The Perceived Valuation of Social Security Contributions: Evidence from Voluntary Contributions in Spain

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Abstract

Social Security contributions often provide returns through future benefit formulas. I study how individuals perceive and respond to these incentives using the unique setting of the Spanish public pension system. In Spain, pension benefits are based on contributions in a limited number of years before retirement, creating extraordinary marginal incentives once contributions become linked to pension benefits. Rather uniquely, self-employed workers in Spain are allowed to voluntarily choose their Social Security contributions. I analyze their contribution behavior to reveal how they perceive the incentives embedded in public pension formulas. First, I document strikingly low contributions near retirement. Despite additional contributions could yield annual real rates of return of up to 35%, more than 70 percent of self-employed workers contributed at the statutory minimum. Second, I exploit a pension reform that generated variation on whether the contribution–benefit linkage occurred at a prominent point in the contribution schedule. I find that responses are substantially larger when the linkage occurs at such a point, suggesting that contribution incentives are better internalized when the linkage timing is more salient. Overall, the results suggest that pension design plays a critical role in shaping the perceived valuation of Social Security contributions.

JEL codes: D91, E21, H55.

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1 Introduction

In most public pension systems, retirees' pension benefits are directly tied to their Social Security contribution (SSC) records. This linkage implies that SSCs provide returns in the form of higher future pension benefits, reducing their distortionary effects compared to standard income taxes (Feldstein & Liebman, 2002; Feldstein & Samwick, 1992; Summers, 1989). However, these efficiency gains critically depend on how workers perceive the implicit returns embedded in pension formulas (Blinder et al., 1980; Liebman & Luttmer, 2012). As population aging increases the need for Social Security financing, the degree to which workers internalize SSC incentives has important implications for economic efficiency (Auerbach & Kotlikoff, 1985). Indeed, in OECD countries, Social Security revenues already exceed income tax revenues, amounting to approximately 9% of national income (OECD, 2022).

This paper studies how individuals perceive and respond to SSC incentives, using the Spanish Social Security system as a natural setting. In Spain, self-employed workers face public pension formulas that mimic the earnings-related formulas used for wage earners. However, while wage earners pay mandatory SSCs based on their labor earnings, self-employed workers are allowed to voluntarily choose the contribution base of their SSCs[1]. This setting allows me to observe voluntary responses to the incentives embedded in Spanish public pension formulas and to infer how these incentives are perceived. I use administrative Social Security microdata that record the exact contribution bases chosen by self-employed workers.

In Spain, pension benefits are computed as an average of contribution bases over a limited number of years prior to retirement[2]. Consequently, contributions made before a threshold *linkage age* do not affect pension benefits, whereas contributions made afterward generate substantial returns. Near retirement, additional SSCs could yield present-value benefits of up to €5.7 per €1 contributed, corresponding to real rates of return exceeding 35%. The extraordinary magnitude of SSC incentives in Spain makes this setting well suited to study incentive perception.

[1]Participation in Social Security is mandatory for the self-employed, but they may select their contribution level within statutory bounds of approximately €250 to €950 per month.

[2]The formula is designed to target income replacement at retirement when labor earnings determine their contribution bases. Self-employed workers face the same formula while choosing their contribution base voluntarily.

The empirical analysis proceeds in two steps. First, I provide descriptive evidence on contribution choices near retirement, the period when SSC incentives are strongest and most predictable, as pension parameters are largely settled, with limited scope for reform. At this stage, self-employed workers are also more likely to be preparing for retirement rather than reinvesting in their businesses. Despite this, voluntary contributions are strikingly low: more than 70 percent of self-employed workers contribute exactly at the statutory minimum, thereby forgoing substantial returns. Even among high-income professionals, contributions remain muted, with 43 percent contributing at the statutory minimum.

This evidence is particularly striking since the SSC incentives in Spain were far higher than in other settings. They imply effective matching rates of 200–470 percent, far exceeding the 50–60 percent rates in other settings (Choi et al., 2011; Duflo et al., 2006; Madrian & Shea, 2001; Saez, 2009). These incentives constitute a clear arbitrage opportunity relative to alternative savings vehicles. In addition, statutory minimum contributions in Spain generate very low pension annuities—less than €800 per month—suggesting that low contributions are unlikely to reflect already sufficient retirement income. The contributions can therefore considered suboptimal and are consistent with misperceptions of SSC incentives.

Second, I focus on how workers increase contributions at the onset of the contribution–benefit link. I exploit pension reforms to provide quasi-experimental evidence on how workers respond to this linkage. I begin by focusing on a 1997 reform, which extended the pension benefit calculation window from the final 8 to the final 15 years before retirement. As a result, the *linkage age* was shifted from 57 to 50 for workers retiring at the statutory age of 65. I evaluate how contributions evolved around the sharp increase in SSC incentives at these *linkage ages*, before and after the reform. Prior to 1997, I detect no increase in contributions at age 57. In contrast, following the reform, contributions rise sharply at age 50.

I investigate this differential response to the *linkage age* through the lens of perceived incentives[3]. Age 50 coincided with a prominent decision point in the contribution schedule. Specifically,

[3]Contrary to the observed pattern, SSC incentives were stronger when the *linkage age* was 57 rather than 50. Before 1997, when benefits were concentrated over 8 years, an additional SSC at age 57 generated €4.1 in discounted

contribution choices at age 50 could affect maximum SSCs near retirement: if SSCs at age 50 exceeded a threshold of approximately €500 per month, the higher level could be maintained in subsequent years; failing to do so permanently capped future SSCs at €500 per month. Given the extraordinary returns near retirement, increasing SSCs above €500 per month by age 50 could generate an option value of up to 82,500€ in present-value benefits. Aligning the *linkage age* with this high-stakes decision point may enhance perception through two channels. First, placing the linkage age at a salient age may improve understanding of the timing of incentives. Second, the high stakes at this point may justify the cognitive costs of processing the incentive structure, mitigating rational inattention (Gabaix, 2019).

Interpreting the response to the 1997 reform as driven by improved perception requires three conditions: (i) the option point is sufficiently salient to generate behavioral responses; (ii) in the absence of alignment, the linkage age does not trigger comparable responses; and (iii) the observed response reflects perceived incentives rather than option-value incentives. I provide evidence supporting each condition.

To address (i) and (ii), I examine a 1993 reform that shifted the option decision point from age 55 to age 50. I find strong responses to this change. Before 1993, contributions increased sharply at age 55, the prevailing option point. After the reform, this increase shifts to age 50: the share of individuals contributing above the statutory minimum rises by 2.4 percentage points among those aged 50–52. This pattern indicates that the option point is sufficiently salient to induce behavioral responses, supporting condition (i). Evidence around the reform also supports condition (ii): during 1991–1993, contributions rise at the option point (age 55), but not at the linkage age (age 57). Because this period predates the 1997 reform, the absence of a response at age 57 does not reflect anticipation of future policy changes.

To address condition (iii), I exploit that option-value incentives apply only to contributions above €500 per month. Responses below this threshold therefore cannot be driven by option incentives. I find that most of the response to the 1997 reform occurs below €500: the reform

future benefits. After 1997, an additional SSC at age 50 generated €2.0 in discounted future benefits.

increases the share contributing above the statutory minimum by 10.4 percentage points, and 85% of this increase arises below the threshold. This pattern suggests that the stronger response at age 50 reflects improved perception of SSC incentives, rather than changes in option-value incentives.

The response to the 1997 reform can be considered sizable relative to baseline contribution levels near retirement. The reform increased the share of contributors above the minimum by 10.4 percentage points, compared to a baseline rate of approximately 30 percent near retirement. Notably, SSC incentives at ages 50–52 are smaller and more uncertain than those at ages 60–64. This pattern suggests that aligning the contribution–benefit linkage at a salient point can substantially enhance the perceived value of contributions.

Taken together, these findings point to substantial barriers to perceiving the implicit contribution incentives embedded in public pension systems. Despite extremely high returns to late-career SSCs, most self-employed workers contributed at the statutory minimum, resulting in low pension benefits[4]. These findings raise concerns about whether SSC incentives are effectively internalized in traditional public pension systems. As long as similar misperceptions apply to individuals whose SSCs are proportional to earnings, the resulting efficiency costs in Social Security financing could be substantial. There are two reasons why the misperception documented for self-employed workers may be even more pronounced in the broader population. First, wage earners tend to exhibit lower levels of financial literacy than the self-employed (Struckell et al., 2022). Second, when contributions are not actively chosen, attention to SSC incentives may be even weaker.

In response, I provide evidence that the design of the contribution–benefit link can affect perceived SSC incentives. I show that pension systems with more prominent contribution–benefit links elicit larger behavioral responses, consistent with improved perception of SSC returns. These findings have broader implications for systems in which SSCs are proportional to labor income. If SSC incentives are better perceived, labor supply distortions associated with Social Security financing may be reduced, with potentially important consequences for economic efficiency.

[4]Pensions for self-employed workers have been around 40% lower than those of wage earners. In 2005, the average retirement pensions for self-employed workers were as low as €750 per month, down from €1,300 per month for wage earners.

Related literature. This paper contributes to four main strands of literature. First, it contributes to the literature on the perception of SSC incentives in public pension systems. A key argument in proposals for investment-based Social Security reforms is that they may improve efficiency by making SSC incentives more transparent and better understood (Auerbach, Kotlikoff, et al., 1987; Feldstein & Liebman, 2002; Kotlikoff, 1996). However, survey evidence by Liebman and Luttmer (2012) suggests that individuals recognize the link between labor supply and future benefits. My results provide behavioral evidence of substantial misperceptions of SSC incentives in traditional systems and show that these perceptions depend critically on the design of the contribution–benefit linkage.

Second, this paper advances on the understanding of how the linkage between current SSCs and future pension benefits affects individual behavior. Prior research examined how future pension entitlements influence pre-retirement labor supply (Brinch et al., 2017; French et al., 2022; Liebman et al., 2009), reported earnings (Dean et al., 2022), and the incidence of SSCs (Bozio et al., 2025). By studying voluntary contributions, I delve into how and when the contribution-benefit linkage is perceived. The results highlight that the design of this linkage is central for perception, with implications for the distortions associated with Social Security financing.

Third, a large literature studies responses to savings incentives, particularly in the context of matching schemes and tax credits (Carroll et al., 2009; Chetty et al., 2014; Madrian & Shea, 2001; Ramnath, 2013; Saez, 2009). Saez (2009), for example, shows that the presentation of incentives affects behavioral responses. However, it remains unclear how these insights translate to contribution incentives embedded in public pension formulas. This paper provides novel evidence on how the design of such incentives shapes behavior in this context.

Fourth, this paper contributes to the literature on behavioral distortions in responses to tax and benefit systems (Mullainathan et al., 2012). Existing work shows that inattention to non-salient attributes affects responses to consumption taxes (Chetty et al., 2009), while complexity and misperceptions shape responses to income taxes (Abeler & Jäger, 2015; Rees-Jones & Taubinsky, 2020) and benefit take-up (Bhargava & Manoli, 2015). I extend this literature by providing new

evidence on how perceived incentives influence responses to SSCs, a central source of public revenue.

The rest of this paper is structured as follows. Section 2 presents the institutional details of this study. Section 3 describes the calculation of Social Security contribution incentives in Spain. Section 4 describes the data and Section 5 empirical strategy. Section 6 presents the estimation results and section 7 discusses them. Finally, Section 8 concludes.

2 Institutional details

This section describes the main institutional features of the Social Security System in Spain that are relevant for this study. First, I provide a general background of the Social Security Scheme for Self-Employed Workers (*Régimen Especial de Trabajadores Autónomos*, RETA). Second, I describe pension benefit formulas in Spain, including the change introduced by the 1997 reform. Finally, I provide details on the rules governing the voluntary SSCs of self-employed workers.

2.1 The RETA scheme: General background

RETA is the mandatory Social Security scheme covering individuals who perform regular economic activity on their own account in Spain. Enrollment is compulsory for self-employed workers who meet statutory criteria regarding the habitual and direct nature of their activity. During the period of study, RETA accounted for approximately 12% of total Social Security affiliates, making it the second-largest contributory regime after the General Social Security Scheme (*Régimen General de la Seguridad Social*, RGSS), which primarily covers wage earners.

Spain operates a contributory, earnings-related public pension system organized into several regimes that share a common benefit formula but differ in contribution rules. While pension entitlements are determined by a unified formula across regimes, RETA grants substantially more flexibility in the determination of contribution bases than the RGSS. Further details on the Spanish pension system and its historical development are provided in García-Gómez et al. (2018).

2.2 Retirement pension formulas

Retirement pensions in Spain follow an earnings-related formula that applies uniformly across Social Security regimes. Upon pension eligibility[5], monthly pension benefits are determined as:

$$P_{R,n} = \alpha_n \times \beta_R \times BB \tag{1}$$

where $P_{R,n}$ denotes the monthly pension when claiming retirement at age R with n contribution years. The parameter α_n is the coefficient for total years of contributions, which penalizes short contribution histories[6]. The parameter β_R is the coefficient for retirement age, penalizing early claiming relative to the statutory retirement age of 65. Finally, BB denotes the benefit base, computed as the average of contribution bases over a specified number of years immediately preceding retirement. Appendix B provides additional details on pension formulas.

Two institutional features are relevant when individuals transition between Social Security regimes. First, the benefit base aggregates contribution histories across regimes. Thus, transitions from self-employment to wage employment do not affect the link between earlier RETA contributions and future pension benefits[7]. Second, if an individual exits contributory employment, missing years within the benefit base period are not retroactively filled by earlier contributions.

A central implication of this formula is that contribution levels affect pension benefits only through the benefit base, and only insofar as they fall within its reference period. I define the earliest age at which contributions enter the benefit base as the *linkage age*, which equals the statutory retirement age minus the number of years included in the benefit-base calculation. Contribution levels made prior to the *linkage age* do not affect pension levels, whereas contributions at or after the *linkage age* generate positive marginal pension entitlements.

[5] Eligibility required at least 15 years of contributions and retirement from age 60. Early retirement was also conditional on meeting the minimum pension threshold.

[6] Importantly, α_n depends only on the number of years contributed, not on the level of contributions.

[7] Pension aggregation is carried out in the most favorable manner for the claimant, either through a unified pension or separate pensions across regimes. Marginal incentives to contribute under RETA are equivalent under both arrangements.

1997 reform: Change in contribution-benefit link

The 1997 pension reform extended the reference period used to compute the benefit base. Prior to the reform, the benefit base was calculated as the average of contribution bases during the final 8 years before retirement. The reform increased this window to the final 15 years[8]. For retirement at the statutory age of 65, the reform shifted the *linkage age* from 57 to 50. Before 1997, the return to contributions surged at age 57; after 1997, the incentive shift occurred at age 50. Consequently, contributions made between ages 50 and 56—previously irrelevant for the benefit base—became pension-relevant after the reform.

2.3 Voluntary contributions under RETA

I describe the main rules governing voluntary contributions under the RETA scheme. Like workers in other schemes, self-employed workers are required to make monthly SSCs under RETA. However, the main distinctive feature of RETA is that self-employed workers are allowed to voluntarily choose their contribution base, within annually legislated minimum and maximum thresholds. Thus, the contribution base for self-employed workers was independent of earnings, while wage earners contributed according to their gross labor earnings.

The selected contribution bases determined both current SSC payments and future contributory benefits – including retirement, disability, and survivor pensions. Monthly SSCs equal to the product of the chosen contribution base and the applicable contribution rate, which was 26.5% over the period of study. In 2021 prices[9], minimum monthly contributions were approximately €250 per month, while maximum contributions were approximately €900 per month. Self-employed workers were allowed to modify their contribution base twice per year by submitting a standardized form, either in person or online. Appendix B provides additional details on annual thresholds and administrative forms under RETA.

[8]The reform also introduced adjustments to contribution years and early retirement coefficients, which are incorporated into SSC incentive calculations; see Appendix B.3.

[9]Throughout the paper, all monetary values are measured in constant 2021 prices.

Maximum contribution rules: Option point at age 50

A special rule regulated maximum voluntary contributions from a pre-specified age – set at age 50 for most of my study period. Generally, maximum contributions were approximately €950 per month. However, a special rule implied that maximum contributions were lower from age 50, at approximately €500 per month. However, the system offered a getaway that allowed contributions exceeding the €500 threshold from age 50. If a worker's contributions at age 50 exceeded the €500 threshold, their contribution level could be maintained in the following year[10]. Additional institutional details on maximum contribution rules are provided in Appendix B.

These special rules were aimed at limiting the possibility of high contributions only near retirement. This could have allowed maximum pensions despite low lifetime contributions. By forcing high contributions at least from age 50 – or allowing reduced maximum contributions of €500 per month – the special rules limited this possibility.

In practice, these special rules implied that contribution choices at age 50 had critical consequences on future maximum contributions. Since SSC incentives were highest near retirement, preserving the option to make higher contributions was potentially valuable. Thus, these contribution rules created an option value on SSCs at age 50, which is substantial as shown in Section 3. These rules generated a high-attention point at age 50, which is central to this study. This decision features the government budget every year, as contribution thresholds are updated[11]. The presence of a deadline could also enhance its prominence in the SSC schedule (Altmann et al., 2022).

1993 reform: Change in the option point

For most of my study period, the option point occurred at age 50. However, the option point was set at age 55 until 1993. Thus, I use the 1993 reform, which shifted the option point from age 55 to 50, to investigate the effect of facing the option point on contribution behavior. The responses to this reform serve to verify whether the option point was perceived by self-employed workers.

[10] Instead, failing to contribute above the €500 threshold at age 50 permanently capped future contributions at €500 per month.

[11] Appendix B.4 shows sample notifications sent by self-employed associations on Social Security regulations, including details of the option value decision at age 50.

3 Social Security contribution incentives

This section presents the contribution incentives embedded in the Spanish Social Security system for self-employed workers. First, I define the measures used to quantify the marginal return to additional SSCs. Second, I present the magnitude of these incentives in the study samples. Third, I introduce the option value of contributions at age 50. Fourth, I discuss how the existence of an option value of contributions at age 50 can contribute to perceived SSC incentives.

3.1 Methodology

I introduce two complementary concepts to measure the return offered by an additional euro of SSCs: the net present value and the internal rate of return.

Net present value. The net present value (NPV) of additional SSCs, also denoted the money's worth (Mitchell et al., 1999), is the increase in discounted expected pension benefits resulting from an additional euro of SSCs at age a and time t[12]:

$$b_{a,t} = \frac{\partial SSW_{a,t}}{\partial SSC_{a,t}} = \sum_{s=R}^{\overline{LE}} \frac{\pi_t(s|a)}{(1+r)^{s-a}} \times \frac{\partial P_s}{\partial SSC_{a,t}}$$

where $SSW_{a,t}$ denotes Social Security Wealth, and r is the discount rate, and $\pi_t(s|a)$ is the probability that an individual aged a at time t survives until age s. R denotes the retirement age and $\overline{LE}$ the maximum attainable age in the mortality tables. P_s denotes the annual pension benefit received at age s. Using the pension formula in Equation (1), the net present value can be expressed as:

$$b_{a,t} = \sum_{s=R}^{\overline{LE}} \frac{\pi_t(s|a)}{(1+r)^{s-a}} \times \left(\alpha_n \beta_R \frac{\partial BB_s}{\partial SSC_{a,t}} \right) \tag{2}$$

This shows that the marginal return to SSCs operates entirely through the benefit base (BB).

Internal rate of return. I also compute the internal rate of return (IRR) offered by additional SSCs, defined as the discount rate that equalizes the cost of an additional euro of SSCs with the

[12] Liebman et al. (2009) labeled this concept as Marginal Social Security Benefits (MSSB).

expected discounted stream of pension benefits it generates. The IRR represents s the minimum required rate of return on private savings to make them weakly preferred to additional SSCs. The IRR is calculated as follows:

$$1 = \sum_{s=R}^{\overline{LE}} \frac{\pi_t(s|a)}{(1+\rho_{a,t})^{s-a}} \times \alpha_n \beta_R \frac{\partial BB_s}{\partial SSC_{a,t}} \tag{3}$$

where $\rho_{a,t}$ denotes the IRR.

3.2 Magnitude of SSC incentives

I describe my calculation of incentives for my two complementary analyses. First, I calculate SSC incentives for my analysis of contribution behavior near retirement. Second, I calculate SSC incentives for my analysis on how contributions evolve around contribution-benefit linkage.

3.2.1 SSC incentives near retirement

I calculate incentives near retirement. I first present the assumptions required for this calculation, and I then quantify the incentives at age 60-64.

Parameters and assumptions. The calculation of SSC incentives in Equations (2) and (3) relies on several parameters and assumptions. First, the NPV of future benefits is calculated using an annual discount rate of 3%, consistent with the pension literature (Coile et al., 2002; Liebman et al., 2009). Second, conditional survival probabilities $\pi_t(s|a)$ are derived from official mortality tables published by the Spanish Office of National Statistics (INE, 2019a, 2019b). Third, the calculated incentives only include retirement pension benefits and exclude disability and survivor pensions. Since disability or survivor formulas were not modified in the period of study, their exclusion lowers the level of calculated incentives but does not affect cross-age or variations in incentives introduced by retirement pension reforms. Fourth, I assume retirement at age 65 and incentives are not undermined by minimum pensions. Given I observe retirement pension parameters, I will select my sample accordingly.

Magnitude at age 60-64. Table 1 presents the average magnitude of SSC incentives at ages 60-64 for individuals retiring at the statutory age of 65, depending on retirement period. The incentives are calculated for individuals retiring in three periods: 1994-1997, 2002-2006, 2007-2011[13]. Columns (1)–(2) report SSC incentives for individuals retiring in period 1994-1997, showing truly extraordinary incentives: an additional euro of SSCs generates €3.9–€5.7 in discounted benefits, corresponding to a IRR as high as 39.7% at age 64. Even after the 1997 reform, the calculations confirm that SSC incentives were still extraordinary: an additional euro of SSCs generates €2.6–€3.3 in discounted benefits, corresponding to IRRs between 11.0 and 21.9%.

Table 1: Late-career SSC incentives among retired individuals by retirement period

Year of age	Pre-1997 reform		Post-1997 reform			
	1994-1997		2002-2006		2007-2011	
	NPV (€) (1)	Rate of return (%) (2)	NPV (€) (3)	Rate of return (%) (4)	NPV (€) (5)	Rate of return (%) (6)
60	3.91	15.25	2.64	11.03	2.72	11.26
61	4.28	18.23	2.68	12.07	2.81	12.50
62	4.62	21.85	2.82	13.80	2.94	14.23
63	5.12	27.97	3.04	16.60	3.18	17.19
64	5.72	39.72	3.32	21.19	3.45	21.91

Notes: The table reports the average return to an additional euro of Social Security contributions (SSCs) by age and period. Net present value (NPV) is the increase in discounted expected retirement pension benefits (in euros) generated by one additional euro of SSCs at the indicated age. The internal rate of return (IRR) is the discount rate that equates the marginal cost of contributions with the expected stream of marginal pension benefits. Calculations assume retirement at age 65, continued contributions until retirement, a 3 percent annual discount rate (for NPV), and cohort-specific survival probabilities from official Spanish mortality tables. The reform sample (columns (1)–(4)) uses pension rules in place at the time contributions are made. The retirees sample (columns (5)–(6)) uses realized pension parameters for individuals retiring at age 65 between 2002 and 2005. The sample excludes workers with contribution histories likely to qualify for minimum pension top-ups. Monetary values are expressed in euros.
Source: MCVL 2005.

3.2.2 SSC incentives around contribution-benefit linkage

I calculate SSC incentives around contribution-benefit linkage between 1991 and 2002. I first present the assumptions required for this calculation, and I then quantify the incentives at age 40-59.

Parameters and assumptions. Additional assumptions on retirement parameters are required for individuals aged around contribution-benefit linkage, as their retirement pension parameters have not yet realized. First, incentives are calculated according to the pension rules in place at the

[13]I do not analyze the intermediate period (1998–2001), as incentives during these years are affected by transitional rules.

time of contribution. Second, individuals are assumed to claim retirement at the statutory age of 65, which is consistent with observed retirement behavior for self-employed workers (Figure C.1)[14]. This implies that $\beta_R = 1$ and defines the *linkage age* – when contributions become linked to pension benefits. Third, individuals are assumed to continue contributing until retirement for the purpose of computing α_n. Fourth, my main sample excludes workers with short contribution careers who could end up receiving minimum pensions at retirement[15]. Further supporting evidence for these assumptions are provided in Appendix C.2.

Magnitude at age 40-59. Columns (1)–(4) present the incentives for periods before the 1997 reform. Prior to 57, additional SSCs did not enter the benefit base and therefore offered zero marginal incentives. After age 57, SSC incentives were very large: an additional euro of SSCs after age 57 increased discounted pension wealth by nearly €4, with corresponding to IRRs above 11%. The positive age gradient in SSC incentives primarily reflects shorter discounting horizons and higher conditional survival probabilities at older ages. Following the 1997 reform, the *linkage age* was reduced to 50 and window over which contributions entered the benefit formula expanded from 8 to 15 years. As a result, Columns (5)–(6) show that positive marginal incentives begin at age 50. For ages 50-64 in 1998-2002, the NPV of additional SSCs exceeds €2 per euro contributed, with IRRs generally above 6%.

3.2.3 Sensitivity to alternative assumptions

I assess the sensitivity of my baseline calculation of incentives to alternative discount rates, mortality assumptions, the possibility of early retirement, and pension policy uncertainty. The calculation of alternative incentive calculations are described in Appendix D.2. In all cases, the calculations show zero incentives before the *linkage age* and strong incentives thereafter.

[14] Retirement at age 65 reflects institutional constraints during the period: early retirement was generally unavailable to the self-employed, and postponing retirement beyond age 65 did not yield actuarial bonus.

[15] Retirees receiving a minimum pension top-up would still earn the minimum benefit regardless of marginal increases in SSCs. I exclude the 20% of individuals with the shortest contribution histories within each age-cohort cell, corresponding to the observed share of self-employed retirees receiving minimum pensions in 2002–2005 (see column (5) in Table 3).

Table 2: Average magnitude of SSC incentives by contribution period

	Pre-1997 reform: Linkage age 57				Post-1997 reform: Linkage age 50	
	1991-1993		1994-1997		1998-2002	
Year of age	NPV (€) (1)	Rate of return (%) (2)	NPV (€) (3)	Rate of return (%) (4)	NPV (€) (5)	Rate of return (%) (6)
≤ 49	0.00	–	0.00	–	0.00	–
50	0.00	–	0.00	–	2.00	5.99
51	0.00	–	0.00	–	2.05	6.22
52	0.00	–	0.00	–	2.09	6.50
53	0.00	–	0.00	–	2.14	6.81
54	0.00	–	0.00	–	2.19	7.15
55	0.00	–	0.00	–	2.26	7.57
56	0.00	–	0.00	–	2.31	8.01
57	3.59	11.72	4.08	12.71	2.37	8.54
58	3.64	12.57	4.18	13.74	2.42	9.11
59	3.69	13.59	4.31	15.07	2.48	9.80

Notes: The table reports the average return to an additional euro of Social Security contributions (SSCs) by age and period. Net present value (NPV) is the increase in discounted expected retirement pension benefits (in euros) generated by one additional euro of SSCs at the indicated age. The internal rate of return (IRR) is the discount rate that equates the marginal cost of contributions with the expected stream of marginal pension benefits. Calculations assume retirement at age 65, continued contributions until retirement, a 3 percent annual discount rate (for NPV), and cohort-specific survival probabilities from official Spanish mortality tables. The reform sample (columns (1)–(4)) uses pension rules in place at the time contributions are made. The retirees sample (columns (5)–(6)) uses realized pension parameters for individuals retiring at age 65 between 2002 and 2005. The sample excludes workers with contribution histories likely to qualify for minimum pension top-ups. Monetary values are expressed in euros.
Source: MCVL 2005.

3.3 Option incentives at age 50

I quantify the additional incentive margin represented by the option value at age 50. I then discuss the implications on perceiving SSC incentives.

Methodology. I provide a narrative description of the method to calculate option incentives at age 50. The option value of SSCs at age 50 is quantified as the present value of the net benefit gains made feasible by the higher contribution ceiling from age 50. Thus, the calculation compares net benefits under the two optimal contribution paths depending on contributions by age 50: (i) when contributions exceed the €500 threshold by age 50, contributions are maintained until retirement at age 65. (ii) when contributions are below the €500 threshold by age 50, individuals optimally contribute at the minimum level until the *linkage age*, when they increase contributions to maximum level ($\simeq$ €500 per month) until retirement. Additional and more formal methodological details are provided in Appendix C.3.

Magnitude: Option value at age 50. Table C.2 reports the potential option value as a function of the SSC level chosen by age 50. Two main patterns of option incentives are central for the empirical analysis. First, contributions below the €500 threshold generate zero option value, since they do not serve to extend future maximum contribution. Second, above the €500 threshold, the option value increases sharply with contribution level. At the statutory maximum contribution level ($\simeq$ €950 per month), the implied option value in period 1998-2002 reaches approximately €82,500. Thus, the option point at age 50 represents a high-stakes decision point.

