Regulation by Public Options: Evidence from Pension Funds*

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Abstract

Many developing countries have private firms administering and investing workers' savings. By relying on private firms, governments protect funds from short-term fiscal needs at the cost of potentially creating market power for these firms. The current political debate in many countries revolves around the role of the high fees charged by private firms in explaining low replacement rates, and the possibility that public options can solve this problem. In this paper, we analyze the equilibrium welfare effects of using public options to regulate market power in the market for individual capitalization pension systems. We develop and estimate a dynamic model of demand and supply in the market for pension funds in Uruguay. We find that the presence of a public option reduces equilibrium fees. Replacing the public option with a private one would increase the fees of the private firms by 16% on average and would more than double the fee of the substitute private option. Additionally, price regulation based on the public option would almost eliminate firms' rents.

JEL Classification: L51, N2, H4, L21

Key words: competition, state-owned firms, pension funds, regulation

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1 Introduction

Many developing countries reformed their traditional pension systems to introduce private firms to administer and invest workers' savings[1]. Private firms were used as a commitment device to keep employees' long-run savings safe from the short-run financial needs of the government. In the past, access to these funds or high inflation was used to expropriate the savings. With these reforms, the government tightened its hands at the cost of potentially creating market power for private firms. The current political debate in many countries revolves around the responsibility of the high fees charged by private firms in the low replacement rates for employees and the possibility that public options can solve this problem. In this paper, we analyze the welfare effects of using public options as a way to regulate market power in the market for individual capitalization pension systems.

The argument in favor of introducing public options is that they can compete more aggressively with private firms by charging lower fees and therefore increase workers' savings. However, while the participation of public options can contribute to solving market failures, existent literature also shows how the equilibrium welfare effects of this policy are *a priori* uncertain Kang (2022). Market segmentation, price-increasing competition, and inefficient provision (Hastings et al. (2017), Chen and Riordan (2008), Duggan and Scott Morton (2006)) can negatively affect the welfare of market participants instead of increasing it (Jiménez-Hernández and Seira (2021), Atal et al. (2021), Fonseca and Matray (2022)). Therefore, the possibility for public options to increase welfare, as well as the optimal regulation of these markets, is an empirical question.

In this paper, we study the welfare consequences of the participation of a State-Owned-Firm (SOF) in the Uruguayan market of Pension Fund Administrators (PFAs). In this market, there are 3 private firms and a public option competing to manage workers' savings, with tight regulation on investment portfolios imposed by Law. PFAs charge workers a fee as a share of gross wages to administer their monthly contributions until retirement and are not allowed to charge different fees to different workers. Furthermore, workers enroll through sales force agents and, once enrolled, switching between firms is infrequent. We observe and analyze three different equilibria, motivated by changes in the

[1]Chile (1980), Perú (1993), Colombia (1994), Argentina (1994), Uruguay (1996), Bolivia (1997), México (1997), El Salvador (1998), Costa Rica (2001), República Dominicana (2003), Nicaragua (2004), Ecuador (2004).

SOF shareholders' preferences and the introduction of price caps.

We use detailed administrative data from the institution that administers social security in Uruguay (BPS). We use a panel of a representative sample of workers who made enrollment decisions between the inception of the system in 1996 and 2020 to recover enrollment preferences. We observe monthly data on gross wages, basic employers' characteristics, spells in and out of the formal labor market, PFA enrollment decisions, and mechanism of affiliation, plus basic demographics (sex and date of birth). We complement these data with monthly publicly available market-level data published by the Central Bank about market shares, fees, investment returns, switchers, sales force agents, contributions, and PFAs' financial statements.

We empirically study three specific periods with different regulatory environments and preferences of the SOF PFA shareholders, which we argue gave rise to three different steady-state equilibria. First, we consider a period where the public option sets fees close to those of the private PFAs and without any regulation on fees. Second, we consider a later period where the SOF reduced the administration fee significantly following what we argue is a change in shareholders' preferences but still without fee regulations. Finally, we study a recent period where a cap on fees that affected private PFAs was imposed by the Government.

We develop and estimate a dynamic model of demand and supply in the market for pension funds. We use a demand system in the tradition of (Berry, 1994; Berry et al., 1995). We utilize micro-level data on workers' choices since the inception of the system, and the fact that in this context, the fees are set nationally by firms but the cost of choosing a specific PFA varies across workers, to identify preferences (Hastings et al., 2017). We consider effective administration costs paid by workers, investment returns, PFAs' fixed effects, and idiosyncratic shocks as the key drivers of choices. The administration costs are based on workers' yearly gross wages and observed fees at the time of enrollment. Following the low switching rates observed for already enrolled workers, we assume that switching costs are infinite so only initial choices matter.

On the supply side, we develop a dynamic model of forward-looking single-product firms that compete for new enrollees with no possibility of price discrimination between new and old cohorts of workers. Private firms maximize the present discounted value of economic profits while the public option considers both profits and workers' welfare in its objective function. Given that firms have a high share of old consumers already

affiliated with high switching costs and in every period compete for a small cohort of new consumers, in the model firms face a trade-off between investment and harvesting motives (Beggs and Klemperer, 1992; Farrell and Klemperer, 2007). We argue that the fees that we observe are an equilibrium between the two.

We estimate the demand and recover the primitives in each period by grouping workers based on demographics and on whether they had the outside option of remaining not enrolled or not[2]. In general, the estimates show how higher income and older workers are more sensitive to administration fees, results that can be rationalized given the available evidence about how financial literacy is positively correlated with age and income (Lusardi, 2008).

Once we recover preferences, we use them to back out enrollment marginal costs assuming that PFAs compete for new enrollees and set fees to maximize an objective function. Different from the previous literature that studies this market assuming zero marginal costs (Hastings et al., 2017; Luco, 2019; Illanes, 2016), we back out marginal costs and find that they are positive and aligned with the variable payment per enrollee that sales force agents receive from PFAs. However, in the case of the public option, marginal cost can not be separately identified from the conduct parameter that weighs profits and workers' welfare. To disentangle this, we use the range of marginal costs estimated for private firms and assume that they are not significantly different. Using this assumption, we are able to recover the profit and non-profit motives parameters for the public option. We find that the conduct parameter that weights profits in the objective function of the public option effectively decreased between the first and second equilibrium in our sample.

We then proceed to analyze counterfactuals to quantify the value of the regulation by a public option. Using the demand primitives, estimated marginal costs, and the SOF weights between profits and workers' welfare, we investigate welfare changes if the SOF PFA is replaced with a private firm. We find that if there were four private firms in the market, fees of the private firms would increase by 16% on average and the firm of the privatized firm would more than double. Therefore, the presence of the SOF PFA reduces fees and it not only benefits its enrollees directly but also private PFAs' enrollees indirectly through competition.

[2]In Uruguay the retirement system is dual, it includes a pay-as-you-go component in addition to the capitalization one. Enrollment in the latter is mandatory only for workers above an income threshold.

Additionally, we consider a counterfactual to measure how close the with and without regulated fees equilibrium is to an optimal benchmark. In our analysis, we define the optimum as a scenario in which a social planner regulates fees to maximize consumer welfare while ensuring the presence of all 4 active firms in the market. In this case, we assume that the firms preserve their varieties from the workers' perspective, but can charge a fee only enough to recover operational costs. Compared to this benchmark, the public option and the regulation on fees reduce firms' economic profits almost to the minimum that would be possible under the current market structure with 4 firms, while the public option alone without regulation on fees closes that gap between the situation with 4 private firms and the optimum by 50%.

In this paper, we contribute to two strands of the literature. First, we contribute with the empirical literature that analyzes the welfare effects of State-Owned-Firms (Fonseca and Matray (2022),Jiménez-Hernández and Seira (2021), Atal et al. (2021), Handbury and Moshary (2021), Curto et al. (2019),Busso and Galiani (2019), Cunha et al. (2019)). In this case, we contribute by understanding what's the value of the public option in the context of forward-looking single-product firms with market power when the public option has a similar quality as private ones. Our results show that its welfare benefits reach workers enrolled in it as well as those enrolled in private PFAs, due to increased competition and lower fees (Jiménez-Hernández and Seira (2021)).

Second, we contribute to the literature that studies the market regulation of pension fund administrators in individual capitalization retirement systems (Hastings and Tejeda-Ashton (2008), Hastings et al. (2017), Illanes (2016), Luco (2019)). In this case, different from previous papers, we can observe a public option operating in the market, instead of estimating its effects as a counterfactual (Hastings et al. (2017)). Furthermore, the changes in the regulatory environment and shareholders' preferences allow us to understand how the welfare effects of the public option change when the institutional configuration also changes. The fact that we consider a mature market, with a low proportion of new affiliates in relation to the old ones, in a scenario where switching costs are high, also implies that the effects of the public option are different than what was previously estimated in the literature. A lower fee of the public PFA pushes private PFAs to reduce fees to compete for new enrollees, instead of increasing them to make more profits out of the already enrolled workers.

2 Institutional background

In 1996, Uruguay reformed its retirement system and introduced an individual capitalization component to complement the ongoing pay-as-you-go system. While the latter is administered by the Banco de Previsión Social (BPS)[3] and it is mandatory for every worker[4], the former has two elements. Before retirement, workers' contributions to individual savings accounts are administered and invested by Pension Fund Administrators (PFAs) regulated by the Central Bank (BCU). After retirement, an annuity based on workers' savings is paid by an insurance company until the deceased.

