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Can auctions increase competition in the pension funds market? The Chilean experience

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Abstract

This paper analyses the auction policy over enrollees' monopoly rights introduced in the Chilean pension system. This policy was designed to promote competition in the pension fund market driven by private firms, after 30 years of operation. Since the Chilean pension fund system has inspired dozens of countries in the last forty years, the analysis of the design and performance of its relatively new auction mechanism is of worldwide interest. We present a theoretical and empirical model. Our theoretical model illustrates firms' incentives to participate in the auction process. Our empirical analysis focuses on the effect of auctions on outcomes, such as fees, mark-ups, demand price elasticity, returns, and risk premiums. Despite the evidence shown for the positive benefits of the auction implementation, the current mechanism design is not considering that the biggest issue is the low individuals' price response levels. Importantly, the current auction design only incentivizes new entrants to participate. Thus, the design generates low competition in the auction processes. Proper design should incentivize all firms to participate. Besides, we find that consumers' price elasticity increased after the implementation of auctions, although demand is still generally inelastic. Interestingly, non-winning auction firms did not react in fees but may have reacted in other characteristics, such as returns and risk premiums.

JEL classification: H55; D44; D43; I38

Keywords: Pension funds; Auction mechanism; Competition

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1. Introduction

Population aging represents a major threat for pay-as-you-go security systems. In this context, the Chilean system (1981) has been of great interest since it relies on funded contribution individual accounts (Cerda, 2008). The U.S. and European countries have followed the Chilean experience to reform their security systems, by considering private managers of individual accounts (Krasnokutskaya et al., 2018). In Chile, private managers of individuals accounts are known as Pension Fund Administrators (AFPs). The AFPs' offer five investment funds to capitalize individuals' mandatory savings.[1] For its service, they charge a fee.[2]

The AFP industry initially worked competitively and attracted large number of firms (Krasnokutskaya et al., 2018). However, by the 2000s, it experienced a high level of concentration with relatively high fees (Fischer et al., 2006). Concentration increased markedly due to mergers and acquisitions, where the number of firms declined from 21 (1994) to six (2003) (Iglesias-Palau, 2009). This generated a debate regarding high fees due to low competition and significant firms' profits, while assets under management have reached the considerable size of 70 % of GDP (Valdes, 2005; Iglesias-Palau, 2009; Villatoro et al., 2022). To introduce more competition, a reform in 2008 introduced a biennial auction mechanism for the assignment of monopoly rights over new enrollees (Barr & Diamond, 2016).[3]

In this paper, we model the design and performance of the Chilean pension auction mechanism from a theoretical and empirical perspective. Since the Chilean model has been followed by several countries, the analysis of its auction model is of interest to several countries with retirement systems with individual accounts (Arenas et al., 2006; Orenstein, 2013; Iglesias-Palau, 2009; Mesa-Lago & Bertranou, 2016).[4] Importantly, the Chilean auction process has been followed by several countries, such as Australia, Peru, Mexico, New Zealand, and Poland.[5]

Studies have analyzed various dimensions of the Chilean system, including its impact on capital markets, aggregate savings, and informal markets and others (Bonilla, 1998; James et al., 2006, 2009; Vial & Melguizo, 2009; Joubert, 2015; Thomas & Spataro, 2016; Barr & Diamond, 2016). Motivated by the Chilean reform, Peru implemented an auction mechanism in 2012 (Bernal & Olivera, 2020). Recent research proposes potential reforms to the pricing mechanisms in the AFP market, while considering auctions for enrollees, to solve market inefficiencies (Flanders et al., 2020). However, there is no evidence regarding the Chilean auction design and performance.

[1] The funds vary according to their financial risk. The riskiest fund is Account A (40–80 % in equities). The range invested in equities for Account B is 25–60 %, 15–40 % for Account C, 5–20 % for Account D, and up to 5 % for Account E.

[2] We refer to fee (f) as the management fee charged by the AFP, measured as a percentage on the contributor's wage (w). The effective price (p) is the payment by contributors, where $p = f \times w$.

[3] We refer to workers enrolled after (before) the implementation of auctions as new (stock) enrollees.

[4] In Latin America, Peru (1993), Argentina (1994), Colombia (1994), Uruguay (1996), Bolivia (1997), Mexico (1997), El Salvador (1998), Ecuador (2001), Costa Rica (2001), Dominican Republic (2003), and Panama (2005). In Europe, funded individual accounts were introduced in the UK (1986), Hungary (1998), Poland (1999), Latvia (2001), Bulgaria (2002), Estonia (2002), Lithuania (2004), Slovakia (2005) and Romania (2008) while multi-pillar systems are also present in Italy and Sweden (Corsini & Spataro, 2015). Funded individual accounts were introduced in China (1998) and Hong Kong (2000) (Barr & Diamond, 2016).

[5] See Garcia & Seira (2015); Heuser et al. (2015); Kurach et al. (2019); Mesa-Lago (2016); The Association of Superannuation Funds of Australia (2017).

In the auction design, all new-incoming labor force is enrolled in the winning firm (i.e., the AFP with the lowest fee) for 24 months (Tuesta, 2014). The objective of the bidding process was to increase competition, to encourage new entrants in the market, to reduce fees, and to improve results for enrollees. The introduction of auctions relies on the idea that competition for enrollees' rights should decrease costs and market fees (Fischer et al., 2006).[6] The bidding rules ensure that the winner's fee is lower than the current minimum and imposes that the winning firm must charge the same to all its enrollees (i.e., new and stock enrollees) (Diario Oficial, 2011).

Recently, various techniques have been used to analyze retirement systems' reforms. Cuesta and Olivera (2014) simulated the effects of three reforms in Colombia to study the impact on reducing distortions on the labor market. Li and Lin (2016) analyzed China's social security reforms and showed under the current replacement and contribution rates, social security debt will be explosive. Makarski and Tyrowicz (2019) model a scenario where an economy has a pay-as-you-go defined benefit scheme and compares it to a defined contribution system and found that in both types of pension system schemes the majority of welfare effects comes from adjustments in taxes and/or prices. Pak (2020) shows that a Pension Fund can increased financial satisfaction among beneficiaries. There is also recent evidence of gender effects in old-age poverty and retirement income levels (Baroni, 2011; Parada-Contzen, 2022).