3.4 Perceived incentives: Prominence of contribution-benefit link at age 50

I discuss how the presence of an option point at age 50 can contribute to perceived SSC incentives after the 1997 reform. As noted, age 50 represents a high-stakes decision point, making it a salient and economically meaningful point in the SSC schedule. When the contribution–benefit linkage occurs at this age, the timing of SSC incentives may be more readily internalized. The alignment may facilitate perception of the timing of SSC incentives through two channels. First, the prominence of the option decision may increase attention to the otherwise non-salient timing of SSC incentives (Chetty et al., 2009). Second, the salient cutoff could inform the timing of SSC incentives (Sandroni & Squintani, 2007).

The option value at age 50, along with the 1997 reform, offer variations on whether contribution-benefit linkage occurred at a prominent age. Before 1997, the *linkage age* occurred at 57, which had no particular administrative prominence. The 1997 reform brought the *linkage age* to the prominent age 50.

4 Data

The empirical analysis of this study relies on administrative microdata from the 2005-2012 waves of the Continuous Sample of Employment Histories (*Muestra Continua de Vidas Laborales*, MCVL), which is made available for research purposes by the Spanish Ministry of Labor, Migration and

Social Security[16]. The MCVL combines administrative Social Security microdata with tax records from the Spanish tax administration and population register data. The MCVL provides a random sample of 4% of the affiliates to Spanish Social Security in a given year, including affiliates contributing to Social Security or receiving a contributory pension.

The MCVL provides detailed information on the employment history of sampled affiliates since 1967, including the dates of employment spells, the type of contract, or the Social Security scheme. Importantly, this dataset contains monthly contribution bases to Social Security since 1980, which includes the contribution choices made by self-employed workers. Furthermore, the dataset incorporates socioeconomic variables such as gender, date of birth, nationality, region of residence, and education[17]. I select two main samples for my empirical analysis.

Near retirement sample. To undertake our analysis on late years contributions, I select a sample of individuals who claimed retirement at age 65 years with pensions above the minimum, which ensures SSC incentives were not affected by minimum pensions. The analysis considers three retirement periods: 1994-1997, 2002-2006 and 2007-2011. Table 3 presents the summary statistics of the retired sample in these three periods.

Contribution-benefit link sample. To estimate the effect of the 1997 reform, I use a sample spanning the period from 1994 to 2002. Specifically, I focus on a sample comprising individuals with Spanish nationality who worked as self-employed during this period. To avoid distorting SSC incentives from minimum pensions, I exclude the 20% with the shortest contribution periods in each age and cohort cell, which corresponds to the share of minimum pension earners among contemporary retirees. The choice of a sample of long-term self-employed workers also ensures the representativeness of my sample of 2005 affiliates for retrospective analysis[18]. Table 4 presents the summary statistics of my sample to estimate the effect of 1997 pension reform.

[16]While the 2004 wave is accessible, it is infrequently used for research due to reported errors.

[17]Since self-employed workers' SSCs are not income-based, information on self-employment incomes is unavailable in this dataset.

[18]Retrospective use of MCVL data may pose challenges when studying labor transitions or subpopulations with extended periods of inactivity, such as females or non-Spanish nationals (Pérez-Salamero et al., 2016). Appendix E demonstrates the stability of my sample over time using additional waves of the MCVL.

Table 3: Summary statistics for the sample near retirement: Age 60-64

	Retirees in 1994-1997		Retirees in 2002-2006		Retirees in 2007-2011	
	Mean (1)	S.D. (2)	Mean (3)	S.D. (4)	Mean (5)	S.D. (6)
Contribution variables						
$1\{C_{iat} > \underline{C}_{iat}\}$ (%)	26.99	(44.40)	30.22	(45.92)	40.41	(49.07)
Real Contr. (2021€)	319.77	(114.14)	338.20	(123.74)	344.45	(122.33)
SSC incentives						
NPV (€)	4.73	(0.96)	2.90	(0.42)	3.03	(0.37)
IRR (%)	24.57	(9.06)	14.88	(3.87)	15.50	(3.96)
Characteristics						
Female (%)	17.34	(37.87)	15.64	(36.32)	20.45	(40.34)
Education level (%)						
Primary	53.28	(49.90)	54.90	(49.76)	50.83	(49.99)
Secondary	16.46	(37.09)	23.88	(42.63)	29.59	(45.65)
Superior	6.88	(25.32)	12.33	(32.88)	16.42	(37.05)
N.A.	23.37	(42.33)	8.89	(28.46)	3.15	(17.48)
Contribution years	31.66	(4.84)	33.62	(5.32)	35.60	(5.56)
Small municipality (%)	0.49	(0.50)	49.15	(49.99)	54.13	(49.83)
N (obs)	3,183		11,861		19,278	

Notes: This table shows the descriptive statistics of the sample entering the study of the average contributions close to retirement. The sample is comprised of individuals who retired at age 65 with pensions above the minimum, and it includes the observations of these individuals when they were aged 60-64. The information is provided for those who retired in periods 1994-1997, 2002-2006 and 2007-2011. I provide mean and standard deviation the probability of making contributions above the minimum and real contributions, as well as the magnitude of SSC incentives, including the net present value (NPV) of additional SSCs, and the internal rate of return (IRR). Finally, the table includes demographic and employment variables such as education, gender, a dummy variable on whether municipality of residence has population smaller than 40,000 inhabitants, contributed years at retirement and the coefficient of contribution years entering the calculation of pension benefits. Fractions of categorical variables may not add up due to rounding.
Source: MCVL 2005.

5 Empirical strategy

I describe the empirical strategies used to exploit the quasi-experimental variations arising from the 1997 pension reform. The 1997 reform changed the age of the contribution-benefit link, the *linkage age*, from 57 to 50 years. The reform increased contribution incentives in the age range 50-56 years, leaving contributions in ages younger than 50 unlinked to pension benefits. I use two complementary strategies.

Table 4: Summary statistics for the reforms sample from 1994 to 2002

	Treated: 40-46 years		Control: 50-52 years		Full sample	
	Mean (1)	S.D. (2)	Mean (3)	S.D. (4)	Mean (5)	S.D. (6)
Outcome variables						
$1\{C_{iat} > \underline{C}_{iat}\}$ (%)	2.50	(15.61)	11.31	(31.67)	5.16	(22.12)
Real Contr. (2021€)	277.72	(35.23)	299.61	(89.87)	284.33	(58.36)
Real Contr. above min. (€2021)	4.29	(34.92)	25.94	(89.65)	10.82	(58.11)
SSC incentives						
NPV (€)	0.00	(0.00)	1.19	(1.02)	0.89	(1.02)
Control variables						
Females (%)	16.47	(37.09)	16.48	(37.10)	16.47	(37.09)
Small municipality (%)	55.74	(49.67)	51.34	(49.98)	54.41	(49.81)
Tenure years	12.37	(5.43)	15.72	(6.86)	13.38	(6.10)
Contributed years	16.82	(3.11)	22.38	(4.18)	18.50	(4.31)
Education level (%)						
Primary or less	35.99	(48.00)	47.70	(49.95)	39.53	(48.89)
Secondary	37.52	(48.42)	31.68	(46.53)	35.76	(47.93)
Superior	24.89	(43.24)	18.34	(38.70)	22.92	(42.03)
N.A.	1.59	(12.51)	2.27	(14.90)	1.80	(13.28)
Economic activity (%)						
Agriculture	1.91	(13.70)	2.26	(14.86)	2.02	(14.06)
Manufacturing	12.59	(33.18)	12.08	(32.59)	12.44	(33.00)
Construction	14.33	(35.04)	12.16	(32.68)	13.68	(34.36)
Retail service	32.09	(46.68)	31.70	(46.53)	31.97	(46.64)
Hospitality	8.79	(28.32)	7.84	(26.87)	8.50	(27.89)
Transport	10.94	(31.22)	12.04	(32.54)	11.27	(31.63)
Finance and real estate	6.06	(23.86)	4.92	(21.62)	5.71	(23.21)
Social services	7.75	(26.74)	8.46	(27.83)	7.97	(27.08)
N.A.	5.52	(22.85)	8.55	(27.96)	6.44	(24.54)
N(obs)	67,801		29,314		97,115	

Notes: This table shows the descriptive statistics of the sample entering the study of the effect of the 1997 pension reforms. The data spans the period from 1994 to 2002. The sample is divided between the control (40-46 years) and treatment groups (50-52 years), as well as providing descriptive statistics for the full sample. I provide mean and standard deviation for my two outcome variables, the probability of making contributions above the minimum and real contributions, as well as demographic and employment variables such as categorical variables on education and economic activity, as well as gender, province GDP per capita, a dummy variable on whether municipality of residence has population smaller than 40,000 inhabitants, tenure years in the current affiliation and contributed years at ages over 26 years (since affiliation data is available since 1967). Fractions of categorical variables may not add up due to rounding.
Source: MCVL 2005.

5.1 Dynamic DiD estimation

I implement a dynamic DiD approach to compare the contribution behavior of self-employed workers in age groups affected and unaffected by the 1997 reform over time. For comparability, I designate those aged 50-52 as the treatment group and those aged 40-46 as the control group. The dynamic

DiD regression takes the following form:

$$Y_{iat} = \alpha_a + D_t + \sum_{s=-3}^{-1} \beta_s (T_a \times D_{1997+s}) + \sum_{s=1}^{5} \beta_s (T_a \times D_{1997+s}) + \mathbf{X_{iat}}\theta + \varepsilon_{iat} \tag{4}$$

where Y_{iat} represents my two outcomes of interest: $Y_{iat} = \mathbf{1}\{SSC_{iat} > \underline{SSC}_t\}$, the indicator variable on whether self-employed worker i of age a contributed above the minimum contribution $\underline{SSC}_t$, and the logarithm of the real contributions $Y_{iat} = \ln(SSC_{iat})$. α_a denotes age dummies and D_t denotes time dummies. Age is defined on the 1st January of year t, when self-employed workers decide their contributions. T_a represents the treatment group indicator, taking value 1 if $a \in [50, 52]$ and 0 if $a \in [40, 46]$. $\mathbf{X_{it}}$ includes province, education and industry dummies, a dummy on whether municipality population is above 40,000 and tenure. Standard errors are clustered at the individual level.

The coefficient estimate β_s measures the average difference in contributions between treatment and control groups s years after the reform, relative to the reform year values. The validity of the DiD approach rests on the parallel trends assumption, which posits that the contributions of self-employed workers aged 50-52 and 40-46 would have followed parallel trends in the absence of the pension reforms. Under this assumption, the coefficient β_s identifies the average treatment effect on the treated (ATT). I use the coefficient estimates β_s for negative values of s to test for pre-trends and provide evidence on the plausibility of the parallel trends assumption.

5.2 2SLS semi-elasticity of contribution incentives

I use the dynamic DiD framework to identify the semi-elasticity of contribution incentives using the variation induced by the 1997 reform. I estimate the following 2SLS regression specification:

$$Y_{iat} = \alpha_a + D_t + \sum_{s=-3}^{-1} \gamma_s (T_a \times D_{1997+s}) + \sum_{s=1}^{5} \epsilon_s b_{a,1997+s} + \mathbf{X_{iat}}\theta + \varepsilon_{iat} \tag{5}$$

where τ_{at} represents the implicit tax rate of additional SSCs at age a at time t. I instrument the net present value of additional SSCs $b_{a,t}$ with $T_a \times D_t$ for each $t \in (1998, 2002)$. The identifying assumption of this IV approach is, once again, that the contributions of workers aged 50-52 and

40-46 would have followed parallel trends absent the 1997 reform. ϵ_s identifies the semi-elasticity of contribution incentives s years after the 1997 reform[19]. The semi-elasticity can be expressed as the Wald ratio of two dynamic DiD estimates:

$$\widehat{\epsilon}_s = \frac{E\left[Y_{1,s}\right] - E\left[Y_{1,0}\right] - \left[E\left[Y_{0,s}\right] - E\left[Y_{0,0}\right]\right]}{E\left[b_{1,s}\right] - E\left[b_{1,0}\right] - \left[E\left[b_{0,s}\right] - E\left[b_{0,0}\right]\right]} \tag{6}$$

where $E\left[Y_{g,s}\right] = E\left[Y_{iat}|T_a = g, t = 1997 + s\right]$ and $E\left[b_{g,s}\right] = E\left[b_{a,t}|T_a = g, t = 1997 + s\right]$.

6 Results

This section presents the empirical results. First, I present descriptive evidence on average contributions near retirement. Second, I present evidence on contributions around contribution-benefit linkage, using variations from the 1993 and 1997 pension reforms. Third, I present DiD estimation results to quantify the response to the pension reform.

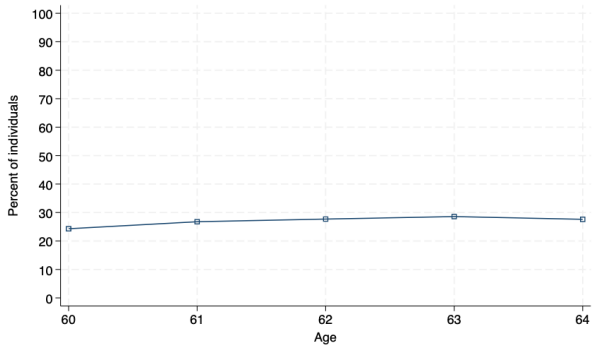
6.1 Contributions near retirement

I present descriptive evidence on the contribution behavior of self-employed workers near retirement. Figure 1 describes average contributions at ages 60-64 for self-employed retirees in three distinct periods: 1994-1997, 2002-2006 and 2007-2011. The evidence concentrates on individuals retiring at age 65 with pensions exceeding the minimum level. For these self-employed retirees, additional SSCs gave exceptional returns, reaching annual real rates of return of up to 35% (Table 1). Near retirement, the uncertainty around pension returns was minimal, as the prospect for future pension reforms impacting their returns is very limited (Luttmer & Samwick, 2018). Additionally, self-employed workers are expected to be planning for retirement, with limited investments into their businesses. This implies that self-employed workers are expected to take advantage of contribution incentives.

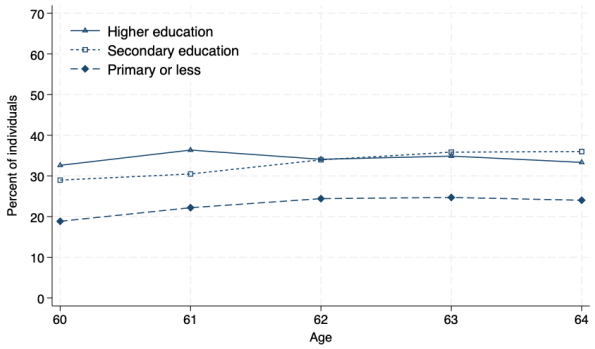
[19] The tax literature typically measures incentives in logarithms to estimate an elasticity. However, implicit net-of-tax rate prior to the reform was 0, which implies that the logarithm is not defined.

Figure 1: Fraction contributing above the minimum at age 60-64 depending on retirement period

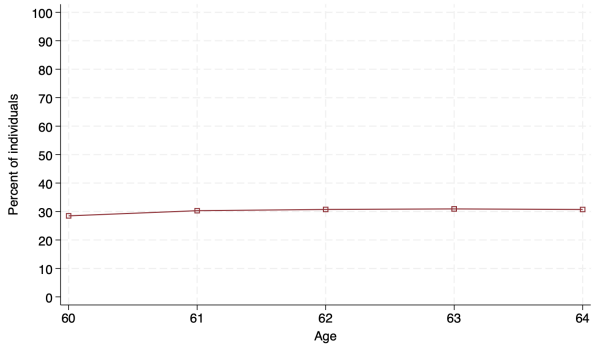
(a) Retirees 1994-1997



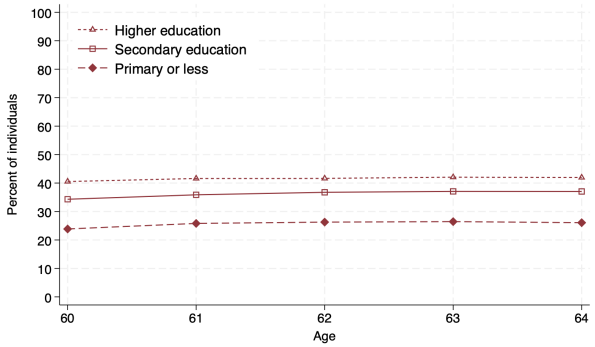
(b) Retirees 1994-1997: Education



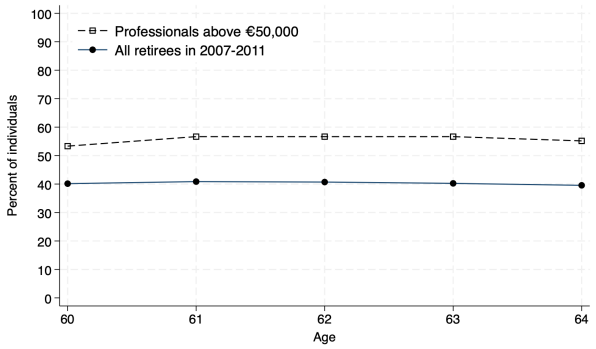
(c) Retirees 2002-2006



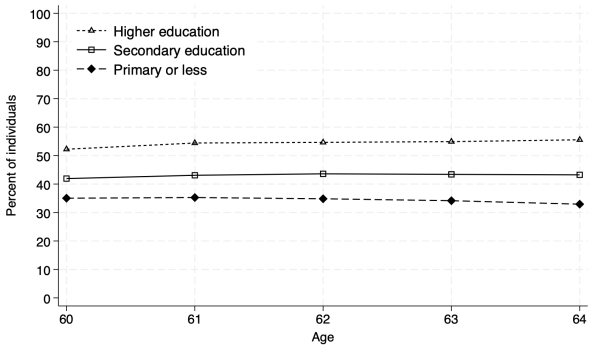
(d) Retirees 2002-2006: Education



(e) Retirees 2007-2011



(f) Retirees 2007-2011: Education



Notes: This figure shows the probability of contributing above the minimum for self-employed workers near retirement. The sample consists of self-employed retirees in 2007 and 2011.
Source: MCVL 2005.

Main evidence. Despite extraordinary incentives near retirement, voluntary contributions were starkly low throughout the study period. For retirees in 1994-1997 and 2002-2006, only 30 percent of self-employed workers contributed above the statutory minimum. This indicates that a majority of self-employed workers completely overlooked the exceptional returns. For retirees in 2007-2011,

while the share was higher at 40 percent, the majority still contributed at the statutory minimum.

Education level. The figure shows that contributions increase with education level, as expected. However, even among those with higher education degrees, the share of individuals contributing above the minimum remains very low. For retirees before 2006, only 40 percent of high-educated individuals contributed above the statutory minimum at age 60-64, while the share reached 55 percent amomg retirees in 2007-2011.

High-income professionals (2007-2011). For retirees in period 2007-2011, the gross income derived from business to business (B2B) transactions can be observed for professional self-employed workers[20]. I evaluate the contribution behavior of those with gross incomes exceeding €50,000. I verify that 43 percent still contributed at the minimum, equivalent to average high-educated individuals. This evidence verifies that liquidity constraints alone could not explain the low contribution behavior.

Comparison to prior literature. The descriptive evidence presented shows strikingly low contribution behavior. The vast majority of individuals overlooked extraordinary contribution incentives in Spain. The evidence is stronger than prior evidence for two main reasons. First, contribution incentives in Spain are substantially larger than in prior studies. Near retirement, SSC incentives in Spain correspond to effective matching rates of 200–400 percent, far exceeding the 50–60 percent rates offered in the US (Saez, 2009). The extraordinary incentives in Spain represent a clear arbitrage opportunity relative to other savings vehicles[21]. Second, statutory minimum contributions in Spain generated relatively low pension annuities— less than €800 per month — thus low contributions could not come from excessive pension annuities. This compares to settings with complementary pension schemes, where incomplete take-up could be justified by sufficient mandatory pension annuities.

Thus, the observed contributions for self-employed workers in Spain can be considered subopti-

[20]In my Social Security data, self-employment income is generally not observed. From 2006, the dataset contains annual turnover occurring B2B, coming from tax withholding files. Thus, a lower bound of their self-employment incomes are available for some professional self-employed workers – lawyers, architects, freelance, etc.

[21]In addition, whereas prior evidence documents incomplete take-up, I observe almost no take-up of economically attractive alternatives.

mal, indicating that SSC incentives are severely misperceived (Gabaix, 2019). This finding contrasts with survey-based evidence suggesting that individuals recognize that higher labor supply increases future pension benefits (Liebman & Luttmer, 2012). Two considerations may help reconcile this discrepancy. First, while median respondents in Liebman and Luttmer (2012) correctly predict that additional work increases benefits, they exhibit limited understanding of which years enter the benefit calculation window—an element that is central to SSC incentives. As a result, individuals may have particular difficulty perceiving incentives at the intensive margin. Second, Liebman and Luttmer (2012) focus on average beliefs, whereas my analysis links individualized SSC incentives to observed contribution choices.

6.2 Response to the contribution-benefit link

I present evidence on the effect of SSC incentives at the *linkage age* on voluntary contribution behavior. First, I provide evidence on average contributions by age around the 1997 reform, which changed the *linkage age* from 57 to 50. Then, I explore the drivers of the observed responses to the *linkage age*, for which I use evidence from a prior 1993 reform. Thus, the reforms are shown in inverse order, in line with the argument.

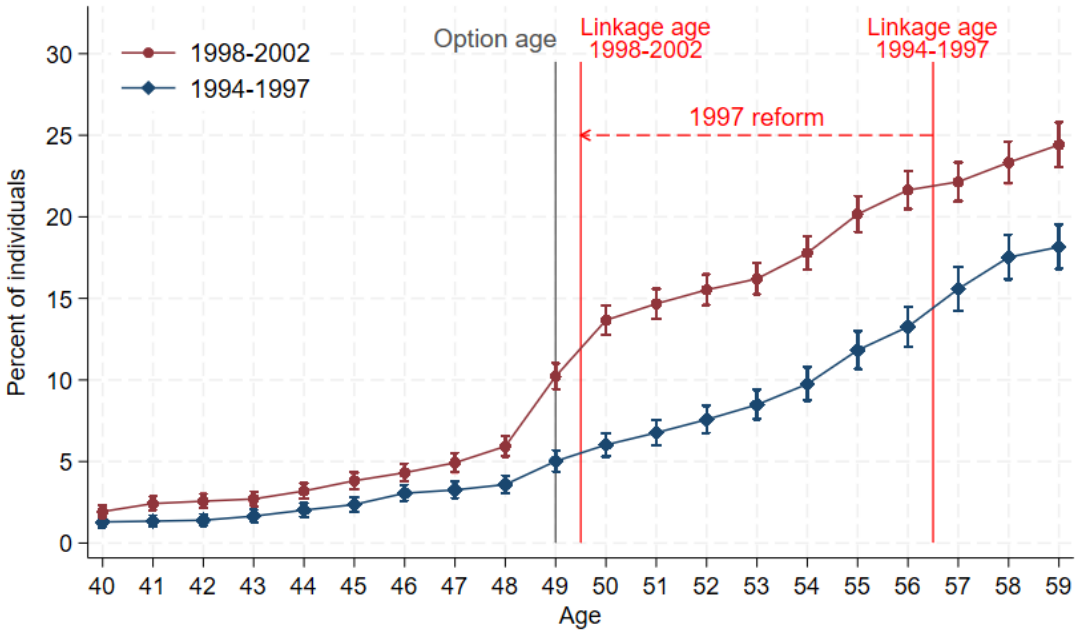
6.2.1 1997 reform: *Linkage age* from 57 to 50

Figure 2 describes the average contribution behavior of self-employed workers by age, distinctly for periods before and after the 1997 reform[22]. Before 1997, the contribution-benefit linkage occurred at age 57, while the 1997 reform brought the *linkage age* to 50. I evaluate contribution responses at the sharp change in SSC incentives induced by the *linkage age*.

Period 1994-1997 (blue line). Before the reform, the fraction contributing above the statutory minimum gradually increased with age, from nearly zero to 18 percent between age 40 and 59. However, no sharp increase in contributions is observed at the *linkage age* at 57. This behavior reveals that workers appear to be aware that SSC incentives were higher at older age, but did not

[22]The figure confirms the low levels of contributions in both periods, showing that less than 25 percent of workers contributed above the minimum.

Figure 2: Fraction contributing above the statutory minimum by age: 1997 reform



Notes: This figure shows the probability of contributing above the minimum for self-employed workers by age around the 1997 reform. I define age on the 1st January of each year, when most self-employed workers decide their contributions. The blue line represents the 1994-1997 period and the red line refers to the 1998-2002 period. The gray vertical lines represent the age of the option value decision (*option age*) and the vertical red dashed line represents the age at which contributions became linked to pensions (*linkage age*).
Source: MCVL 2005.

perceive the large change in incentives at the *linkage age*.

Period 1998-2002 (red line). The figure shows a sharp contribution increase at age 50, revealing that individuals perceived a sizable change in incentives at the *linkage age* after the 1997 reform. Thus, a response to the *linkage age* at 50, while not before the reform at age 57, despite sharper incentives. Additionally, the fraction of contributors is generally higher after the 1997 reform.

6.2.2 Mechanism: Differential perception of SSC incentives

I explore the mechanisms of the differential response to the *linkage age* through the lens of perceived SSC incentives. I investigate the role of the alignment of the *linkage age* with the prominent option decision at age 50 after the 1997 reform. Before 1997, the contribution-benefit linkage occurred at age 57, which had no other particular prominence. The 1997 reform brought the *linkage age* to 50, making it coincide with the option decision, a prominent point in the SSC schedule.

This alignment could enhance perception of the timing of SSC incentives at least in two ways. First, bringing the *linkage age* to a prominent age in the schedule may favor correctly internalizing the timing of SSC incentives. Second, high-stakes decision points could justify the cognitive costs of processing SSC incentives at age 50, mitigating behavioral inattention (Gabaix, 2019).

Interpreting this differential response through enhanced perception of SSC incentives relies on three conditions:

(i) The option value decision is a prominent point in the SSC schedule,

(ii) The response to the *linkage age* comes from alignment of with the option point,

(iii) Alignment drives behavior through perceived SSC incentives – not option incentives.

Below, I provide evidence on these factors.

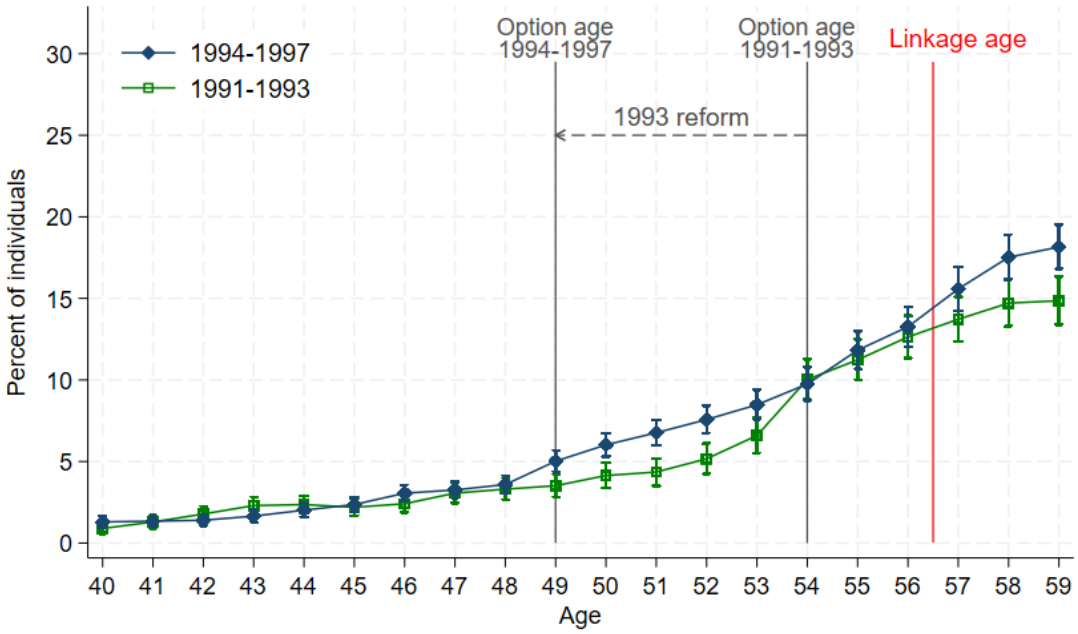
Points (i) and (ii): Evidence from 1993 reform

I investigate the response to a prior reform in 1993 for evidence on points (i) and (ii). The 1993 reform shifted the option point from age 55 to 50. Figure 3 shows contributions by age before and after the reform. A significant response to the 1993 reform would reveal that workers perceive the option point.

