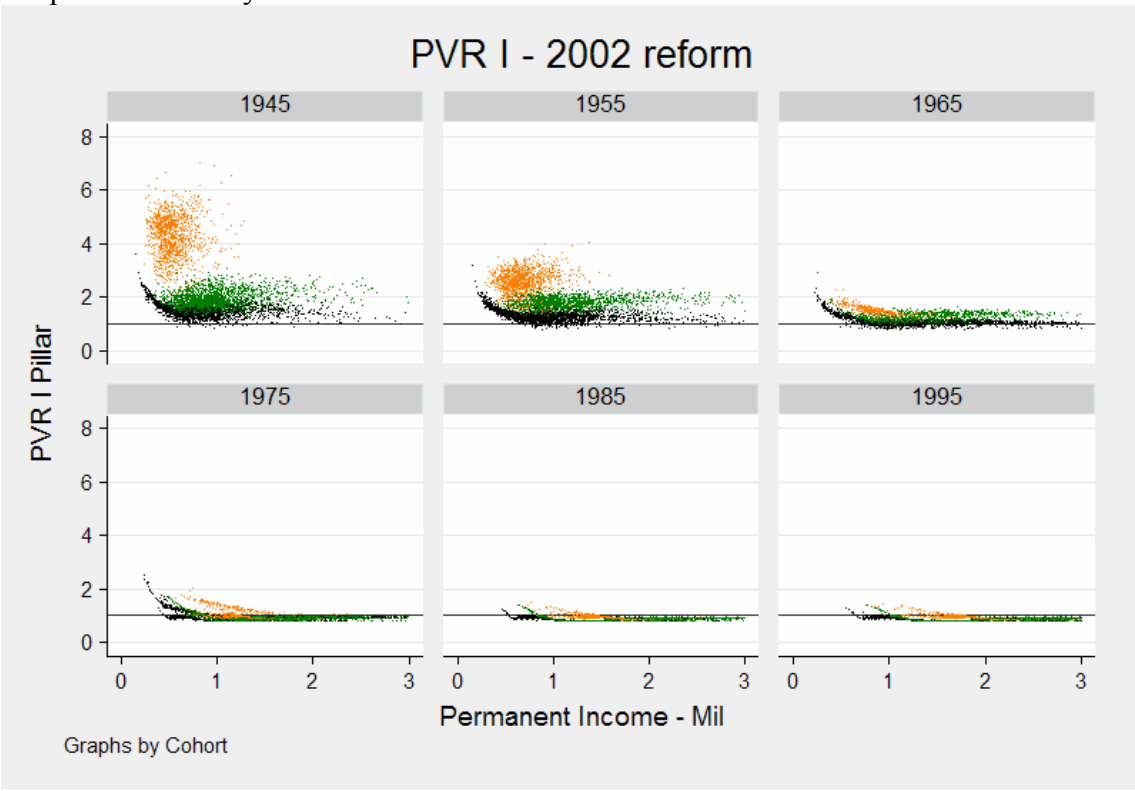
Table 5 – 2002 reform with age shift (2%)

		Men			Women		
		FPLD	**INPDAP**	**Self-empl**	**FPLD**	**INPDAP**	**Self-empl**
1945	*Ret Age (mean)*	58.8	56.4	57.7	55.8	56.0	56.6
	RR 1	62.24	79.85	76.76	64.10	80.96	78.69
	RR 2	0.07	0.00	0.21	0.00	0.00	0.00
	RR 1 Net	77.80	95.63	91.06	73.94	95.69	91.77
	RR 2 Net	0.09	0.00	0.25	0.00	0.00	0.00
1955	*Ret Age (mean)*	59.6	57.4	59.3	55.9	57.0	58.5
	RR 1	62.12	79.94	76.43	63.66	82.04	78.08
	RR 2	2.26	0.00	8.53	1.08	0.00	6.89
	RR 1 Net	78.24	97.41	91.33	81.45	99.21	93.22
	RR 2 Net	2.97	0.00	10.15	1.35	0.00	8.19
1965	*Ret Age (mean)*	60.8	59.4	61.3	56.6	59.2	60.6
	RR 1	53.11	62.83	50.10	50.17	64.08	49.36
	RR 2	5.62	0.00	22.39	3.83	0.00	19.43
	RR 1 Net	68.74	79.60	63.90	67.19	80.33	62.81
	RR 2 Net	7.75	0.00	27.15	4.89	0.00	23.55
1975	*Ret Age (mean)*	60.6	60.0	61.6	58.2	59.3	61.3
	RR 1	49.06	47.18	41.67	51.10	49.83	40.76
	RR 2	8.18	0.00	33.80	7.00	0.00	29.47
	RR 1 Net	64.04	62.36	55.79	68.50	64.24	53.34
	RR 2 Net	11.55	0.00	42.87	9.20	0.00	37.61
1985	*Ret Age (mean)*	61.5	60.3	61.9	61.7	59.4	61.6
	RR 1	50.76	47.30	41.36	58.44	51.12	36.57
	RR 2	10.74	0.00	43.65	11.35	0.00	35.12
	RR 1 Net	65.93	62.46	55.60	75.71	65.52	49.05
	RR 2 Net	15.37	0.00	56.09	15.30	0.00	45.94
1995	*Ret Age (mean)*	62.5	60.5	62.2	62.6	59.4	61.8
	RR 1	53.23	46.66	41.82	61.27	51.03	37.62
	RR 2	11.22	0.00	43.79	12.13	0.00	36.67
	RR 1 Net	68.70	61.78	55.60	78.84	65.40	50.02
	RR 2 Net	16.00	0.00	56.25	16.37	0.00	47.89