2.1 Workers contributions and PFA enrollment

The workers' contribution rate is fixed at 15% of gross wages[5]. Workers with gross wages above US$ 1,535[6] have to contribute to the individual capitalization sub-system. Conditionally on not being already enrolled the first time they cross this threshold, they have 2 months to choose a PFA when they do so. If they do not choose one, the BPS assigns the worker one by default[7]. Except for this mechanism, workers can only enroll through the sales force agents employed by PFAs. On the other hand, enrollment for workers with gross wages below US$ 1,535 is optional, and if they decide to enroll, they contribute half of their contribution to each subsystem.

Regarding the distribution of savings between sub-systems for individuals with wages above US$ 1,535, for gross wages above US$ 2,303 contributions to the pay-as-you-go sub-system are capped at 15% of US$ 1,535. Therefore, 15% of any dollar over this later threshold and up to a total gross wage of US$ 4,605 goes to individual savings accounts. For gross wages below US$ 2,303, contributions based on gross wages up to US$ 1,535 are divided in half between the sub-systems, and 15% of every dollar earned in excess of US$ 1,535 and up to US$ 2,303 goes to the pay-as-you-go sub-system.[8]

[3] Equivalent to the Social Security Administration.

[4] Except for small groups of workers that have particular retirement systems.

[5] Employers' contributions go exclusively to the pay-as-you-go pillar.

[6] Converted from Uruguay Pesos to US Dollars using April 2021 reference values. The value of the thresholds is adjusted yearly according to the Average Wage Index.

[7] Until 2014, the assignment was made by lottery in proportion to firms' market share. Since then, they are distributed between the two firms with the lowest administration fees, unless the gap between the two exceeds 20%. If this occurs, default affiliations are made only to the firm with the lowest fee. In practice, this enrollment mechanism accounts for 10-12% of new enrollments each year and since 2014 the SOF PFA has been the only beneficiary.

[8] There is a second alternative to distribute contributions once enrolled but in practice, it is rarely chosen

2.2 PFAs' market structure and regulation

There are currently 4 active PFAs in the market, 3 of them are private firms and the remaining one is a public option: a SOF firm that operates under the rules of private firms but whose shareholders are other state-owned institutions. This option exists since the inception of the system in 1996 and its shareholders are BROU (SOF bank, 51%), BPS (SSA, 37%), and BSE (SOF insurance, 12%). In the case of private firms, the market started with 5 firms and reached its current equilibrium following the merger of 4 firms into 2 in 2001.

PFAs receive workers' net contributions to individual accounts and invest them in available assets that belong to certain categories authorized by law. For their services, PFAs charge workers a fee that is a percentage of the gross monthly contribution that they make to their accounts in the individual capitalization sub-system. While until 2008, firms could charge both a fixed and a variable fee over the monthly gross contribution, nowadays they can only charge a variable fee. PFAs are not allowed to price discriminate, so they charge every enrollee the same fee. Moreover, in 2018 the Parliament imposed a cap on fees based on the lowest available fee in the market[9], which was fully implemented in 2020 following a transition period of 2 years.

Regarding portfolio rates of return, different regulations in place leave little room for differentiation between PFAs. The fact that close to 60% of total assets are some form of Government debt and that less than 15% of those assets are invested outside the country gives firms limited investment opportunities. Additionally, by law, a PFA is responsible for compensating workers when the rate of return that it obtains is below the minimum between 2% and the average return of the system minus 200 b.p. Furthermore, different from other individual capitalization systems, in Uruguay workers can not decide how to allocate savings between the 2 available investment funds within a PFA. While until 2014 there was a single investment fund available within a PFA, since then allocation rules between funds are based only on enrollees' age. Taken together, portfolio regulations, workers' insurance, and lack of decision-making regarding risk profiles give PFAs incentives to hold similar investment portfolios and therefore translate into PFAs offering similar rates of returns to their enrollees.

Finally, workers can switch between PFAs but switching rates have been historically

by individuals. It implies that contributions to the pay-as-you-go component are capped at 15% of US$ 1,535, so workers save in their individual accounts 15% of gross wages in excess of that threshold.

[9]The cap stands at 1.5x times the lowest fee in the market.

low. To switch PFAs workers need at least 6 months of contributions in the old one, and different from the initial enrollment mechanism, they can not switch through a sales force agent but need to carry out a face-to-face procedure at the PFA office. Though this last requirement was slightly simplified in previous years, switching rates are still relatively low compared with other Latin American countries with capitalization systems.

3 Data and descriptive statistics

3.1 Data

We combine several data sources about workers' characteristics and choices in the pension system, as well as PFAs' financial statements and data about fees, sales force agents, and portfolio rates of return. First, we use a novel database with administrative records collected by BPS for a representative random sample of workers since the inception of the market in 1996 and until 2020. The dataset is a monthly panel of workers' records with information about wages, employer characteristics, demographics (date of birth, sex, area of residence), and PFA enrollment decisions (enrollment mechanism and date, selected PFA and an ever-switched indicator). Second, we use publicly available information at the market level published by the Central Bank about market shares, fees, investment returns, contributions, switchers, and sales force agents for the period 1996-2022. Finally, we use firms' financial statements for the period 2001-2020, also publicly available on the web of the regulator.

3.2 Descriptive statistics

The markets that are created around the individual capitalization retirement systems have two subsequent phases before the moment when workers start leaving the labor market. At the very beginning, most workers have not chosen a PFA, and therefore there are few workers already enrolled and many to enroll. A model for firms' competition in this period is proposed in Hastings et al. (2017). Then, during the following years, there is a sizeable stock of workers already affiliated and a smaller flow of them entering the market each year. In this paper, we focus on this later phase, which we identify as starting in 2002 when the ratio of new to old enrollees fell below 10%.

In Table 1 we show descriptive statistics at aggregated market level for the average

year of the sample. The average number of already affiliated workers is 1,146,540, while the average size of the cohort of new enrollees entering the formal labor market is 63,317, which represents 5.5% of the stock. Additionally, the average number of switchers per year is low. It is worth noticing that the switching rate (0.31%) is even lower than the ones observed in similar regimes in Latin American countries[10]. Low switching rates in this market have been documented and analyzed in previous work (Luco (2019), Illanes (2016)).

Table 1: AGGREGATED MARKET DESCRIPTIVE

	Average year	% Affiliates
Affiliates	1,146,540	
New affiliates	63,317	5.52%
Net switchers	3,497	0.31%

Notes. Av. for period 2002-2020. Net switchers are expressed in annual terms.

During the period analyzed in the paper, we observe what we consider to be three different equilibria. These equilibria originated in structural changes regarding the preferences of the shareholders of the public option following a change in the Government in 2005 and in the introduction of a cap on market fees[11]. The change in shareholders' preferences materialized in lower fees, and its consequences are easily noticeable in accounting profits. It is worth noticing that, making references to the evolution of accounting profits does not imply that economic profits are not the relevant measure of profits. In fact, it is economic profits the measure that guides the analysis in the following sections. However, given that accounting profits changed significantly during the period, we believe it is worth highlighting them to better identify the three different equilibrium phases we are going to characterize in our supply and demand models.

- **Equilibrium 2002-2005: Relatively high SOF PFA fee, no fee regulation.** This period is characterized by the SOF PFA charging slightly lower fees than private firms and Return-Over-Equity (ROE) similar to the average ROE of private firms.

- **Transition 2006-2013: SOF PFA reduces fees, no fee regulation.** In 2006, the SOF

[10]See https://www.aiosfp.org/ for detailed information on the percentage of switchers over affiliates by country.

[11]These equilibria are depicted in grey in Figure 1.

began to reduce its fee, a change of behavior that we argue comes from a change in the preferences of its shareholders, as documented in public shareholders meetings' minutes. The change had the purpose of favoring workers and allowed the PFA managers to reduce the fee as long as the ROE remained above some minimum threshold level imposed by the main shareholder[12].

- **Equilibrium 2014-2017: Low SOF PFA fee, no fee regulation.** The SOF continued with the same mandate from the shareholders, but the ROE become a constraint to continuing the fee reduction policy. If we compare this equilibrium with the first one, the fee of the SOF PFA fell by half while private PFAs reduced it only slightly. As a result, during this period the ROE of private PFAs increased and that of the public option fell from 40% to 12%. This is preliminary and descriptive evidence of a change in the behavior of the SOF PFA. However, in our model, this behavioral change of the SOF will not be imposed but recovered from the data.

- **Transition 2018-2019: Low SOF PFA fee, progressive implementation of a cap on fees.** Between 2018 and 2019, the regulator implemented a transition phase that allowed firms to converge from pre-regulation observed fees towards the maximum ones allowed by the new law: firms were allowed to charge workers a fee up to 50% above the lowest fee in the market. The discussion about the potential introduction of the cap began in December 2017, so it doesn't affect our analysis of the previous period. The reduction in PFA fees observed during this period is motivated by this regulation. Since 2019, the fees of private PFAs have been equal to the maximum established by law.