In period 1991-1993, the green line displays a sharp increase in contributions at age 54, coinciding with the option point. Following the 1993 reform, the blue line shows that contributions increased at ages 49-53. The contribution response to the option point reveals workers perceive this element in the SSC schedule, validating point (i). Thus, the option point is well perceived in the SSC schedule.

The figure also displays no sharp response at the *linkage age* at 57 years neither in 1991-1993 nor in 1994-1997. Evidence in period 1991-1993 confirms that the lack response in 1994-1997 was not driven by the proximity of the 1997 reform. This lends further support to the fact that contribution-benefit linkage does not trigger a sharp response in isolation, validating point (ii). Thus, responses to the contribution-benefit linkage are stronger when aligned with the option point.

Figure 3: Fraction contributing above the statutory minimum by age: 1993 reform



Notes: This figure shows the probability of contributing above the minimum for self-employed workers by age around the 1993 reform. I define age on the 1st January of each year, when most self-employed workers decide their contributions. The green line refers to the 1991-1993 period, the blue line represent the 1994-1997 period. The gray vertical lines represent the age of the option value decision (*option age*) and the vertical red dashed line represents the age at which contributions became linked to pensions (*linkage age*).
Source: MCVL 2005.

Point (iii): Decomposition of responses to 1997 reform

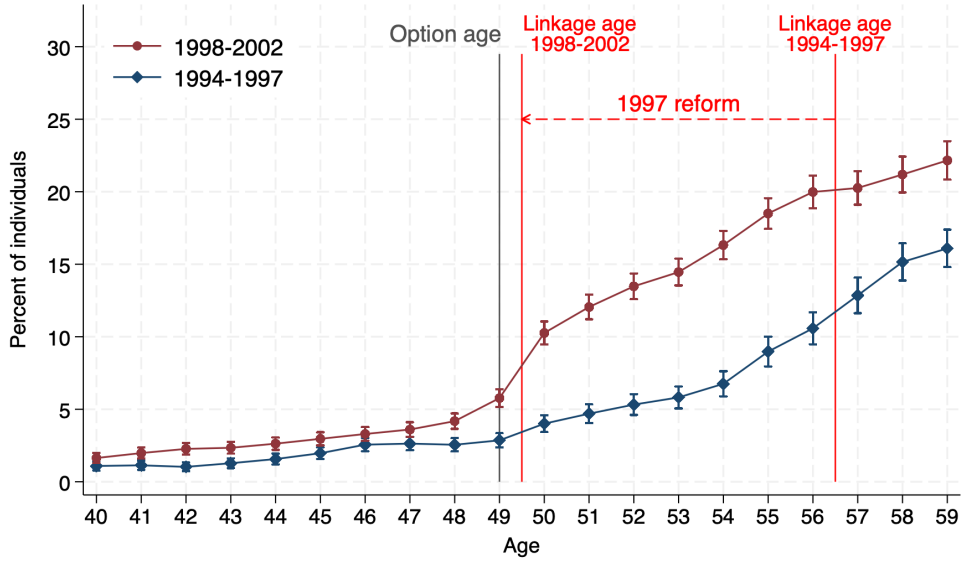
The evidence on points (i) and (ii) indicates that the alignment with the *linkage age* is key in driving the response to the 1997 reform. However, if the response to the 1997 reform was driven by option incentives at age 50, this could potentially confound interpreting results as fully coming from better perceived SSC incentives. To address this, I use that option incentives only exist above the option threshold at approximately €500 per month. Thus, responses to the 1997 reform for contribution levels below €500 per month could be attributed to perceived SSC incentives.

Figure 4 decomposes the share of contributions above the minimum into those who contribute below and above the option threshold. The figure shows that the response primarily occurred at contribution levels below the €500/month threshold, where the option had no real economic implications. While contributions did increase above the option threshold at ages 49-50, this is

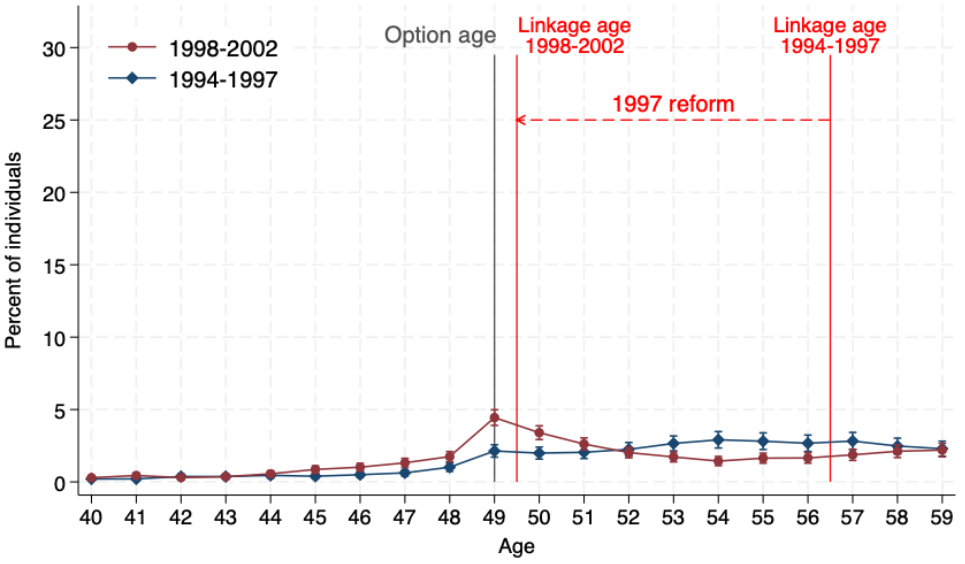
small compared to the large response below the threshold. This suggests that increased prominence, rather than the option's intrinsic value, drove the higher response to the *linkage age* at 50.

Figure 4: Decomposition of fraction of contributions above the minimum around 1997

(a) $\leq$ Option threshold ($\simeq$ 500€)



(b) > Option threshold ($\simeq$ 500€)



Notes: This figure shows the probability of contributing above the minimum for self-employed workers by age around the 1997 reform, decomposing responses below the option threshold (panel a) and above the option threshold (panel b). I define age on the 1st January of each year, when most self-employed workers decide their contributions. The blue lines represent the 1994-1997 period and the red lines refer to the 1998-2002 period. The gray vertical lines represent the age of the option value decision (*option age*) and the vertical red dashed line represents the age at which contributions became linked to pensions (*linkage age*).
Source: MCVL 2005.

Overall, this graphical evidence shows that responses to the contribution-benefit linkage are substantially larger when the linkage occurs at a prominent point. This suggests that SSC incentives are better internalized when the linkage timing is more salient.

6.3 DiD results: 1997 reform

I present the DiD results to quantify the dynamic response to the 1997 pension reform. First, I describe my baseline dynamic DiD results. Second, I perform a number of robustness checks. Third, I present the heterogeneity of the estimated responses.

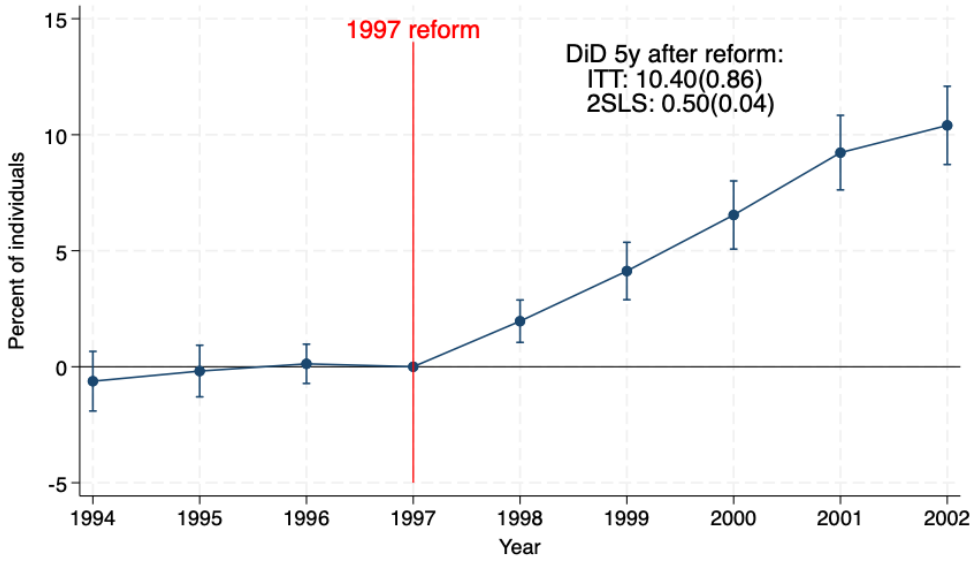
6.3.1 Baseline results

Figure 5 illustrates the dynamic DiD estimates on the probability of contributing above the minimum for the 1997 pension reform. The figure shows well-aligned pre-trends for both reforms, supporting the parallel trends assumption that underlies the DiD strategy. The figure shows a gradual response to the reform, possibly reflecting learning and better preparation for increasing contributions. Five years after the reform, I estimate that the 1997 reform increased the probability of contributing above the minimum by 10.40 ppt for self-employed workers aged 50-52 years.

I estimate 2SLS results to assess responses relative to the change in contribution incentives. I estimate that a 0.1€ increase in future benefits per 1€ contributed – equivalent to a 10% match on contributions – would increase the probability of contributing above the minimum by 0.5 ppt for self-employed workers aged 50-52. While the semi-elasticity points to a modest response, this may be partly explained by the non-linearity of responses. Pre-reform incentive levels were very low, so a large share of incentive variations occurs in ranges that do not trigger responses.

The response to the 1997 reform is sizable in comparison to the generally low contribution levels near retirement. This reform induced sharp increases in the share of contributors by 10.4 percent, while contributors near retirement were approximately 30 percent. SSC incentives at age 50-52 are much smaller and uncertain than at age 60-64. This evidence suggests that interventions aligning contribution-benefit linkage at salient points can substantially improve perceived incentives.

Figure 5: Dynamic DiD results on the response to the 1997 reform



Notes: The figure shows the dynamic DiD response to the 1997 reform, measured in terms of the probability of contributing above the minimum. The treatment group is represented by self-employed workers aged 50-52 and the control group by those aged 40-46. I define age on the 1st January, when most self-employed workers decide their contributions. The vertical red line denotes the 1997 reform year (panel b).
Source: MCVL 2005.

Table 5 also reports how the response is decomposed between above and below the option threshold, above which option incentives exist. I find that most of the response to the 1997 reform comes from below the option threshold, since the share of contributions between the minimum and the option threshold increased by 8.72 ppt, while above the threshold only 1.68 ppt. Thus, the bulk of the response to the 1997 reform can be confidently attributed to an increase in perceived SSC incentives, not option incentives. Finally, I also estimate that the 1997 reform increased real contributions by 6.67% for those aged 50-52, corresponding to a semi-elasticity of 0.32%.

6.3.2 Robustness checks

I assess the robustness of my baseline dynamic DiD results to the 1997 reform for alternative specifications, as well as to alternative assumptions for calculating incentives. I first estimate my baseline DiD specification without controls to check the importance of the composition of treatment and control groups. Second, I verify the robustness of my results by extending the age range of the

treatment group to include those aged 50-53 and 50-54 years. Third, I restrict the control group to those aged 40-44, ruling out any effect of early retirement, and those aged 42-46, who are closer and more comparable to the treatment group. Table 5 indicates that my estimated results are robust to these specifications.

Table 5: Dynamic DiD results on the 1997 reform using alternative specifications

	Baseline	No controls	Treatment group		Control group	
			50-53y	50-54y	40-44y	42-46y
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Intention-to-Treat (β_5)						
Prob above min.	10.40***	10.58***	10.69***	10.46***	10.94***	10.02***
	(0.86)	(0.88)	(0.77)	(0.71)	(0.86)	(0.89)
Below option ($\simeq$ €500)	8.72***	8.85***	9.39***	9.70***	9.18***	8.35***
	(0.79)	(0.80)	(0.71)	(0.66)	(0.79)	(0.82)
Above option ($\simeq$ €500)	1.68***	1.73***	1.30***	0.77*	1.76***	1.67***
	(0.41)	(0.42)	(0.35)	(0.32)	(0.41)	(0.42)
Log of real contributions	6.67***	6.80***	6.70***	6.29***	6.93***	6.52***
	(0.55)	(0.56)	(0.48)	(0.44)	(0.55)	(0.56)
Panel B: 2SLS semi-elasticity (ε_5)						
Prob above min.	0.50***	0.51***	0.51***	0.49***	0.53***	0.48***
	(0.04)	(0.04)	(0.04)	(0.03)	(0.04)	(0.04)
Log of real contributions	0.32***	0.33***	0.32***	0.30***	0.33***	0.31***
	(0.03)	(0.03)	(0.02)	(0.02)	(0.03)	(0.03)
N (obs)	97,115	97,115	106,499	115,283	77,200	78,162

Notes: This table provides the dynamic DiD estimates four years after the 1993 reform (panel a) and five years after the 1997 reform (panel b) using alternative specifications. The outcome variables are the probability of contributing above the minimum and the logarithm of real contributions. My baseline specification compares those aged 50-52 to those aged 40-46 (column 1). I further consider including no covariates (column 2), extensions of the treatment group to include those aged 50-53 (column 3) and aged 50-54 (column 4), reducing the control group to those aged 40-44 (column 5) and aged 42-46 (column 6). The coefficient estimates on the log of real contributions are multiplied by 100 to represent percentage points of real contributions. Pre-trends report the p-value of joint significance of the periods before the reform. Standard errors in parenthesis. * p<0.05, ** p<0.01, *** p<0.001.
Source: MCVL 2005

I then verify the robustness of my 2SLS semi-elasticity of contribution incentives to alternative assumptions for calculating incentives. First, I consider alternative discount rates of 1% and 5% to calculate the present value of future benefits. Second, I apply replacement rates of 70% and 100% to the benefit base, instead of my baseline 92.16% rate. Third, I consider applying the mortality rates of individuals who were 5 years older or younger than my treatment group aged 50-52. Fourth, I consider early retirement at 62 years. Fifth, I assess the robustness to policy uncertainty, considering that the certainty equivalent of pension benefits under current rule was

Table 6: 2SLS semi-elasticity of contribution incentives under alternative assumptions

	Baseline	Discount rate		Contr. year coef.		Mortality		Early ret.	Policy unc.
		d = 1%	d = 5%	α = 100%	α = 70%	45-47y	55-57y	R = 62y	CE = 57.8%
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A: Prob. above min.									
ϵ_5	0.50***	0.31***	0.79***	0.71***	0.50***	0.42***	0.63***	0.55***	0.87***
	(0.04)	(0.03)	(0.06)	(0.06)	(0.04)	(0.03)	(0.05)	(0.05)	(0.07)
Panel B: Log of real contr.									
ϵ_5	0.32***	0.20***	0.50***	0.46***	0.32***	0.27***	0.40***	0.35***	0.55***
	(0.03)	(0.02)	(0.04)	(0.04)	(0.03)	(0.02)	(0.03)	(0.03)	(0.05)
N (obs)	97,115	97,115	97,115	97,115	97,115	97,115	97,115	97,115	97,115

Notes: This table provides the semi-elasticities of contribution incentives 5 years after the 1997 reform using alternative assumptions for calculating incentives. The semi-elasticities represent the Wald ratio of the effect of the 1997 reform on contributions, relative to the effect on contribution incentives (see Equation 6). The DiD approach compares those aged 50-52 to those aged 40-46. The outcome variables are the probability of contributing above the minimum and the logarithm of real contributions. The table includes my baseline semi-elasticity (column 1). I further estimate the semi-elasticity for a discount rate of 1% (column 2) and 5% (column 3), replacement rate of 100% (column 4) and 70% (column 5); using the survival probabilities of those aged 45-47 years (column 6) and 55-57 years (column 7) for my target population are those aged 50-52; early retirement at 62 years (column 8); and accounting for policy uncertainty using a certainty equivalent (CE) of 57.8% (column 9).
Source: MCVL 2005

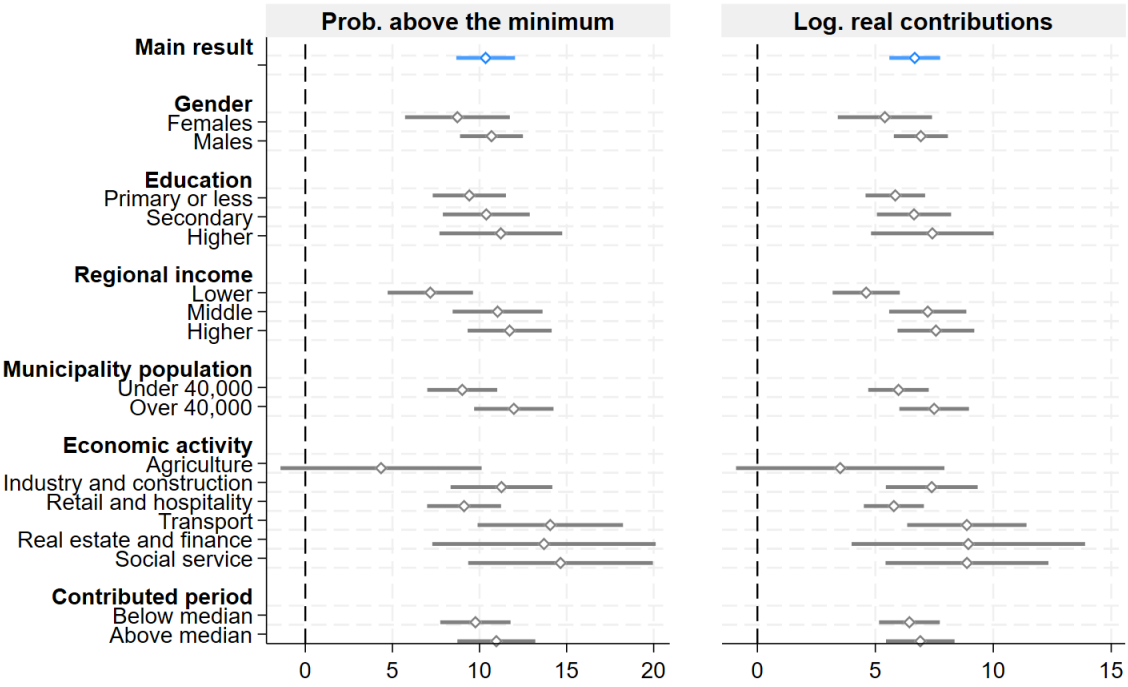
57.8%[23] (Luttmer & Samwick, 2018). Table 6 indicates that my estimated semi-elasticities remain qualitatively similar in all cases, pointing to modest responses to contribution incentives.

6.3.3 Heterogeneity analysis

I assess the heterogeneity of my baseline results depending on available demographic characteristics. Figure 6 shows that the heterogeneity of contribution responses to the 1993 was small, while the heterogeneity to the 1997 reform was somewhat larger. Responses to the 1997 reform were lower for workers living in regions with lower incomes, and increasing in education, municipality size, and for males compared to females. However, the overall heterogeneity in contribution responses could be considered modest, which aligns with Liebman and Luttmer (2012) finding a low association between demographic characteristics and awareness of pension rules.

[23] I derive this value from Luttmer and Samwick (2018), who found that US taxpayers aged 50-54 years were willing to accept 57.8% of their pensions under current rule to avoid pension reforms.

Figure 6: Heterogeneity of responses to the 1997 pension reform



Notes: The figure shows the heterogeneity of responses to the 1997 pension reform for self-employed workers aged 50-52. Coefficient estimates report dynamic DiD effects five years after the 1997 reform. The coefficient estimates on the log of real contributions are multiplied by 100 to represent percentage points of real contributions. Heterogeneity by regional income classifies Autonomous Communities by GDP per capita in 1997, resulting in regions with higher income (Balearic Islands, Basque Country, Catalonia, Madrid and Navarre), middle income (Aragon, Asturias, Canary Islands, Cantabria, Castile-Leon, Ceuta, La Rioja, Melilla and Valencian Community) and lower income (Andalusia, Castile La Mancha, Extremadura, Galicia and Murcia).
Source: MCVL 2005.

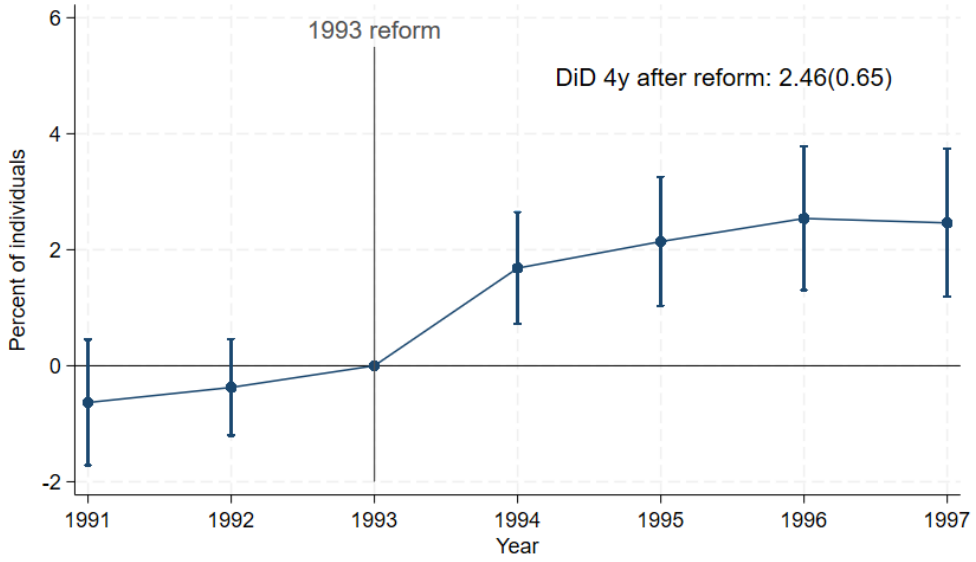
6.4 DiD result: 1993 reform

I also quantify the dynamic response to the 1993 reform using a dynamic DiD approach. The 1993 reform changed the option point from age 55 to age 50. I quantify the effect of the reform by looking at contributions at age 50-52, whose contribution after 1994 reflect facing the option point, to those aged 40-46, whose contributions are before the option point, both before and after the reform. In this manner, I provide causal evidence on the effect of facing the option point. Table G.1 provides the summary statistics of the sample used to estimate the effect of the 1993 reform.

Figure 7 shows the dynamic DiD result on the effect of the 1993 reform. The figure shows well-aligned pre-trends, supporting the parallel trends assumption that underlies the DiD strategy.

The effect of the reform appears rather instantaneous. Four years after the reform, I estimate that the 1993 reform increased the probability of contributing above the minimum by 2.46pp for those aged 50-52.

Figure 7: Dynamic DiD results on the probability of contribution above the minimum



Notes: The figure shows the dynamic DiD response of self-employed workers to the 1993 reform. The treatment group is represented by self-employed workers aged 50-52 and the control group by those aged 40-46. I define age on the 1st January, when most self-employed workers decide their contributions. The vertical gray line represents the 1993 reform year.
Source: MCVL 2005.

Despite smaller in magnitude than the contribution responses to other reforms, the sharp response is remarkable in a setting characterized by very low contributions. Option incentives only existed for very high contributions, and the reform occurred when contributions gave no ex-ante incentives. Thus, the significant response to the option point reveals appropriate perception by self-employed workers. This contributes to interpreting the response to the 1997 reform through the lens of better perceived SSC incentives.

7 Discussion

I discuss the main implications of the results. First, I discuss the implications of the findings for the deadweight loss (DWL) of Social Security financing in traditional public pension systems. Second,

I discuss the external validity of my results for broader public pension systems and populations. Third, I present broader implications for pension design.

7.1 Deadweight loss of Social Security financing

I evaluate the implications of my findings on the DWL of Social Security financing in pension systems where SSC levels are mandatory and proportional to labor income.

Valuation wedges and the DWL. I derive how valuation wedges in SSC incentives feed into the DWL of Social Security financing in such systems. Following Mullainathan et al. (2012), behavioral distortions are modeled as wedges in perceived marginal returns. Let perceived SSC returns be

$$\tilde{b} \equiv b + \mu \tag{7}$$

where b captures true SSC incentives and μ captures the misperception in SSC incentives. Deviations from optimal contribution behavior indicate valuation wedges in SSC incentives. In the context of voluntary contributions in Spain, these wedges include inattention to non-salient incentives (Chetty et al., 2009) and incorrect beliefs on SSC incentives (Sandroni & Squintani, 2007). Individuals may also exhibit present bias (Laibson, 1997), where $\beta \in (0, 1)$ denotes the weight placed on retirement utility at the time of decision.

The deadweight loss of Social Security financing can be approximated by[24]

$$DWL_{SS} = DWL_{\tau}(1 - \beta\tilde{b})$$

where DWL_{τ} denotes the deadweight loss of financing when benefits are unrelated to current SSCs, e.g. for income taxation[25] (Harberger, 1964). This expression can be decomposed as

$$DWL_{SS} = \underbrace{DWL_{\tau}(1-b)}_{\text{Rational benchmark}} + \underbrace{DWL_{\tau}(1-\beta)b}_{\text{Effect of present bias}} + \underbrace{DWL_{\tau}\beta(b-\tilde{b})}_{\text{Effect of valuation wedge}} \tag{8}$$

[24] See Appendix A for details of the derivation.

[25] $DWL_{\tau} = \frac{1}{2}\varepsilon w L_0 \tau^2$, where ε is the wage elasticity of labor supply, wL_0 are gross income under no tax, τ represents the SSC rate.

Undervaluations of SSC incentives directly increase the DWL of Social Security financing in earnings-related pension systems. The extent of these undervaluations interact with present bias, which also enters the calculation directly.

The unique setting of Spain allows me to observe how individuals perceive and respond to the SSC incentives embedded in the benefit formulas of a traditional public pension system. My findings offer two main lessons on the DWL of Social Security financing. First, my findings cast doubt on whether SSC incentives embedded in traditional public pension formulas are effectively internalized. Despite extraordinary incentives, most self-employed workers overlooked them, contributing at the statutory minimum level. This suggests that misperceived SSC incentives may be contributing to a substantial DWL in Social Security financing. Second, my evidence from the 1997 reform suggests that SSC incentives are better internalized when the contribution-benefit linkage occurs at a prominent point in the SSC schedule. Thus, careful design of the contribution-benefit formula could contribute to a substantial efficiency gain.

7.2 External validity

I discuss the external validity of my findings for self-employed workers in Spain to understand the perception of contribution incentives in broader populations and pension systems.

Pension systems. The pension formulas for self-employed workers in Spain are identical to those for wage earners. They are also broadly comparable to pension systems applied in other OECD countries (OECD, 2023). Similar earnings-related formulas are applied in public pension systems based on late career earnings (e.g. Costa Rica, Uruguay, or Colombia), best years of earnings (e.g. United States, Austria, France, Lithuania, Portugal, or Slovenia) or lifetime earnings (e.g. Belgium, Canada, Germany, Finland, Greece, Japan, Korea, Turkey, Hungary, or Czech Republic).

Broader populations. These results also offer valuable insights for the perception of contribution incentives for broader population groups. First, I focus on self-employed workers, recognized as one of the most financially literate groups (Struckell et al., 2022). Second, the general population do not need to make a contribution decision as the Spanish self-employed do, potentially paying less

attention to contribution incentives. This suggests that the level of misperception of contribution incentives may be even more pronounced among the broader population.

7.3 Implications for pension design

The findings of this study have three complementary implications for the design of public pension systems.

Design of contribution-benefit link. I find that the design of the contribution-benefit link can critically shape perceived SSC incentives. This implies that pension designs where the contribution-benefit link is more prominent could lead to efficiency gains in raising Social Security financing. This calls for considering the presentation of the design of contribution-benefit linkage more carefully, as this low cost intervention could lead to substantial efficiency gains.

Redistributive pensions. My findings point to a limited perceived valuation of SSC incentives in contributory pension systems, consistent with limited efficiency gains from tighter linkages. In the presence of limited efficiency gains from tighter linkages, the DWL of progressive pension formulas is reduced (Fehr et al., 2013). This logic could have contributed to a combination of highly progressive benefits in public pension systems, with investment-based complementary pension schemes.

Pension schemes for self-employed workers. My findings also offer policy implications for pension schemes for self-employed workers. In many countries, self-employed workers enjoy greater discretion in retirement provision compared to wage earners (OECD, 2018). My findings suggest that larger pension provision discretion for self-employed workers may not be justified by the assumption of rational saving behavior. Consequently, these results align with the recent trend towards equalizing Social Security coverage for both self-employed workers and wage earners.

8 Conclusion

This paper explores how individuals perceive the contribution incentives embedded in public pension systems. My empirical approach uses the unique context in Spain, where self-employed workers can

voluntarily choose their SSCs, coupled with quasi-experimental variations in contribution incentives arising from pension reforms.

Despite the pension formulas in Spain offer extraordinary contribution incentives, I document that self-employed workers made strikingly low contributions near retirement. More than 60% of workers overlooked SSC incentives exceeding annual rates of return of 35%, equivalent to government matching rates of 200-470%. This evidence suggests taxpayers face challenges in perceiving the contribution incentives embedded in public pension formulas.