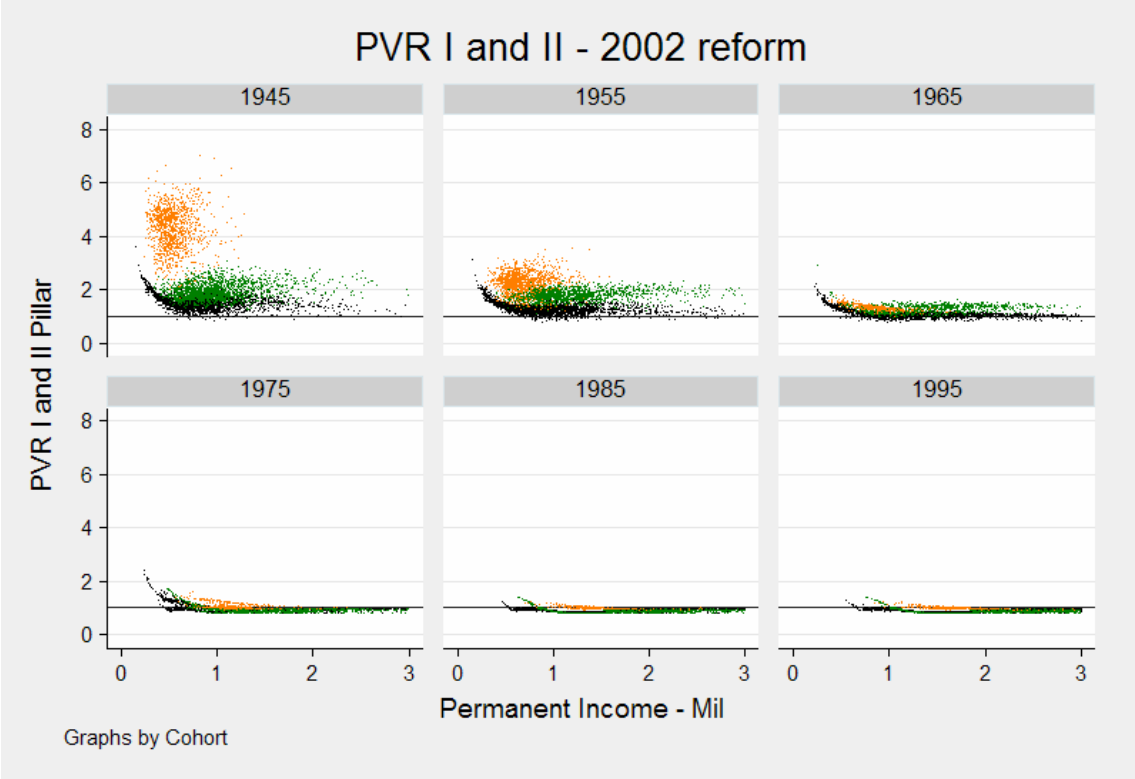
Table 6 – 2002 reform with 4% real rate of return for pension funds