The objective of this paper is to analyze the design and performance of the Chilean pension auction model. Our results contribute to the policy design in Chile and other countries with similar systems. To analyze the design, we consider a theoretical model of players' economic incentives to participate. Then, we use regression analysis to study the performance of auctions considering market features such as fees, mark-ups, price-elasticity, financial risk, and returns. All data used in this paper is publicly available from the Chilean Bureau of Pensions (SP, from Superintencia de Pensiones, from now on).[7]

Our results indicate that auctions help to decrease market average fees. Auctions also have a statistically significant negative impact on mark-ups, meaning competition has increased. We find several shortcomings in the design of the auctions since it fails to recognize that consumers might not only value fees but also returns and quality of service. Additionally, smaller entrant's firms always have an advantage in winning the auction, and therefore, the odds of an incumbent bidding are extremely low.

2. Auction implementation: stylized facts

2.1. Auction design, participants, bids, and fees

Auctions for monopoly rights over new enrollees were designed in the 2008 reform and were first implemented in 2010. The implementation of auctions had four objectives: 1) to encourage price competition and achieve lower fees, 2) to increase price sensitivity, 3) to promote the entry of new firms and 4) to protect enrollees' accumulated wealth (Berstein, 2010). Is noted in Berstein (2010) that the reform also seeks to promote competition in price, returns, and quality of service.

[6] The reform also introduced significant public benefits (James et al., 2010) and strengthened the individual account by requiring the participation of self-employed workers (Berstein, Castaneda et al., 2010).

[7] Superintendencia de Pensiones (n.d.). Estadisticas e Informes. https://www.spensiones.cl/portal/institucional/594/w3-propertyname-621.html.

Table 1
Auction processes, bidders, and bids.

Process	Adjudication date	Auctioned period	Bidders	Bid (fee over wage)
Auction 1	Jan-2010	Aug-2010/Jul-2012	Cuprum	1.32 %
			Habitat	1.21%
			Modelo(w)(E)	1.14 %
			Planvital	1.19 %
Auction 2	Jan-2012	Aug-2012/Jul-2014	Modelo(w)	0.77 %
			Planvital	0.85 %
			Regional	1.04 %
Auction 3	Jan-2014	Aug-2014/Jul-2016	Modelo	0.72 %
			Planvital(w)	0.47 %
Auction 4	Jan-2016	Aug-2016/Jul-2018	Planvital(w)	0.41 %
Auction 5	Jan-2018	Aug-2018/Jul-2020	No bids	—
Auction 6 (R)	Feb-2019	Aug-2019/Jul-2021	Uno(w)(E)	0.69 %
Auction 7	Feb-2019	Oct-2019/Sept-2021	Uno(w)	0.69 %
Auction 8	Feb-2021	Oct-2021/Sept-2023	Modelo(w)	0.58 %
			Uno	0.62 %
Auction 9	Feb-2023	Oct-2023/Sep-2025	Modelo	0.57 %
			Uno(w)	0.49 %

Note: (a) w = Winning firm. (b) R= Remedial auction. (c) E = Entrant firm. (d) Own elaboration.

Auctions happen every 2 years. New enrollees are assigned for 24 months to the winning AFP and, afterward, they can choose whether to stay in the firm or move. There are specific cases under which new enrollees can switch firms before this period: i) if the winning firm does not charge the lowest fee for two months, ii) if the return is under the required minimum, iii) if the lowest fee does not compensate the financial gain that could have been earned in another firm. In the case no bid is below the current lowest fee, no firm wins the auction and new enrollees are assigned to the AFP that offers the lowest fee at the time.

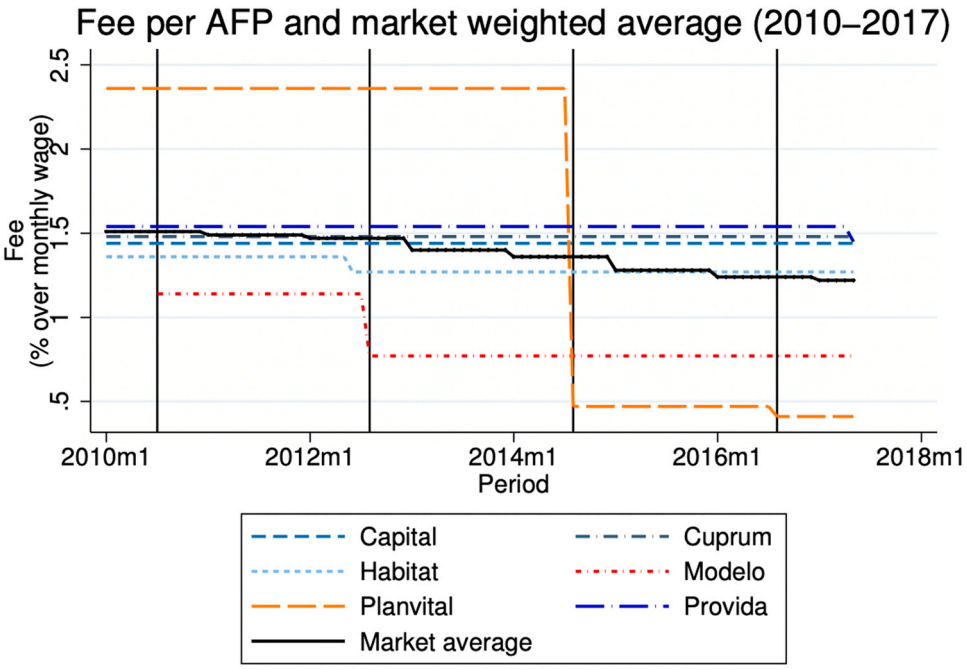
To the date, there have been 9 auction processes, 3 winners and 2 entrants. (see Table 1 for bidders, bids, and winners). Over time, average market fee has decreased (see Fig. 1). However, in the same graph, when studying fees by firm, the pattern indicates that non-winning firms have not reacted to the drop winner's fee. Indeed, non-winning firms have tended to keep their fees, while winning firms have substantially decreased fees, driving the market average fee to decrease.

2.2. Marginal costs

We proxy for marginal cost by calculating the average operational cost per enrollee. While there is heterogeneity in marginal costs, presumably arising from differences in the service offered, there is a constant pattern between Modelo and Planvital (see Fig. 2). Modelo consistently presents lower marginal costs, while Planvital's marginal costs decreased after its auction adjudication. This pattern is expected since the only allocation rule for the auction are fees. Firms that can reduce their marginal costs are more likely to win the auction.