My results also highlight that responses are larger when the contribution-benefit linkage occurs at a prominent point in the SSC schedule. This suggests that SSC incentives are better internalized when the timing of the contribution-benefit linkage is more salient. These results reveal that the design of contribution-benefit linkage could have large implications the deadweight loss of Social Security financing, and ultimately on economic efficiency.

While providing valuable insights, this study has some limitations that future research should aim to further develop. First, further research should aim to investigate whether the strikingly low voluntary SSCs reflects inattention or incorrect beliefs on incentives. Second, data constraints preclude an exploration of the role of substitution dynamics between pension contributions and other forms of savings for self-employed workers in Spain. Finally, pension reforms in Spain offer variations on whether the contribution-benefit linkage occurs at a prominent age, which informs the timing of SSC incentives. However, this does not to inform the magnitude of SSC incentives in Spain. In moving forward, addressing these limitations will contribute to a more nuanced understanding of the factors shaping the perceived valuation of SSC incentives.

References

Abeler, J., & Jäger, S. (2015). Complex tax incentives. *American Economic Journal: Economic Policy*, *7*(3), 1–28.

Altmann, S., Traxler, C., & Weinschenk, P. (2022). Deadlines and memory limitations. *Management Science*, *68*(9), 6733–6750.

Auerbach, A. J., & Kotlikoff, L. J. (1985). The efficiency gains from Social Security benefit-tax linkage. *NBER Working Paper*, *No. 1645*.

Auerbach, A. J., Kotlikoff, L. J., et al. (1987). *Dynamic fiscal policy* (Vol. 11). Cambridge University Press.

Bhargava, S., & Manoli, D. (2015). Psychological frictions and the incomplete take-up of social benefits: Evidence from an IRS field experiment. *American Economic Review*, *105*(11), 3489–3529.

Blinder, A. S., Gordon, R. H., & Wise, D. E. (1980). Reconsidering the work disincentive effects of social security. *National Tax Journal*, *33*(4), 431–442.

Bozio, A., Breda, T., Grenet, J., & Guillouzouic, A. (2025). Does tax-benefit linkage matter for the incidence of payroll taxes? *Review of Economic Studies*, rdaf059.

Brinch, C. N., Hernæs, E., & Jia, Z. (2017). Salience and Social Security benefits. *Journal of Labor Economics*, *35*(1), 265–297.

Carroll, G. D., Choi, J. J., Laibson, D., Madrian, B. C., & Metrick, A. (2009). Optimal defaults and active decisions. *The Quarterly Journal of Economics*, *124*(4), 1639–1674.

Chetty, R., Friedman, J. N., Leth-Petersen, S., Nielsen, T. H., & Olsen, T. (2014). Active vs. passive decisions and crowd-out in retirement savings account: Evidence from Denmark. *The Quarterly Journal of Economics*, *129*(3), 1141–1220.

Chetty, R., Looney, A., & Kroft, K. (2009). Salience and Taxation: Theory and Evidence. *American Economic Review*, *99*(4), 1145–1177.

Choi, J. J., Laibson, D., & Madrian, B. C. (2011). $100 bills on the sidewalk: Suboptimal investment in 401 (k) plans. *Review of Economics and Statistics*, *93*(3), 748–763.

Coile, C., Diamond, P., Gruber, J., & Jousten, A. (2002). Delays in claiming social security benefits. *Journal of Public Economics*, *84*(3), 357–385.

Dean, A., Fleitas, S., & Zerpa, M. (2022). Dynamic incentives in retirement earnings-replacement benefits. *The Review of Economics and Statistics*, 1–45.

Duflo, E., Gale, W., Liebman, J., Orszag, P., & Saez, E. (2006). Saving incentives for low- and middle-income families: Evidence from a field experiment with HR Block. *The Quarterly Journal of Economics*, *121*(4), 1311–1346.

Fehr, H., Kallweit, M., & Kindermann, F. (2013). Should pensions be progressive? *European Economic Review*, *63*, 94–116.

Feldstein, M., & Liebman, J. B. (2002). Social Security. In *Handbook of public economics* (pp. 2245–2324, Vol. 4). Elsevier.

Feldstein, M., & Samwick, A. (1992). Social security rules and marginal tax rates. *National Tax Journal*, *45*(1), 1–22.

French, E., Lindner, A. S., O'Dea, C., & Zawisza, T. A. (2022). Labor supply and the pension-contribution link. *NBER Working Papers*, (30184).

Gabaix, X. (2019). Behavioral inattention. In *Handbook of behavioral economics: Applications and foundations 1* (pp. 261–343, Vol. 2). Elsevier.

García-Gómez, P., Garcia-Mandicó, S., Jiménez-Martín, S., & Vall-Castelló, J. (2018). Trends in employment and Social Security incentives in the Spanish pension system, 1980–2016. In *Social security programs and retirement around the world: Reforms and retirement incentives* (pp. 317–371).

Harberger, A. C. (1964). The measurement of waste. *The American Economic Review*, *54*(3), 58–76.

INE. (2019a). Hipótesis de mortalidad en España: Tablas de mortalidad proyectadas 2018-2067: Esperanza de vida por edad y sexo. https://www.ine.es/jaxi/Tabla.htm?tpx=28990&L=0

INE. (2019b). Tablas de mortalidad por año, sexo, edad y funciones. series desde 1991. https://www.ine.es/jaxiT3/Tabla.htm?t=27153

Kotlikoff, L. J. (1996). Privatization of social security: How it works and why it matters. *Tax policy and the economy*, *10*, 1–32.

Laibson, D. (1997). Golden eggs and hyperbolic discounting. *The Quarterly Journal of Economics*, *112*(2), 443–478.

Liebman, J. B., & Luttmer, E. F. P. (2012). The perception of Social Security incentives for labor supply and retirement: The median voter knows more than you'd think. *Tax Policy and the Economy*, *26*(1), 1–42.

Liebman, J. B., Luttmer, E. F. P., & Seif, D. G. (2009). Labor supply responses to marginal Social Security benefits: Evidence from discontinuities. *Journal of Public Economics*, *93*(11), 1208–1223.

Luttmer, E. F. P., & Samwick, A. A. (2018). The welfare cost of perceived policy uncertainty: Evidence from Social Security. *The American Economic Review*, *108*(2), 275–307.

Madrian, B. C., & Shea, D. F. (2001). The power of suggestion: Inertia in 401(k) participation and savings behavior. *The Quarterly Journal of Economics*, *116*(4), 1149–1187.

Mitchell, O. S., Poterba, J. M., Warshawsky, M. J., & Brown, J. R. (1999). New evidence on the money's worth of individual annuities. *The American Economic Review*, *89*(5), 1299–1318.

Mullainathan, S., Schwartzstein, J., & Congdon, W. J. (2012). A reduced-form approach to behavioral public finance. *Annual Review of Economics*, *4*(1), 511–540.

OECD. (2018). *The future of social protection: What works for non-standard workers?*

OECD. (2022). Social Security contributions (indicator). https://doi.org/https://doi.org/10.1787/3ebfe901-en

OECD. (2023). *Pensions at a glance 2023*. https://doi.org/https://doi.org/10.1787/678055dd-en

Pérez-Salamero, J. M., Castillo, M. R., & Meliá, C. V. (2016). Análisis de la representatividad de la MCVL: El caso de las prestaciones del sistema público de pensiones. *Hacienda Pública Española / Review of Public Economics*, *217*(2), 67–130.

Ramnath, S. (2013). Taxpayers' responses to tax-based incentives for retirement savings: Evidence from the saver's credit notch. *Journal of Public Economics*, *101*, 77–93.

Rees-Jones, A., & Taubinsky, D. (2020). Measuring "schmeduling". *The Review of Economic Studies*, *87*(5), 2399–2438.

Saez, E. (2009). Details matter: The impact of presentation and information on the take-up of financial incentives for retirement saving. *American Economic Journal: Economic Policy*, *1*(1), 204–228.

Sandroni, A., & Squintani, F. (2007). Overconfidence, insurance, and paternalism. *American Economic Review*, *97*(5), 1994–2004.

Struckell, E. M., Patel, P. C., Ojha, D., & Oghazi, P. (2022). Financial literacy and self employment–the moderating effect of gender and race. *Journal of Business Research*, *139*, 639–653.

Summers, L. H. (1989). Some simple economics of mandated benefits. *The American Economic Review*, *79*(2), 177–183.

Appendix to

The Perceived Valuation of Social Security Contributions: Evidence from Voluntary Contributions in Spain

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July 24, 2026

This Appendix serves as a supplementary resource to the conceptual framework (Appendix A), institutional details outlined in Section 2 (Appendix B), complements to the methodology to calculate Social Security contribution incentives (Appendix C), complements on the variation of incentives induced by the 1997 reform (Appendix D), complementary details on the sample selection (Appendix E), additional DiD results by age (Appendix F), additional results on the response to the 1993 reform (Appendix G), additional results on the response to the 1997 pension reforms (Appendix H), additional results on the response to the 2003 reform (Appendix I), and details on private pensions by levels of public pensions for self-employed retirees (Appendix J).

A Conceptual framework

This section develops a simple conceptual framework to show how voluntary contribution choices can be used to infer valuation wedges in SSC incentives. I then derive how these wedges affect the efficiency of Social Security financing when SSC levels are mandatory.

A.1 Voluntary contributions and valuation wedges

Valuation wedges in SSC incentives can be inferred by comparing optimal contribution rules to observed behavior, potentially subject to misperceptions in pension returns.

Environment. Time consists of a working period w and a retirement period r. At the beginning of period w, individuals hold wealth a_0, and earn exogenous income Y. They choose working-period consumption C_w, Social Security contributions $SSC \geq \underline{SSC}$, and retirement savings $a_r \geq -\overline{c}$ to maximize lifetime utility:

$$U = u(C_w) + \delta u\left(P(SSC) + (1+r)(a_0 + Y - C_w - SSC)\right)$$

where $u' > 0$, $u'' < 0$, $\delta \in (0, 1]$, r is the return earned on private savings (or paid on borrowing). Pension benefits are linear in SSCs, $P(SSC) = \omega SSC$. Define the actuarial marginal return to SSCs, discounted by private savings, $b \equiv \frac{\omega}{1+r}$.

Rational benchmark. The marginal effect of increasing SSC, holding feasibility fixed, is

$$\frac{\partial U}{\partial SSC} = \delta u'(C_r)(\omega - (1+r)) = \delta u'(C_r)(1+r)(b-1)$$

Since $\delta u'(C_r)(1+r) > 0$, the sign of the marginal gain depends only on $b - 1$. Because pension accrual is linear, there is generically no interior solution; contributions are chosen at a corner:

- **Case 1:** $b \leq 1$. The marginal pension return does not exceed the market return. The optimal choice is $SSC^* = \underline{SSC}$.
- **Case 2:** $b > 1$. The marginal return to SSCs exceeds the market return. Additional contributions strictly increase lifetime utility. The individual wishes to increase contributions as

long as liquidity allows.

I focus on contributions above the statutory minimum $\underline{SSC}$ because optimality can be established without specifying the borrowing constraint, and liquidity needs are the lowest. Specifically, the decision entails

$$SSC^* > \underline{SSC} \quad \Longleftrightarrow \quad b > 1 \quad \text{and} \quad a_0 + Y + \bar{c} - C_w^{\underline{SSC}} > \underline{SSC} \tag{1}$$

where $C_w^{\underline{SSC}}$ is the optimal working-period consumption when contributions are fixed at $\underline{SSC}$, which satisfies the standard Euler condition: $u'(C_w^{\underline{SSC}}) = \delta(1+r)u'(C_r^{\underline{SSC}})$.

Behavioral individuals. Following Mullainathan et al. (2012), behavioral distortions are modeled as wedges in perceived marginal returns. Let perceived SSC returns be

$$\tilde{b} \equiv b + \mu \tag{2}$$

where μ captures the misperception in pension accrual. Individuals may also exhibit present bias, where $\beta \in (0,1)$ denotes the weight placed on retirement utility at the time of decision. The contribution decision for behavioral individuals becomes:

$$SSC^b > \underline{SSC} \quad \Longleftrightarrow \quad \tilde{b} > 1 \quad \text{and} \quad a_0 + Y + \bar{c} - C_w^{\underline{SSC},\beta} > \underline{SSC} \tag{3}$$

where $C_w^{\underline{SSC},\beta} > C_w^{\underline{SSC}}$, implying that present bias could affect SSCs via liquidity.

Conditional on liquidity not binding, voluntary contribution choices identify whether $\tilde{b} > 1$, revealing bounds of the valuation wedge $b - \tilde{b}$.

Drivers of valuation wedges. Valuation wedges could arise from factors including inattention to non-salient attributes (Chetty et al., 2009; DellaVigna, 2009), or biased beliefs (Sandroni & Squintani, 2007; Spinnewijn, 2015). Following Mullainathan et al. (2012), it can be specified as:

$$\mu = \theta \times \hat{b} - b \tag{4}$$

where $\theta \in (0,1)$ is the degree of attention, and $\hat{b}$ reflects beliefs about SSC incentives.

A.2 Mandatory SSCs and labor supply

I derive the expression of the deadweight loss of Social Security financing and I show how this depends on behavioral wedges in perceiving SSC incentives.

A.2.1 Rational individuals

Environment. SSCs are mandatory and proportional to earnings $SSC = \tau wL$, where τ is the SSC rate, w is the hourly wage and L is the labor supply, with $L = T - \ell$. The optimization problem under mandatory SSCs involves choosing leisure ℓ, consumption C_w and savings a_r:

$$\max_{\ell, C_w, a_r} U = u(C_w) + v(\ell) + \delta u(C_r) \tag{5}$$

with $v' > 0$, $v'' > 0$. For simplicity, I derive under $u'' = 0$. The budget constraints are:

$$\begin{aligned} C_w &= a_0 + wL(1-\tau) - a_r \\ C_r &= P(SSC) + (1+r)a_r \end{aligned} \tag{6}$$

Optimal labor supply. The first order condition for leisure is:

$$v'(\ell^*) = (1-\tau)w + \delta\tau w P'(SSC) \tag{7}$$

Under credit market clearing, the effective net wage is $w_n = w[1-\tau(1-b)]$. Let L_0 denote labor supply at $\tau = 0$, and $\varepsilon = \frac{w}{L_0}\frac{\partial L}{\partial w_n}|_w$ the compensated wage elasticity of labor supply. Linearizing around $\tau = 0$:

$$L_0 - L^* = \frac{\partial L}{\partial w_n}|_{w_n = w} \times (w - w_n) = L_0 \varepsilon \tau (1-b) \tag{8}$$

The Harberger triangle gives:

$$\begin{aligned} DWL^r_{SS} &= \frac{1}{2}\tau w(L_0 - L^*) = \frac{1}{2}\varepsilon w L_0 \tau^2 (1-b) = \\ &= DWL_\tau (1-b) \end{aligned} \tag{9}$$

where $DWL_\tau = \frac{1}{2}\varepsilon w L_0 \tau^2$ is the deadweight loss of income taxation. The value of pension accruals attenuates the distortion proportionally to b.

A.2.2 Behavioral individuals

Behavioral individuals perceive pension incentives $\tilde{b}$, and are subject to present bias β. The effective wage for labor supply decisions becomes $\widetilde{w}_n = w[1-\tau(1-\beta\tilde{b})]$. The deadweight loss Social Security financing for behavioral individuals is:

$$DWL^b_{SS} = \frac{1}{2}\varepsilon w L_0 \tau^2 (1-\beta\tilde{b}) \tag{10}$$

This shows that the efficiency cost of Social Security financing is balanced proportionally to the perceived benefits of SSCs. The expression can be further decomposed as

$$DWL^b_{SS} = \underbrace{DWL_\tau(1-b)}_{\text{Rational benchmark}} + \underbrace{DWL_\tau(1-\beta)b}_{\text{Effect of present bias}} + \underbrace{DWL_\tau\beta(b-\tilde{b})}_{\text{Effect of valuation wedge}} \tag{11}$$

Behavioral distortions therefore increase the efficiency cost of earnings-related pension financing both through present bias and through misperceived pension incentives. Undervaluations of SSC incentives directly increase the efficiency cost of Social Security financing in earnings-related pension systems. The extent of these undervaluations interact with present bias, which also enters the calculation directly.

B Institutional details

This appendix provides additional details on the Special Scheme for Self-Employed Workers (RETA), as well as describing the changes in pension formulas introduced by the 1997 pension reform.

B.1 Voluntary contributions under RETA

Figure B.1 provide a sample of the form for changing contributions for self-employed workers covered under RETA in 2010. The form had four sections. The first section covered the personal identification of the worker. The second section covered the selection of the new contribution base. The third section specified the future automatic increases of this contribution base. Finally, the bank details for the payment of Social Security contributions was provided.

B.2 Contribution and pension thresholds under RETA

The RETA scheme regulates the Social Security provisions for self-employed workers in Spain. One of its noteworthy features is the provision that allows self-employed workers to autonomously select their contribution bases to Social Security, within annually legislated maximum and minimum limits. Table B.1 provides an overview of the maximum and minimum contribution bases under RETA, along with the Social Security contribution (SSC) rates between 1994 and 2002.

B.3 Pension formulas and the 1997 reform

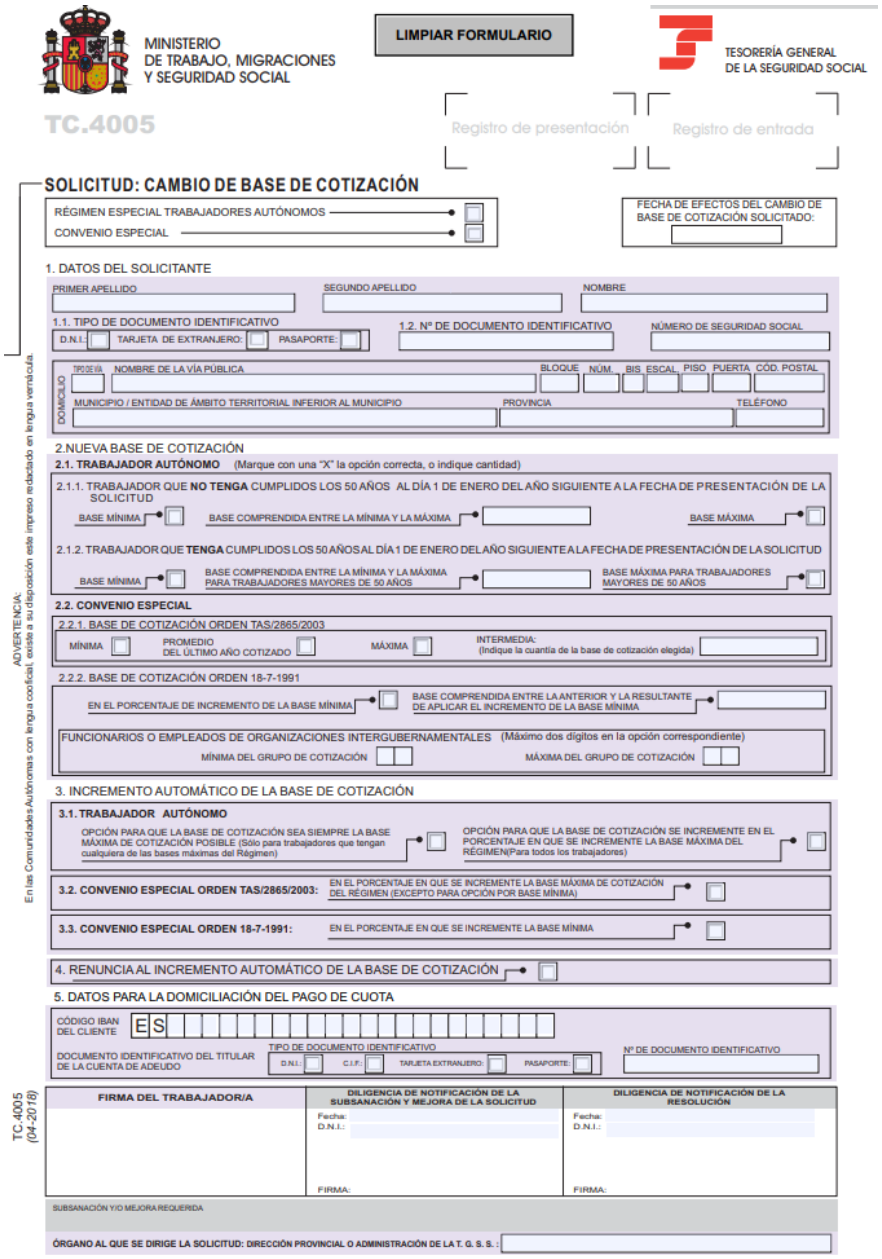
This section describes the pension formulas and the 1997 pension reform. This describes the background and the precise formulation of pension formulas before and after the 1997 reform.

Background

The 1997 pension reform was implemented in July 1997[1]. The primary objective of the reform was fiscal consolidation and it was applied to all Social Security schemes in Spain. Therefore, the reform was not designed with a specific focus on self-employed workers. Importantly, the reform left most

[1]Law 24/1997, of 15th July, of Consolidation and Rationalization of the Social Security system.

Figure B.1: Form for changing self-employed workers' contribution base under RETA


MINISTERIO
DE TRABAJO, MIGRACIONES
Y SEGURIDAD SOCIAL

LIMPIAR FORMULARIO

TESORERÍA GENERAL
DE LA SEGURIDAD SOCIAL

TC.4005

Registro de presentación

Registro de entrada

SOLICITUD: CAMBIO DE BASE DE COTIZACIÓN

RÉGIMEN ESPECIAL TRABAJADORES AUTÓNOMOS

CONVENIO ESPECIAL

FECHA DE EFECTOS DEL CAMBIO DE BASE DE COTIZACIÓN SOLICITADO:

1. DATOS DEL SOLICITANTE

PRIMER APELLIDO | SEGUNDO APELLIDO | NOMBRE

1.1. TIPO DE DOCUMENTO IDENTIFICATIVO

D.N.I. | TARJETA DE EXTRANJERO: | PASAPORTE:

1.2. Nº DE DOCUMENTO IDENTIFICATIVO

NÚMERO DE SEGURIDAD SOCIAL

DOMICILIO

TIPO DE VÍA | NOMBRE DE LA VÍA PÚBLICA | BLOQUE | NÚM. | BIS | ESCAL. | PISO | PUERTA | CÓD. POSTAL

MUNICIPIO / ENTIDAD DE ÁMBITO TERRITORIAL INFERIOR AL MUNICIPIO | PROVINCIA | TELÉFONO

2.NUEVA BASE DE COTIZACIÓN

2.1. TRABAJADOR AUTÓNOMO (Marque con una "X" la opción correcta, o indique cantidad)

2.1.1. TRABAJADOR QUE **NO TENGA** CUMPLIDOS LOS 50 AÑOS AL DÍA 1 DE ENERO DEL AÑO SIGUIENTE A LA FECHA DE PRESENTACIÓN DE LA SOLICITUD

BASE MÍNIMA | BASE COMPRENDIDA ENTRE LA MÍNIMA Y LA MÁXIMA | BASE MÁXIMA

2.1.2. TRABAJADOR QUE **TENGA** CUMPLIDOS LOS 50 AÑOS AL DÍA 1 DE ENERO DEL AÑO SIGUIENTE A LA FECHA DE PRESENTACIÓN DE LA SOLICITUD

BASE MÍNIMA | BASE COMPRENDIDA ENTRE LA MÍNIMA Y LA MÁXIMA PARA TRABAJADORES MAYORES DE 50 AÑOS | BASE MÁXIMA PARA TRABAJADORES MAYORES DE 50 AÑOS

2.2. CONVENIO ESPECIAL

2.2.1. BASE DE COTIZACIÓN ORDEN TAS/2865/2003

MÍNIMA | PROMEDIO DEL ÚLTIMO AÑO COTIZADO | MÁXIMA | INTERMEDIA: (Indique la cuantía de la base de cotización elegida)

2.2.2. BASE DE COTIZACIÓN ORDEN 18-7-1991

EN EL PORCENTAJE DE INCREMENTO DE LA BASE MÍNIMA | BASE COMPRENDIDA ENTRE LA ANTERIOR Y LA RESULTANTE DE APLICAR EL INCREMENTO DE LA BASE MÍNIMA

FUNCIONARIOS O EMPLEADOS DE ORGANIZACIONES INTERGUBERNAMENTALES (Máximo dos dígitos en la opción correspondiente)

MÍNIMA DEL GRUPO DE COTIZACIÓN | MÁXIMA DEL GRUPO DE COTIZACIÓN

3. INCREMENTO AUTOMÁTICO DE LA BASE DE COTIZACIÓN

3.1. TRABAJADOR AUTÓNOMO

OPCIÓN PARA QUE LA BASE DE COTIZACIÓN SEA SIEMPRE LA BASE MÁXIMA DE COTIZACIÓN POSIBLE (Sólo para trabajadores que tengan cualquiera de las bases máximas del Régimen)

OPCIÓN PARA QUE LA BASE DE COTIZACIÓN SE INCREMENTE EN EL PORCENTAJE EN QUE SE INCREMENTE LA BASE MÁXIMA DEL RÉGIMEN(Para todos los trabajadores)

3.2. CONVENIO ESPECIAL ORDEN TAS/2865/2003: EN EL PORCENTAJE EN QUE SE INCREMENTE LA BASE MÁXIMA DE COTIZACIÓN DEL RÉGIMEN (EXCEPTO PARA OPCIÓN POR BASE MÍNIMA)

3.3. CONVENIO ESPECIAL ORDEN 18-7-1991: EN EL PORCENTAJE EN QUE SE INCREMENTE LA BASE MÍNIMA

4. RENUNCIA AL INCREMENTO AUTOMÁTICO DE LA BASE DE COTIZACIÓN

5. DATOS PARA LA DOMICILIACIÓN DEL PAGO DE CUOTA

CÓDIGO IBAN DEL CLIENTE: E S

DOCUMENTO IDENTIFICATIVO DEL TITULAR DE LA CUENTA DE ADEUDO

TIPO DE DOCUMENTO IDENTIFICATIVO: D.N.I. | C.I.F. | TARJETA EXTRANJERO: | PASAPORTE:

Nº DE DOCUMENTO IDENTIFICATIVO

FIRMA DEL TRABAJADOR/A	DILIGENCIA DE NOTIFICACIÓN DE LA SUBSANACIÓN Y MEJORA DE LA SOLICITUD	DILIGENCIA DE NOTIFICACIÓN DE LA RESOLUCIÓN
	Fecha: D.N.I.: FIRMA:	Fecha: D.N.I.: FIRMA:

SUBSANACIÓN Y/O MEJORA REQUERIDA

ÓRGANO AL QUE SE DIRIGE LA SOLICITUD: DIRECCIÓN PROVINCIAL O ADMINISTRACIÓN DE LA T. G. S. S. :

ADVERTENCIA: En las Comunidades Autónomas con lengua cooficial, existe a su disposición este impreso redactado en lengua vernácula.

TC.4005 (04-2016)

Notes: The figure provides the form that the self-employed need to provide in order to change their contribution base in 2010. The form has four sections. First, personal identification. Second, the selection of the new contribution base. Third, the future automatic increase of this contribution base. Four, bank details for the payment of Social Security contributions.
Source: Social Security General Treasury.

of the remaining parameters in the pension system unchanged, including the Social Security rate, retirement age, or disability and survivor benefits.

Table B.1: Social Security Parameters under RETA, 1991–2002

	SSC rate (%)	Contribution bases (€)			Social Security contributions (€)			Retirement pensions 65+ (€)		
		Min.	Maximum		Min.	Maximum		Minimum		Max.
			> opt. age	≤ opt. age		> opt. age	≤ opt. age	Dep. spouse	No dep. spouse	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1991	28.8	831.4	2,016.8	3,810.9	239.4	580.8	1,097.6	728.5	619.2	3,210.3
1992	28.8	877.6	2,006.5	3,771.5	252.7	577.9	1,086.2	725.8	616.9	3,198.3
1993	28.8	939.6	2,052.7	3,792.8	270.6	591.2	1,092.3	729.3	619.8	3,213.4
1994	27.0	1,004.8	1,960.1	3,748.3	271.3	529.2	1,012.0	727.0	617.9	3,203.4
1995	26.5	1,009.0	1,936.2	3,710.5	267.4	513.1	983.3	726.0	617.0	3,198.7
1996	26.5	1,008.3	1,928.8	3,708.1	267.2	511.1	982.6	725.5	616.6	3,196.5
1997	26.5	1,034.4	1,953.3	3,737.7	274.1	517.6	990.5	731.3	621.6	3,222.0
1998	26.5	1,055.5	1,975.9	3,748.5	279.7	523.6	993.4	733.4	623.4	3,231.4
1999	26.5	1,056.5	1,985.5	3,726.6	280.0	526.2	987.6	735.6	625.3	3,240.8
2000	26.5	1,046.6	1,973.3	3,674.3	277.4	522.9	973.7	758.0	643.7	3,261.0
2001	26.5	1,032.2	1,934.3	3,624.1	273.5	512.6	960.4	752.8	639.2	3,238.5
2002	26.5	1,021.6	1,914.1	3,621.9	270.7	507.2	959.8	758.9	644.4	3,264.9

Notes: The table reports the main Social Security parameters of the Spanish Special Regime for Self-Employed Workers (RETA) between 1991 and 2002. Column (1) reports the Social Security contribution (SSC) rate. Columns (2)–(4) report the monthly minimum and maximum contribution bases. The maximum contribution base depends on whether workers are above or below the optional-age threshold, which was 55 during 1991–1993 and 50 during 1994–2002. Columns (5)–(7) report the corresponding monthly minimum and maximum SSC payments implied by the contribution rates and bases. Columns (8)–(10) report monthly retirement pension amounts for individuals aged 65 or older, including the minimum pension for retirees with and without a dependent spouse, and the maximum pension. All monetary values are expressed in constant 2021 euros. SSC contributions are paid over 12 monthly installments per year, whereas pensions are paid in 14 installments; pension amounts are converted to 12-payment equivalents for comparability.
Source: Spanish General Government Budget 1991-2002.