		Men			Women		
		FPLD	**INPDAP**	**Self-empl**	**FPLD**	**INPDAP**	**Self-empl**
1945	*Ret Age (mean)*	58.8	56.4	57.7	55.8	56.0	56.6
	RR 1	62.24	79.85	76.76	64.10	80.96	78.69
	RR 2	0.09	0.00	0.26	0.00	0.00	0.00
	RR 1 Net	77.80	95.63	91.06	73.94	95.69	91.77
	RR 2 Net	0.12	0.00	0.31	0.00	0.00	0.00
1955	*Ret Age (mean)*	59.2	56.8	58.9	55.8	56.4	58.0
	RR 1	61.68	79.88	75.76	63.30	82.07	77.05
	RR 2	2.95	0.00	10.95	1.45	0.00	8.75
	RR 1 Net	77.75	97.36	90.56	80.98	99.40	92.17
	RR 2 Net	3.88	0.00	13.03	1.80	0.00	10.41
1965	*Ret Age (mean)*	60.3	57.6	60.2	56.3	57.5	59.2
	RR 1	52.20	60.98	47.97	49.58	64.10	46.83
	RR 2	8.43	0.00	31.98	5.73	0.00	26.86
	RR 1 Net	67.69	77.74	62.22	66.48	80.20	60.34
	RR 2 Net	11.60	0.00	38.68	7.28	0.00	32.46
1975	*Ret Age (mean)*	58.2	57.5	60.4	57.1	57.5	59.5
	RR 1	42.40	42.42	38.55	48.43	49.56	36.23
	RR 2	11.87	0.00	53.94	11.36	0.00	44.51
	RR 1 Net	56.43	56.90	53.04	66.06	64.00	49.76
	RR 2 Net	16.66	0.00	68.26	14.83	0.00	56.75
1985	*Ret Age (mean)*	57.6	57.5	60.5	58.3	57.7	59.9
	RR 1	40.18	42.34	37.74	48.76	49.76	35.53
	RR 2	16.06	0.00	76.39	18.74	0.00	66.75
	RR 1 Net	53.86	56.75	52.86	66.31	64.23	49.90
	RR 2 Net	23.03	0.00	98.33	25.17	0.00	86.69
1995	*Ret Age (mean)*	57.6	57.5	60.6	58.3	57.7	59.9
	RR 1	39.81	41.84	37.88	48.74	49.78	36.59
	RR 2	16.24	0.00	77.55	19.79	0.00	71.80
	RR 1 Net	53.36	56.12	52.94	66.27	64.28	51.11
	RR 2 Net	23.24	0.00	99.80	26.59	0.00	92.83

Graph 1 – PVR I by cohorts



Graph 2 – PVR I and II by cohorts



Note: - orange points represent self-employed
- green points represent public sector workers
- black points represent private sector workers

Table 7 – Reynolds-Smolensky index

	RS I pillar	RS I and II pillar
Baseline scenario: 2002 reform - 2%		
1945	0.013	0.013
1955	0.010	0.010
1965	0.010	0.010
1975	0.011	0.012
1985	0.003	0.003
1995	0.002	0.002
2004 reform - 2%		
1945	0.013	0.013
1955	0.012	0.012
1965	0.008	0.009
1975	0.009	0.009
1985	-0.001	0.000
1995	-0.001	-0.001
2002 reform with age shift - 2%		
1945	0.013	0.013
1955	0.010	0.010
1965	0.008	0.008
1975	0.009	0.009
1985	0.000	0.000
1995	-0.001	-0.001

Appendix: The microsimulation model[7]

The micro-simulation model CeRPSIM is made up of two main modules: the cohort population module, that simulates the lifetime patterns of individuals, and the pension module, that computes pension benefits according to the Italian legislation. A third module on taxation has been added.

A1. The cohort population module

This module includes a demographic section and a labour market section, which simulate all the main life events for individuals belonging to different cohorts. As typical in artificial populations organised by cohorts, individuals are simulated from birth to death, and do not interact with each other.
Once individuals are born, their lives evolve according to various routines which determine the day and month of birth, gender, the region of residence, performance in the labour market, family status, survival. We describe these routines in turn, after having briefly described the data sources used.