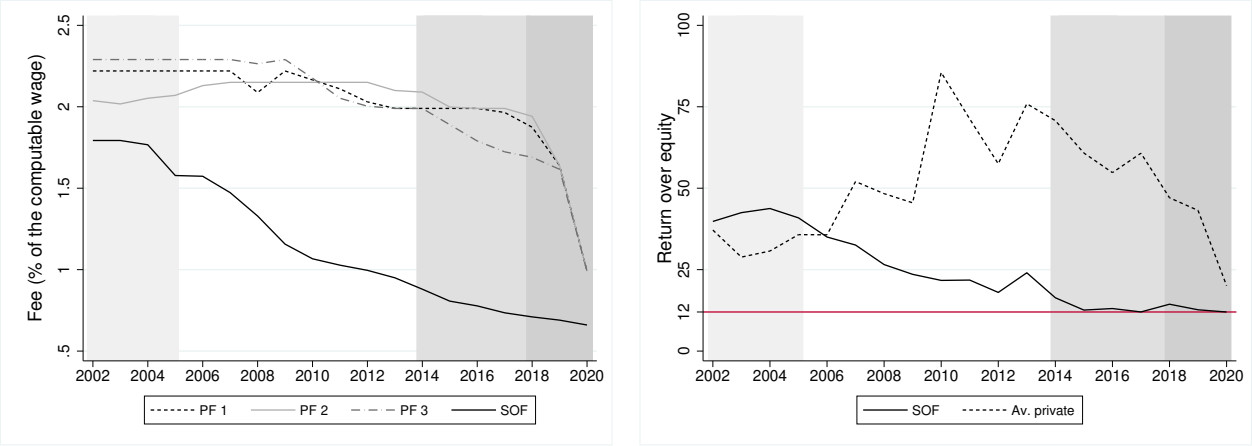
- **Equilibrium 2020: Low SOF PFA fee, fully implemented cap on fees.** The fully implemented policy of caps on fees generated a new equilibrium in which private PFAs' fees fell by half with respect to the average 2014-2017. Additionally, private PFAs ROE decreased from approximately 60% to 20%.

Within each equilibrium period, private PFAs' fees are relatively stable and have no sizeable difference between them. Additionally, in Figure A.1 it can be observed that the evolution of the share of old workers does not show important changes over time. The

[12]Shareholders' meeting for the fiscal year 2017: "(...) *distributable profits stood at a ROE of 14.4%, exceeding the minimum requirement of 12% established by the majority shareholder.*" (...) *"it is requested to continue with the fee reduction policy (...)"*.

Figure 1: EVOLUTION OF FEES AND ROE OVER TIME

(a) Fees (b) ROE



Note. Fees are reported as a percentage of the gross wage fraction relevant for contributions to each subsystem. Return-Over-Equity is calculated as the ratio between distributed profit in t and equity in $t-1$. The red line represents the minimum acceptable ROE imposed by the main shareholder on the SOF PFA. Shaded areas indicate the 3 equilibrium periods: 2002-2004, 2014-2017, and 2020.

SOF PFA is the leading firm with almost 40% of the market. There is also heterogeneity in shares across the wage distribution, with the SOF PFA obtaining a greater market share the higher the wage level of the worker[13]. In fact, for low-wage workers the public option is currently not the leading firm in the market, something that looks consistent with previous evidence on individual capitalization pension systems and on the correlation between income and financial literacy (e.g. Hastings and Ashton (2008); Lusardi and Mitchell (2011); Hastings et al. (2017)).

To complete the description of the firm's characteristics, in Figure A.2 we show the evolution of the real annual rate of return by firm, and the difference with the market average. There is no evidence of persistent out-performance of private PFAs over the SOF PFA. On the contrary, the median return of the public option during the entire period is 4.1%, 10b.p. above the median of private PFAs. Additionally, the median rate of return difference between the firms ranked in second and third place is 30 b.p., which implies that, similar to what happens with similar systems in other Latin American countries, the rate of return is not a first-order dimension of the competition and differentiation between firms (e.g. Luco (2019) for Chile and Hastings et al. (2017) for Mexico). In relation to the sale force, in Table A.2 of the appendix we show the average share by firm in each period.

[13]See shares by income bracket in Table A.1 in the Appendix.

It can be seen that the SOF PFA is the leader also in terms of sales force agents, with an average between 35% and 36%, and their share is stable between the three periods.

In Table 2 we show descriptives of selected demographics for the microdata sample. We have 125.453 individuals, of which 48% are women. The median age of the individuals entering the formal labor market is 23.5 years old, and the median age of enrollment is 24.9. In Figure A.4 it can be seen that conditional on enrollment and for non-forced enrollees, 75% do so in the first two years after entering the market. In the main demand specification, we work with all individuals, regardless of the time that elapses between entering the labor market and their affiliation[14]. The median enrollment wage in the sample is US$ 834 and 15% of the sample had gross wages above the first contribution threshold at the moment of entering the market. For its part, for those individuals whose salary ever exceeded the threshold that requires them to enroll, 24% were enrolled by default. Finally, for individuals that have the option not to enroll (gross wages below the first income threshold), 74% choose to save in an individual account in the capitalization sub-system.

Table 2: WORKERS' SAMPLE SUMMARY STATISTICS

Individuals	125,453
Gender (female)	0.48
Age when entering the market (median)	23.2
Age when enrolling (median)	24.9
Gross wage (median, US$)	834
Share with enrollment gross wage above threshold (US$ 1,535)	0.15
Outside option (conditional on gross wage below US$ 1,535)	0.26

Notes. The Table reports descriptive statistics for selected demographics for the available sample. Average 1996-2020. UYU expressed in US$ 2017.

4 Model

The model characterizes the competition of forward-looking firms in the individual capitalization pension market. As described before, the market is composed of single-product firms, with no possibility of price discrimination between new and old cohorts of work-

[14] As a robustness check, we conduct an alternative demand estimation only with individuals who enter the market and make their first decision in the first two years after entry, with no relevant differences in the pattern of the elasticities.

ers. Private firms have similar and stable prices and market shares over time and workers present a behavior consistent with high switching costs. In markets with these characteristics, firms face a trade-off between investment and harvesting motives. Following Beggs and Klemperer (1992) and Farrell and Klemperer (2007), we work using the fact that in these markets exists an equilibrium with constant prices over time. This price is higher than the equilibrium price that would emerge in a market without switching costs.

The main focus of the model is to capture the investment harvesting trade-off and the strategic interaction of private firms with the public option. On the supply side, we model single-product forward-looking private firms competing in prices. The SOF firm has an objective function that includes both profits and workers' welfare. On the demand side, the model represents workers' choices among firms for cohorts entering the market, and we assume that they face infinite switching costs.

In our model, we make the following assumptions. First, workers choose a PFA considering variables at time t and after that remain enrolled in the firm until retirement. This is consistent with the reduced levels of switching observed in the market. Second, following the previous literature on dynamic competition, we assume that firms play a dynamic game. The previous assumptions imply that firms are forward-looking but consumers are myopic[15] and have infinite switching costs. Third, given that in each equilibrium we do not observe meaningful variation in fees, we assume that firms play a closed-loop game, committing to a single fee during the entire period. Fourth, we focus on price competition and rely on the fact that, given the regulation, firms cannot substantially differentiate in rates of return. Then, we assume that firms' non-price characteristics are set exogenously. Finally, we allow the SOF PFA to have not-for-profit motives as a device to incorporate the mandate to reduce the administration fee that its SOF stakeholders impose on it.

We model a simultaneous decision game for all firms, with the following timing regarding the occurrence of events. First, firms simultaneously set fees at t for all periods (from t to T), given an initial share of old workers, workers' preferences, and the state of the institutional environment (SOF PFA shareholders' preferences and fee regulation). Second, individual idiosyncratic shocks at time t realize, new workers entering the labor market choose a PFA to remain enrolled there until retirement R years later, and a fraction of old workers retire.

[15]Their discount factor is equal to zero.

4.1 Demand

We model the demand of new workers d_{ijt} with a conditional logit specification where individual i chooses between PFAs to manage her savings until retirement. The indirect utility that worker i receives from firm j is:

$$u_{ijt} = \theta_{it} \times C_{ijt}(y_{it}, f_{jt}) + \delta_{jt} + \epsilon_{ijt} \tag{1}$$

The term C_{ij} represents the cost of administration that individual i has to pay to firm j, which depends on the worker's short-term expected stream of gross wages y_{it} and the fee of firm j at t. The parameter θ_i represents the cost sensitivity, which, as explained in greater detail in equation 6, we will allow to vary linearly with individual's i gross wages at t. The term δ_{jt} considers non-cost components of firm j, some of them observed (rates of return r_{jt}) and others unobserved by the econometrician (brand value ξ_{jt}). Finally, we assume that ϵ_{ijt} is drawn i.i.d. from a Type 1 Extreme Value distribution.

4.2 Supply

In this section, we develop the supply side model that describes the competition in fees of forward-looking single-product firms. In every period, these firms face two types of workers. On one side, there are new cohorts of workers entering the formal labor market. These individuals make a one and for all decision based on product and PFAs' characteristics, as described in the previous section. On the other side, there are already enrolled workers (old) with infinite switching costs, that remain in the same PFA until retirement.

Firms face the investment-harvesting trade-off. On one hand, firms have incentives to harvest by charging a high fee to their existing base of workers to make more profits at t. On the other hand, by charging lower fees, PFAs can obtain more market share at t of new cohorts of workers that are going to remain enrolled between t and retirement at $t + R$, and therefore, to make more profits out of them in the future.