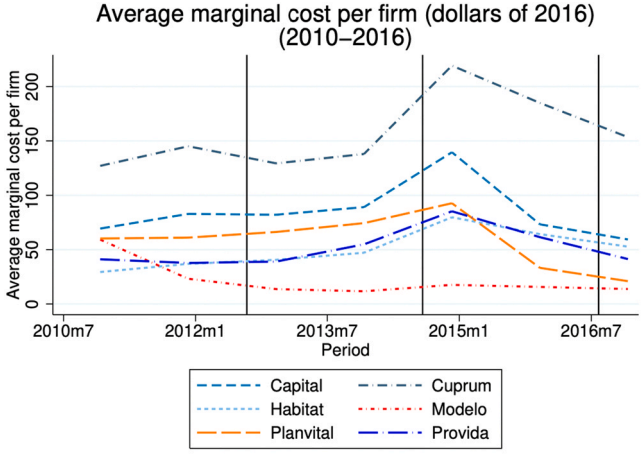
2.3. Market shares, competition, and enrollees' turnover

i) Market shares: Enrollees can either be active (contributors) or inactive. Active enrollees pay for the services, while inactive are working-age individuals who were once enrolled in the retirement system but are not currently receiving a salary and therefore are not contributing or



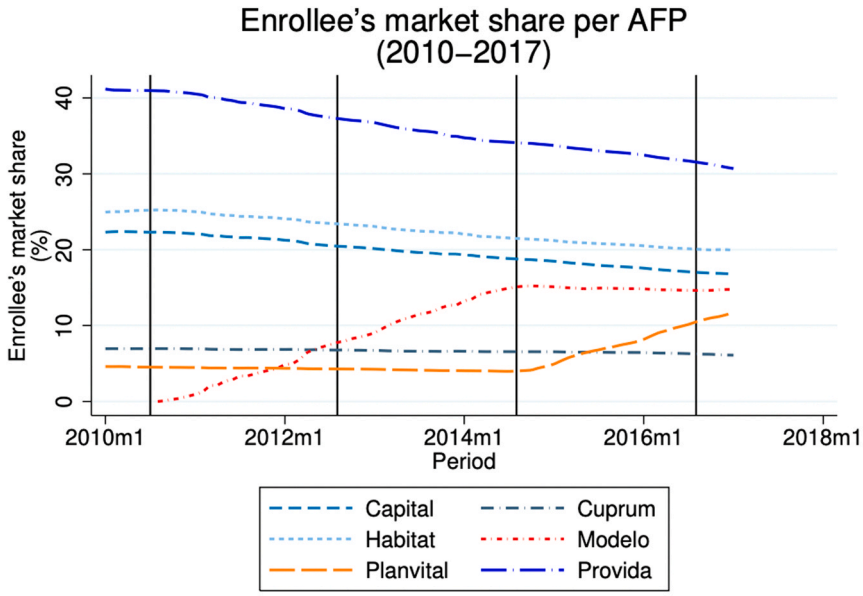
Note: (a) Vertical lines indicate auction periods. (b) Own elaboration.

Fig. 1. Fee per AFP and market average weighted by enrollees' market share (2010–2017).



Note: (a) Vertical lines indicate the starting of each auction period. (b) Marginal cost is calculated using the average operational cost per enrollee at December of each year. (c) All prices expressed in dollars of 2016. (d) Own elaboration.

Fig. 2. Average marginal cost per firm (2010–2016).



Note: (a) Vertical lines indicate auction periods. (b) Own elaboration.

Fig. 3. Dynamics of AFP market shares (%) (2010–2017).

paying fees. However, the AFP still must manage their accounts. Enrollees' market shares are presented in Fig. 3. After the implementation of auctions, market shares have substantially increased (decreased) for auction-winning firms (for non-winning firms). Contributors represent around 55 % of total enrollees. There are no substantial differences between enrollees' and contributors' market shares.

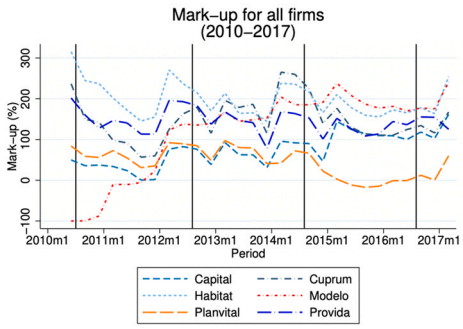
ii) Concentration: because of changes in the market share composition, market concentration also changed (measured by the Herfindahl-Hirschman Index, HHI). While the market is still concentrated, there has been substantial reduction (see Table 2).

Table 2
Herfindahl-Hirschman Concentration Index (HHI) (2010–2016).

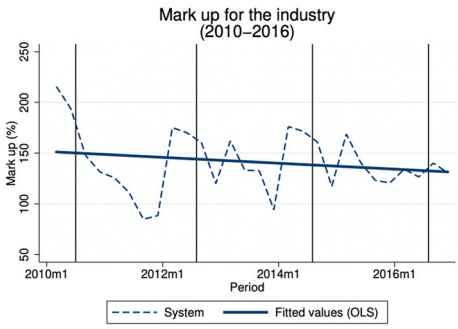
Year	HHI (enrollees)	ΔHHI (%)
2010	2843	-1.49
2011	2634	-7.35
2012	2446	-7.14
2013	2315	-5.36
2014	2236	-3.41
2015	2122	-5.10
2016	2022	-4.71

Note: (a) Own elaboration

(a) Mark-up per firm



(b) Industry mark-up with fitted tendency



Note: (a) Mark-up = margin / operational costs. (b) Data is available in March, June, September and December of each year. (c) Vertical lines indicate auction periods. (d) Own elaboration.

Fig. 4. Mark-ups per firm and for the industry (%) (2010–2016).

iii) Mark-ups: we define the mark-up to be the margin (total revenue - operational costs) over operational costs. Consider that in the AFP industry there is little product differentiation (Schlechter et al., 2019) and that mark-ups larger than one do not always imply that firms are operating under market power if there are overhead costs. Overhead costs are not directly associated with production but include sales, marketing, executive compensations, and other costs (De Loecker & Eeckhout, 2017).[8] On average, mark-ups have tended to decrease (see Fig. 4a). For about one year after its entry, Modelo evidenced a negative mark-up, which has tended to converge to one of the other firms. Starting in 2015, all mark-ups, except for Planvital's, show convergence to similar levels. To evaluate the tendency of the industry mark-up over time, we fit the values using ordinary least squares which show a decreasing tendency (see Fig. 4b).

iv) Enrollees' turnover: correspond to movements across firms from stock enrollees or new enrollees after the 24 months period. Fig. 5 presents turnovers as a share over the total number of enrollees.[9] Turnovers are relatively low, representing average less than 6 %. We use percentage as an increase in absolute movements is expected as the number of enrollees has increased too. An interesting case is Planvital, whose turnovers decrease after they won the auctions, suggesting that individuals respond to lower fees.