Public pension formulas

Upon satisfying the eligibility criteria for a pension, monthly pension benefits are calculated using the following formula[2]:

$$P_{R,n} = \alpha_n \times \beta_R \times BB \tag{12}$$

where $P_{R,n}$ denotes monthly pension benefits when claiming retirement at age R with n contribution years. α_n represents the coefficient for the number of contribution years n, which penalized contribution periods shorter than 35 years. β_R stands for the coefficient for retirement age R, which penalized early retirement before the statutory retirement age of 65 years. BB refers to the benefit base, calculated as the average of the contribution bases during the last years before claiming retirement. Monthly pension benefits are bounded by maximum and minimum pensions. I describe the three components of pension formulas before and after the 1997 reform.

[2]Eligibility to a retirement pension required 15 years of contributions to Social Security, and retirement at least at 60 years of age. Early retirement also required accrued pensions to exceed minimum pensions.

Benefit base. The 1997 pension reform extended the calculation period for the benefit base from the last 8 to the last 15 years. The computation of the benefit base in both the pre- and post-1997 pension systems is expressed as follows:

$$BB_t^{1985} = \frac{1}{112}\left(\sum_{i=1}^{24} CB_{t-i} + \sum_{i=25}^{96} CB_{t-i}\frac{CPI_{t-25}}{CPI_{t-i}}\right) \qquad BB_t^{1997} = \frac{1}{210}\left(\sum_{i=1}^{24} CB_{r-i} + \sum_{i=25}^{180} CB_{r-i}\frac{CPI_{r-25}}{CPI_{r-i}}\right)$$

where BB_t^{1985} represents the benefit base for retirees at time t in the system between 1985 and 1997, CB_{t-i} denotes the contribution base made i periods before retirement date t, CPI_{t-i} stands for the Consumer Price Index (CPI) i months before the retirement date t and BB_t^{1997} represents the benefit base in the post-1997 pension system. The division of 96 months of contributions by 112 accounts for taxpayers paying SSCs 12 times a year, while pensioners receive 14 annual pension payments at retirement. The increase in the number of years of contributions was implemented gradually based on the year of retirement, considering 9, 10, 11, 12, 13, and 15 years for retirement in 1997, 1998, 1999, 2000, 2001, and 2002 onward.

Coefficient for contribution years. The 1997 pension reform increased the penalization for insufficient contribution years from 2% to 3% for those retiring with contribution years between 15 and 25. The coefficient for contribution years before and after the 1997 reform is expressed as follows:

$$\alpha_n^{1985} = \begin{cases} 0 & \text{if } n < 15 \\ 0.6 + 0.02(n-15) & \text{if } 15 \le n < 35 \\ 1 & \text{if } n \ge 35 \end{cases} \qquad \alpha_n^{1997} = \begin{cases} 0 & \text{if } n < 15 \\ 0.5 + 0.03(n-15) & \text{if } 15 \le n < 25 \\ 0.8 + 0.02(n-25) & \text{if } 25 \le n < 35 \\ 1 & \text{if } n \ge 35 \end{cases}$$

where α_n^{1985} refers to the coefficient for contribution years for individuals retiring between 1985 and 1997 with n years contributed to Social Security and α_n^{1997} for individuals retiring after 1997 with n contribution years.

Coefficient for retirement age. The 1997 pension reform reduced the penalization for early retirement from 8% to 7% for those retiring with contribution years above 40. The formulas for the coefficient of retirement age before and after the 1997 pension reform are expressed as follows:

$$\beta_R^{1985} = \begin{cases} 0 & \text{if } R < 60 \\ 1 - 0.08(65 - R) & \text{if } 60 \leq R < 65 \\ 1 & \text{if } R \geq 65 \end{cases} \qquad \beta_{R,n}^{1997} = \begin{cases} 0 & \text{if } R < 60 \\ 1 - 0.08(65 - R) & \text{if } 60 \leq R < 65 \text{ and } n < 40 \\ 1 - 0.07(65 - R) & \text{if } 60 \leq R < 65 \text{ and } n \geq 40 \\ 1 & \text{if } R \geq 65 \end{cases}$$

where β_R^{1985} represents the retirement age coefficient for individuals retiring between 1985 and 1997 with age R and $\beta_{R,n}^{1997}$ represents the coefficient for individuals retiring after 1997 with age R and n years contributed to Social Security.

B.4 Option value decision

This section describes the main regulations giving rise to the option value decision and its implications in terms of incentives and salience.

Description. Above some age, which I term the *option age*, the maximum ceiling of contributions for following years depends on current contributions. Specifically, the maximum ceiling for contributions was substantially smaller compared to the regular maximum contribution base, with precise values for these thresholds are provided Table B.1. However, if self-employed workers chose a contribution base above this reduced threshold right before the *option age*, they would be able to choose a contribution base as large as their previous years' contribution base. In subsequent years, their contribution base could only be increased in line with the growth rate of the maximum contribution base. Therefore, if self-employed workers would like to contribute above the reduced ceiling when they are older than the *option age*, they should have decided to increase their contributions before reaching the *option age*.

I describe how maximum contributions depend on the contributions at the *option age* and beyond. We can define three possible cases depending on the contribution choice at the *option age*

are considered in respective panels in Figure B.2:

(a) **Contributions equal or below the option threshold** ($C_{a^o t} \leq C_t^{opt}$): If self-employed workers chose a contribution equal or below the option threshold of around €500/month at the *option age*, the maximum contribution until retirement will be the option threshold - around €500/month.

(b) **Contributions above the option threshold, kept in future years** ($C_{a^o t+s} = C_{a^o t} > C_t^{opt}$ for all $s \in [1, R - a^o]$): If self-employed workers chose a contribution above the option threshold of around €500/month at the *option age*, the maximum contribution starting from the following year will be their chosen contribution. Panel (b) shows that if they kept this contribution level in subsequent years, they could keep this level until retirement.

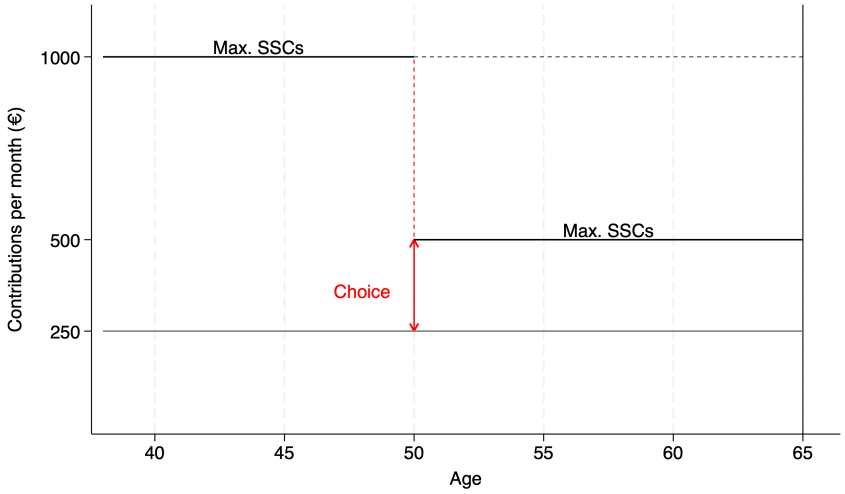
(c) **Contributions above the option threshold, decreased in future years** ($C_{a^o t} > C_t^{opt} \geq C_{a^o t+s} =$ for some $s \in [1, R - a^o]$): If self-employed workers chose a contribution above the option threshold of around €500/month at the *option age*, the maximum contribution starting from the following year will be their chosen contribution. Panel (c) shows that if they decreased this contribution level in some year in the future, their maximum contribution would also be reduced for subsequent years. If their contribution ever came below the option threshold, then the option threshold - around €500/month - would be the maximum contribution until retirement.

Information and salience

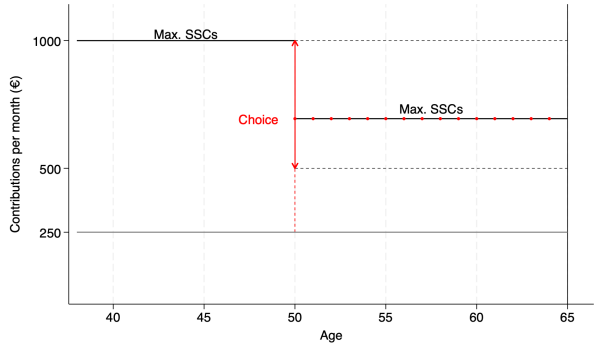
The decision features in the government budget every year when the contribution thresholds are updated. I verified that self-employed associations forward notifications on the updates on Social Security regulations, including the option value decision. Therefore, by prompting self-employed workers to consider their contributions, the option value decision could act as a reminder. Figure B.3 displays a sample notification informing the conditions of the option value decision. Figure B.4 displays a table of contribution limits, which shows the differences in contribution thresholds by age.

Figure B.2: Maximum contribution base depending on contributions at the *option age*

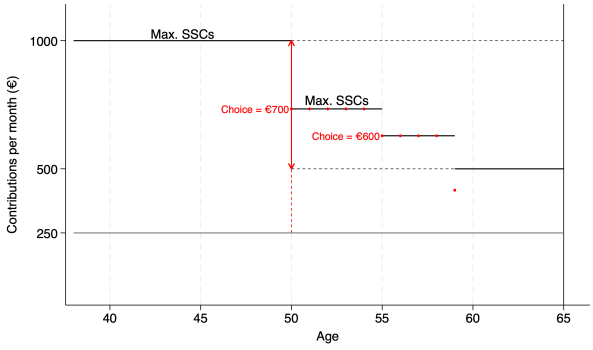
(a) Contribution base ≤ option threshold



(b) Contribution base > option threshold

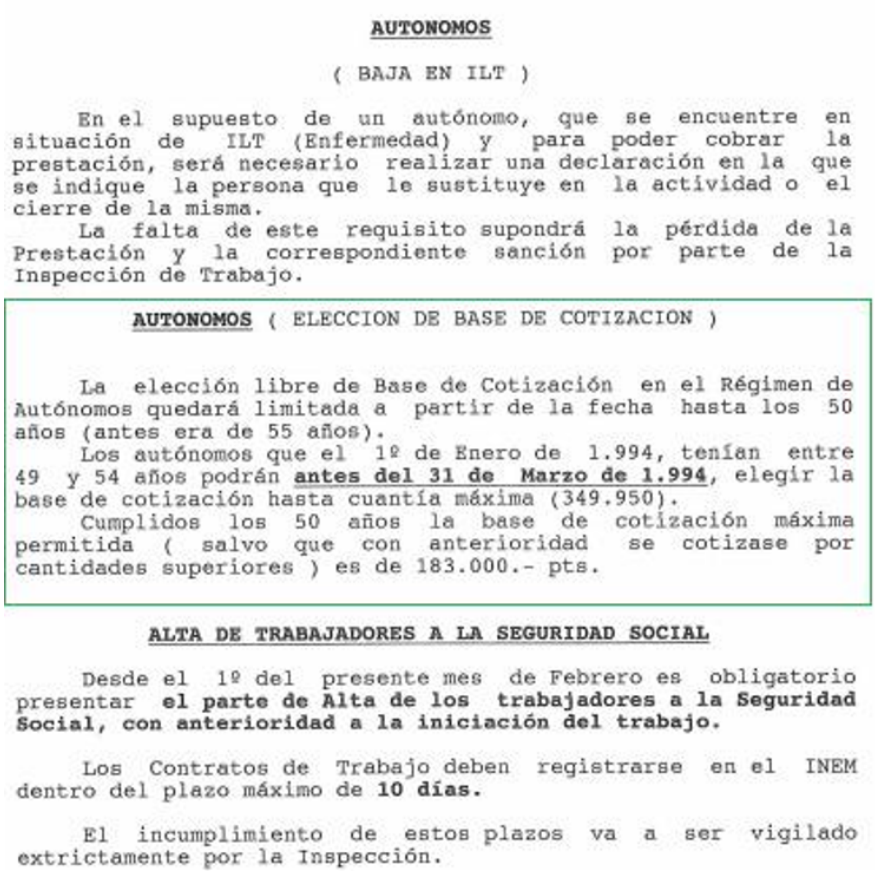


(c) Contribution base > option threshold



Notes: The figure shows the the maximum contributions depending on the contributions at the *option age*. Panel (a) shows the maximum contribution base when self-employed workers chose a contribution base equal or below the option base at the *option age*. In this case, the maximum contribution past the *option age* would be the option base at around 500€/month. Panels (b) and (c) display the maximum contribution base when self-employed workers chose a contribution base above the option base at the *option age*. They show how the maximum contribution base differs depending on future choices.

Figure B.3: Extract from a letter with information for self-employed in 1994.



AUTONOMOS

(BAJA EN ILT)

En el supuesto de un autónomo, que se encuentre en situación de ILT (Enfermedad) y para poder cobrar la prestación, será necesario realizar una declaración en la que se indique la persona que le sustituye en la actividad o el cierre de la misma.

La falta de este requisito supondrá la pérdida de la Prestación y la correspondiente sanción por parte de la Inspección de Trabajo.

AUTONOMOS (ELECCION DE BASE DE COTIZACION)

La elección libre de Base de Cotización en el Régimen de Autónomos quedará limitada a partir de la fecha hasta los 50 años (antes era de 55 años).

Los autónomos que el 1º de Enero de 1.994, tenían entre 49 y 54 años podrán **antes del 31 de Marzo de 1.994**, elegir la base de cotización hasta cuantía máxima (349.950).

Cumplidos los 50 años la base de cotización máxima permitida (salvo que con anterioridad se cotizase por cantidades superiores) es de 183.000.- pts.

ALTA DE TRABAJADORES A LA SEGURIDAD SOCIAL

Desde el 1º del presente mes de Febrero es obligatorio presentar **el parte de Alta de los trabajadores a la Seguridad Social, con anterioridad a la iniciación del trabajo.**

Los Contratos de Trabajo deben registrarse en el INEM dentro del plazo máximo de **10 días.**

El incumplimiento de estos plazos va a ser vigilado extrictamente por la Inspección.

Notes: This figure displays an extract from the letter received by self-employed that are part of a Self-employed Association in 1994. The green rectangle indicates the part of the letter where this informs about the change of the option value from 55 years to 50 years. The translation to English: *"The free choice of the contribution bases under the Social Security scheme for the self-employed will be limited from the age of 50 years (it was previously 55 years). The self-employed aged 49-54 years on the 1st January 1994 will be able to choose their contribution base up to the maximum contribution base (349,500 pesetas) by the 31st March 1994. Once aged 50 years, the maximum contribution base will be 183,000 pesetas (except for those who were contributing by larger contribution bases)."*
Source: Self-employed association for hairdressers in Navarre.

Figure B.4: Extract from a letter with information for self-employed in 2009.

➢ **Cotizaciones año 2.009.**

RÉGIMEN ESPECIAL DE TRABAJADORES AUTONOMOS

Base de Cotización		Tipo de cotización	Cuota con I.T.	Bonificación reducción
Máxima	3.166,20 €	29,90%	946,69 €	
Máx. 50 años	1.649,40 €		493,17 €	30% cuota mínima (30 meses) hombres 30 años, mujeres 35 años. Importe 74, 51€
Mínima	833,40 €	(26,50% + 3,30% por IT + 0,10% riesgo maternidad y lactancia	249,18 €	50% cuota mínima (60 meses). Alta inicial minusválidos. Importe: 124,18€
Mínima venta ambulante	714,00 €		217,64 €	
Mínima 50 años	458,40 €		145,12 €	100% cuota mínima. (12 meses) mujeres reincorporadas despues del parto.
	885,30 €		264,70 €	
Accidentes de Trabajo y Enfermedad Profesional, tarifa establecida en Disp. Final 13ª Ley 2/2008				

➢ **Salario mínimo interprofesional para el 2.009**: R.D. 2128/2008 de 26 de Diciembre (B.O.E. día 30) Incremento 2008/2009:4%; Anual: 8736,00€; Mensual: 624,00€; Diario: 20,80€.

➢ **Convenio de Peluquerías 2.009.** El pasado 31 de Diciembre de 2.008 venció la vigencia del convenio colectivo para nuestro sector. A día de hoy no tenemos todavía noticias de cuándo ni en qué términos vamos a iniciar las negociaciones para el futuro. En cuanto tengamos las primeras noticias os iremos informando,

➢ **REAL DECRETO 1975/2008, de 28 de noviembre, sobre las medidas urgentes a adoptar en materia económica, fiscal, de empleo y de acceso a la vivienda.**

«Artículo 3. Plan extraordinario para la contratación indefinida de trabajadores desempleados con responsabilidades familiares.

1. Los empleadores que, desde la fecha de entrada en vigor de este precepto hasta el día 31 de diciembre de 2010, contraten indefinidamente a tiempo completo a trabajadores desempleados con responsabilidades familiares, tendrán derecho a una bonificación en la cuota empresarial a la Seguridad Social de 125 euros/mes (1.500 euros/año) o, en su caso, de su equivalente diario, por trabajador contratado, durante dos años. A estos efectos, podrán utilizar cualquier modalidad de contratación indefinida prevista en el ordenamiento tanto ordinaria como de fomento de la contratación indefinida.

2. A efectos de lo establecido en este artículo, se considerará que el trabajador tiene responsabilidades familiares si tiene uno o más hijos a su cargo. Si la tenencia de cargas familiares no consta en la Oficina Pública de Empleo, podrá acreditarse en el momento de la contratación.

➢ **Reducción del 50% de la cotización a la Seguridad social en los supuestos de cambio de trabajo por riesgo durante el embarazo o lactancia natural, así como en los supuestos de enfermedad profesional (Disposición adicional 7ª)**

a) En los casos de riesgo durante el embarazo o lactancia natural prevé una reducción del 50% de la cuota empresarial por contingencias comunes si se destina a la trabajadora a un puesto de trabajo o función diferente y compatible con su estado durante el tiempo que dure dicho cambio de puesto.

b) En los casos de enfermedad profesional se prevé que el cambio de puesto de trabajo en la misma empresa u otra a un puesto compatible con la enfermedad profesional exista una reducción del 50% de la cotización empresarial por contingencias comunes, pero precisa el desarrollo reglamentario.

III.- VARIACIÓN DE DATOS EN LA SEGURIDAD SOCIAL PARA EL 2.009.

Recordamos a aquellos socios que deseen variar sus datos (Base de Cotización del Régimen Especial de Autónomos para el año 2.009, Opciones Incapacidad Temporal, etc.) que podrán hacerlo, siempre que así lo soliciten de la Tesorería General de la Seguridad Socia **antes del 1 de Abril,** con efectos del 1 de Julio del ejercicio vigente. Cualquier variación deberán de realizarlo por escrito ante dicha Tesorería. No obstante, si alguien necesita asesoramiento, puede dirigirse directamente a las oficinas de la Asociación.

IV.- Cursos SUBVENCIONADOS para AUTÓNOMOS y TRABAJADORES POR CUENTA AJENA para el ejercicio 2009 y 2.010 en Navarra Adelantaros mediante estas líneas que desde estas oficinas se está trabajando con la administración para programar cursos de reciclaje subvencionados al 100% para nuestro sector. Las Cosas están cambiando mucho y en estos momentos no tenemos calendario de programación. En cuanto sepamos noticias os iremos informando. En el caso de que no saliera formación subvencionada intentaríamos programarla otro tipo de formación.

V.- TALLER CON CREATIVE NAILS: (subvencionado para el socio y trabajadores de los socios).

Lugar: Escuela de Peluquería y Moda. (plaza San Rafael 5 bajo) Pamplona
Fechas: Finales Marzo principios Abril (pendiente de confirmación según grupo).
Plazas: Limitadas.
Imparte: Creative Nails, número uno a nivel internacional.
Inscripciones: Avda. de Zaragoza 27, Tfno 948249419.
Contenido y desarrollo del curso: **MANICURA SPA MÁS MANICURA FRANCESA PERMANENTE** por la mañana, y por la tarde **PEDICURA SPA MÁS REALCE UÑA PIE.**

Sin otro particular atentamente,

Fdo.

Notes: This figure displays an extract from the letter received by self-employed that are part of a Self-employed Association in 2009. The green rectangle indicates the part of the letter where the maximum and minimum contribution bases are announced, which include the values of maximum contribution bases from the age of 50 years, the SSC rate and the resulting SSCs.
Source: Self-employed association for hairdressers in Navarre.

C Social Security contribution incentives

This appendix provides details on the calculation of Social Security contribution incentives for self-employed workers in Spain.

C.1 Methodology

I present the methodology for calculating the implicit net-of-tax rate of public pension contributions for self-employed workers in Spain. The implicit net-of-tax rate of public pension savings is determined as the net discounted value of the discounted pension benefits offered by additional contributions to the public pension system. This takes the following form:

$$b_{a,t} = \frac{\partial SSW_{a,t}}{\partial SSC_{a,t}}(r) = \sum_{s=R}^{\overline{LE}} \frac{\pi_t(s|a)}{(1+r)^{s-a}} \times \frac{\partial P_s}{\partial SSC_{a,t}} \tag{13}$$

where $\tau_{a,t}$ denotes the tax rate of saving through the public pension system for an individual aged a at time t, $SSC_{a,t}$ stands for the SSCs at time t for someone aged a, $SSW_{a,t}$ represents the Social Security Wealth at time t for someone aged a, P_t stands for the pension annuity at time t, $\pi_t(s|a)$ is the survival probability for a person aged a at time t to remain alive at age s, R is the retirement age, $\overline{LE}$ stands for the maximum life expectancy. I further develop $\frac{\partial P_t}{\partial SSC_{a,t}}$ based on the pension formulas in the Spanish pension system:

$$\frac{\partial P_t}{\partial SSC_{a,t}} = \begin{cases} \alpha_n \times \beta_{R,n} \times \frac{w_{a,t}}{T \times \tau} & \text{if } a \in (R-T, R) \text{ and } P_t \in (\underline{P}_t, \overline{P}_t) \\ 0 & \text{otherwise} \end{cases} \tag{14}$$

where α_n stands for the coefficient of contribution years, $\beta_{R,n}$ stands for the coefficient of retirement age, $w_{a,t}$ stands for the weight of each contribution base of age a at time t[3], T stands for the number of years of contributions entering the calculation of the benefit base and τ stands

[3]The benefit base in the Spanish pension system can be expressed as

$$BB_t = \frac{1}{T} \sum_{a=R-T}^{R} w_a CB_{a,t}$$

for the SSC rate, $\underline{P}_t$ and $\overline{P}_t$ stand for the minimum and maximum statutory pensions respectively. Equation 14 shows that an increase in the payment of SSCs only leads to an increase in pension benefits if SSCs are made within the last T years before retirement and if pension benefits are within maximum and minimum limits.

C.2 Parameters and assumptions

A number of parameters and assumptions are used to calculate contribution incentives for self-employed workers in Spain.

Conditional survival probabilities - $\pi_t(s|a)$. Conditional survival probabilities by cohort, age, and gender are extracted from mortality tables provided by the Spanish Office of National Statistics (INE, 2019a; INE, 2019b).

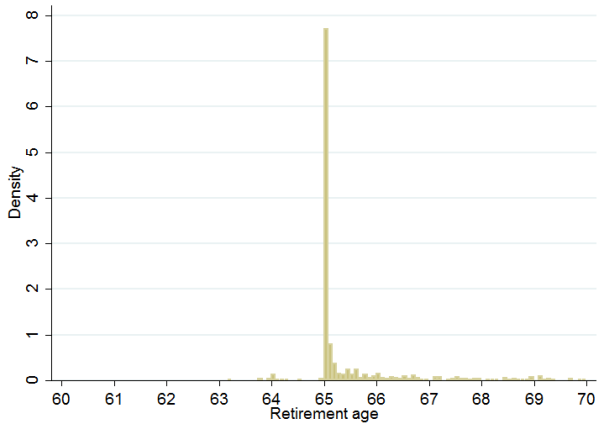
Retirement age at 65 years old. It is assumed that self-employed workers plan to retire at the normal retirement age of 65 years old. Figure C.1 illustrates the histograms of retirement age for self-employed workers, revealing that the majority retire at age 65. Additionally, it is assumed that self-employed workers contribute until retirement. Self-employed have incentives to do this. First, self-employed workers faced legal restrictions for early retirement. Second, retirement beyond the normal retirement age of 65 did not offer any bonus until 2003.

Coefficient for contribution years. For individuals who did not yet retire, the coefficient for contribution years is calculated by assuming they will work until retirement at age 65. This implies a penalization for insufficient contribution years was 5.3% and 20.7%, respectively, for males and females.