4.2.1 Current period profits function

We first describe the per-period profits function and then, the net present value function for the firms. The per-period profits function of firm j in period t is:

$$\pi_{jt} = \underbrace{f_j \times M_t \times (\underbrace{s_j^n(\mathbf{f}) \times \alpha \times (1-\rho_t^n)}_{\text{New workers}} + \underbrace{s_j^o \times (1-\alpha) \times (1-\rho_t^o)}_{\text{Old workers}})}_{\text{Revenue}} - \underbrace{MC_j \times s_j^n(\mathbf{f}) \times \alpha \times M_t}_{\text{Marginal cost}} - \underbrace{F_j}_{\text{Fixed cost}} \quad (2)$$

The terms f_j and M_t represent the fee of firm j and the total mass of gross wages affected to the individual capitalization sub-system in period t, respectively. The shares $s_j^n(\mathbf{f})$ and s_j^o of new and old workers are compound terms that depend both on the workers' enrollment decisions in current and previous periods, as well as on weights associated with the importance of individual gross wages in the aggregated wage mass M_t. This reflects the fact that richer individuals have a higher positive impact on PFAs' revenues than poorer ones through the one-to-one connection between revenues and gross wages. Also, notice how the share of new workers depends on the vector of fees while the share of old ones does not, following the infinite switching cost assumption. Additionally, α is the share of M_t associated with new workers entering the labor market, ρ is the share of retirees, and F_j firms' fixed costs.

Furthermore, instead of assuming marginal costs equal to 0 as in previous literature (Hastings et al., 2017; Luco, 2019), following anecdotal evidence we gathered from industry participants we are going to differentiate between the marginal cost of enrolling a new worker and the marginal cost of managing an additional account. While we still work under the assumption that the latter is irrelevant to the pricing problem, we are going to estimate the former in the model using the Nash-Bertrand competition assumption. Therefore, in our model MC_j represents the variable payment that PFAs make to their sales force agents for affiliating new workers. This variable payment is usually tied to the "quality" of the new enrollee in terms of wage level, expected density of future contributions, etc. To better reflect this feature, the effective marginal cost of enrolling an additional worker depends on the income characteristics of new enrollees.

4.2.2 Net Present Value profits function

Now we discuss the net present value of the profits function, assuming that firms are committed to a single price in all periods from t to T. The net present value of firm j in

period t expressed as a summation of cohorts is:

$$\begin{aligned} V_{jt} &= f_j \times M_t \Big[W^o(\alpha, \beta, \rho_t^o) \times s_j^o + W^n(\alpha, \beta, \rho_t^n) \times s_j^n(\mathbf{f}) \Big] \\ &- \frac{(1-\beta^T) \times MC_j \times \alpha \times M_t \times s_j^n(\mathbf{f})}{(1-\beta)} - \frac{(1-\beta^T) \times F_j}{(1-\beta)} \end{aligned} \tag{3}$$

where the weights between old and new workers are given by the following expressions:

$$W^o = (1-\alpha) \times \Big[(1-\rho_1^o) + ... + (1-\beta^{t-1}) \times \Pi_{i=1}^{t}(1-\rho_i^o) + ... + (1-\beta^{T-1}) \times \Pi_{i=1}^{T}(1-\rho_i^o) \Big]$$

$$W^n = \alpha \times \Bigg(\underbrace{\sum_{t=1}^{t+R} \beta^{t-1}}_{\text{Cohort 1}} + \underbrace{\sum_{t=2}^{t+R} \beta^{t-1}}_{\text{Cohort 2}} + ... + \underbrace{\sum_{t=T}^{T} \beta^{t-1}}_{\text{Cohort T}} \Bigg)$$

with R being the expected years of work until retirement.

From Equation 3, the problem is similar to the static one in t. However, the value function has a different weight for new and old workers than the static problem. These weights depend on α, ρ_t^o, ρ_t^n, R and β. We assume $\beta = 0.99$ and set α according to the observed relative size of new cohorts of workers entering the labor market. The parameter ρ_t^o is set according to the observed age composition at each period t and assumes that the age of retirement is 62.5 (average retirement age in Uruguay). Finally, we assume that new workers retire 41 years after enrollment ($R = 40$) and that the wage mass M_t remains constant.

4.2.3 SOF PFA objective function

We assume that the objective function that the SOF PFA maximizes takes into account two goals: the net present value of profits (as in the case of private firms) and workers' welfare. We measure workers' surplus according to the standard formula derived from the expected utility of a model with T1EV shocks (see Equation (6)):

$$CS_i(\mathbf{f}) = \frac{1}{\theta_i} \times log \left[1 + \sum_j exp(\theta_i \times C_{ij}(y_i, f_j) + \delta_j + \epsilon_{ij}) \right] \tag{4}$$

And consider the average $\overline{CS}_{sof}$ in the public option objective function.

The weight of each objective is given by the conduct parameter $\lambda \in [0, 1]$, where $\lambda = 1$

implies that the SOF behaves as a private firm (full for-profit) and $\lambda = 0$ implies that it only considers workers' welfare (full not-for-profit). Therefore, the objective function of the SOF is:

$$\begin{aligned} \mathcal{W}(\mathbf{f})_{soft} &= \lambda \times \underbrace{V(\mathbf{f})_{sof}}_{\text{NPV}} \\ &+ (1-\lambda) \times \underbrace{\left(\overline{CS}_{sof}(\mathbf{f}) \times s^{n}_{sof}(\mathbf{f}) \times M \times W^{n} + \overline{CS}_{sof}(\mathbf{f}) \times s^{o}_{sof} \times M \times W^{o}\right)}_{\text{Workers' welfare of SOF enrollees}} \end{aligned} \tag{5}$$

5 Estimation and results

5.1 Demand estimation and identification

We estimate workers' demand following Hastings et al. (2017). In order to allow for flexible preference heterogeneity, we estimate conditional logit models separately for 16 demographic brackets (or cells c) using workers' microdata. First, we divide the population between individuals with and without outside option[16]. For individuals without an outside option, we divide the population into 4 cells that consider 2 age groups (below and above the median) and gender. We don't consider income brackets for this group because they are already relatively high-income workers. Finally, for individuals with an outside option we use 12 brackets according to 2 age groups, gender, and gross wage tertiles.

$$u^{c}_{ijt} = (\alpha^{c} + \gamma^{c} \times w_{it}) \times C_{ijt}(y_{it}, f_{jt}) + \eta^{c}_{j} \times \zeta^{c}_{t} + \epsilon^{c}_{ijt} \tag{6}$$

In the demand specification, $\alpha^{c} + \gamma^{c} \times w_{it}$ reflects the sensitivity to the administration cost. This sensitivity is allowed to vary linearly with individual i's current monthly gross wage w_{it}. We include interacted fixed effects by firm η^{c}_{j} and year ζ^{c}_{t}, in order to capture variation in workers' preferences over time in PFAs' non-cost characteristics. To calculate the effective administration cost C_{ijt}, we use the present discounted value of the stream of gross wages during the first 12 months m after individual i enters the formal labor market $y_{it} = NPV(\{w_{im}\}^{m+12}_{m})$. This is consistent with assuming that workers consider their total administration cost at t.

The identification of the price sensitivity comes from the fact that fees are plausibly

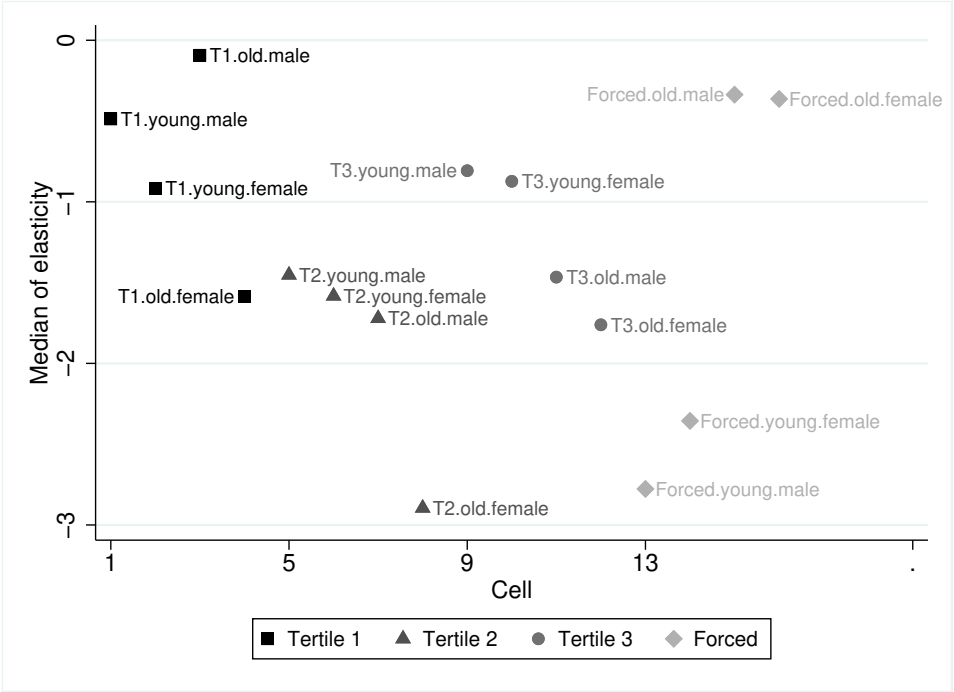
[16] See section 2

exogenous Hastings et al. (2017). In this setting, firms set national fees, but costs are worker-specific and vary with gross wages and spells in the formal labor market. This individual-level variation of the effective administration cost of every PFA, even among individuals with similar demographic characteristics, gives us arguably exogenous variation to estimate the relevant fee sensitivity parameters.