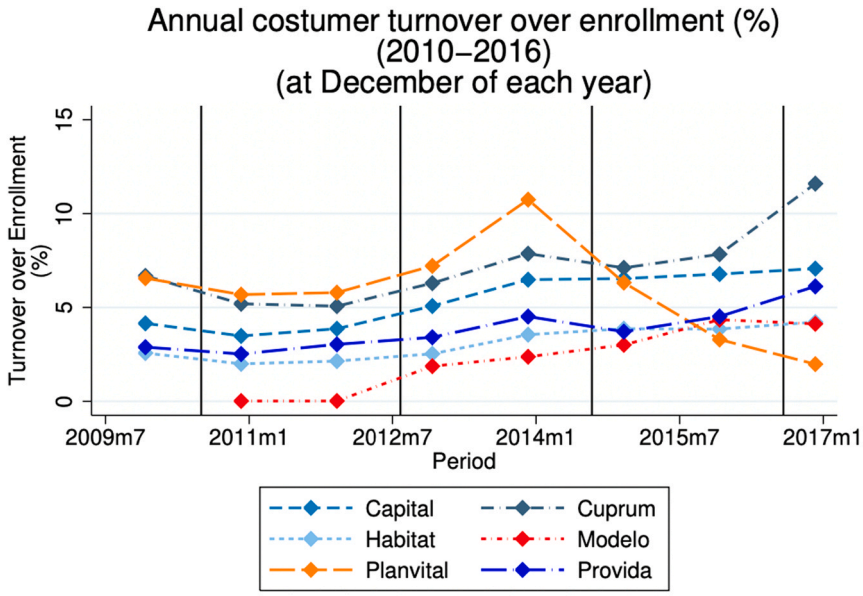
3. Illustrative simple model: firms' incentives to participate in auctions

3.1. Setting

In this section, we model firms' incentives to participate in a reserve auction. Through this auction, the authority wants to assign, to the lowest fee (bid), the monopoly rights over new

[8] In an oligopoly setting, products with substitutes tend to have low mark-ups; while if there are no good substitutes available, products have high mark-ups and high prices relative to cost (Berry et al., 1995).

[9] Unfortunately, given the aggregated nature of this data, we cannot distinguish whether those turnovers are coming from contributors or non-active enrollees.



Note: (a) Vertical lines indicate auction periods. (b) Own elaboration.

Fig. 5. Annual turnover over enrollment per firm (%) (2010–2016).

enrollees to the pension system. We denoted new enrollees by Δ. Without loss of generality, we assume that the industry, before the auction, is consisting of:

- One *incumbent* denoted by I, serving a set of stock of enrollees $D > \Delta$, who is charging them a fee $\hat{f}_I \in [0,1]$. The effective price of $\hat{p}_I = \hat{f}_I \cdot w_I$, where $w_I > 0$ represents the average wage of contributors enrolled in firm I.
- An *entrant* denoted by E, facing an entry cost of $k > 0$.

Both firms can serve both, new and stock enrollees. However, the evidence shows that after the auctions, transfers of stock enrollees to the winning firm are negligible and therefore, in practice, entrant firms tend to serve only new enrollees. We capture this fact assuming that if the entrant wins the auction, he will consider just serving new enrollees (Δ), but if incumbent wins, he will serve both segments ($D + \Delta$). Note that if serving both segments, the same fee must be applied to both.[10]

We model firms' cost structure by considering, first, that the incumbent has constant but differentiated marginal cost. That is, the marginal cost of serving new enrollees (cN)is lower than the marginal cost of serving stock enrollees (cS), i.e. $cN < cS$.[11] This assumption relies on

[10] We basically assume that both demands are price-insensitive, i.e. D and Δ do not depend on prices.

[11] Note that this assumption is supported by the estimated marginal cost computed from the firms' financial reports. These estimates were presented in the previous section.

the idea that business models are different for firms serving stock enrollees than for firms serving new enrollees.[12] Second, and for the sake of simplicity, we assume that the entrant firm would operate with the same marginal costs ($cN > 0$) of the incumbent, if winning the auction.

The auction runs when each firm simultaneously bids its proposed fee. Bids are: $fI \in [0, 1]$ for the incumbent and $fE \in [0,1]$ for the entrant. New enrollees have an average wage of $wE > 0$. This directly implies effective prices of $pI = fI \cdot wI$ and $pE = fE \cdot wE$, respectively. The relevant auction's rules are:

- Any participating bid must be lower than the current minimum market fee, f^*.[13]
- The firm who offered the lowest fee wins the auction and must serve the new enrollees at the winning fee.
- If it is the case that the winner is the incumbent, it also has to charge the winning fee to its stock enrollees.[14]

3.2. The model

Given the profile of bids (fI, fE) and the corresponding vector of effective prices(pI, pE) the incumbent's and entrant profit function are respectively:

$$\Pi_I = \begin{cases} (p_I - c_S)\cdot D + (p_I - c_N)\cdot \Delta \text{if} & f_I < f_E \leq f^* \\ (\hat{p}_I - c_S)\cdot D \text{if} & f_I > f_E \geq f^* \end{cases} \tag{1}$$

$$\Pi_E = \begin{cases} (p_E - c_N)\cdot \Delta \text{if} & f_E < f_I \leq f^* \\ 0 \text{if} & f_E > f_I \geq f^* \end{cases} \tag{2}$$

Then the auction participation constraints for the incumbent is:

$$(p_I - c_N)\cdot \Delta \geq (\hat{p}_I - p_I)\cdot D \tag{3}$$

and for the entrant is:

$$(p_E - c_N)\cdot \Delta \geq k \tag{4}$$

Eq. 3 states that the incumbent firm participates in the auction only if the gains produced by the new enrollees, compensate the losses from the lower prices charged for the stock's enrollees. Clearing pI, we have that the minimum effective price that makes the incumbent willing to participate is:

$$p_I \geq \frac{D\cdot \hat{p}_I + \Delta \cdot c_N}{D + \Delta} \tag{5}$$

Analogously, from Eq. 4, we have the following entry condition:

[12] Stock enrollees require more services than new enrollees as they are closer to the retirement age. These consumers may need to go often to the firm to ask for advises, guidance, or information. Additionally, new enrollees are mostly young individuals. Hence, AFPs serving this segment are relying on technological advances. In these firms, individuals can manage their accounts online and ask for guidance through computers and mobile applications, avoiding the branch offices. With these implementations, firms can reduce operational costs.