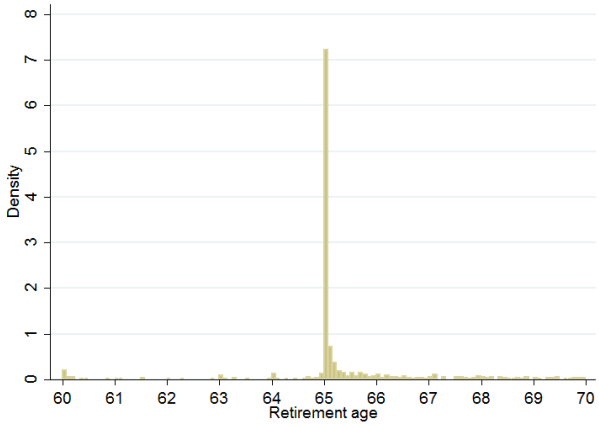
No disincentive of minimum pensions. If pensions accrued by self-employed workers fall below the minimum pension threshold, increasing their contributions to Social Security would still result in receiving the minimum pension. Consequently, minimum legal pensions may act as a disincentive for self-employed workers to contribute more to Social Security. This potential disincentive is particularly relevant for self-employed workers facing a substantial penalization coefficient for in-

Figure C.1: Retirement age for Spanish self-employed workers between 1997-2002

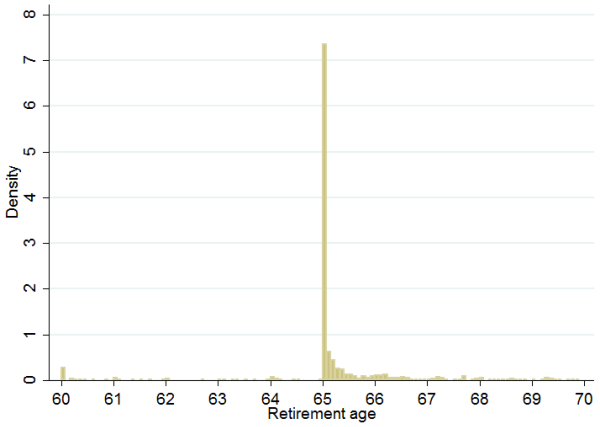
(a) 1997



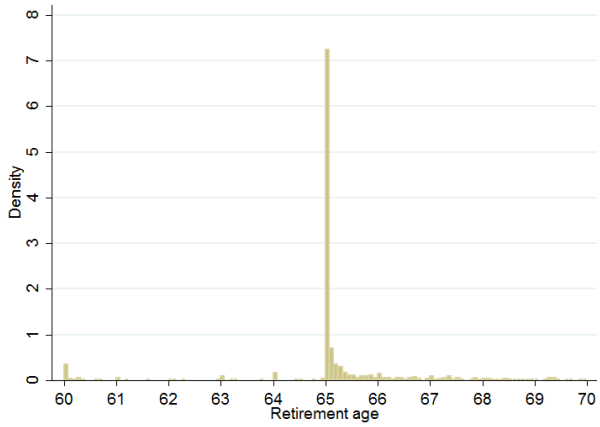
(b) 1998



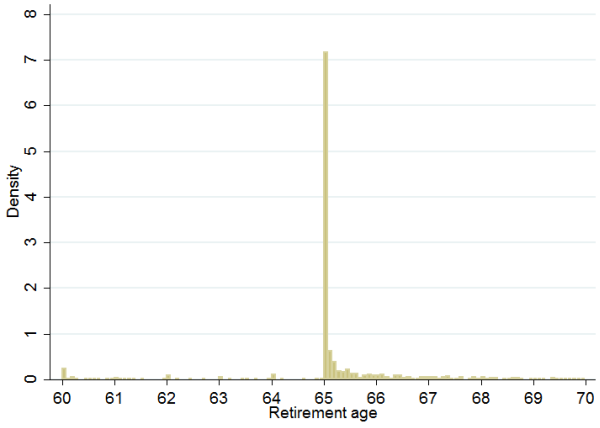
(c) 1999



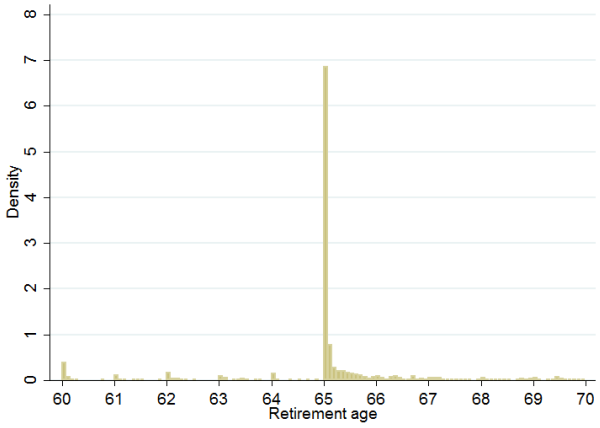
(d) 2000



(e) 2001



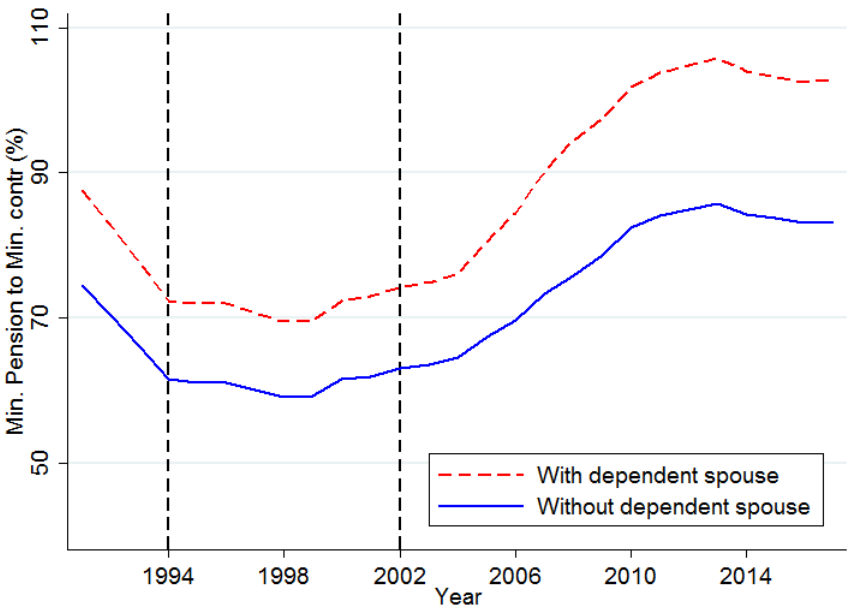
(f) 2002



Notes: The figure displays the histogram of retirement ages for self-employed workers retiring in 1997 (panel a), 1998 (panel b), 1999 (panel c), 2000 (panel d), 2001 (panel e) and 2002 (panel f).
Source: MCVL 2005.

sufficient contribution years, possibly leading to a "minimum pension trap"[4]. Figure C.2 illustrates the ratio between minimum pensions and contributions under RETA remained low and stable during the study period 1994-2002, ranging from 60-65% for those without a dependent spouse and 70-75% for those with a dependent spouse[5]. To address the potential disincentive posed by minimum pensions during the study period, I focus on a sample of long-term self-employed workers, excluding the bottom 20% with the shortest careers, which approximately represents the proportion of self-employed retirees receiving minimum pensions in 2005. There is a significant gender disparity in the contribution years for self-employed workers retiring in 2005, which explains why females constitute a small share of my final sample.

Figure C.2: Ratio of minimum pensions to minimum contribution bases under RETA



Notes: The figure shows the minimum pension as a fraction of the minimum contribution base under RETA. The vertical dashed line in 1994 and 2002 indicate the beginning and end of the period of study respectively. The red dashed line refers to the ratio for self-employed workers with a dependent spouse, while the blue line refers to self-employed workers without a dependent spouse.
Source: Presupuestos Generales del Estado, 1991-2016.

Progressive taxes. Contribution incentives are calculated post-tax. Thus, I account for the effect of progressive income taxes. Pension benefits are liable for income taxes, but SSCs are also

[4]See Sánchez-Martín (2019) for detailed information of this disincentive for Spain between 2008 and 2016.
[5]Conde-Ruiz and González (2016) highlighted the erosion of the contributory nature of the Spanish pension system due to the increasing minimum pension-to-minimum contribution ratio since the mid-2000s.

deduced from income tax payments, except for the group presenting objective income tax declarations. Table C.1 describes the calculation of the fiscal effect of progressive taxes for individuals aged 50-52. The calculation balances the average deduction rate when paying SSCs with the marginal tax paid when receiving pension benefits. I calculate that progressive taxes induce a penalization of 4% for males, while it provides a bonus of 0.19% for females.

Table C.1: Effect of progressive income taxes on contribution incentives for aged 50-52 (%)

	Age 50-52			Age 65-75	Net effect
	Share deducing SSCs	Marginal tax rate	Deduction rate	Marginal tax rate	
	(1)	(2)	(3)	(4)	(5)
Males	78.33	32.36	25.35	29.35	-4.00
Females	67.18	33.15	22.27	22.08	0.19
Total	75.69	32.45	24.56	26.60	-2.04

Notes: This table describes the variables for the calculation of the effect of progressive taxes on contribution incentives. Column (1) describes the share of self-employed under the direct estimation method, who receive an income tax deduction for their SSCs, column (2) describes the average marginal tax rate of self-employed workers aged 50-52, column (3) describes the mean reduction rate, which results from multiplying columns (1) and (2). Column (4) describes the average marginal tax rate at retirement, and column (5) describes the resulting fiscal effect. All values are presented in percentages.
Source: Panel de Declarantes del IRPF 1999-2016.

Survivor and disability benefits. My calculations exclusively consider contribution incentives provided by old-age pensions. Although SSCs also give rise to disability and survivor benefits, there were no reforms in these benefits during the study period 1994-2002. Consequently, while contribution incentives may be underestimated in levels, the impact of the 1997 reform is accurately represented.

Discount rates. Expected future benefits are discounted with a 3% rate of return, which is the benchmark rate of return used in studies calculating the present value of pension benefits (Coile et al., 2002; Liebman et al., 2009).

C.3 Option value incentives at age 50

I calculate the potential option value of contributions at age 50. SSCs above a threshold of approximately €500 per month allow extending the ceiling of SSCs in subsequent years, and therefore allow capitalizing more of the extraordinary SSC incentives described in the previous subsection.

C.3.1 Methodology

I define the option value of selecting contribution level $SSC_{50,t}$ at age 50 in period t as the present value of future net gains made feasible by the higher contribution ceiling, minus the additional cost required to access it. Formally,

$$V_t(SSC_{50,t}) = \underbrace{1\{SSC_{50,t} \geq SSC^{opt}_{t+1}\} \times (SSC_{50,t} - SSC^{opt}_{t+1}) \times \frac{b_{51,t+1} - 1}{(1+r)}}_{\text{Net benefits of excess SSCs at age 51}} - \underbrace{(SSC_{50,t} - \underline{SSC}_t)}_{\text{Cost at age 50}} + \underbrace{\frac{V_{t+1}(SSC_{50,t})}{1+r}}_{\text{Option value at age 51}}$$

The indicator $1\{SSC_{50,t} \geq SSC^{opt}_{t+p}\}$ equals one if contributions exceed the institutional threshold SSC^{opt}_{t+p} (approximately €500) in period $t+p$. The term $\underline{SSC}_t$ (approximately €250) denotes the minimum contribution level. The parameter $b_{51,t+1}$ is the marginal net present value of SSCs at age 51, as defined in Section 3. The first term captures the net pension gain from excess contributions at age 51; the second term represents the additional payment required at age 50 relative to the minimum; and the third term is the discounted continuation value of the option.

The continuation value $V_{t+1}(SSC_{50,t})$ compares two contribution paths from age 51 onward. If the option is exercised, the individual maintains the chosen contribution level until retirement at age 65, benefiting from the relaxed ceiling. If the option is not exercised, the individual is constrained to contribute at the minimum level prior to the linkage age and at the maximum available level thereafter. The option value therefore measures the difference in lifetime pension wealth between these two contribution regimes, net of the initial incremental cost at age 50.

Relative option value. For comparison with alternative options, we can measure the option value in relative terms. For this, I divide extra option benefits by extra option costs.

Assumptions. The calculation relies on the same assumptions outlined for direct contribution incentives. In addition, I assume that surviving individuals would expect to maintain their current contribution level in future years, implying $1\{SSC_{50,t+s} \geq SSC^{opt}_{t+s}\} = \pi_t(50+s|50)$. This assumption represents the upper bound of the option value.

Calculated option value (1991-2002). Table C.2 reports the potential option value as a function of SSCs at the option point, assuming the contribution level is maintained until retirement at age 65. The option value is shown for contribution incentives before and after the 1997 reform. First, the table shows that contributions below the €500 threshold generate no option value. Second, above this level, option value rises steeply with SSCs in both period.

The 1997 reform increased average option incentives, mainly because the option cost is smaller relative to optimal contribution behavior. Rational individuals after 1997 would increase contributions to the maximum anyway, while before 1997 they would only do it after age 57. This accounts for the extra contributions before compared to after the reform. Near the maximum contribution (€950 per month), the implied option value reaches approximately €82,551 after the 1997 reform. Given the irreversibility of this decision, this represents a high-stakes decision point in the SSC schedule.

Comparing extra benefits relative to extra costs of exercising the option value, we can observe that the incentives are again increasing and sizable. For each additional € contributed for the option value, individuals receive more than 2€ of future benefits.

Table C.2: Option value (OV) of contributions depending on contribution level at option point

	1991-1993: Age 55				1994-1997: Age 50				1998-2002: Age 50			
SSC level	Benefit (1)	Cost (2)	Net OV (3)	Rel. OV (4)	Benefit (5)	Cost (6)	Net OV (7)	Rel. OV (8)	Benefit (9)	Cost (10)	Net OV (11)	Rel. OV (12)
300	0	525	-525	0.00	0	360	-360	0.00	0	283	-283	0.00
350	0	1,125	-1,125	0.00	0	960	-960	0.00	0	883	-883	0.00
400	0	1,725	-1,725	0.00	0	1,560	-1,560	0.00	0	1,483	-1,483	0.00
450	0	2,325	-2,325	0.00	0	2,160	-2,160	0.00	0	2,083	-2,083	0.00
500	0	2,925	-2,925	0.00	0	2,760	-2,760	0.00	0	2,683	-2,683	0.00
550	0	3,525	-3,525	0.00	10,355	25,948	-15,593	0.40	10,829	7,567	3,262	1.41
600	5,249	13,131	-7,882	0.39	26,296	33,394	-7,098	0.79	28,208	15,035	13,173	1.87
650	21,750	18,617	3,133	1.17	42,237	40,840	1,397	1.03	45,587	22,502	23,084	2.02
700	38,251	24,104	14,147	1.59	58,178	48,285	9,892	1.20	62,965	29,970	32,995	2.10
750	54,753	29,591	25,162	1.85	74,119	55,731	18,388	1.33	80,344	37,437	42,907	2.14
800	71,254	35,077	36,177	2.03	90,059	63,177	26,883	1.42	97,723	44,905	52,818	2.17
850	87,755	40,564	47,191	2.16	106,000	70,622	35,378	1.50	115,101	52,373	62,729	2.20
900	104,257	46,051	58,206	2.26	121,941	78,068	43,873	1.56	132,480	59,840	72,640	2.21
950	120,758	51,537	69,220	2.34	137,882	85,514	52,368	1.61	149,859	67,308	82,551	2.22

Notes: The table reports the potential option value of choosing a given monthly Social Security contribution (SSC) level at age 50. The option arises because contributions above the institutional threshold (approximately €500 per month) increase future contribution ceilings, allowing individuals to capitalize on high marginal pension returns in subsequent years. For each SSC level at age 50, the table reports: (i) the present value of additional future pension benefits enabled by relaxing the contribution ceiling ("Option benefit"); (ii) the present value of additional contributions required to access the higher ceiling relative to the minimum contribution ("Option cost"); (iii) the net option value, defined as benefits minus costs; and (iv) the relative option value, defined as the ratio of option benefits to option costs. All monetary amounts are expressed in 2021 euros and discounted to age 50. Calculations assume that the contribution level chosen at age 50 is maintained until retirement at age 65. Individuals who do not exercise the option are assumed to contribute at the minimum level prior to the linkage age and at the maximum level thereafter. Survival probabilities are cohort-specific and obtained from official Spanish mortality tables. A real annual discount rate of 3 percent is used. The pre-reform columns apply pension rules in place during 1994–1997; the post-reform columns apply the rules implemented after the 1997 reform. The sample excludes individuals likely to receive minimum pension top-ups. Values are expressed in 2021€s. *Sources:* MCVL 2005.

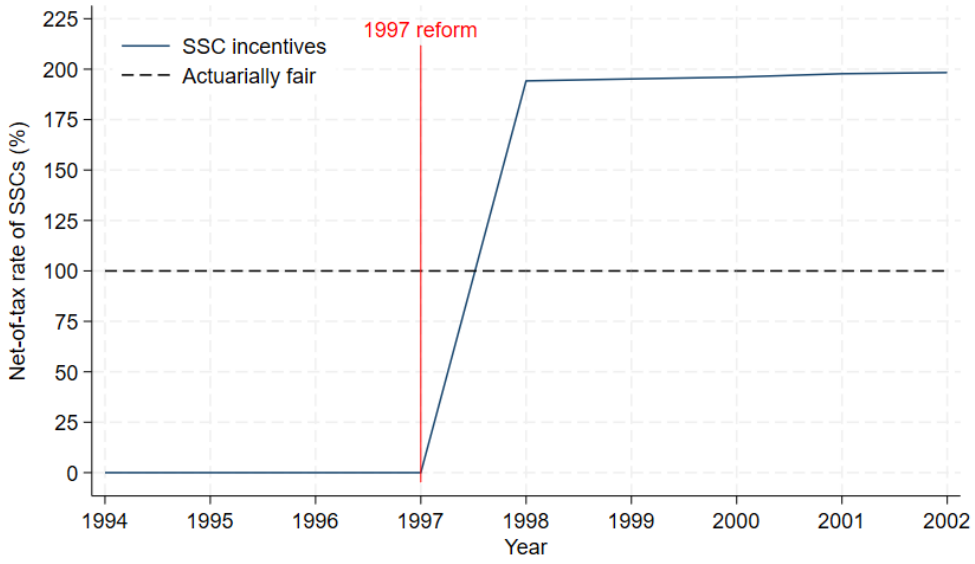
D Contribution incentives for 1997 reform

This appendix presents the calculation of the change in incentives induced by the 1997 reform. I first calculate the baseline incentives under the my primary assumptions. I then describe the sensitivity of incentives to alternative assumptions.

D.1 Baseline incentives

Figure D.3 illustrates the change in incentives resulting from the 1997 reform for self-employed workers aged 50-52. Before 1997, the implicit net-of-tax rate of additional SSCs was 0% as SSCs were not linked to pension benefits. However, following the 1997 reform, the implicit net-of-tax rate increased to 198.3% by 2002. This implies that additional SSCs nearly doubled the present value offered by actuarially fair markets, dominating alternative savings options[6]. Therefore, these incentives would suggest large responses to the 1997 reform.

Figure D.3: Contribution incentives for self-employed workers aged 50-52



Notes: This figure shows the implicit net-of-tax rate of additional SSCs for self-employed workers aged 50-52 between 1994 and 2002. The black dashed line represents 100%, which is the implicit net-of-tax rate offered by annuities discounted at 3%. The red vertical line in 1997 denotes the reform year.
Source: MCVL 2005.

[6]The real rate of return of additional SSCs rose to 6.08% for workers aged 50-52 after the 1997 reform. Prior studies argued that delaying retirement claiming was optimal in the US, which provided Social Security annuities with a 3% real rate of return (Coile et al., 2002; Altig et al., 2023).

D.2 Sensitivity to alternative assumptions

This subsection presents the sensitivity of the baseline calculation of SSC incentives induced by the 1997 reform for self-employed workers aged 50-52. I examine alternative assumptions for five key parameters: (1) the discount rate, (2) the coefficient on contribution years applying to the benefit base, (3) mortality rates at each age, (4) early retirement and (5) perceived policy uncertainty. Figure D.4 provides graphical evidence on the sensitivity of incentives for those aged 50-52 around the 1997 pension reform.

(1) Discount rate. I consider how the use of different rates of discount affect the current value of future pension benefits. While my baseline calculation of incentives entails a 3% discount rate, I re-calculate contribution incentives using discount rates of 1% and 5%. Figure D.4a illustrates that incentives for those aged 50-52 decrease to around 125% when a 5% discount rate is used, while this increases over 300% when using a discount rate of 1%.

(2) Coefficient on contribution years. I consider the the sensitivity of contribution incentives to the coefficient on contribution years α_n. To assess its impact, I calculate incentives for coefficients of 70% and 100%, compared to the baseline coefficients of 94.8% for males and 79.3% for females[7]. Figure D.4b illustrates that decreasing the coefficient on contribution years to 70% results in an implicit net-of-tax rate around 150%, while an increase to 100% yields incentives of 215%.

(3) Mortality rates. Mortality rates influence contribution incentives because they determine the expected length of pension annuity receipt. The sensitivity analysis involves applying different mortality profiles to my main group of interest aged 50-52, considering the profile of those five years younger (aged 45-47) and older (aged 55-57). Figure D.4c illustrates that applying mortality rates of those five years older decreases the implicit net-of-tax rate to 155%, while applying mortality rates of those 5 years younger increases the rate to 240%.

(4) Early retirement. I consider the effect early retirement at 62 years on contribution incentives, compared to retirement at age of 65 years. On the one hand, early retirement involves a

[7]These values are derived from the average penalization on contribution periods for self-employed retirees in 2005.

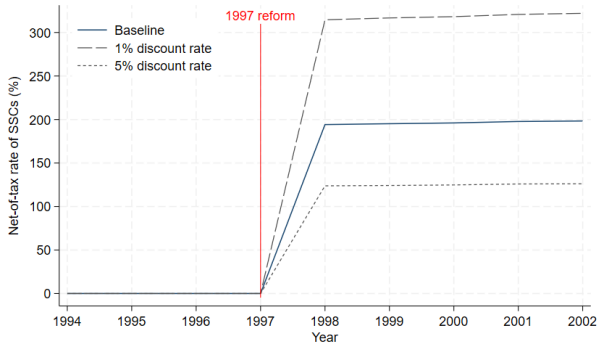
penalization of 8% for each year of early retirement and an additional 2% per year for shorter contribution years below 35 years. On the other hand, early retirees earn pension benefits for additional years as they claim before. Figure D.4d illustrates that early retirement at age 62 slightly reduced the implicit net-of-tax rate to 175%.

(5) Perceived policy uncertainty. The possibility of reforms cutting the generosity of public pensions could decrease the value of expected future benefits. To account for the impact of policy uncertainty, I follow Luttmer and Samwick (2018), who found that US taxpayers aged 50-54 years were willing to accept 57.8% of the pensions under current rule to avoid future pension reforms[8]. Figure D.4e illustrates that accounting for policy uncertainty decreases the implicit net-of-tax rate to around 115%. However, it is worth mentioning that Luttmer and Samwick (2018) derived their results in 2011, when the consequences of population aging were more noticeable than in my study period 1994-2002. Consequently, contribution incentives under the considered policy uncertainty may be considered a lower bound of incentives.

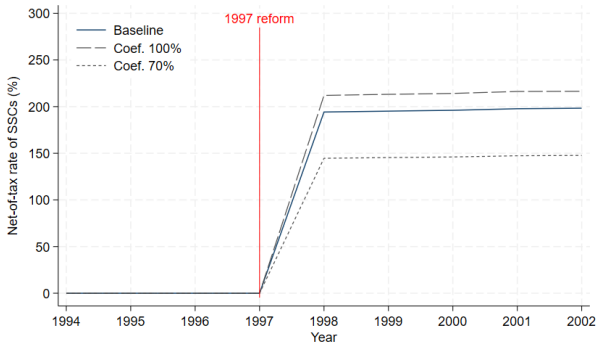
[8] US taxpayers aged 50-54 expected to receive 67.7% of the pensions under current rule and they would be willing to pay a premium of 9.9% to eliminate policy uncertainty.

Figure D.4: Sensitivity of contribution incentives for self-employed aged 50-52

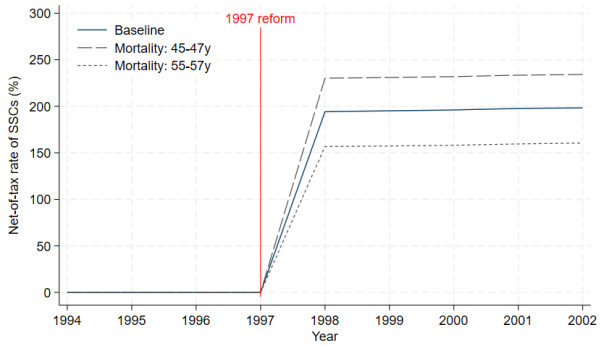
(a) Discount rate



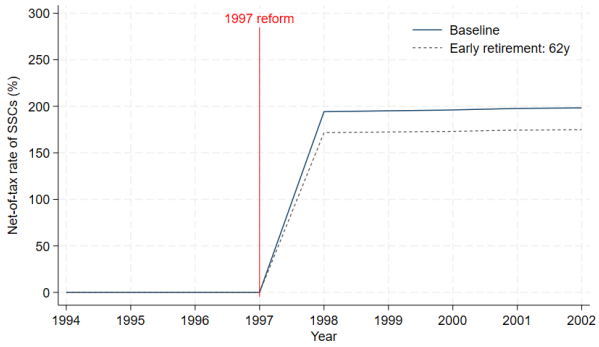
(b) Coef. of contribution years



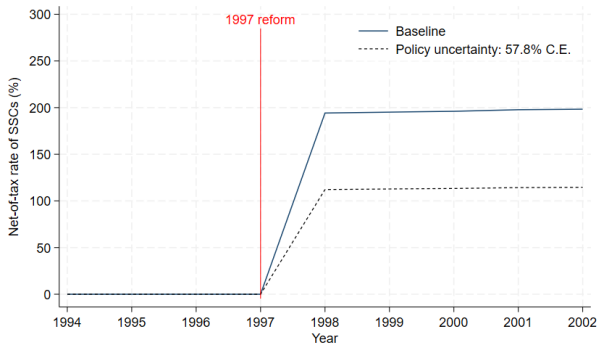
(c) Mortality rates



(d) Early retirement at 62y



(e) Policy uncertainty (C.E. = 57.8%)



Notes: The figure shows of the net present value offered by SSCs for self-employed workers aged 50-52 under alternative parameters for the calculation of incentives. These consider sensitivity to (panel a) discount rates, (panel b) contribution years coefficients, (panel c) mortality rates, (panel d) early retirement at age 62, and (panel e) perceived policy uncertainty, where individuals have a certainty equivalent of 57.8% of the pensions under current rule. The short-dashed lines represent the lower bound of incentives and the long dashed lines represent the upper bound of incentives. The red vertical line in 1997 denotes the reform year.
Source: MCVL 2005.

E Sample selection

This appendix presents evidence on the stability of my primary sample. This study uses data from the 2005 wave of the MCVL, which is representative of individuals affiliates to the Spanish Social Security in 2005. To study the effect of the 1997 reform, I use the MCVL data retrospectively between 1994 and 2002. I define a population that is likely to maintain an ongoing relationship with the Spanish Social Security. Therefore, I focus on a sample of individuals with Spanish nationality working as self-employed between 1994 and 2002. In addition to this, I exclude the 20% with shortest contribution periods per each age and cohort cell. Table E.1 illustrates that the sample size per block of age and year remains stable throughout the period 1994-2002. To further validate the representativeness of my sample, I apply the same sample selection criteria to the 2007 wave. As shown in Table E.2, the number of observations using the 2007 wave aligns closely with the 2005 wave. This alignment supports that individuals with Spanish nationality working as self-employed between 1994 and 2002 maintain an ongoing relationship with the Spanish Social Security over time.

Table E.1: Number of observations by age and year in my sample. MCVL 2005

	40	41	42	43	44	45	46	47	48	49	50	51	52	Total
1994	1080	1055	1107	1070	1168	1237	1136	1110	1154	1075	1055	904	776	13927
1995	1035	1078	1057	1104	1067	1163	1248	1126	1107	1147	1068	1045	900	14145
1996	1154	1029	1081	1053	1106	1064	1161	1240	1120	1104	1143	1063	1042	14360
1997	1044	1153	1033	1075	1061	1104	1066	1159	1243	1117	1102	1142	1059	14358
1998	1048	1042	1149	1032	1073	1053	1095	1064	1158	1235	1118	1102	1137	14306
1999	1034	1047	1039	1150	1023	1076	1059	1098	1058	1152	1237	1118	1096	14187
2000	1067	1035	1045	1041	1152	1022	1074	1047	1099	1060	1148	1233	1115	14138
2001	1015	1064	1035	1041	1040	1149	1028	1072	1048	1094	1056	1148	1232	14022
2002	961	1012	1063	1028	1040	1034	1146	1019	1066	1039	1084	1050	1141	13683
Total	9438	9515	9609	9594	9730	9902	10013	9935	10053	10023	10011	9805	9498	127126

Notes: This table shows the sample size of each year of age between 40 and 52 years and year block between 1994 and 2002 in the selected sample in this study. This consists of those with Spanish nationality who worked as self-employed between 1994 and 2002. This also includes those who left self-employment to claim a retirement pension. This excludes the 20% of the self-employed with the shortest contribution histories within each age and year block.
Source: MCVL 2005.

Table E.2: Number of observations by age and year in my sample. MCVL 2007

	40	41	42	43	44	45	46	47	48	49	50	51	52	Total
1994	1076	1049	1094	1057	1160	1234	1125	1104	1140	1054	1034	897	775	13799
1995	1025	1072	1052	1090	1054	1155	1236	1118	1101	1133	1051	1030	893	14010
1996	1146	1021	1076	1047	1095	1052	1153	1230	1113	1096	1130	1046	1027	14232
1997	1035	1145	1023	1069	1053	1091	1049	1151	1231	1111	1095	1127	1042	14222
1998	1034	1033	1140	1020	1067	1047	1085	1052	1150	1230	1107	1092	1124	14181
1999	1021	1033	1031	1141	1020	1070	1047	1087	1045	1144	1227	1106	1089	14061
2000	1058	1023	1032	1030	1145	1018	1068	1040	1088	1047	1140	1224	1103	14016
2001	1010	1055	1022	1032	1029	1142	1020	1068	1041	1082	1044	1140	1221	13906
2002	959	1007	1054	1015	1026	1023	1139	1015	1060	1032	1073	1037	1133	13573
Total	9364	9438	9524	9501	9649	9832	9922	9865	9969	9929	9901	9699	9407	126000

Notes: This table shows the sample size of each year of age between 40 and 52 years and year block between 1994 and 2002 using the same criteria for sample selection as in this study, using the 2007 wave of MCVL instead of the 2005 wave. This consists of those with Spanish nationality who worked as self-employed between 1994 and 2002. This also includes those who left self-employment to claim a retirement pension. This excludes the 20% of the self-employed with the shortest contribution histories within each age and year block.
Source: MCVL 2007.

F Additional results: DiD estimation by age

This appendix provides difference-in-differences results on the effect of the 1993 and 1997 pension reforms by individual year of age. This provides graphical evidence on the age ranges where the effects of reforms are concentrated.