5.2 Demand results

Figure 3 shows the median demand elasticity to the administration cost C_{ij} for individuals in each estimation bracket. We calculate these elasticities using the estimated parameters and observed fees and characteristics. Demand estimates are presented in Tables A.3 and A.4 of the Appendix. Overall, our estimates imply low elasticities, with older and female workers being relatively more elastic. Low-income workers are also more inelastic. This pattern is in line with the previous literature on individual capitalization pension systems in other Latin American countries (e.g. Hastings and Ashton (2008); Hastings et al. (2017)), and on financial literacy, Lusardi (2008). In Figure A.5 we show the elasticities by period, with the same general pattern.

Figure 3: MEDIAN ELASTICITY BY BRACKET



Note. Within bracket median PFA elasticity (all period). Elasticities are calculated at the observed fee levels and individual characteristics. Computed using estimates from equation (6) to generate the logit choice probability for each individual for each firm.

5.3 Supply: backing out of marginal cost

We back out enrollment marginal cost MC_j for two different periods, characterized by the different behavior of the SOF (2002-2005 and 2014-2017) using the demand primitives of each period, the observed shares of already enrolled workers s_j^o and fees f_j, solving the system of first-order conditions (FOC) given by equation (7) for PF and (9) for SOF:

$$M \times [s_j^o \times W^o + s_j^n(f) \times W^n + \frac{\partial s_j^n}{\partial f_j} \times f_j \times W^n] - \frac{\frac{\partial s_j^n}{\partial f_j} \times M \times \alpha \times MC_j}{1-\beta} = 0 \qquad (7)$$

$$\begin{aligned}
\lambda \quad & \times M \times [s^o_{sof} \times W^o + s^n_{sof}(f) \times W^n + \frac{\partial s^n_{sof}}{\partial f_{sof}} \times f_{sof} \times W^n - \frac{\frac{\partial s^n_j}{\partial f_j} \alpha MC_j}{1-\beta}] \qquad (8) \\
- \quad & (1-\lambda) \times M \times \left(\frac{\partial \overline{CS}_{sof}(\mathbf{f})}{\partial f_{sof}} \times s^n_{sof}(\mathbf{f}) \times W^n \right. \\
+ \quad & \left. \overline{CS}_{sof}(\mathbf{f}) \times \frac{\partial s^n_{sof}(\mathbf{f})}{\partial f_{sof}} \times W^n + \frac{\partial \overline{CS}_{sof}(\mathbf{f})}{\partial f_{sof}} \times s^o_{sof}(\mathbf{f}) \times W^o \right) = 0
\end{aligned}$$

In Table 3 we present marginal costs for both periods. For private firms, we estimate enrollment marginal costs between US$ 30 and US$ 50 in 2002-2005, and increasing to US$ 49 - 76 in 2014-2017. As discussed in the model, the marginal cost in this market is mainly associated with paying sales force agents for new enrollees. Although we do not directly observe the variable wage component that sales force workers receive for each affiliation, using data on the sales force average productivity[17] and aggregated wages, and on their minimum wage established in Collective Agreements, we can approximate the observed variable wage they earn. For 2017 this calculation implied a mean variable wage component of US$ 63 dollars per enrollee[18], a figure close to our enrollment marginal cost estimates.

Table 3: Back out marginal cost and SOF profit motive

Period	Marginal cost				Profit motive SOF	
	PF 1	PF 2	PF 3	SOF*	Mean	Min
	(1)	(2)	(3)	(4)	(5)	(6)
2002-2005	45	50	30	-191	0.86	0.86
2014-2017	76	75	49	-403	0.72	0.73

Notes. Back out of marginal cost based on FOC of equation (7). Back out of SOF profit motive based on FOC of equation (9), imposing mean marginal cost of PF in column (5) and the minimum in column (6). For each period, the primitives of demand of that period are used. Marginal cost in US$ 2017. *Assumes full for-profits ($\lambda = 1$).

For the SOF we cannot separately identify the marginal cost and for-profits motives. We then analyze two scenarios. In the first scenario, presented in column 4 of Table 3, we recover the marginal cost of the SOF, imposing $\lambda = 1$. Under this full-for-profits behavior

[17] Calculated as the ratio between monthly new enrollees per firm over monthly total sales force agents.
[18] In the Appendix B we show in detail how we arrived at these values.

of the SOF PFA, we obtain negative marginal costs. Therefore, we cannot rationalize its behavior as a pure profit-maximizing firm, not even during the first equilibrium under consideration before the change in shareholders' preferences. In the second scenario, we impose the average marginal cost of private PFAs on the SOF PFA to recover for-profit motives. Results are presented in columns 5 and 6 of Table 3. Under this assumption, we observe a decrease in the weight of for-profit motive between the first and second period of 0.86 to 0.72[19], consistent with the descriptive evidence and the information we gathered about the SOF PFA behavioral adjustment following a change in shareholders' preferences in 2006.

6 Counterfactuals

We use our estimates about preferences and marginal costs to understand the value of the public option and the effect of the regulation on fees in the market. In particular, we analyze two counterfactuals. In the first one, we substitute the public option with a private firm that resembles the other private options. Here we try to capture the value of the public option by comparing the observed market equilibrium with an alternative configuration with private PFAs only. In the second group, we analyze how far were observed equilibria from an optimal benchmark where fees were set such that PFAs have zero economic profits. We separate the analysis between 2014-2017 and 2020 to account for the effects of the introduction of the fee regulation in the later period. We calculate counterfactual equilibrium fees using the demand primitives of the period of interest, but always with the marginal cost parameters of 2014-2017. In Table A.6 we show the implementation details.

To analyze the impact of these policies, we use measures of firms' profits and workers' welfare, the latter measured by the standard consumer surplus. As discussed in Hastings et al. (2017), given the role that advertising and sales force agents play in enrollment decisions, as well as the lack of knowledge about whether it is an informative or persuasive role, it is debatable whether it is best to perform welfare calculations based on the demand estimates. Therefore, an alternative is to directly analyze changes in PFAs profits, which imply a change of equal amount and opposite sign in workers' net savings. From this per-

[19]The decrease is from 0.86 to 0.73 if we use the minimum marginal cost. Given that the difference generated between both criteria is small, hereafter we work with the average marginal cost for the SOF PFA.

spective, the social outcomes that we analyze in the counterfactuals do not imply changes in total welfare, but in its distribution between workers and firms[20]. This is particularly relevant considering the ongoing discussion in Latin America about how should these systems be redesigned to improve workers' outcomes and the trade-off between reducing firms' market power and tying Governments' hands in the use of funds.

Period 2014-2017 During this period there is no cap on fees and the SOF PFA is playing with lower for-profit motives[21]. In the baseline, reported in row 1 of Table 4, we observe how private firms charged workers fees that were more than twice as high as that of the public option.

We present two counterfactuals. The first one address a question similar to Hastings et al. (2017): what are the effects on private firms' fees of introducing a public option? Their main result is that this policy generates an increase in private fees as the optimal response. In our setting, however, we start from a baseline situation in which the public option is already participating, and with a mature market where workers' switching costs are key for understanding firms' strategic interactions. In this dynamic competitive setting with high switching costs, the share of already enrolled workers at t is relevant for the equilibrium (the greater the share, the more the harvesting motive weighs). Therefore, we conduct a counterfactual consisting of assuming that the SOF PFA is not in the market, and instead, there is a fourth private firm (row 2 of Table 4), whose characteristics are an average of the 3 private ones observed[22]. We include an additional PF because it is reasonable to think that the non-existence of SOF would lead to the existence of a 4th PF, and because we want to abstract from the effect generated by going from 4 to 3 firms that is not explained by its public option nature.

In the counterfactual with 4 private PFAs, the optimal response of private firms already in the market is to increase fees on average 16%, reducing workers' welfare by 5%. However, given the fact that the fee of the 4th private firm that we introduce raises significantly, total average fees increase by 30%. We understand that this counterfactual uncovers the

[20] Except for the effect of fees on workers' diversion to the outside option. Our estimates do not indicate that this would have a strong effect on the market though.