[13] Since in our simple model there is just one incumbent then $f^* \equiv \hat{f}_I$.

[14] Any incumbent faces the trade-off between reducing fees to win the auction and not being aggressive in the auction to keep the current stock profits.

$$p_E \geq \frac{k}{\Delta} + c_N \tag{6}$$

The condition for entry implies a price high enough to pay the marginal costs and the entry costs. The bigger the number of the new enrollees considered in the auction, the lower the auction price offered by the firm. Again, the attractiveness of the auction is increased by the size of the new enrollees.

From the incumbent's perspective, it is easy to note that his incentives to participate in the auction are low. From Eq. 1, note that under a benchmark of a competitive market, we should expect $\hat{p}_I = cS$. If the auction is designed so that the bids also simulate a competitive market, if the entrant wins the auction, it must be that $(pI - cS)\cdot D < (pI - cN)\cdot\Delta$ because it must be that $f_I < \hat{f}_I$ considering that w_I remains constant. The only way that an incumbent would have incentive to win the auction is if there is a mark-up so that $\pi_I > 0$. This would mean that the auction would not achieve an outcome close to the competitive market outcome.

The entrant will have absolute advantages when the lowest feasible bid of the incumbent in the Eq. 7 is higher than the lowest feasible bid of the entrant 6. This implies that:

$$\frac{1+\alpha}{\alpha}\cdot k < (\hat{p}_I - c_N)\cdot D \tag{7}$$

where $\alpha\cdot D = \Delta$. An important implication of Eq. 7 is that if entry barriers are low, the entrant always wins. It is important to note that if $cS < cN$, unlike what happened in the Chilean case, Eq. 7 never holds. In that case, there would have been no entry at all. Mathematically, as the cost the entrant increases, the entrant's bidding also increases.

3.3. Analysis of the auction design

Considering the illustrative case of the demand price insensitivity, the auction mechanism tends to promote the entry of new competitors rather than the competition of incumbent firms. This result occurs when entry barriers are low, the entrant will always win. This eventually introduces a higher level of competition. Note that what has been observed in the market: new firms tend to reduce costs by relying on technological progress and win the auctions. This is consistent with the fact that transfers from AFP to other firms are not zero but very low.[15]

From a dynamic perspective, incumbent firms will have increasing incentives to participate because their stock of enrollees will grow old, exposing their business to an expiration date. Despite this apparent incentive to participate, incumbents are disincentivized because of their heavier cost structure. Firms could be forced to change their business models to a low-cost firm, with lower levels of service and potentially poorer levels of financial returns.

With repeated interaction, if a winning firm offered a fee close to its marginal cost (average cost in the presence of entry costs), it would be difficult for it to participate again. This is exactly what happened in the fifth auction when there were no bids. Thus, in a repeated game, only firms with lighter costs structures will stay in the market. This type of incentive is particularly risky in this kind of industry, and potentially damaging to social welfare.

[15] As reported in the literature, a small costumer reaction could have several explanations (see Hastings et al., 2011; Hastings et al., 2017; Mitchell et al., 2008; Illanes, 2016; Luco, 2019). The Chilean auction model is not considering any of the features characterized by the literature as causes of low responses from enrollees, although they are a common issue in the literature.

Finally, there is an additional risk that arises if firms compromise their financial returns and quality of service. On this subject, one should remember that the "core business" of the AFPs is not only to capture enrollees but to diligently invest their savings, which requires acquisition of advanced human capital and infrastructure. A more sophisticated, but very few, customer will always evaluate all these aspects (returns and quality of service) and not only the fee.

4. Empirical evaluation of the auction performance

To evaluate the performance and impacts of the auctions, we focus on the reform's objectives. As mentioned before, the reform seeks to: 1) encourage price competition and achieve lower fees, 2) increase price sensitivity, 3) promote the entry of new firms and 4) to protect enrollees' accumulated wealth (Berstein, 2010).

4.1. Impact of auctions on fees

To start with, we test whether the auction's implementation affected market fees by comparing average market fees across periods (see Table 3). The average market fee is significantly lower for auctions 2 and 3 (panel i)). We find little evidence that auctions affect market fees for non-winning firms. In panel ii), we exclude the winning firm per period, finding that the average market fee is significantly lower only in the third auction period. When comparing the average market fee for each auction period excluding Modelo and Planvital, to disentangle the effect of winning firms, we find that means are not statistically different.

Table 3
Market average fee per auction period.

Period	Date	Average fee	S.D.	Difference	
				pp	rate
i) Including all firms					
Year before	07/2009 – 07/2010	1.51	0.20	–	–
Auction 1	08/2010 – 07/2012	1.49	0.21	-0.02	-1.32
Auction 2	08/2012 – 07/ 2014	1.39	0.31	-0.09 *	-6.47
Auction 3	08/2014 – 07/ 2016	1.27	0.35	-0.13 * **	-9.35
Auction 4	08/2016 – 05/ 2017	1.23	0.39	-0.04	-3.15
ii) Excluding auction-winning firm for each auction period					
Year before	07/2009 – 07/2010	1.51	0.20	–	–
Auction 1	08/2010 – 07/2012	1.50	0.21	0.00	0.00
Auction 2	08/2012 – 07/ 2014	1.48	0.22	-0.02	-1.33
Auction 3	08/2014 – 07/ 2016	1.33	0.27	-0.15 * **	-10.14
Auction 4	08/2016 – 05/ 2017	1.33	0.27	0.00	0.00
iii) Excluding all ever auction-winning firm for all periods					
Year before	07/2009 – 07/2010	1.47	0.07	–	–
Auction 1	08/2010 – 07/2012	1.46	0.08	0.00	0.00
Auction 2	08/2012 – 07/ 2014	1.44	0.11	-0.02	-1.36
Auction 3	08/2014 – 07/ 2016	1.44	0.11	0.00	0.00
Auction 4	08/2016 – 05/ 2017	1.44	0.11	0.00	0.00

Note: (a) * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. (b) Annual weighted average using enrollees' market shares. (c) Auction period 4 considers up to May of 2017. (d) For panel i), all firms are included, and in panel ii), Modelo is excluded for auction 1 and 2; and Planvital is excluded for auction 3 and 4; in panel iii), Modelo and Planvital are excluded for all periods. (e) Own elaboration.