Empirical strategy. I use a DiD approach to estimate the effects of the reforms by individual year of age. The DiD regression by age takes the following form:

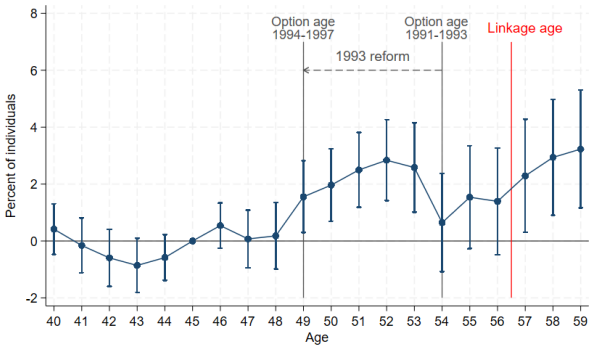
$$Y_{iat} = \alpha_a + D_t + \sum_{a=40}^{\bar{a}} \rho_a \alpha_a \times Post_t + \mathbf{X_{iat}}\theta + \varepsilon_{iat} \tag{15}$$

where Y_{iat} represents my two outcomes of interest: $Y_{iat} = \mathbf{1}\{C_{iat} > C^L_{iat}\}$, the indicator variable on whether self-employed worker i of age a contributed above the minimum contribution C^L_{iat} in period t, and the logarithm of the real contributions $Y_{iat} = \ln(C_{iat})$. α_a denotes age dummies, where age 45 is omitted, and D_t denotes time dummies. $Post_t$ represents the post-reform indicator, taking value 1 if $t \in [1994, 1997]$ and 0 if $t \in [1991, 1993]$ for the 1993 reform, while for the 1997 reform it takes value 1 if $t \in [1998, 2002]$ and 0 if $t \in [1994, 1997]$. $\mathbf{X_{it}}$ includes province, education and industry dummies, a dummy on whether municipality population is above 40,000, tenure, and province real GDP per capita. Standard errors are clustered at the individual level.

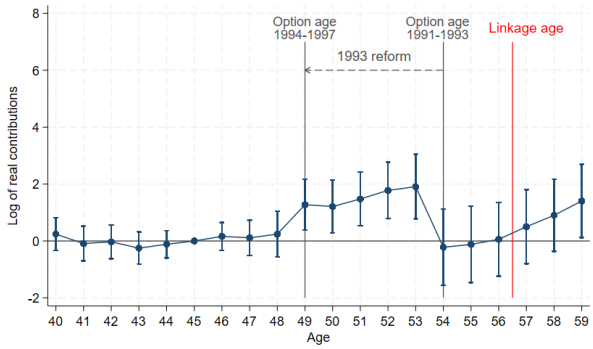
Contributions at ages younger than 49 years remained unaffected by the 1993 and 1997 reforms. The parallel trends assumption posits that contributions at ages affected by the reforms would have followed the same trend as contributions at age 45 in the absence of the reforms.

Figure F.1: DiD response to the 1993 reform by age

(a) Prob. above minimum



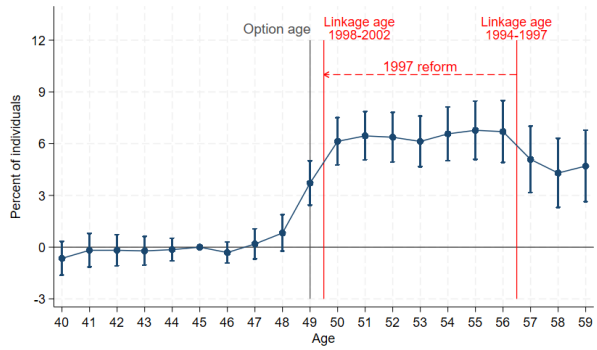
(b) Log of real contributions



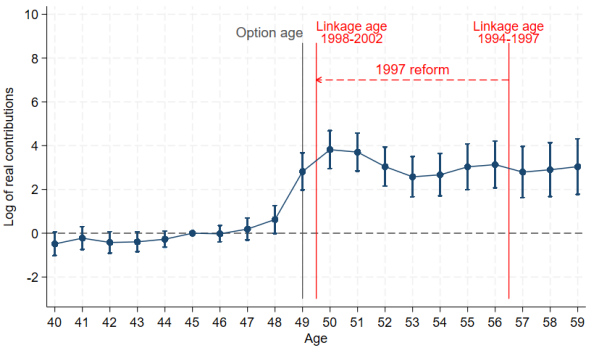
Notes: This figure shows DiD estimates on the effect of the 1993 reform by age. This compares the probability of contributing above the minimum (panel a) and on the log of real contributions (panel b), in period 1994-1997 compared to 1991-1993, relative to the difference at age 45. The gray vertical line represents the age of the option value decision (*option age*) and the vertical red line represents the age at which contributions became linked to pensions (*linkage age*). The coefficient estimates on the log of real contributions are multiplied by 100 to represent percentage points of real contributions.
Source: MCVL 2005.

Figure F.2: DiD response to the 1997 reform by age

(a) Prob. above minimum



(b) Log of real contributions



Notes: This figure shows DiD estimates on the effect of the 1997 reform by age. This compares the probability of contributing above the minimum (panel a) and on average real contributions (panel b), in period 1998-2002 compared to 1994-1997, relative to the difference at age 45. The gray vertical line represents the age of the option value decision (*option age*) and the vertical red line represents the age at which contributions became linked to pensions (*linkage age*). The coefficient estimates on the log of real contributions are multiplied by 100 to represent percentage points of real contributions.
Source: MCVL 2005.

G Additional results: 1993 reform

This appendix presents additional results on the response to the 1993 pension reform. The reform changed the age of the option value decision from age 55 to 50. My DiD approach compares the average contribution behavior of those aged 50-52, whose contributions reflect their option value decision after the 1993 reform, with those aged 40-46.

Summary statistics. Table G.1 provides the summary statistics of the sample used to estimate the effect of the 1993 reform.

Graphical evidence. Figure G.1 offers graphical evidence on the average contribution behavior of the treatment (age 50-52) and control groups (age 40-46) to support the validity of the DiD approach in studying the effect of the 1993 reform. Before 1994, the contribution behavior of those aged 50-52 and 40-46 followed similar evolutions, supporting the plausibility of the parallel trends assumption. After the 1993 reform, the contribution behavior of self-employed workers aged 50-52 making contributions above the minimum increased from 5% to 7% between 1993 and 1997. In contrast, the fraction remained around 2% for those aged 40-46 years. Average real contributions increased for both groups followed a parallel evolution before the 1993 reform, reflecting increases in minimum contributions. After 1994, the contributions of those aged 50-52 increased more than those of aged 40-46.

Full dynamic DiD results. Table G.2 provides the full dynamic DiD responses to the 1993 pension reform for alternative specifications. I estimate that the 1993 reform increased the probability of those aged 50-52 contributing above the minimum by 2.46 percentage points, while real contributions increased by 0.97% over the same period. No significant pre-trends are observed in the run-up to the 1993 reform, supporting for the parallel-trends assumption. The table also shows that the effects are similar across specifications.

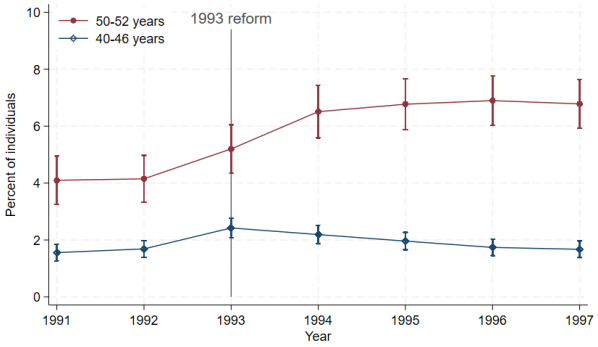
Table G.1: Summary statistics for the reforms sample from 1994 to 2002

	Treated: 40-46 years		Control: 50-52 years		Full sample	
	Mean (1)	S.D. (2)	Mean (3)	S.D. (4)	Mean (5)	S.D. (6)
Outcome variables						
$1\{C_{iat} > \underline{C}_{iat}\}$ (%)	1.89	(13.63)	5.95	(23.65)	3.00	(17.05)
Real Contr. (2021€)	266.98	(35.20)	278.40	(74.81)	270.09	(49.50)
Real Contr. above min. (€2021)	3.33	(33.20)	14.08	(73.58)	6.26	(47.94)
SSC incentive						
NPV (€)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Control variables						
Females (%)	16.34	(36.98)	17.27	(37.80)	16.60	(37.20)
Small municipality (%)	53.64	(49.87)	48.93	(49.99)	52.36	(49.94)
Tenure years	10.34	(5.88)	13.78	(7.11)	11.27	(6.43)
Contributed years	15.89	(3.55)	20.21	(4.97)	17.07	(4.42)
Education level (%)						
Primary or less	43.36	(49.56)	51.93	(49.96)	45.69	(49.81)
Secondary	34.18	(47.43)	28.51	(45.15)	32.64	(46.89)
Higher education	20.68	(40.50)	16.47	(37.09)	19.54	(39.65)
N.A.	1.78	(13.22)	3.09	(17.30)	2.14	(14.46)
Economic activity (%)						
Agriculture	2.03	(14.10)	2.59	(15.88)	2.18	(14.61)
Manufacturing	12.74	(33.34)	9.78	(29.71)	11.94	(32.42)
Construction	13.67	(34.35)	8.97	(28.58)	12.39	(32.95)
Retail service	31.50	(46.45)	28.98	(45.37)	30.81	(46.17)
Hospitality	8.20	(27.44)	6.86	(25.27)	7.83	(26.87)
Transport	11.34	(31.70)	11.82	(32.29)	11.47	(31.87)
Finance and real estate	5.45	(22.70)	4.03	(19.67)	5.06	(21.93)
Social services	8.07	(27.23)	7.97	(27.09)	8.04	(27.19)
N.A.	7.01	(25.53)	19.00	(39.23)	10.27	(30.36)
N(obs)	52,986		19,809		72,795	

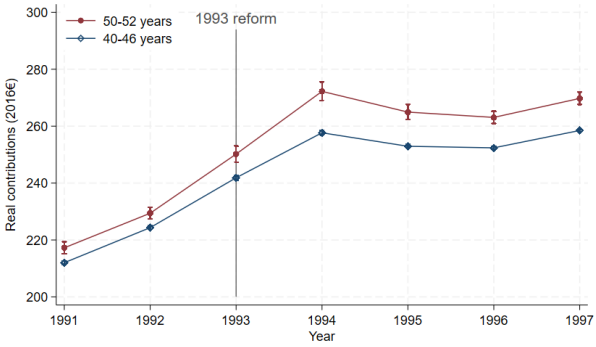
Notes: This table shows the descriptive statistics of the sample entering the study of the effect of the 1993 pension reforms. The data spans the period from 1991 to 1997. The sample is divided between the control (40-46 years) and treatment groups (50-52 years), as well as providing descriptive statistics for the full sample. I provide mean and standard deviation for my two outcome variables, the probability of making contributions above the minimum and real contributions, as well as demographic and employment variables such as categorical variables on education and economic activity, as well as gender, province GDP per capita, a dummy variable on whether municipality of residence has population smaller than 40,000 inhabitants, tenure years in the current affiliation and contributed years at ages over 26 years (since affiliation data is available since 1967). Fractions of categorical variables may not add up due to rounding.
Source: MCVL 2005.

Figure G.1: Contributions of aged 50-52 and 40-46 between 1991-1997

(a) Prob. above minimum

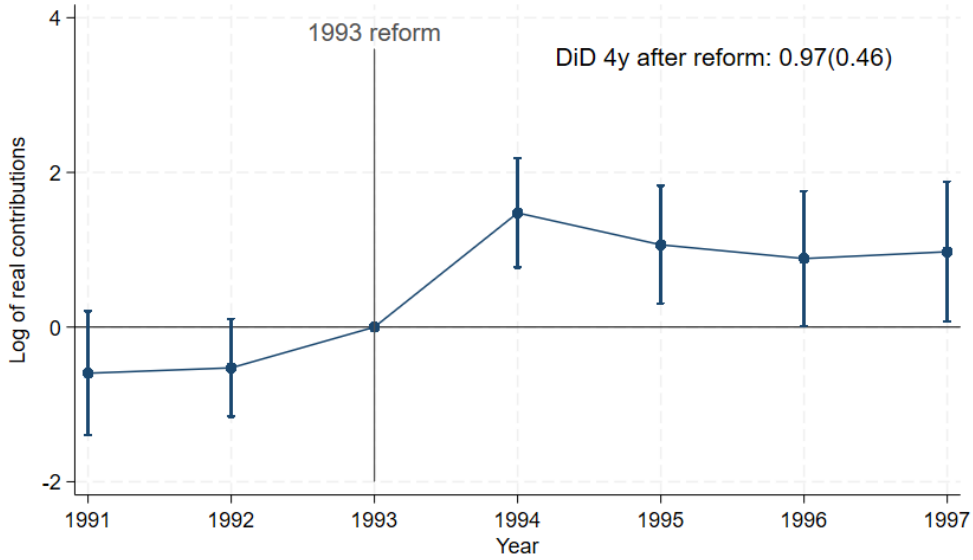


(b) Real contributions



Notes: This figure shows the fraction of self-employed workers contributing above the minimum (panel a) and of average real contributions (panel b) between 1991 and 1997. I define age on the 1st January of each year, when most self-employed workers decide their contributions. The red lines refer to the treatment group (50-52 years), while blue lines represent average values of the control group (40-46 years). The vertical gray line in 1993 denote the reform year.
Source: MCVL 2005.

Figure G.2: Dynamic DiD results on the 1993 reform: Log of real contributions



Notes: The figure shows the dynamic DiD response of self-employed workers aged 50-52 to the 1993 reform. The figure provides results on the log of real contributions (panel b) between 1991 and 1997. The treatment group is represented by self-employed workers aged 50-52 and the control group by those aged 40-46. I define age on the 1st January, when most self-employed workers decide their contributions. The vertical gray line in 1993 denotes the reform year. The coefficient estimates on the log of real contributions are multiplied by 100 to represent percentage points of real contributions.
Source: MCVL 2005.

Table G.2: Dynamic DiD results for the 1993 reform using alternative specifications

	Baseline	No controls	Treatment group		Control group	
			50-53y	50-54y	40-44y	42-46y
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Prob above min.						
β_{-2}	-0.63	-0.24	-0.09	-0.05	-0.91	-0.44
	(0.55)	(0.55)	(0.51)	(0.48)	(0.57)	(0.58)
β_{-1}	-0.37	-0.31	0.01	0.08	-0.60	-0.28
	(0.42)	(0.43)	(0.40)	(0.39)	(0.43)	(0.44)
β_1	1.68**	1.54**	1.86***	1.61***	1.88***	1.81***
	(0.49)	(0.50)	(0.39)	(0.38)	(0.50)	(0.50)
β_2	2.14***	2.03***	2.33***	1.85***	2.22***	2.44***
	(0.57)	(0.58)	(0.49)	(0.45)	(0.58)	(0.58)
β_3	2.54***	2.38***	2.84***	2.60***	2.48***	2.80***
	(0.63)	(0.65)	(0.54)	(0.51)	(0.64)	(0.65)
β_4	2.46***	2.33***	3.13***	2.96***	2.28***	2.83***
	(0.65)	(0.66)	(0.60)	(0.56)	(0.65)	(0.68)
Pre-trends (p-value)	0.51	0.77	0.96	0.92	0.25	0.73
Panel B: Log of real contr.						
β_{-2}	-0.60	-0.42	-0.33	0.00	-0.87*	-0.51
	(0.41)	(0.40)	(0.39)	(0.38)	(0.41)	(0.42)
β_{-1}	-0.53	-0.51	-0.30	-0.25	-0.72*	-0.47
	(0.32)	(0.32)	(0.31)	(0.31)	(0.32)	(0.33)
β_1	1.48***	1.37**	1.52***	1.30***	1.44***	1.54***
	(0.36)	(0.36)	(0.29)	(0.29)	(0.36)	(0.37)
β_2	1.06**	0.97*	1.28***	0.95**	0.95*	1.22**
	(0.39)	(0.39)	(0.34)	(0.32)	(0.39)	(0.40)
β_3	0.89*	0.76	1.27***	1.14**	0.75	0.96*
	(0.44)	(0.45)	(0.38)	(0.36)	(0.44)	(0.46)
β_4	0.97*	0.86	1.32**	1.26**	0.86	1.12*
	(0.46)	(0.47)	(0.42)	(0.39)	(0.45)	(0.48)
Pre-trends (p-value)	0.24	0.28	0.62	0.55	0.06	0.36
N (obs)	72,259	72,259	77,971	83,517	56,740	57,538

Notes: This table provides the dynamic DiD estimates of contribution response to the 1993 pension reform using alternative specifications. The outcome variables are the probability of contributing above the minimum (Panel A) and the logarithm of real contributions (Panel B). My baseline specification compares those aged 50-52 years to those aged 40-46 using the specification in Equation 4 (column 1). I consider the regressing Equation 4 without covariates (column 2), extensions of the treatment group to include those aged 50-53 (column 3) and aged 50-54 (column 4), reducing the control group to those aged 40-44 (column 4) and aged 42-46 (column 5). Pre-trends report the p-value of joint significance of the pre-reform coefficients. Standard errors in parenthesis. * p<0.05, ** p<0.01, *** p<0.001.
Source: MCVL 2005

H Additional results: 1997 reform

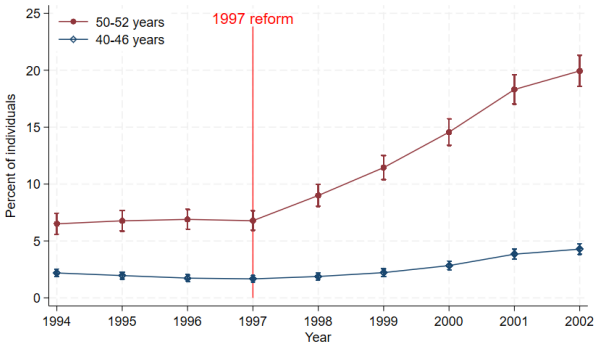
This appendix presents additional results on the response to the 1997 reform. The DiD approach compares self-employed workers' contributions at age 50-52 to those at age 40-46.

H.1 Baseline results

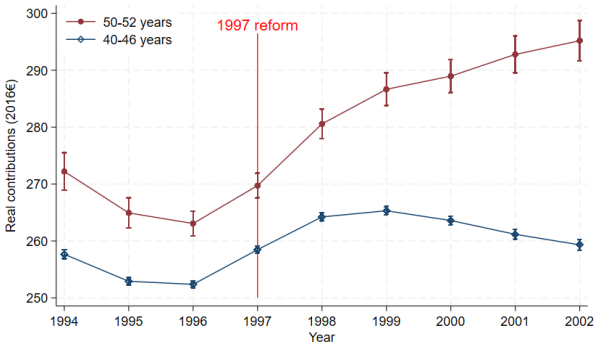
Graphical evidence. Figure H.1 offers graphical evidence on the average contributions of treatment (age 50-52) and control groups (age 40-46) before and after the 1997 reform. Before the reform, the contribution behavior of both groups remained small, stable and parallel, supporting the parallel trends assumption. After the 1997 reform, the contributions of treatment and control groups substantially diverged. The fraction of self-employed workers aged 50-52 contributing above the minimum gradually increased from 7% to 20% by 2002, while the fraction remained below 5% for those aged 40-46. Average real contributions for both groups followed a parallel evolution before the 1997 reform, substantially diverging afterward.

Figure H.1: Contributions of aged 50-52 and 40-46 between 1994-2002

(a) Prob. above minimum



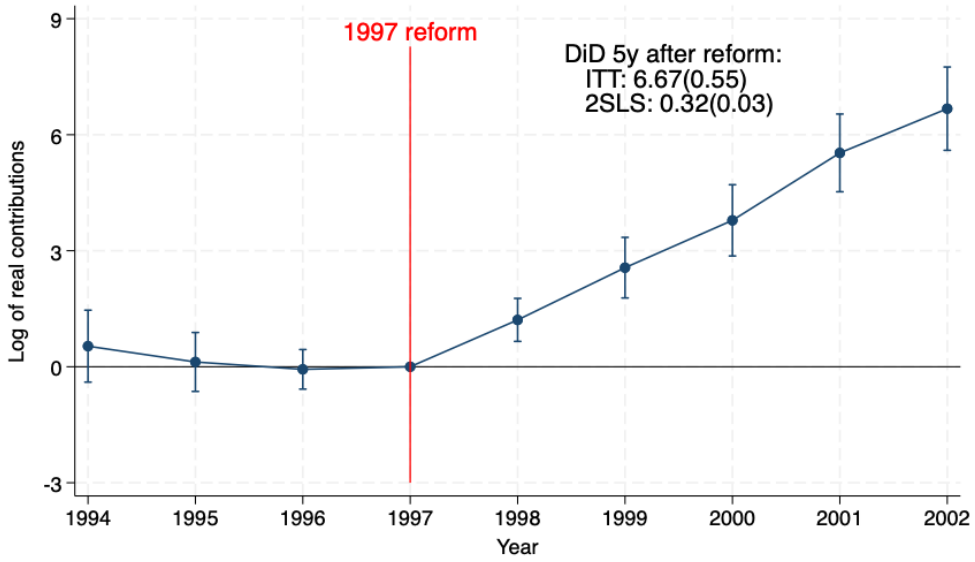
(b) Real contributions



Notes: This figure shows the fraction of self-employed workers contributing above the minimum (panel a) and of average real contributions (panel b) between 1994 and 2002. I define age on the 1st January of each year, when most self-employed workers decide their contributions. The red lines refer to the treatment group (50-52 years), while blue lines represent average values of the control group (40-46 years). The vertical red line in 1997 denotes the reform year.
Source: MCVL 2005.

Dynamic DiD results on the log of real contributions. Figure H.2 provides the dynamic DiD results on the log of real contributions.

Figure H.2: Dynamic DiD results on the 1997 reform: Log of real contributions



Notes: The figure shows the dynamic DiD response of self-employed workers aged 50-52 to the 1997 reform. The figure provides results on the log of real contributions (panel b) between 1994 and 2002. The treatment group is represented by self-employed workers aged 50-52 and the control group by those aged 40-46. I define age on the 1st January, when most self-employed workers decide their contributions. The vertical red line in 1997 denotes the reform year. The coefficient estimates on the log of real contributions are multiplied by 100 to represent percentage points of real contributions.
Source: MCVL 2005.

Full dynamic DiD results. Table H.1 provides the full dynamic DiD responses to the 1997 pension reform for alternative specifications. Five years after the 1997 reform, the fraction of self-employed workers aged 50-52 who contributed above the minimum increased by 10.35 percentage points, while real contributions increased by 6.67% during the same period.

Table H.1: Dynamic DiD results for the 1997 reform using alternative specifications

	Baseline	No controls	Treatment group		Control group	
			50-53y	50-54y	40-44y	42-46y
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Prob above min.						
β_{-3}	−0.66	−0.79	−1.15*	−1.23*	−0.28	0.91
	(0.66)	(0.67)	(0.54)	(0.48)	(0.66)	(0.67)
β_{-2}	−0.22	−0.30	−0.73	−1.00*	0.04	0.30
	(0.57)	(0.58)	(0.46)	(0.42)	(0.57)	(0.58)
β_{-1}	0.13	0.05	−0.25	−0.33	0.25	0.02
	(0.43)	(0.44)	(0.35)	(0.32)	(0.44)	(0.44)
β_1	1.97***	2.00***	1.52***	1.63***	1.99***	2.00***
	(0.47)	(0.48)	(0.39)	(0.34)	(0.47)	(0.48)
β_2	4.10***	4.11***	3.58***	3.70***	4.19***	3.95***
	(0.63)	(0.64)	(0.53)	(0.47)	(0.64)	(0.65)
β_3	6.51***	6.61***	5.95***	5.56***	6.51***	6.35***
	(0.75)	(0.77)	(0.64)	(0.57)	(0.76)	(0.77)
β_4	9.18***	9.36***	8.38***	8.43***	9.70***	8.86***
	(0.82)	(0.84)	(0.73)	(0.66)	(0.82)	(0.85)
β_5	10.35***	10.55***	10.66***	10.46***	10.90***	9.98***
	(0.86)	(0.88)	(0.77)	(0.71)	(0.86)	(0.89)
Pre-trends (p-value)	0.548	0.504	0.177	0.058	0.756	0.397
Panel B: Log of real contr.						
β_{-3}	0.53	0.50	0.25	0.08	0.60	0.45
	(0.47)	(0.48)	(0.38)	(0.33)	(0.48)	(0.48)
β_{-2}	0.12	0.11	−0.04	−0.24	0.13	0.13
	(0.39)	(0.40)	(0.32)	(0.27)	(0.39)	(0.39)
β_{-1}	−0.07	−0.11	−0.05	−0.13	0.08	−0.13
	(0.26)	(0.27)	(0.22)	(0.19)	(0.26)	(0.26)
β_1	1.22***	1.23***	0.85***	0.76***	1.25***	1.26***
	(0.28)	(0.29)	(0.24)	(0.21)	(0.29)	(0.29)
β_2	2.57***	2.60***	2.00***	1.89***	2.61***	2.50***
	(0.40)	(0.41)	(0.32)	(0.29)	(0.40)	(0.41)
β_3	3.79***	3.86***	3.55***	3.03***	3.79***	3.67***
	(0.47)	(0.48)	(0.38)	(0.33)	(0.47)	(0.48)
β_4	5.52***	5.64***	4.94***	4.88***	5.75***	5.37***
	(0.51)	(0.53)	(0.45)	(0.40)	(0.51)	(0.53)
β_5	6.67***	6.80***	6.70***	6.30***	6.93***	6.51***
	(0.55)	(0.56)	(0.48)	(0.44)	(0.55)	(0.56)
Pre-trends (p-value)	0.450	0.447	0.665	0.330	0.323	0.519
N (obs)	97,115	97,115	106,417	115,075	77,200	78,162

Notes: This table provides the dynamic DiD estimates of contribution response to the 1997 pension reform using alternative specifications. The outcome variables are the probability of contributing above the minimum (Panel A) and the logarithm of real contributions (Panel B). My baseline specification compares those aged 50-52 years to those aged 40-46 years using the specification in Equation 4 (column 1). The coefficient estimates on the log of real contributions are multiplied by 100 to represent percentage points of real contributions. I consider the regressing Equation 4 without covariates (column 2), extensions of the treatment group to include those aged 50-53 years (column 3) and 50-54 years (column 4), reducing the control group to those aged 40-44 years (column 4) and 42-46 years (column 5). Pre-trends report the p-value of joint significance of the 3 lags of the reform. Standard errors in parenthesis. * p<0.05, ** p<0.01, *** p<0.001.
Source: MCVL 2005

Table H.2: 2SLS results on the semi-elasticity of contribution incentives

	Baseline	Discount rate		Contr. year coef.		Mortality		Early ret.	Policy unc.
		d = 1%	d = 5%	α = 100%	α = 70%	45-47y	55-57y	R = 62y	CE = 57.8%
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A: Prob above min.									
ϵ_{t+1}	0.010	0.006	0.016	0.009	0.014	0.009	0.013	0.011	0.018
ϵ_{t+2}	0.021	0.013	0.033	0.019	0.028	0.018	0.026	0.024	0.036
ϵ_{t+3}	0.033	0.020	0.052	0.030	0.045	0.028	0.041	0.038	0.057
ϵ_{t+4}	0.046	0.029	0.073	0.042	0.062	0.039	0.058	0.053	0.080
ϵ_{t+5}	0.052	0.032	0.082	0.048	0.070	0.044	0.064	0.059	0.090
Panel B: Log of real contr.									
ϵ_{t+1}	0.006	0.004	0.010	0.006	0.008	0.005	0.008	0.007	0.011
ϵ_{t+2}	0.013	0.008	0.021	0.012	0.018	0.011	0.016	0.015	0.023
ϵ_{t+3}	0.019	0.012	0.030	0.018	0.026	0.016	0.024	0.022	0.033
ϵ_{t+4}	0.028	0.017	0.044	0.026	0.037	0.024	0.035	0.032	0.048
ϵ_{t+5}	0.034	0.021	0.053	0.031	0.045	0.028	0.042	0.038	0.058

Notes: This table provides the 2SLS results on the semi-elasticity of contribution incentives after the 1997 reform using alternative measurements of incentives. The semi-elasticity represents the Wald ratio of the DiD contribution response to the 1997 reform, divided by the effect on contribution incentives. My DiD compares self-employed workers aged 50-52 to those aged 40-46. The outcome variables are the probability of contributing above the minimum (Panel A) and the logarithm of real contributions (Panel B). The table includes my baseline semi-elasticity (column 1). I further estimate the semi-elasticity for a discount rate of 1% (column 2) and 5% (column 3), replacement rate of 100% (column 4) and 70% (column 5); using the survival probabilities of those aged 45-47 (column 6) and aged 55-57 (column 7), while my target population are aged 50-52; retirement at 62 years (column 8); and accounting for policy uncertainty using a certainty equivalent (CE) of 57.8% (column 9).
Source: MCVL 2005

H.2 Effect of eligibility to the option value decision

This appendix provides evidence on the effect of making the option value decision at the time when contributions are becoming linked to pension benefits. For this, I exploit the cohort-based eligibility to make the option value decision after the 1997 pension reform. Self-employed workers born in 1947 and before were already 50 years old in 1997, making them ineligible to make the option value decision after 1997. However, those born after 1948 were younger than 50 years in 1997 and therefore eligible to fully adjust their option value decisions once the reform was approved. Table H.3 shows the birth cohorts by age and year, highlighting eligibility cut-off to make option value decision after 1997.