[21] See Section 5.3

[22] In Table A.5 of the Appendix we show a second counterfactual, assuming that the SOF PFA plays as a profit-maximizing firm. Interestingly, in this equilibrium, the SOF charges a fee of 5.8% because it can exploit the fact that workers have a very inelastic residual demand for it. Nevertheless, this counterfactual is not the preferred one when it comes to understanding what the market would be like without a public option because we can not disentangle the different elements that compose the non-price characteristics of the public option.

value of the public option in a situation where we hold fixed the number of firms in the market. Notice that the positive effect of the public option benefits all workers through the competition for new enrollees, but fundamentally those enrolled in it. With this counterfactual, we show how the presence of the public option helps discipline the market, different from what was estimated in Hastings et al. (2017)

The second set of counterfactuals, reported in row 3 of Table 4 is carried out to understand how close the baseline equilibrium is with respect to an optimal benchmark where there is a social planner whose objective function is to maximize workers' welfare while maintaining the existing varieties in the market by allowing firms to cover their operating costs. Compared to the baseline, the benchmark implies an average reduction of 61% in private firms' fees and an increase in workers' welfare and total welfare of 9% and 1%, respectively. This counterfactual ignores potential economies of scale that would result from the existence of a centralized institution managing savings accounts, and the social gains that would result from reducing sales force expenses. This exercise does not consider either how private PFAs incentives would change and affect non-price characteristics, for example, portfolio returns through changes in PFAs' investment policies, or the deployment of sales force agents[23]. We do believe that it is still a useful benchmark to compare the effect of different policies implemented in the market.

Table 4: COUNTERFACTUAL ANALYSIS. PERIOD 2014-2017.

	Fee (%)				Av. Δ	Outside	Profit		CW	ΔCW	TW	ΔTW
	PF 1	PF 2	PF 3	SOF	PF fee	option	PF	SOF		(%)		(%)
1- Baseline	1.98	2.02	1.85	0.80	-	21	41	8	551	-	600	-
2- 4 PFA	2.24	2.31	2.21	1.90*	16	25	106	-	523	-5	629	5
3- Optimal	0.74	0.67	0.40	0.55	-61	15	0	0	600	9	600	1

Notes. Fee as a % of the gross wage component relevant for contributions to individual savings accounts. (2) distribute SOF PFA enrolled workers equally. CS consumer-worker welfare. TW total welfare. CS, Profit and TW are per year and expressed in US$ millions. (*) Fee of the 4th private PFA.

Caps as Fee Regulation In 2020, the cap on fees is implemented and the SOF PFA plays with low for-profit motives. In row 1 of Table 5 we show the baseline, with the three private firms charging the maximum fee allowed by the regulator (up to 1.5x times the minimum market fee).

[23]Future work will address these dimensions.

In this case, we present two counterfactuals to understand the consequences of the cap on fees. In row 2 of Table 5 we show a counterfactual with the optimal benchmark described previously, but using the demand primitives of 2018-2019[24]. In this case, fees of private PFAs are 39% lower and workers' welfare 5% higher than in the baseline scenario. Additionally, in row 3 of Table 5 we show the fees that would have existed without caps, to understand the effects of the regulation. In this case, fees of private PFAs in the scenario without caps would have been 92% higher while workers' welfare would have been 9% lower. Based on these counterfactuals, the regulation on fees (Baseline 2020) favored workers by reducing fees and increasing their net savings. Without it, private firms would have charged fees almost twice as high for their services.

Table 5: COUNTERFACTUAL ANALYSIS. PERIOD 2020.

	Fee (%)				Av. Δ	Outside	Profit		CW	ΔCW	TW	ΔTW
	PF 1	PF 2	PF 3	SOF	PF fee	option	PF	SOF		(%)		(%)
1- Baseline 20	0.99	0.99	0.99	0.66	-	13	8	2	436	-	446	-
2- Optimal	0.75	0.66	0.40	0.55	-39	12	0	0	456	5	456	2
3- No caps	2.01	1.91	1.78	0.66	92	17	40	2	399	-9	441	-1

Notes. Demand 2018-2019, enrollment marginal cost 2014-2017. CS consumer-worker welfare. TW total welfare. CS, Profit and TW are per year and expressed in US$ millions.

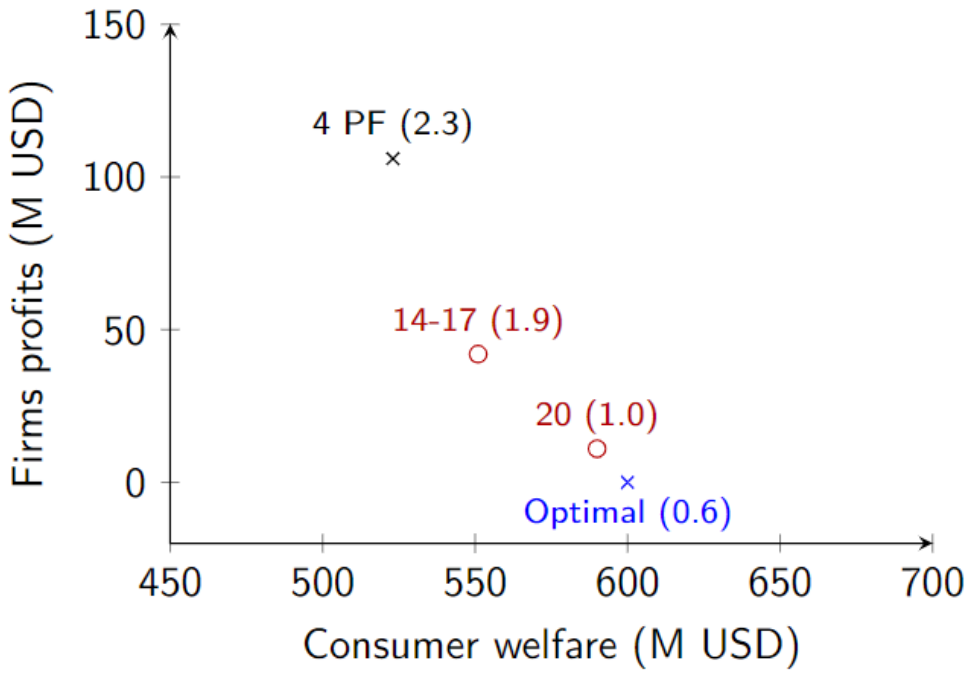
Summary Finally, in order to compare the observed outcomes in 2014-2017 and 2020[25] with the two main counterfactuals, we summarize the results in Figure 4. To abstract from changes in preferences between periods, we present the results using only the demand estimates for 2014-2017. The main conclusion is that, either by looking at workers' welfare or firms' profits, the equilibrium in 2020 where the SOF PFA plays with low for-profits motives and there is a binding cap on fees generated market outcomes that were near the optimal benchmark. Additionally, if we think in terms of how close each institutional arrangement was to this benchmark, the inclusion of a SOF PFA led to profits that were almost half the distance between the market equilibrium with 4 private PFAs and the benchmark. Furthermore, the public option together with the regulation on fees shrank

[24]The sample ends in April of 2020, so we assume that time-firm fixed effects remain constant in 2020. Additionally, as a result, the consumer welfare levels included in this table are not comparable with the figures included in Table 4.

[25]In both cases, the SOF PFA has low for-profit motives, but only in the latter the cap on fees is known by market participants and binding.

the profits gap between the two theoretical equilibria by more than 90%.

Figure 4: SUMMARY MAIN COUNTERFACTUALS



Note. Demand primitives, marginal costs and for-profits conduct parameter of 2014-2017. Profits and consumers-workers welfare per year expressed in US$ millions. In parentheses, 3 private PFAs' average fee in each equilibrium. 1) 4 PF: replaces SOF with private PFA with average characteristics of the 3 observed. 2) 14-17: baseline for that period, no cap on fees and 3) 20: baseline for that period, cap on fees, 4) Optimal: social planner maximizes workers' welfare s.t. covering the 4 observed firms' operational costs.

7 Final comments

This paper examines the competitive and welfare consequences of the participation of a SOF PFA in a mature individual capitalization pension system in which workers face high inertia and low fee sensitivity. Relying on a data set with rich details on workers' demographics and enrollment decisions, we estimate workers' demand and use those estimates to recover both the marginal cost of enrollment and the weight of for-profits motives in the SOF PFA objective function. Marginal cost estimates are broadly in line with variable payments that sales force agents receive for enrolling workers, while the model pins down a decrease in for-profits motives beginning in 2005 that we document in the SOF PFA shareholders minutes.

We conduct two main sets of counterfactuals. In the first one, we estimate that admin-

istration fees of private PFAs are 16% lower (and total fees 30% lower) due to the presence of a public option with not-for-profit motives. Therefore, we show that the presence of a public option helps discipline the market by forcing private firms to compete more aggressively for new enrollees. In the second one, we calculate the optimal regulation for workers, by setting fees in a way that private firms and the SOF have zero economic profits. In this case, optimal average fees of private PFAs are 61% lower than the baseline in 2014-2017 (no fee caps) and 39% than in 2020 (fee caps). Additionally, we show that the baseline situation of 2014-2017 generates profits that are 50% closer to the optimum if we compare with the market solution without a public option, while the situation with the SOF PFA plus the cap on fees brings the market 90% closer to the optimal.

Our findings suggest that creating a public option with high not-for-profit motives helps to discipline the market power of private firms. However, the competitive effect is not strong enough to bring the equilibrium to the optimal point, leaving room for additional regulation. For its part, the combination of a public option with fee regulation seems to be a good alternative to additionally reduce the market power of private firms in a market with little room for differentiation in rates of return, while preserving the ability of this system to discipline Governments by making it more costly for them to use the savings. Nevertheless, our analysis leaves open the question of what efficiency gains can be generated by centralizing the management of individual accounts and allowing private firms to compete only for the investment of funds.