Table 4
Impact of auctions on fees.

	I			II		
	All firms			Never-winning firms		
	(1)	(2)	(3)	(1)	(2)	(3)
Auction 1	0.15 *	-0.03	-0.02	0.00	0.01	0.20
	(0.08)	(0.06)	(0.04)	(0.03)	(0.02)	(0.02)
Auction 2	0.13	-0.11	-0.11$* *	-0.02	-0.03	0.01
	(0.14)	(0.08)	(0.05)	(0.05)	(0.03)	(0.02)
Auction 3	-0.34 *	-0.53 * **	-0.55 * **	-0.02	-0.05	0.02
	(0.19)	(0.15)	(0.14)	(0.06)	(0.03)	(0.03)
Auction 4	-0.35	-0.55 * **	-0.59 * **	-0.02	-0.06	0.03
	(0.23)	(0.16)	(0.14)	(0.07)	(0.04)	(0.03)
Change in SIS	-0.65 * **	-0.62 * **	-0.60 * **	-0.65 * **	-0.54 * **	-0.54 * **
	(0.11)	(0.13)	(0.11)	(0.11)	(0.11)	(0.11)
Contributors age	No	Yes	Yes	No	Yes	Yes
Historical return	No	Yes	Yes	No	Yes	Yes
S.D. historical return	No	Yes	Yes	No	Yes	Yes
Firm effects	No	No	Yes	No	No	Yes
Sample size	609	609	609	534	534	534
Adjusted R^2	0.672	0.845	0.885	0.877	0.915	0.919

Note: (a) * p < 0.1; ** p < 0.05; *** p < 0.01. (b) Dependent variable = monthly fee. (c) Sample period = Jan-2003 to Dec-2016. (d) Contributors age = contributors average age. Historical returns = lagged (in one month) moving average of returns for all funds. S.D. historical return = standard deviation of historical returns for all funds. (e) All models include a constant term and year fixed-effects. (f) Robust standard errors in parentheses. (g) Own elaboration.

Because the consumers' utility not only depends on fees and effective prices but also on the quality of the product (returns) and service, we estimate the following regression model:

$$f_{it} = \beta_0 + \beta_1 I(A_1) + \beta_2 I(A_2) + \beta_3 I(A_3) + \beta_4 I(A_4) + \beta_5 I(SIS) + \beta_6 X_{jt} + \epsilon_{jt} \quad (8)$$

where *fjt* is the fee over wage charged by firm j in period t (months), $I(\cdot)$ in an indicator function that takes 1 for each auction {1, 2, 3, 4} and 0 otherwise, or 1 for periods where the new pricing mechanism for the disability and survival insurance was implemented.[16] *Xjt* is a vector of product and firm characteristics and ϵ_{jt} is a mean-zero stochastic term. The coefficients of interest are $\beta 1$, $\beta 2$, $\beta 3$, and $\beta 4$. We estimate two models: I) using all firms and II) excluding winning firms from the sample. We try different specifications. The results for all regressions are presented in Table 4. The preferred specification is specification 3.

We find no significant effect of auctions on non-winning firms' fee. Auctions 3, and 4 significantly explain lower fees, after controlling by other product characteristics. Importantly, in a simple model that does not allow correlation with product characteristics, we find that only auction 3 significantly explains a decrease in fees. When correcting for product and firm characteristics, we find that auction Table 4: periods 2, 3, and 4 significantly explain lower fees.

[16] As a result of the Reform in 2008, changes in the pricing mechanism for the disability and survival insurance were implemented on July of 2009 (Coloma, 2019).

4.2. Impact of auctions on mark-ups

To evaluate the effect of auctions on mark-ups, we estimate the following model:

$$m_{jt} = \beta_0 + \beta_1 I(A_1) + \beta_2 I(A_2) + \beta_3 I(A_3) + \beta_4 I(A_4) + \beta_5 X_{jt} + \epsilon_{jt} \quad (9)$$

where mjt is the mark-up of firm j in period t (quarters), $I(\cdot)$ in an indicator function that takes 1 for each auction {1, 2, 3, 4} and 0 otherwise, Xjt is a vector of firm characteristics, and ϵ_{jt} is a mean-zero stochastic term. We try different specifications including individual, product, and firms' effects in Xjt. The coefficients of interest are $\beta 1$, $\beta 2$, $\beta 3$, and $\beta 4$. Two sets of models are estimated: I) using all firms and II) excluding winning firms from the sample.

All results are presented in Table 5. The preferred specification is the third one, which include individual characteristics (contributors average age), product characteristics (historical returns and their standard deviations), and firm fixed effects. All models and specifications show that auctions have a statistically significant negative impact on mark-ups, meaning that its implementation has increased competition. This result is consistent with the previous evidence that showed that mark-ups where converging over time across firms. The effect of auction periods over mark-ups when only considering never-winning firms is smaller than when considering all firms, which is consistent with the fact that Planvital is the one that presented the biggest decreased in mark-ups.

4.3. Impact of auctions on demand price-elasticity

The reform discussion argued that a way to increase competition was through bid-cap auctions. This idea relied on the assumption that individuals' price sensitivity would increase after the auction because consumers will have more information regarding the lowest fee in the market and because winning auction firms may induce other firms to decrease prices. For testing this prediction, we estimate a reduced-form demand equation for AFPs built upon a discrete-choice model of product differentiation for estimating price-elasticity (Berry, 1994; Berry et al., 1995; Nevo, 2000). We consider a firm-specific demand rather than a product-specific specification as in the Chilean retirement system, there is no product specific fee.

Let the indirect utility to individual i from j at t is $U(X_{jt}, p_{ijt}, \epsilon_{ijt})$ where X_{jt} are observed product and firm characteristics, $p_{ijt} = f_{jt} \times w_{it}$ is the effective price paid by consumers, with w_i the individual's i wage. Utility also depends on consumer heterogeneity which enters through a separable additive random shock, assumed to be distributed i.i.d. with a Type I extreme-value distribution. By taking the mean utility of firm j as a linear regression equation and by normalizing the mean utility of the outside good to zero, we estimate[17]:

$$\log(s_{jt}) = \gamma_0 + \gamma_1 f_{jt} \bar{w}_{jt} + \gamma_2 I(\cdot) f_{jt} \bar{w}_{jt} + \gamma_3 X_{jt} + \epsilon_{jt} \quad (10)$$

where $\log(s_{jt})$ is the market share (enrollees) (in logs), $\bar{w}_{jt}$ the average monthly wage of contributors enrolled, $I(\cdot)$ an indicator variable that takes the value of 1 after the implementation of auctions and 0 otherwise, X_{jt} a vector of observed characteristics, and ϵ_{jt} is a mean-zero stochastic term. The coefficient γ_2 captures the effect of auctions in price-elasticity.