A1.1. Data sources

In addition to the information available from the national statistics data, we obtain the relevant probabilities (and the labour income profiles) from two micro data sets: the Bank of Italy Survey of Households' Income and Wealth (SHIW), and a sample of administrative data, drawn from the INPS archive '*Estratti Conto*'.
The INPS archive officially records the complete earnings and contribution histories of all participants, i.e. employees in the private sector and some categories of self-employed (craftsmen, tradesmen and farmers). The available sample is formed by all individuals born on the 5 of March – so that the theoretical sample frequency is 1:365 – and reports spells from 1985 to 1998. The archive contains very rich information about the earnings histories of the covered workers, recording spells of unemployment as well as the labour income earned each year.
As typical with administrative data, demographic information is, on the other hand, less rich: the sample records the date and the province of birth of the worker, and gender. No information about the family status is available, nor about the education level of the worker. This kind of information, for a sample representative of the Italian population, is available on the Bank of Italy survey (SHIW), which is run about every two years since 1989 to 2002.

A1.2 Life-invariant characteristics

At the beginning of the simulation of each cohort, a user-set number of individuals aged zero are created. Each individual then enters the *life-invariant characteristics* routine which assigns the date of birth, gender and the region of residence.

[7] This appendix is the same as in Borella and Coda Moscarola (2006) with some modifications for recently added modules.

The routine assigns, through the extraction of a random number from the uniform distribution, a day of the year in which the individual is born. It follows that in each cohort the date of birth is uniformly distributed through the year of birth: this feature of the program permits to model accurately the moment in which a worker is eligible for a pension benefit according to the so called "exit windows", as this moment depends, among other things, on the date of birth.
Gender and region of residence are also randomly assigned, through a Monte Carlo procedure, according to the gender and regional distribution of newly born children in the year 2002 (source: ISTAT, 2003a).

A1.3 Mortality

In each time period every individual enters the mortality subroutine, which determines whether he will survive or not in the simulated time period on the basis of gender specific mortality tables. Individuals who are predicted to die in the simulated year still enter all the subsequent routines, until the cycle for the year in progress is completed. Afterwards, they are recorded as dead and they do not enter the population routines again.
Our simulations are based on RG48 mortality tables shifted according to life expectancy evolution by cohort.

A1.4 Education

In the program, individuals are forced into education until they turn 15 (that is, they complete compulsory education). As recorded in the SHIW data, the fraction of individuals who do not complete compulsory education for cohorts born after 1950 is low and tends to zero for younger cohorts. In addition, according to the Italian legislation, individuals cannot work before reaching the age of 15, which means that they cannot start contributing into the pension system before that age.
After an individual has completed his compulsory school, he decides whether to continue studying or not. The routine models this decision as a random process, and the probabilities of getting a higher or university degree are computed using the SHIW data. The probabilities vary according to: cohort (born before 1960, born in or after 1960), gender, region of residence (north, centre or south).
Once the individual decides to start a cycle of study, he completes it (in other words, there are no drop-outs); this hypothesis is induced by the information available from the SHIW data, which report the degree achieved by each individual. Individuals who choose not to continue studying and individuals who complete their college enter the participation routine[8].

A1.5 Participation

When individuals choose (or are forced by the program as they are college graduates) to be no longer students, they decide whether or not to enter the labour force. This decision is modelled as a once and for all choice: if an individual decides to enter the labour

[8] Post-graduate education in Italy is still quite limited and it is not modelled.

force, he will remain active into the labour market until he retires (or dies), possibly facing spells of unemployment. On the other hand, if an individual decides not to enter the labour force, he will remain forever out of it.
Participation rates are specific for cohort (born before or after 1968), gender and region, and refer to the year 2002 (source: Istat, 2003b).

A1.6 First job

When an individual first enters the labour force, he enters the first job routine, where he succeeds in finding his first job in the current year according to a certain probability. If he is not successful, he is recorded as not employed; in the subsequent time periods he will re-enter this routine until he succeeds in finding an occupation. Once a worker finds his first job, he will never enter this routine again.
The probability of finding the first occupation is drawn from SHIW data, for the only cohort for which this kind of information is available (individuals born between 1970 and 1979, i.e. the 1975 cohort); we are therefore assuming that there are no cohort effects in the probability of finding the first job.
The probabilities are computed according to: age class (less or more than 24), gender, region of residence (north, centre and south). As the probabilities vary according to age class, we are implicitly taking into account the education level (college graduate enter the labour force after 24).