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A Appendix

Table A.1: MARKET SHARES OF NEW ENROLLEES BY WAGE BRACKET AND PERIOD

	Firm			
	PF 1	PF 2	SOF	PF 3
Period 2002-2005				
Wage tertile 1	0.21	0.27	0.19	0.32
Wage tertile 2	0.18	0.25	0.31	0.27
Wage tertile 3	0.17	0.17	0.48	0.18
% above threshold	0.12	0.10	0.64	0.14
Period 2014-2017				
Wage tertile 1	0.25	0.28	0.21	0.26
Wage tertile 2	0.21	0.23	0.26	0.30
Wage tertile 3	0.16	0.22	0.36	0.27
% above threshold	0.10	0.15	0.57	0.18
Period 18-19				
Wage tertile 1	0.24	0.24	0.23	0.28
Wage tertile 2	0.20	0.22	0.24	0.34
Wage tertile 3	0.21	0.17	0.33	0.29
% above threshold	0.08	0.02	0.85	0.05

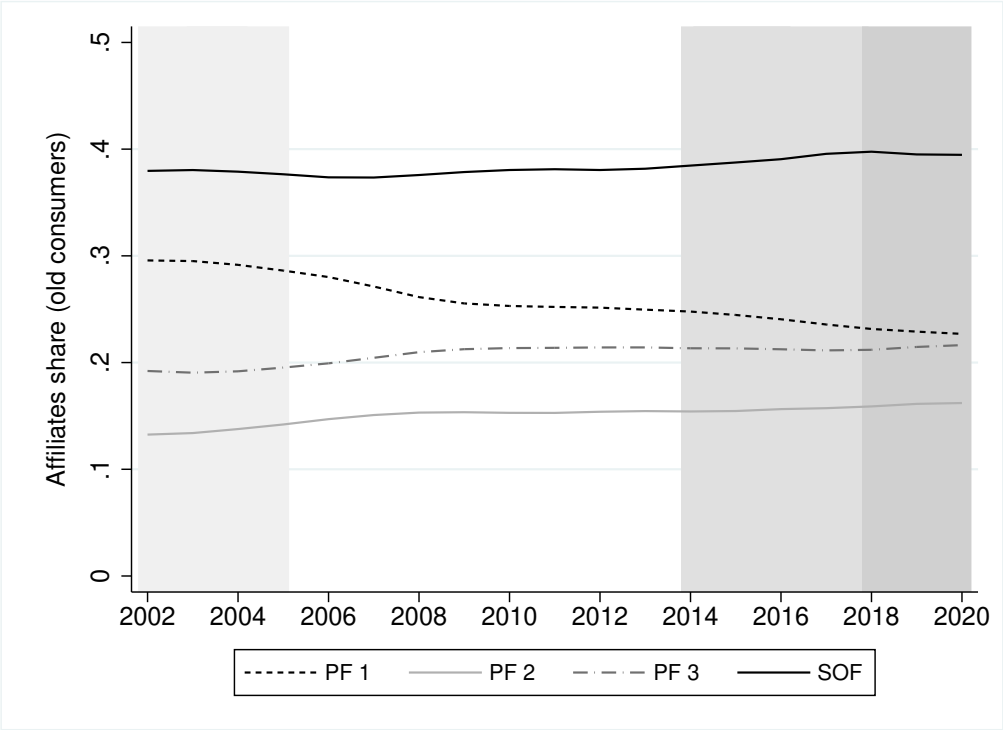
Notes. For each level of gross wages we display the average share of new enrollees by PFA. The three tertiles are composed of workers whose wages are below the compulsory enrollment threshold. The 4th group is composed of individuals above the threshold.

Table A.2: SHARE OF SALE FORCE AGENTS BY PFA AND PERIOD

Period	Firm			
	PF 1	PF 2	SOF	PF 3
'02-'05	0.21	0.24	0.35	0.21
'14-'17	0.22	0.15	0.36	0.27
'18-'19	0.24	0.15	0.36	0.25

Notes. Average share of the sales force by firm and period.

Figure A.1: MARKET SHARE BY PFA OVER TIME, ALL ENROLLEES

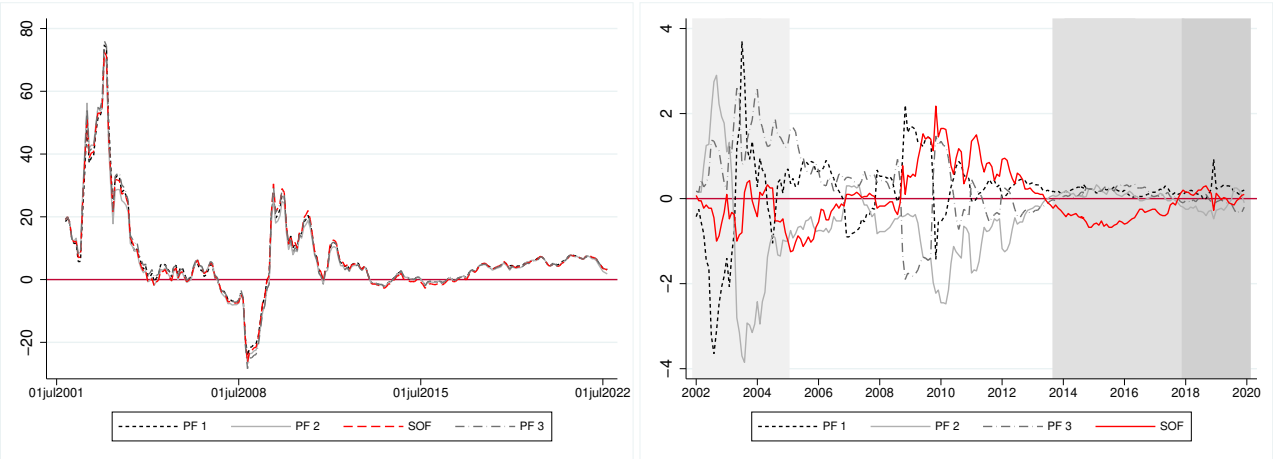


Note. Evolution of markets shares of old consumers by firm.

Figure A.2: EVOLUTION OF THE REAL ANNUAL RATE OF RETURN BY FIRM

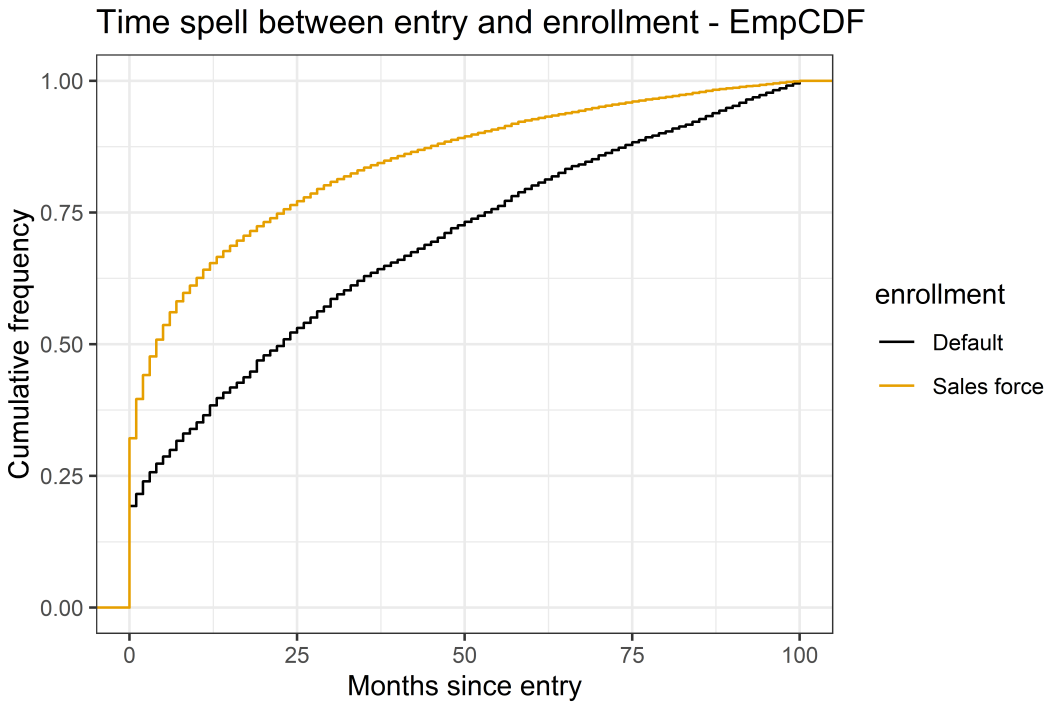
(a) Rate of return

(b) Variation from the mean



Note. On the left, is the evolution of the real gross annual return in adjustable units, and on the right, is the variation with respect to the average.