[17] This specification is standard in the reduced form empirical industrial organization literature. For more details, please see Berry (1994), Berry et al. (1995) and Nevo (2000).

Table 5
Impact of auctions on firms' mark-ups.

	I			II		
	All firms			Never-winning firms		
	(1)	(2)	(3)	(1)	(2)	(3)
Auction 1	-98.88(29.92)***	-84.39(9.14)***	-91.18(13.44)***	-81.63(27.00)***	-85.63(14.03)***	(10.99)
Auction 2	-127.72(42.33)***	-102.79(19.46)***	-119.11(20.81)***	-112.10(36.56)***	-113.66(23.16)***	-102.73(22.10)***
Auction 3	-172.20(57.10)***	-150.32(29.36)***	-161.96(28.87)***	-167.11(44.59)***	-163.53(33.74)***	-148.36(31.90)***
Auction 4	-164.36(66.41)***	-142.28(32.38)***	-153.29(30.27)***	-159.06(46.37)***	-154.53(34.98)***	-129.48(34.53)***
Contributors age	No	Yes	Yes	No	Yes	Yes
Historical return	No	Yes	Yes	No	Yes	Yes
S.D. historical return	No	Yes	Yes	No	Yes	Yes
Firm effects	No	No	Yes	No	No	Yes
Sample size	205	205	205	180	180	180
Adjusted R^2	0.527	0.789	0.855	0.783	0.834	0.869

Note: (a) * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. (b) Dependent variable = mark-up. (c) Sample period = Jan-2003 to Mar-2017. Panel I: all firms are included. Panel II: only never-winning firms are included. (d) Contributors age = contributors average age. Historical returns = lagged (in one month) moving average of returns for all funds. S.D. historical return = standard deviation of historical returns. (e) All models include a constant term and year fixed-effects. (f) Robust standard errors in parentheses. (g) Own elaboration.

Table 6
Impact of auctions on demand price-elasticity.

	(1)	(2)	(3)
fee*wage	-1.554 (0.081)***	-0.234 (0.071)***	-0.369 (0.080)***
fee*wage*auction indicator	1.713 (0.128)***	0.066 (0.035)*	-0.105 (0.040)***
Firm indicator	No	Yes	Yes
Enrollees' (log) balances	No	No	Yes
Sample size	990	990	990
Adjusted R^2	0.161	0.796	0.837
Endogeneity test (p-value)	0.756	0.796	0.183

Note: (a) * p < 0.1; ** p < 0.05; *** p < 0.01. (b) Dependent variable = participation share of firm ***j*** in month ***t*** (in logs). (c) Sample period = Jan-2003 to Dec-2016. (d) All models include a constant term and year fixed-effects. (e) Robust standard errors in parentheses. (f) Endogeneity test for testing the null if controls are exogenous. (g) Own elaboration.

Individuals not only value prices but also firm characteristics such as financial returns and quality of customer service.[18] Because financial products are complex and consumers may value different characteristics (e.g., short-run returns, long-run returns, standard deviations, risk premiums, firm reputation, among others), we make no strong assumptions over preferences. Thus, we control for firm fixed effects to capture firm and product characteristics that may impact demand. Note that saving balances is an essential variable to characterize the demand since effective prices are computed over the contributor's wage but returns on savings are based on the individual's accumulated balances.[19]

Estimations results are presented in Table 6. Three models were estimated, where our preferred model is specification (3) since the fit of the model is better, and it solves bias due to omitted variables. In all specifications, the null that controls are exogenous cannot be rejected, thus we keep a one-stage linear regression specification. In all cases, the estimated coefficient on the effective price is negative and statistically significant. As expected, we find that the omitting firm's effects and balances result in an over-estimation of the price elasticity before the implementation of auctions. After controlling for omitted variables, we find that the demand is inelastic to price. Recall total price elasticity after the implementation of auctions equals $\gamma_1 + \gamma_2$.We find that the implementation of auctions significantly increased (in absolute value) enrollees' price elasticity by 0.105 % points. Still, total price elasticity remains inelastic.

4.4. Impact of auctions on returns and risk premiums

We now evaluate whether the implementation of auctions had an impact on competition based on product characteristics. We focus on: pension funds' returns, risk premiums, and risk premium as a ratio of market risk premiums by estimating:

$$r_{fjt} = \beta r_{mt} + \alpha_0 + \alpha_1 I(A_1) + \alpha_2 I(A_2) + \alpha_3 I(A_3) + \alpha_4 I(A_4) + \alpha_5 T_t + \alpha_6 X_j + \epsilon^1_{jt} \quad (11)$$

[18] Omission of firm effects result in an over-estimation (towards zero) of the elasticity of demand and the interaction term between elasticity and auction indicator.

[19] If balances are omitted, then the estimated coefficient on the elasticity of demand and on the interaction between elasticity and auction indicators will be capturing behaviors that could be related to the individual's behavior toward returns.

Table 7
Impact of auctions on returns and risk premiums of pension funds.

Dependent variable:	I Monthly returns		II Sharpe ratio		III Sharpe ratio/Market sharpe ratio	
	Coeff.	(S.E.)	Coeff.	(S.E.)	Coeff.	(S.E.)
i) Pension fund A						
Auction 1	1.21	(0.79)	0.26	(0.21)	-11.58 * **	(4.22)
Auction 2	2.44$* **	(0.89)	0.49 * *	(0.24)	-8.75 *	(4.51)
Auction 3	1.87 *	(1.07)	0.27	(0.30)	-4.09	(4.89)
Auction 4	2.81 * *	(1.32)	0.47	(0.38)	5.88	(7.96)
ii) Pension fund B						
Auction 1	0.80	(0.54)	0.13	(0.29)	-10.07 * *	(4.31)
Auction 2	1.79 * **	(0.61)	0.25	(0.47)	-6.13	(4.72)
Auction 3	1.36 *	(0.75)	-0.10	(0.65)	-0.47	(5.29)
Auction 4	2.06 * *	(0.93)	-0.01	(0.84)	6.98	(8.24)
iii) Pension fund C						
Auction 1	0.34	(0.32)	0.58	(0.37)	-8.53 * *	(4.11)
Auction 2	1.12 * **	(0.37)	1.06 * **	(0.40)	-4.34	(4.55)
Auction 3	0.90 *	(0.50)	1.00 * *	(0.46)	2.01	(5.17)
Auction 4	1.47 * *	(0.64)	1.40 * **	(0.53)	3.49	(8.35)
iv) Pension fund D						
Auction 1	0.13	(0.20)	0.46	(0.29)	-7.13 *	(4.32)
Auction 2	0.67 * **	(0.25)	1.06 * **	(0.33)	-6.64	(4.83)
Auction 3	0.58	(0.36)	1.06 * *	(0.43)	-0.13	(5.52)
Auction 4	1.12 * *	(0.47)	1.66 * **	(0.54)	-11.67	(9.45)
v) Pension fund E						
Auction 1	-0.14	0.16	0.19	(0.28)	15.32 * **	(3.87)
Auction 2	0.08	0.24	0.56	(0.35)	7.15	(5.36)
Auction 3	0.12	0.33	0.72	(0.45)	11.09 *	(5.88)
Auction 4	0.37	0.42	1.14 * *	(0.55)	-10.84	(9.86)