A1.7 Kind of employment and social security scheme

Once an individual finds an occupation, he is randomly assigned to a social security scheme and a professional qualification. He will not change these characteristics through all his life.
The assignment of the social security scheme proceeds in two steps. A first random draw determines which of the three main schemes the worker belongs to: FPLD (private sector employee), INPDAP (public sector employee), or self-employed. The relevant probabilities, computed from the SHIW data, vary according to: region of residence (north, centre or south), education level (mandatory school, high school, university degree), gender, and cohort (born before or after 1960).
A second random draw determines the social security sub-scheme to which the worker belongs, when relevant: "regular" private sector employee (86.7%) or agricultural worker (13.3%), if the main scheme is private sector employee; craftsman (40%), tradesman (40%) or farmer (20%) if the main scheme is self-employed. The relevant frequencies are computed from our administrative data sample, without any further sub-grouping, as the number of observations at this level of disaggregation is limited. Although there is a variety of different social security sub-schemes also in the public sector, all the public workers are modelled as belonging to the main sub-scheme[9].
A third random draw determines, where relevant, whether the individual is a white or a blue collar, conditional on the scheme he belongs to. Individuals who start working before age 18 are registered as blue collars, individuals who start working after that age face a probability of being blue collars equal to 35% in the private sector, and to 10% in

[9] Which is the sub-scheme for local government employees (CPDEL).

the public one. These frequencies are computed from the administrative data (SHIW for public sector workers), without any further sub-grouping, as the number of observations at this level of disaggregation is limited.
It should be noted that, due to the lack of data, we do not model the new forms of temporary jobs which are covered by a dedicated scheme characterised by a reduced payroll tax rate ("*Gestione Separata INPS*"). As this scheme has been introduced in 1995, and its legislation is continuously updated, projections of contributions and of pension benefits are very difficult to implement and highly dependent on discretional hypotheses.

A1.8 Number of weeks

Conditional on having a job, this routine determines, in two stages, *a)* whether the individual is employed or unemployed in a given year, and *b)* the number of weeks worked during that year, conditional on them being greater than zero.
The probabilities of being unemployed while in the previous year the worker was employed, and of being employed while in the previous year the worker was unemployed have been computed using our administrative sample separately for private employees, employees in the agricultural sector, and self-employed [10]. These probabilities vary according to age (in classes), gender, and region of residence[11].
In addition, private employees and employees in the agricultural sector face a certain probability of working less than a full year, conditional on being employed. These probabilities have been also computed from administrative data for the two groups of workers, and vary according to age and gender. Self-employed workers are assumed, if working, to do it for a full year[12].

A1.9 Earnings

Earnings profiles have been estimated on administrative data separately for private sector and self-employed workers, men and women, white and blue collars[13].
The estimated equation is:

$$\ln y_{it} = x_{it}\beta + \gamma_i + \varepsilon_{it}$$

$$\varepsilon_{it} = \rho\varepsilon_{it-1} + \eta_{it}$$

$$\gamma_i \sim (0,\ \sigma_\gamma^2)\ ;\quad \eta_{it} \sim (0,\ \sigma_\eta^2)$$

[10] Public sector employees do not face unemployment spells: on the one hand, we lack data to compute unemployment probabilities for this group of workers, on the other, it seems a reasonable assumption given the stability of work relationships in the Italian public sector.
[11] Due to sample size, the probability of being employed conditional on being unemployed in the previous year varies only according to age class and gender.
[12] According to our administrative data, the fraction of self-employed working less than a full year is negligible, and we do not model it.
[13] Self-employed are further distinguished in craftsmen and tradesmen, excluding farmers. In our administrative sample farmers who do not report zero income are less than 5%, resulting in a sample size too small to enable an estimate of the income profile. The zero-income report is mainly due to the pension legislation which requires a minimum payroll tax to be paid up to a threshold. All farmers with income below that threshold (i.e. the very vast majority) report zero income and pay the minimum payroll tax.

where x_{it} is a vector of individual characteristics, including a constant, a polynomial in age (third degree for self-employed, fourth degree for employees), cohort dummies (cohorts 1935, 1945, 1955, 1965, 1975), regional dummies (north, centre, south), and time dummies, which are assumed to sum up to zero and be orthogonal to a time trend.
The unobserved component is assumed to be the sum of a random effect (γ_i) which does not vary over time and is uncorrelated with the explanatory variables included into the equation, plus an AR(1) component with parameter ρ. The AR(1) process plus individual random effect has been found to be a good characterization of the unobserved component of earnings in Italy in previous work (Borella, 2004a).
In the micro-simulation model, each individual is given his average log earnings profile for his age and group (defined by cohort, gender, region and occupation) plus an error term formed by the sum of the two unobserved components. The first one is drawn from a normal distribution with variance σ_γ^2 at the beginning of the active life, and it permanently shifts up or down the average profile for the individual it refers to. The second component, which is also individual-specific and varies over time, is formed by the shock from the previous period, times the autoregressive parameter ρ plus an error term drawn from a normal distribution with variance σ_η^2 (see table A.1).