Empirical strategy. I study the discontinuity in DiD responses to the 1997 reform for those born pre-1947 and post-1948. I estimate the discontinuity of responses to the 1997 reform controlling for age-specific effects and a linear trend of the dynamic treatment effect after 1997. The regression

Table H.3: Cohorts of self-employed entering treatment and control groups

	40	41	42	43	44	45	46	47	48	49	50	51	52
1994	1953	1952	1951	1950	1949	1948	1947	1946	1945	1944	1943	1942	1941
1995	1954	1953	1952	1951	1950	1949	1948	1947	1946	1945	1944	1943	1942
1996	1955	1954	1953	1952	1951	1950	1949	1948	1947	1946	1945	1944	1943
1997	1956	1955	1954	1953	1952	1951	1950	1949	1948	1947	1946	1945	1944
1998	1957	1956	1955	1954	1953	1952	1951	1950	1949	1948	1947	1946	1945
1999	1958	1957	1956	1955	1954	1953	1952	1951	1950	1949	1948	1947	1946
2000	1959	1958	1957	1956	1955	1954	1953	1952	1951	1950	1949	1948	1947
2001	1960	1959	1958	1957	1956	1955	1954	1953	1952	1951	1950	1949	1948
2002	1961	1960	1959	1958	1957	1956	1955	1954	1953	1952	1951	1950	1949

Notes: This table shows the cohorts of self-employed workers entering the treatment and control groups between 1994 and 2002. The control group, consisting of self-employed workers aged 40-46, is shaded in light blue. The treatment group, consisting of those aged 50-52, is shaded in light red before the 1997 reform. After 1998, the treatment group is shaded in red for cohorts born in 1947 and before, while they are shaded in darker red for cohorts born in 1948 and after, who were eligible to fully adjust their decisions for the option value.

specification takes the following form:

$$\begin{aligned} Y_{iact} =& \alpha_a + D_t + \sum_{\tau=1}^{15} \gamma_{-\tau} T_a \times D_{1997-\tau} + \sum_{a=50}^{52} \gamma_a \mathbf{1}\{age_{it} = a\} \times \mathbf{1}\{t \geq 1998\} + \delta \mathbf{1}\{c_i \geq 1948\} + \\ &+ \lambda t \times \mathbf{1}\{t \geq 1998\} T_a + \mu \mathbf{1}\{c_i \geq 1948\} \times \mathbf{1}\{t \geq 1998\} + \mathbf{X_{iat}}\theta + \varepsilon_{iat} \end{aligned} \tag{16}$$

where Y_{iact} refers to my two outcomes of interest, which are $Y_{iact} = \mathbf{1}\{C_{iact} > C_t^L\}$, the indicator variable on whether self-employed worker i of age a born in cohort c contributed above the minimum contribution C_t^L in period t, and $Y_{iact} = \mathbf{1}\{C_{iact} > C_t^{M50}\}$, the indicator variable on whether self-employed worker i of age a born in cohort c contributed above the 50+ maximum contribution C_t^{M50} in period t. α_a refers to age dummies, and D_t refers to time dummies measured in quarters, T_a refers to the treatment group indicator, which takes value of 1 if $a \in [50, 52]$ and value of 0 if $a \in [40, 46]$. $\mathbf{X_{it}}$ refers to the set of controls, which include province dummies, education level dummies, industry of the economic activity, whether individuals live in municipalities above 40,000 people, tenure and real GDP per capita at the province level. Standard errors are clustered at the individual level. The parameter of interest is μ, which measures the effect of the eligibility to make the option value decision at the same time when contributions became linked to pension benefits.

H.2.1 Post-1948: Eligibility to option decision

I examine heterogeneous responses depending on the cohort-based eligibility to make the option value decision after the 1997 reform. Figure H.3 provides graphical evidence on the dynamic DiD estimates by quarter of birth on probability of contributing above the minimum and above the 50+ maximum, respectively for the self-employed aged 50, 51 and 52. The top panel of the figures illustrates a sharp increase in the probability of contributing above the minimum for cohorts born post-1948, compared to those born pre-1947. In contrast, the bottom panel indicates no increase in the probability of contributing above the 50+ maximum, where the option value extends the range of available contributions. This implies that the response to making the option value decision can be attributed to the behavioral aspect of the decision, rather than to option value incentives.

Table H.4 shows that eligibility for the option value decision amplified the responsiveness to the 1997 reform by 2.84pp. However, eligibility for the option value decision had no effect on contributions above the threshold where option value incentives exist, which attributes the response to the increased attention of the decision.

Table H.4: Effect of eligibility to the option value on the response to the 1997 reform

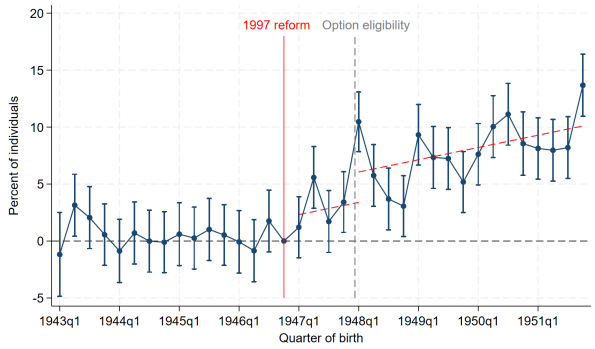
	Eligibility: Post-1948	Placebo eligibility		
		Post-1947	Post-1949	Post-1950
	(1)	(2)	(3)	(4)
Prob above min	2.84*	0.08	0.93	0.86
	(1.41)	(1.53)	(1.54)	(1.72)
Prob above option threshold	-0.05	0.15	-0.98	1.03
	(0.68)	(0.70)	(0.70)	(0.85)
N (obs)	97,115	97,115	97,115	97,115

Notes: This table provides the coefficient estimates on the effect of eligibility to the option value decision, which is defined by cohorts born after 1948, on the DiD response to the 1997 pension reform for self-employed aged 50-52 years (column 1). This also provides the results for a placebo eligibility cut-off of cohorts born in 1947 (column 2) 1949 (column 3) and 1950 (column 4). The outcomes of interest are the probability of contributing above the minimum and above the option threshold. Standard errors in parenthesis. * p<0.05, ** p<0.01, *** p<0.001. *Source:* MCVL 2005

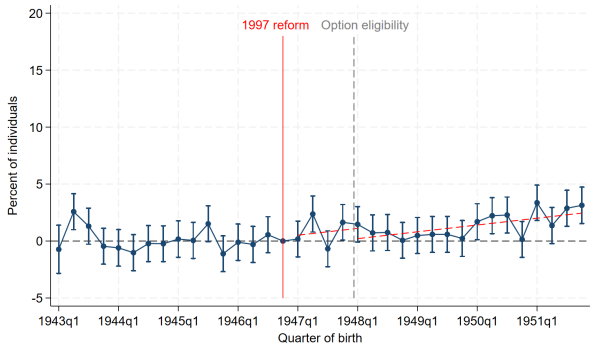
For robustness, I perform the analysis using placebo eligibility cut-offs for cohorts 1947, 1949 and 1950, finding no significant responses. This helps attribute the increase in response to the option value decision.

Figure H.3: Graphical evidence of the effect of eligibility to the option value decision

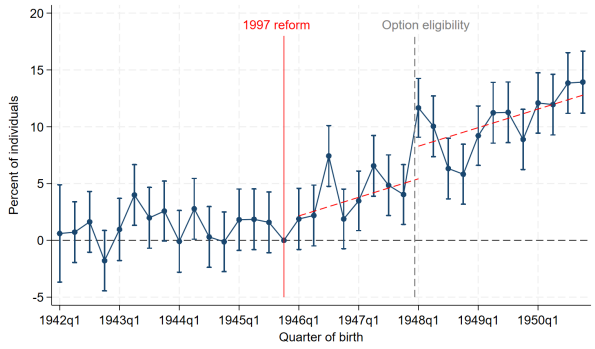
(a) Age 50: Prob. above minimum



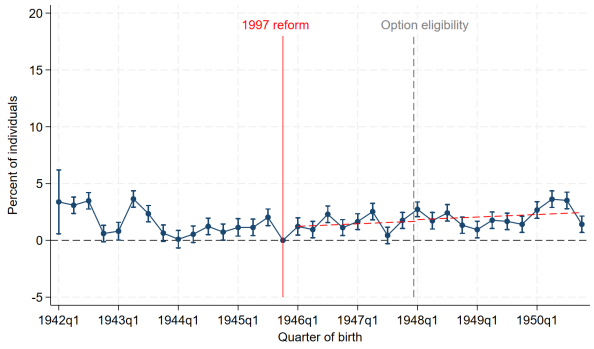
(b) Age 50: Prob. above option threshold



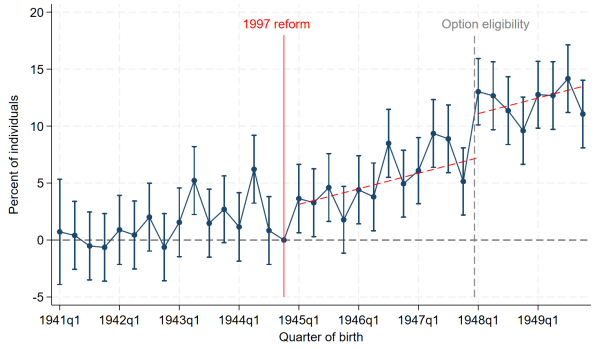
(c) Age 51: Prob. above minimum



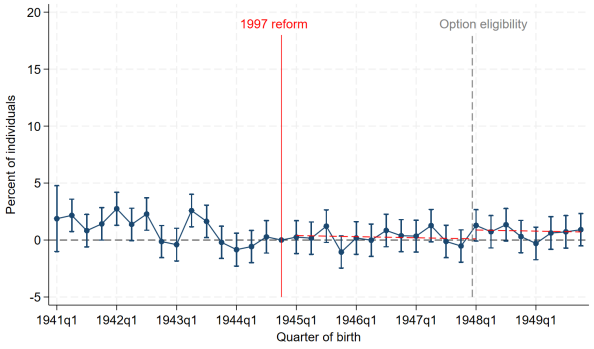
(d) Age 51: Prob. above option threshold



(e) Age 52: Prob. above minimum



(f) Age 52: Prob. above option threshold



Notes: The figure displays dynamic DiD estimates on the effect of the 1997 reform by quarter of birth at age 50, 51 and 52. The control group consists of individuals aged 40-46. The responses are reported for the probability of contributing above the minimum (left panels) and above the threshold providing an option value (right panels). The vertical red line indicates the 1997 reform. The vertical gray dashed line indicates post-1948 cohort, who were eligible to to the option value decision after 1997.
Source: MCVL 2005.

H.3 Evidence on take-up of reduced contributions

I provide evidence on two instances where self-employed workers could contribute below the statutory minimum level. These concern entry and exit from self-employment. They show a strong preference to contribute at least the statutory minimum level, suggesting loss aversion of future contributions.

H.3.1 Voluntary SSCs after drop out

I consider another margin of voluntary contributions. When individuals drop out of self-employment and thereby from RETA, they can sign up to a Special Scheme and make voluntary contributions in the absence of any economic activity. Among individuals contributing under RETA at age 59, I document that 20 percent dropped out from self-employed before retirement. Among them, 55% opted in for voluntary contributions without any activity[9]. Among them, 90% decided to contribute by the statutory minimum. This indicates an aversion to contribute by anything but the minimum contribution level, contradicting an inability to make voluntary contributions. Among individuals making these voluntary contributions, 18% ended up receiving minimum pensions, implying their contributions gave no pension return, effectively leaving money on the table. These contribution decisions point to a widespread misperception of contribution incentives in Spain.

[9]This excludes individuals maybe going into other forms of employment

I Additional results: 2003 reform

This appendix provides additional evidence on the response to 2003 reform. I describe the institutional details, the sample and the main results of responses of eligible self-employed workers.

I.1 Institutional details

Between April 2003 and January 2005, certain groups of new self-employed workers were allowed to choose contributions that were 25% lower than the statutory minimum level for their first three years as self-employed workers. Specifically, eligible groups were new self-employed workers younger than 30 and females older than 45 years. The availability of reduced contributions was justified by the lower financial capacity of new self-employed workers, as well as aiming to reduce unemployment of vulnerable groups.

I.2 Sample characteristics

I use contribution data for the period 2002-2004 for entrants into self-employment for the first time at an age younger than 30 or older than 45 for females, who are eligible to reduce their contributions following the reform. Table I.1 presents the summary statistics for new self-employed between 2002 and 2004 for estimating the effect of the 2003 reform.

I verify that most individuals have no incentive to contribute above the minimum, either because their contributions are outside the linkage age, or because their low contribution careers would lead them to earn minimum pensions. As shown in Table I.1, these workers have low contribution histories.

I.3 Results

We describe the main results on the contributions selected by new self-employed workers, as well as additional evidence on the evolution of contributions.

Table I.1: Summary statistics for new self-employed between 2002 and 2004

	Eligible: 18-30 years		Eligible: 45-64 years		All eligible	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Outcome variables						
$1\{C_{iat} < C^L_{iat}\}$	28.612	(15.612)	16.366	(37.006)	27.201	(44.500)
Real Contr. (2016€)	248.730	(35.309)	271.905	(87.039)	251.393	(44.996)
Control variables						
Female	0.356	(0.478)	1.000	(0.000)	0.431	(0.495)
Education level						
Primary	0.139	(0.346)	0.339	(0.473)	0.163	(0.369)
Secondary	0.411	(0.492)	0.326	(0.469)	0.401	(0.490)
Superior	0.423	(0.494)	0.275	(0.447)	0.405	(0.491)
N.A.	0.026	(0.159)	0.058	(0.233)	0.030	(0.171)
Economic activity						
Agriculture	0.016	(0.126)	0.034	(0.181)	0.018	(0.134)
Manufacturing	0.062	(0.242)	0.056	(0.231)	0.062	(0.241)
Construction	0.179	(0.383)	0.064	(0.246)	0.166	(0.372)
Retail service	0.203	(0.403)	0.293	(0.455)	0.214	(0.410)
Hospitality	0.100	(0.300)	0.172	(0.377)	0.108	(0.310)
Transport	0.042	(0.202)	0.024	(0.152)	0.040	(0.197)
Estate & Finance	0.136	(0.343)	0.187	(0.390)	0.142	(0.349)
Social service	0.110	(0.313)	0.104	(0.305)	0.110	(0.312)
N.A.	0.148	(0.355)	0.063	(0.243)	0.138	(0.345)
Small municipality	0.527	(0.499)	0.443	(0.496)	0.517	(0.500)
Contribution years	3.217	(3.289)	7.778	(9.090)	3.748	(4.709)
N (obs)	14,567		1,882		16,449	

Notes: This table shows the descriptive statistics for the sample entering the study of the effect of the 2003 reform. This include new self-employed eligible to decrease their contributions aged 18-30 years and females aged over 45 years. I provide mean and standard deviation for my two outcome variables, the probability of contributing below the ordinary minimum and real contributions, as well as demographic and employment variables such as categorical variables on education and economic activity, as well as gender, a dummy variable on whether municipality of residence has population smaller than 40,000 inhabitants and contribution years. Fractions of categorical variables may not add up due to rounding.
Source: MCVL 2005.

I.3.1 Main results

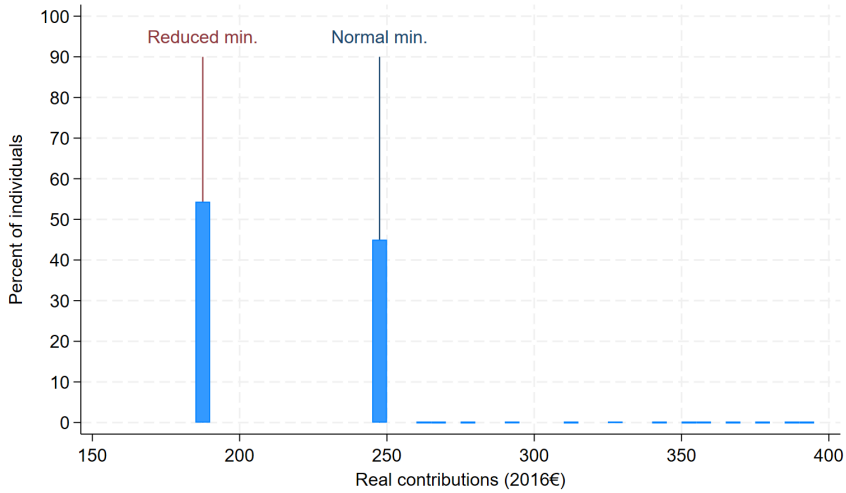
Figure I.1 shows that more than 45% of the new self-employed workers younger than 30 years did not opt for reduced contributions, while for females older than 45 years, this percentage was as high as 70%[10]. Among those who did not reduce their contributions, the majority of eligible self-employed opted for the ordinary minimum level.

The adherence to the ordinary minimum level, acting as a social default, can be attributed to the challenges associated with understanding incentives (Altmann et al., 2022). Therefore,

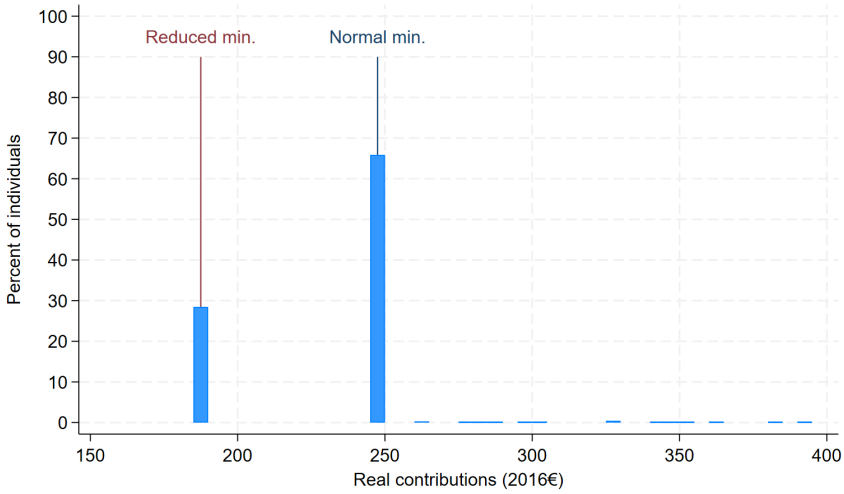
[10]Figure I.2 shows limited learning, since the fraction of self-employed workers opting for reduced contributions remained stable over time.

Figure I.1: Histogram of contributions new self-employed workers eligible to reduced contributions

(a) Aged 30 or less



(b) Females aged 45 or more



Notes: This figure displays the histogram of contributions of eligible new self-employed workers aged less than 30 (panel a) and females aged over 45 (panel b) in 2004. The red vertical line represents the reduced minimum for eligible workers and the blue vertical line represents the normal minimum contributions.
Source: MCVL 2005.

the limited adoption of reduced minimum contributions could serve as evidence that a significant portion of self-employed workers misunderstand the link between SSCs and pension benefits. Since self-employed workers actively choose their contributions at registration, the low responses to the opportunity to reduce contributions may not be explained by inertia (Carroll et al., 2009) or fixed decision costs (Almunia et al., 2020).

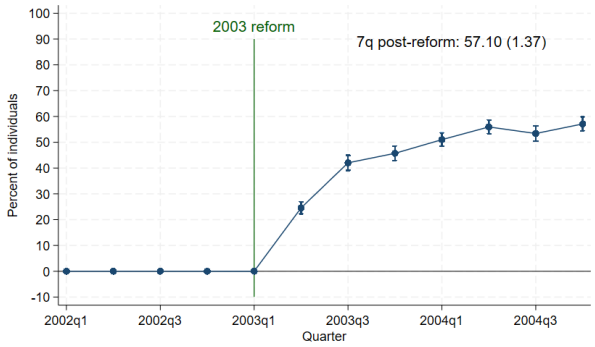
New entrants into self-employment could be expected to be more financially constrained than long-term self-employed workers, making them more predisposed to opting for smaller contributions. Consequently, the estimated contribution reduction to the 2003 reform could be considered as an upper bound relative to my primary sample of long-term self-employed workers.

I.3.2 Evolution of responses over 2002-2004

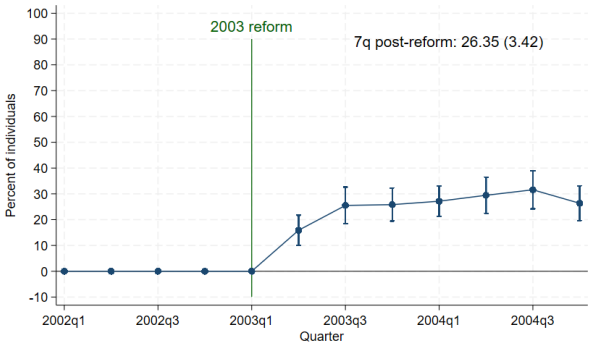
Figure I.2 displays the fraction of new self-employed workers contributing at the reduced minimum by quarter between 2002 and 2004. While some increase in responses is observed over time, the increase can be considered modest, particularly for females aged 45 or more.

Figure I.2: Fraction of new self-employed workers contributing by the reduced minimum

(a) Aged 30 or less



(b) Females aged 45 or more



Notes: This figure displays the fraction of new self-employed workers contributing below the reduced minimum for those aged less than 30 years (panel a) and females aged over 45 years (panel b). The vertical green line represents the 2003 reform.
Source: MCVL 2005.

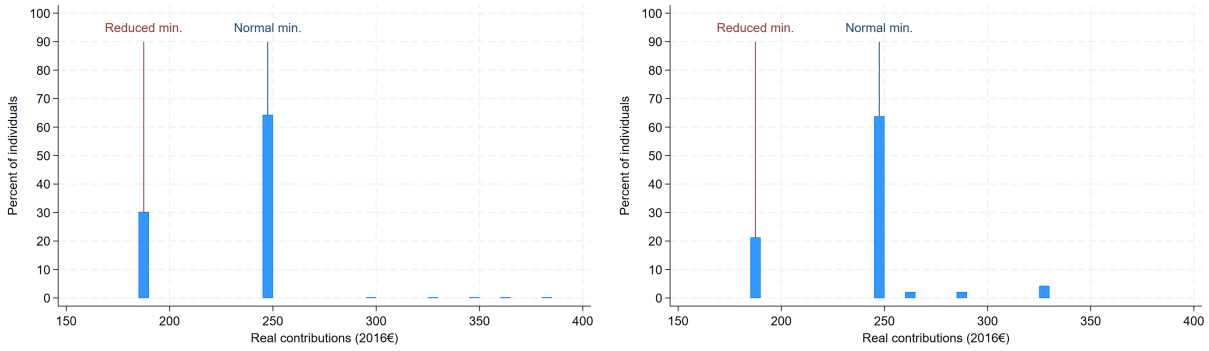
I.3.3 Females older than 50 years.

This appendix also provides evidence on the response of new self-employed workers aged above 50 depending on their potential contribution years at retirement. In this manner, I consider the group of self-employed workers whose contributions could be potentially linked to pension benefits. Figure I.3 shows the histogram for females aged over 50 years categorized by the length of contribution periods, which determines whether minimum pensions override contribution incentives. Among the self-employed with expected contributed periods above 30 years, whose contributions are likely

to count for pensions, 21.73% of self-employed reduce their contributions. In contrast, among those with expected contribution periods shorter than 25 years and therefore without pension incentives, only 31.54% reduce their contributions. The reduction in contributions is relatively small, considering that these contributions do not count for pension benefits.

Figure I.3: Histogram of contributions for female new self-employed aged ≥50 years in 2004

(a) Expected cont. years < 25 (b) Expected cont. years > 30

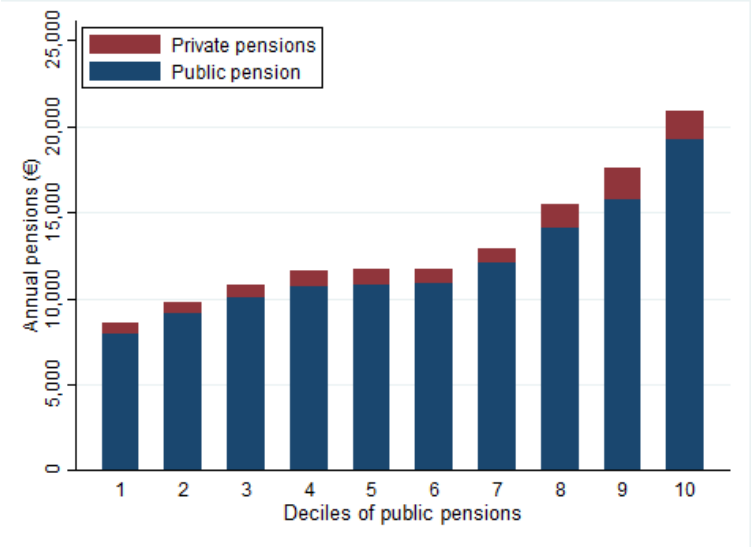


Notes: This figure displays the histogram of contributions for female new self-employed workers older than 50 years in 2004, expected contribution periods below 25 years (panel a) and above 30 years (panel b). Expected contributed years assume the self-employed work until retirement at 65 years. The red vertical line represents the reduced minimum contribution and the blue vertical line represents the ordinary minimum contribution.
Source: MCVL 2005.

J Private annuity pensions

This appendix provides evidence on the private pensions received by Spanish self-employed workers at retirement. I use that Social Security data is merged with data coming from tax withholding files since 2006, which allows observing both public and private pensions. I select a sample of self-employed retirees aged 65-70 of cohorts 1944-1948, which are closest to the treatment group of my analysis on the 1997 reform. Figure J.1 illustrates that average private pensions are generally low across all deciles of public pensions, suggesting minimal substitution between public and private pensions.

Figure J.1: Public and private pensions for self-employed retirees



Notes: This figure shows the average annual public and private pensions received by Spanish self-employed retirees of cohorts 1944-1948 when aged between 65 and 70, classified by deciles of annual public pension benefits. Public pensions represent the annual public pension, while private pensions represent the average private pensions received between age 65 and 70.
Source: MCVL 2006-2018.

References in Appendix

Almunia, M., Guceri, I., Lockwood, B., & Scharf, K. (2020). More giving or more givers? the effects of tax incentives on charitable donations in the UK. *Journal of Public Economics*, *183*, 104114.

Altig, D., Kotlikoff, L. J., & Ye, V. Y. (2023). How much lifetime social security benefits are americans leaving on the table? *Tax Policy and the Economy*, *37*(1), 135–173.

Altmann, S., Grunewald, A., & Radbruch, J. (2022). Interventions and cognitive spillovers. *The Review of Economic Studies*, *89*(5), 2293–2328.

Carroll, G. D., Choi, J. J., Laibson, D., Madrian, B. C., & Metrick, A. (2009). Optimal defaults and active decisions. *The Quarterly Journal of Economics*, *124*(4), 1639–1674.

Chetty, R., Looney, A., & Kroft, K. (2009). Salience and Taxation: Theory and Evidence. *American Economic Review*, *99*(4), 1145–1177.

Coile, C., Diamond, P., Gruber, J., & Jousten, A. (2002). Delays in claiming social security benefits. *Journal of Public Economics*, *84*(3), 357–385.

Conde-Ruiz, J. I., & González, C. I. (2016). From Bismarck to Beveridge: The other pension reform in Spain. *SERIEs*, *7*(4), 461–490.

DellaVigna, S. (2009). Psychology and economics: Evidence from the field. *Journal of Economic Literature*, *47*(2), 315–372.

INE. (2019a). Hipótesis de mortalidad en España: Tablas de mortalidad proyectadas 2018-2067: Esperanza de vida por edad y sexo. https://www.ine.es/jaxi/Tabla.htm?tpx=28990&L=0

INE. (2019b). Tablas de mortalidad por año, sexo, edad y funciones. series desde 1991. https://www.ine.es/jaxiT3/Tabla.htm?t=27153

Liebman, J. B., Luttmer, E. F. P., & Seif, D. G. (2009). Labor supply responses to marginal Social Security benefits: Evidence from discontinuities. *Journal of Public Economics*, *93*(11), 1208–1223.

Luttmer, E. F. P., & Samwick, A. A. (2018). The welfare cost of perceived policy uncertainty: Evidence from Social Security. *The American Economic Review*, *108*(2), 275–307.

Mullainathan, S., Schwartzstein, J., & Congdon, W. J. (2012). A reduced-form approach to behavioral public finance. *Annual Review of Economics*, *4*(1), 511–540.

Sánchez-Martín, A. R. (2019). Elección de base de cotización de trabajadores autónomos: Cálculo de incentivos. *FEDEA Studies on the Spanish Economy*, *eee2019-29*.

Sandroni, A., & Squintani, F. (2007). Overconfidence, insurance, and paternalism. *American Economic Review*, *97*(5), 1994–2004.

Spinnewijn, J. (2015). Unemployed but optimistic: Optimal insurance design with biased beliefs. *Journal of the European Economic Association*, *13*(1), 130–167.