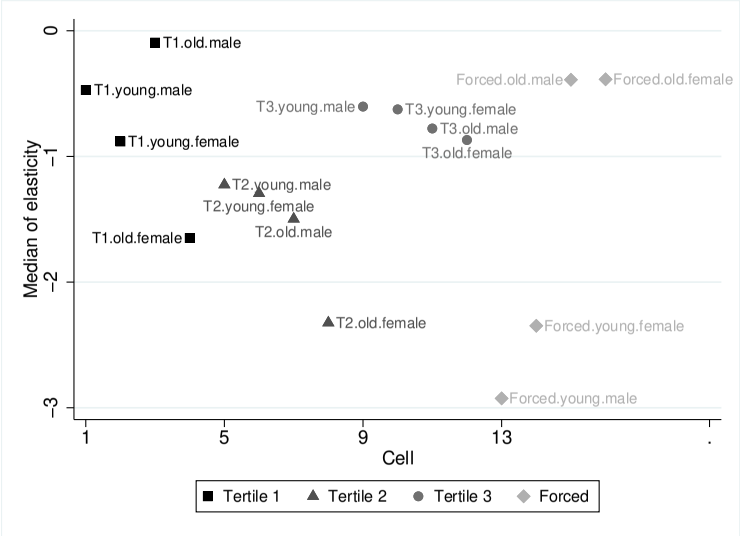
Figure A.4: ENTRY AND ENROLLMENT



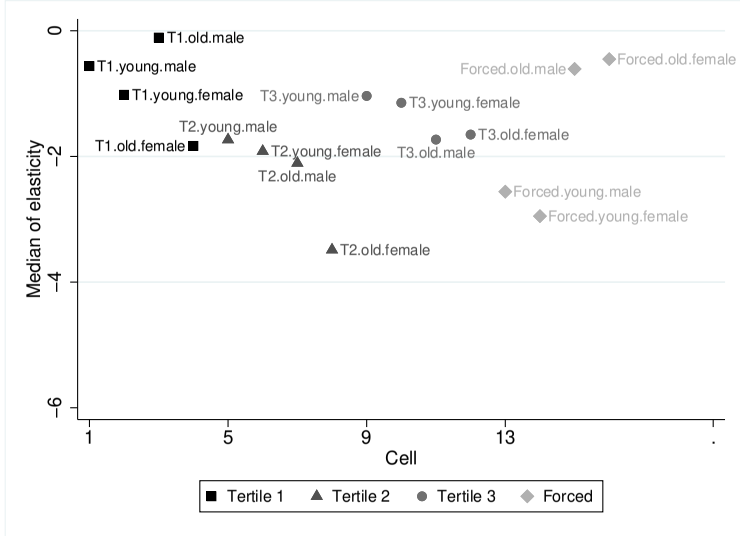
Note. Yellow curve: empirical cumulative distribution function of time spell between entry to the labor market and enrollment for individuals voluntarily affiliated. Black curve: cumulative distribution function of time spell between entry to the labor market and enrollment for individuals enrolled by default.

Figure A.5: MEDIAN FIRM ELASTICITY BY BRACKET AND PERIOD.

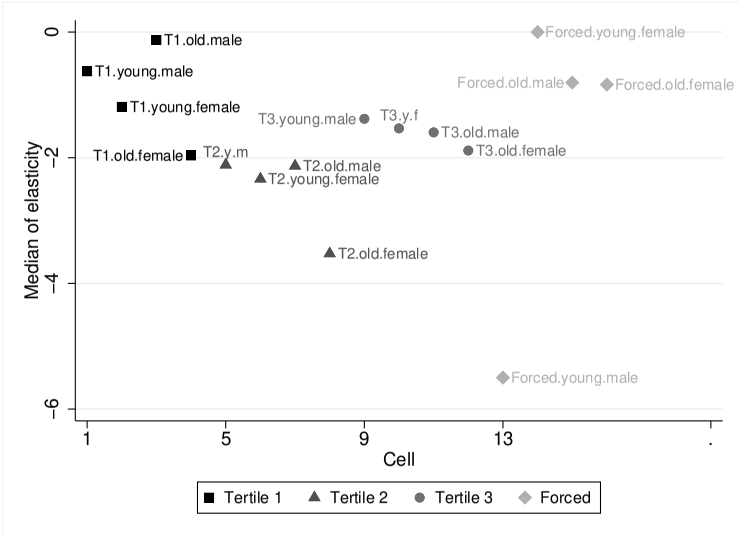
(a) 2002-2005



(b) 2014-2017



(c) 2018-2019



Note. Median elasticity by bracket and period. Elasticities are calculated at the observed fee levels and individual characteristics. Computed using estimates from equation (6) to generate the logit choice probability for each individual for each firm.

Table A.3: DEMAND ESTIMATION. CELLS 1 TO 8

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Total cost	-0.0073***	-0.0133***	-0.0032***	-0.0180***	-0.0147***	-0.0169***	-0.0138***	-0.0223***
	(0.0008)	(0.0009)	(0.0011)	(0.0011)	(0.0008)	(0.0009)	(0.0008)	(0.0010)
Cost Wage	3.0e-07***	5.3e-07***	1.9e-07***	6.7e-07***	3.4e-07***	4.0e-07***	3.4e-07***	5.2e-07***
	(4.3e-08)	(4.8e-08)	(5.6e-08)	(5.2e-08)	(2.7e-08)	(3.3e-08)	(2.6e-08)	(3.1e-08)
Tertile	1	1	1	1	2	2	2	2
Age	Young	Young	Old	Old	Young	Young	Old	Old
Gender	Male	Female	Male	Female	Male	Female	Male	Female
Outside option	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	36,975	35,390	30,195	38,395	47,690	39,045	27,150	27,070

Notes. Standard errors in parentheses*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Estimation of equation (6) via maximum likelihood. All specifications include fixed effects by firm and year interacted. Individuals that entered the market between 1997-2019. Cells 1 to 12 include an outside option and cells 13 to 16 no.

Table A.4: DEMAND ESTIMATION. CELLS 9 TO 16

	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Total cost	-0.0034***	-0.0044***	-0.0029***	-0.0039***	-0.0051***	-0.0017	-0.00048*	-0.00059
	(0.0002)	(0.0005)	(9.45e-05)	(0.0002)	(0.0009)	(0.0017)	(0.0002)	(0.0005)
Cost wage	5.7e-09***	2.1e-08***	9.3e-10***	7.1e-09***	8.0e-09	-2.8e-08*	3.3e-10**	1.4e-09*
	(8.8e-10)	(6.4e-09)	(5.2e-11)	(1.0e-09)	(6.1e-09)	(1.6e-08)	(1.4e-10)	(8.2e-10)
Tertile	3	3	3	3	-	-	-	-
Age	Young	Young	Old	Old	Young	Young	Old	Old
Gender	Male	Female	Male	Female	Male	Female	Male	Female
Outside option	Yes	Yes	Yes	Yes	No	No	No	No
Observations	43,600	25,675	41,045	30,635	5,032	2,856	4,128	3,068

Notes. Standard errors in parentheses*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Estimation of equation (6) via maximum likelihood. All specifications include fixed effects by firm and year interacted. Individuals that entered the market between 1997-2019. Cells 1 to 12 include an outside option and cells 13 to 16 no.

Table A.5: SOF PLAYING AS A PROFIT-MAXIMIZING FIRM. FACTUAL 2014-2017.

	Fee (%)				Av. Δ	Outside	Profit		CW	ΔCW	TW	ΔTW
	PF 1	PF 2	PF 3	SOF	PF fee	option	PF	SOF		(%)		(%)
1- Factual 14-17	1.98	2.02	1.85	0.80	-	21	41	8	551	-	600	-
2- SOF NB	2.12	2.36	2.15	5.75	13	28	50	184	499	-9	734	22

Notes. Fee expressed as a % of the relevant gross wage for contribution to the sub-system. For-profits parameter $\lambda = 1$. Share old workers distributed equally between PFAs. CS consumers-workers welfare. TW total welfare. CS, Profit, and TW expressed in US$ millions per year.

Table A.6: COUNTERFACTUALS IMPLEMENTATION

		Marginal cost		For profit	
	Demand	PF	SOF	motive SOF (λ)	Share old
1- Factual 14-17	14-17	Backed out 14-17	Av. PF	Backed out 14-17	Observed
2- 4 PF	14-17	Backed out 14-17	Av. PF	-	Splitted equally
3- Optimal 14-17	14-17	Backed out 14-17	Av. PF	0	Observed
4- Factual 20	18-19	Backed out 14-17	Av. PF	Backed out 14-17	Observed
5- Optimal 20	18-19	Backed out 14-17	Av. PF	0	Observed
6- No caps 20	18-19	Backed out 14-17	Av. PF	Backed out 14-17	Observed

Notes. For the period 2020, we use the demand primitives of 2018-2019. For the same period, we use the backed-out MC of 2014-2017 because in 2018-2020 there is a cap on fees operating, so it is not possible to use the FOC to back-out the MC.

B Appendix: Salesforce average variable payments per enrollee

We define the wage mass of the sale force of firm j in month t as:

$$W_{jt} = L_{jt}^{sf}(w_{jt}^{fixed} + Aff_{jt}.w_{jt}^{variable}) \tag{9}$$

being L_{jt}^{sf} the sales force, w_{jt}^{fixed} the average fixed wage, Aff_{jt} the average number of affiliates through sales force and $w_{jt}^{variable}$ the average variable wage.

We observe L_{jt}^{sf}, W_{jt} and Aff_{jt}. Regarding w_{jt}^{fixed}, we construct the following proxy. In Uruguay, the minimum wage by sector is set through collective bargaining and there is a specific negotiation group for PFAs' employees (group 11, Sub-group 1.3). The negotiation does not set the variable salary. However, the minimum wage set in the negotiation for the sales force (US$ 513 dollars) is taken as a proxy for the fixed-wage component, so the results obtained are an upper bound of the variable wage component.