A1.10 Marital status

In this routine individuals are recorded as children (as opposed to heads of households) until they finish their schooling years. When they are aged between 14 and 50, provided they are no longer students, they may get married according to the gender- and age-specific probabilities available from the 1991 Census data. Conditional on being married, an individual faces the possibility of becoming divorced (probabilities also in 1991 Census data) or widow(er) according to the mortality table used in the program.
We assign a marital status to each individual, although we take an individual perspective, as this influences the present value of benefits at retirement.

A2. The pension module

The pension module is a very detailed module able to compute pensionable earnings and the contributions paid, to check the eligibility requirements and to compute the pension benefit and contributions paid for the first and second pillar. Pension benefits are computed for individuals who retire from the year 2000 onwards. The program flexibility enables the user to implement one reform at a time, starting with the one in 1992 and up to the 2004 one.
When all the reforms are active, the regimes covered in the program are: *a)* the modified defined benefit (MDB) regime, applying to those workers who contributed into their scheme at least for 18 years in 1995; *b)* the *pro-rata* (PR) regime, which applies to workers who started contributing to their scheme before 1996 but had less than 18 years

of service in 1995; *c)* the notional defined contribution (NDC[14]) scheme, which applies to workers who started contributing into their scheme in or after 1996[15].
Contribution to the second pillar is simulated from the 2007 onward for private employees and self-employed.
In addition, the same module computes the minimum pension – applying to retirees in regimes *a*) and *b*) – and the old age income maintenance – applying to non-retirees in regimes *a*) and *b*) and to all individuals in regime *c*).
The schemes covered are: private sector employees, employees in the agricultural sector, public sector employees and self-employed, distinguished in craftsmen, tradesmen, farmers and farmers in disadvantaged regions. All these schemes differed in eligibility rules, payroll taxes and computation of benefits formulae before the 1995 reform. This reform set the principle of the uniformity of rules, confirmed then by the subsequent reforms, and since that year a convergence process started, which is at present almost completed. Differences in the definition of pensionable earnings (or income) and in payroll-tax rates are nonetheless maintained also in the future.
As retirement behaviour is not modelled, individuals are assumed to claim their pension benefit as soon as they are eligible: this requires not only that they meet the minimum eligibility requirement but also that they wait for an "exit window" to be active[16].
This module also computes, for each individual at the moment of retirement, the present value of payroll taxes paid during the whole working life and the present value of the pension benefits to be received separately for each pillar. These quantities are the building blocks for various money's worth measures used in the analysis[17].
Finally, this module computes a measure of permanent income, defined as the present value at retirement of lifetime working incomes.

Table A.1 – Estimates for unobserved error component

	Males			Females		
	Blu collar	white collar	Self-employed	Blu collar	white collar	Self-employed
ρ	0.432	0.529	0.165	0.419	0.440	0.070
σ_η	0.126	0.110	0.313	0.175	0.162	0.309
σ_γ	0.242	0.335	0.263	0.332	0.360	0.229

Note: authors' estimates from SHIW, various years.

[14] First pillar annuity rates are updated according to ISTAT2000 mortality tables shifted to account for longevity increases.
[15] When there are no reforms active, all workers are under the same rules, regardless of their seniority; when only the 1992 reform is active, there are two groups of workers (depending on their seniority being greater or less than 15 years in 1992). From the application of the 1995 reform onwards, there are the three groups described in the text.
[16] Workers eligible to claim a pension can retire only in four predetermined periods during the year (the so-called "exit windows").
[17] The formula for the evaluation at retirement of the present value of the social security benefits is available on request from the authors.

A.3 Taxation module [to be completed]

We implement taxation rules from 1999 to 2007 including labour and pension income deductibles. From 2007 on, they remain constant. Dependent relatives deductibles are not included as the model does not simulate households.
Second pillar pension benefits are subjected to independent taxation (where the tax rate depends on the seniority in the fund).