Note: (a) * p < 0.1; ** p < 0.05; *** p < 0.01. (b) Sample period: Jan-2003 to Dec-2016. (c) All models include a constant term, firm fixed-effects, monthly, and yearly fixed-effects. In I: in addition, each model controls for the monthly stock market return. In II: in addition, each model controls for the market Sharpe index. (d) Robust standard errors in parentheses. (e) Own elaboration based on data of the SP and Bolsa de Santiago.

$$RP_{fjt} = \beta RP_{mt} + \alpha_0 + \alpha_1 I(A_1) + \alpha_2 I(A_2) + \alpha_3 I(A_3) + \alpha_4 I(A_4) + \alpha_5 T_t + \alpha_6 X_j + \epsilon^2_{jt} \quad (12)$$

$$\frac{RP_{fjt}}{RP_{mt}} = \alpha_0 + \alpha_1 I(A_1) + \alpha_2 I(A_2) + \alpha_3 I(A_3) + \alpha_4 I(A_4) + \alpha_5 T_t + \alpha_6 X_j + \epsilon^3_{jt} \quad (13)$$

Where r_{fjt} is the financial return of fund f, firm j, period t, RP_f is the fund-specific risk premium (Sharpe ratio) and RP_m is the market Sharpe ratio. We include indicator functions for each auction period, $I(\cdot)$. To control for other characteristics that might affect returns, we add year and month controls, T_t, and firm fixed-effects, X_j. The terms ϵs i.i.d. mean-zero stochastic terms, independent across equations. Results are presented in Table 7.

We find that for all funds except for Account E, auction periods are jointly significant in explaining returns. This effect is statistically positive, meaning that the implementation of auctions has increased the quality of the product that firms are offering. Across funds, the only

auction period that is consistently individually insignificant is period 1. This result suggests that it took firms one period to react. We also find that the estimated coefficients on auction periods are jointly significant in explaining risk premiums. For the Sharpe ratio, the stronger effects are in the safer accounts. The first auction period is not significant for any of the accounts, while the rest of the auction periods 2, 3, and 4 are significant in accounts C and D. These results suggest that firms may have to compete in other characteristics that consumers value after the implementation of auctions.

5. Conclusion and policy implications

This paper evaluates the design and performance of the Chilean auction model for monopoly rights over new enrollees in the pension system. We consider several dimensions of the AFPs industry (e.g., fees, markups, price-elasticity, returns, risk premiums) to find the impacts of auctions on competition. Our results indicate that most of the objectives defined by the reform are fulfilled. Our analysis indicates that while non-winning firms did not react by lowering prices to auctions, implementing auctions has increased the quality of the product that AFPs offer. The market has improved return results and risk premiums. We find that it took firms one auction period to react on the quality of the product dimension after the auction period started. This finding suggests that policy instruments such as incorporating auction mechanisms are positive for reaching better equilibrium with strong welfare implications. Policymakers should not only care about fees when designing policies but also about the quality of the product. In addition, we find that auctions have a statistically significant negative impact on markups, meaning that its implementation increased competition in the pension fund industry. The impacts of auctions on mark-ups are for both, all firms but also never-winning firms, which indicates that the market has approached to better competitive levels.

We also find that while consumers in the AFP industry are price insensitive and their price elasticity is still inelastic after implementing auctions, they effectively increased individuals' price elasticity. The implication of this result is relevant for the policy discussion in regulated markets with complex financial products in the context of retirement systems with individual-funded accounts. Several factors explain low price elasticity, such as that the enrollees' decision is based not only on price but also on returns and quality of service, the lack of information or poor understanding from the consumer side, myopic behavior, and perceived switching cost, among others. Consider as well that we are treating with a market of mandatory participation where the benefit of consumption does not necessarily contribute to the current period utility, but to future consumption. While the literature has documented sources of low consumer responses to prices, lessons from the Chilean auction implementation show that consumer responses change as more attention is put to fee levels and operation. Each auction period not only came with lower fees but also implied more public discussion regarding current fees in the industry and the winner's bid compared with the competitors' price levels.

Despite the evidence shown for the positive benefits of the auction implementation, the current mechanism design is not considering that the biggest issue is the low individuals' response levels. Importantly, the current auction design only incentivizes new entrants to participate. This design generates low competition in the auction processes. Given the low individual price response, firms that are already in the market have no incentive to decrease prices for all enrollees. Proper design should incentivize all firms to participate.

While this paper evaluates the design and impacts of the Chilean auction implementation, we do not discuss possible reforms. There is plenty of room for studying policy reforms that could

incentivize firm participation. For example, to explore the effects of policies that increased the horizon length of monopoly rights, combined with other incentives for firms in the market to participate. Future research should also explore the possibility of eliminating the maximum bid, at least for a segment of the enrollees.

A potential solution to the disincentive for old firms to participate, is the possibility of allowing price discrimination between stock and new enrollees. If different fees are allowed for different segments, firms would have an incentive to participate by lowering fees to stock enrollees without needing to achieve new enrollees' levels. Such reform would incentivize participation since it would allow firms to treat these two groups as different segments. Future research should investigate alternative allocation rules. The criteria, rather than being based in parameters (e.g., fees), could be based on welfare effects that post-auction parameters would generate. The current adjudication rule considers that individuals only care about fees, while they could also have preferences for quality of the product and quality of service. While this might be true for new enrollees, whose individual accumulated savings balances are small and required different services than stock enrollees.

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