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On the (Social) Efficiency of the Chilean Privately Managed Pension System

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On the (social) efficiency of the Chilean privately managed pension system

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ABSTRACT

The aim of this paper is to identify the underlying reasons of the high costs in the privately-run Chilean pension system, to investigate the existence of potential efficiency gains and to analyse some actions that may lead to the achievement of these gains.

A dynamic model of optimising behaviour sets the framework to analyse a panel of 12 Chilean PFMCs. The results obtained provide evidence of economies of scale and a predominant effect of vendors on consumers' decisions. Both findings cast doubts on the possibilities of the current Chilean system to perform efficiently, and support the recent change in the design of the system to allow for PFMCs managing several funds.

1. Introduction

The Chilean privately managed pension system stands as a benchmark reference for pension reforms. One of the more criticised aspects of the Chilean system relates the high fees and commissions charged by PFMCs (pension fund management companies). As this is also the case in other privately managed pension systems (see Diamond 1994), this raises questions on the social convenience of private management of pension systems.

Fundamentally, the ultimate public policy objectives for a pension system concern the achievement of a target level of consumption for old aged people. The definition of such an adequate level of consumption is a normative issue, and should precede any discussion on pension reform.[1] On the other hand, discussing the efficiency of (any) pension scheme is a purely positive matter. It ignores the adequacy of benefits to concentrate on the costs of delivering them.

The aim of this paper is to identify the underlying reasons of the high costs in the private-run Chilean pension system, to investigate the existence of potential efficiency gains and to analyse specific actions that may lead to the achievement of these gains. This study is aimed to contribute to the understanding of the social implications of privately managed social security services.

The presentation proceeds as follows. Section 2 sets a dynamic model to capture some of the central characteristics of the Chilean system. The role of the government, workers (consumers) and PFMCs (pension fund management companies) are specified, and the conditions for the long-run equilibrium for the latter are derived. The model motivates the interest in testing for the existence of economies of scale and the relative sensitivity of consumers while making their choice of PFMC. Consequently, the presentation continues with the presentation of new evidence on these matters. Section 3 describes the data and

[1] Unfortunately, the issue is largely ignored in most current debates on pension reforms.

section 4 presents the regression results. Finally, section 5 analyses political economy implications and summarises the conclusions of this study.

The results obtained provide evidence of economies of scale and a predominant effect of vendors on consumers' decisions. At the very least, both findings cast doubts on the possibilities of the current Chilean system to perform efficiently.

2. The Basic Model

The model in this section captures some of the main characteristics of the Chilean pension system. There are 3 types of agents: the government (who designs the system and regulates the operation of PFMCs), workers (customers) and PFMCs (firms).

Government

First, the government has the power of establishing the compulsory character of membership and contributions to the system, and does so while opting for a privately managed system. Additionally, it has allowed free choice of PFMC for workers.

Having entrusted the management of the system to private companies, the government may make use of regulation to improve efficiency, and possibly change the design of the system when it induces companies or customers to engage in inefficient behaviour.

In the model, the government has set the rules under which PFMCs can operate (see chapter 2 for details on the Chilean system). It regulates most aspects on how the system is run. For instance, it sets the requirements for new entrant companies, the definition of the information that can be provided to members and the establishment of investment

limits for pension funds. In this model, however, having set the rules the government takes a passive role with respect to the running of the system.

Workers

Demand for pension services is largely the result of the imposition of workers compulsory contributions (by the government). Each worker must contribute an amount of *d* to one PFMC (s/he can choose which one). S/he must also pay a fee to the PFMC (*f*). Since this is fixed by each company, the individual "gross" contribution (*d*+*f*) depends on the PFMC each workers decides to join.

Each individual worker maximises a utility function in terms of consumption while working and retired. For presentation purposes I will initially assume that they live two periods.

$$\text{Max } U_t = U(c_t, c_{t+1}) \qquad (1)$$

Where:

c_t is consumption while working

c_{t+1} is consumption while retired

As seen in chapter 1, in the context of the life cycle hypothesis, workers would save in order to achieve their optimal lifetime consumption path. The existence of a pension system would have little impact on the way individuals allocate consumption over time. However, in a different framework, or if we consider that individuals are myopic, that there are no adequate financial instruments to save or that there are credit constraints, the incorporation of a pension system will change individuals allocation of consumption over their lifetimes.

Let us consider a situation where savings are not possible (or undesired)[2]. As individuals will consume all their current disposable incomes, the relevant restrictions for the maximising problem of workers are:

$$c_t = w_t - d_t - f_{jt} \quad (2)$$

$$c_{t+1} = p_{t+1} - f_{jt+1} \quad (3)$$

Where:

w_t is labour earnings, in period t

d_t is the statutory contribution to the pension scheme, in t

f_{jt} represents fees charged by the PFMC j, in period t

p_{t+1} is the pension (before fees) in period t+1

Let IRR be the implicit rate of return offered by the PFMC, defined as follows:

$$IRR_{t+1} = \frac{p_{t+1} - f_{t+1}}{d_t} - 1 \quad (4)$$

Thus, using (1) to (4) utility functions can be restated as:

$$U_t = U(w_t - (d_t + f_{jt}), (1 + IRR_{t+1}) \cdot d_t) \quad (5)$$

While facing the decision of choosing a PFMC, individuals will consider how *f* and *IRR*, will affect their budget constraint.

Indifference curves in the (*f*, *IRR*) space can be obtained by differentiating (5) with respect to *f* and *IRR*, and equalising the resulting expression to zero. The slope of indifferent curves (MRS) would be given by:

$$MRS = \left.\frac{\partial IRR}{\partial f}\right|_{U=U_0} = \frac{1}{d_t}\frac{U_1}{U_2} \quad (6)$$

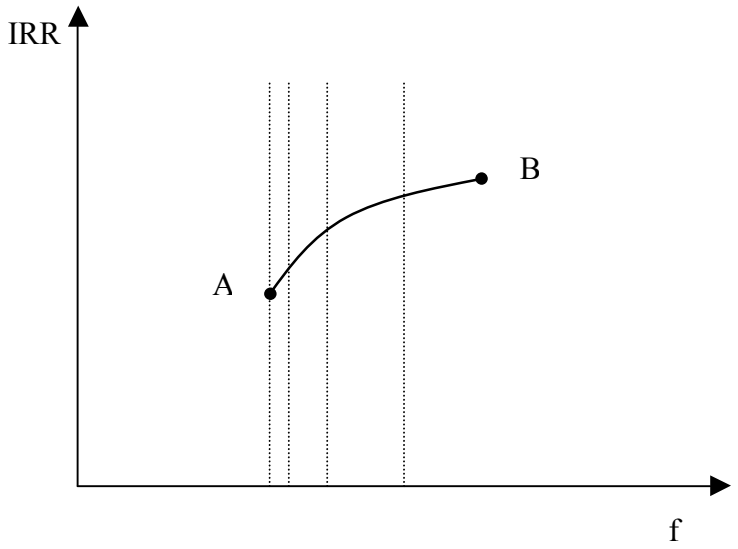
[2] This assumption allows an easy derivation and intuition of the indifference curves to be shown below.

This should be positive and increasing over f, according to the normal assumptions for U.

Let us now assume that the market of PFMCs offers a continuum of alternative combinations of fees and (expected) implicit rates of return (locus AB in figures 1 to 3 below)[3]. Let us also assume no risk aversion and certainty, so all that individuals will care about is the marginal reduction in current income (f) and the implicit return (IRR) provided by the pension company.

For myopic workers (extremely high discount rate) who only care about the first period, the best PFMC is the one that charges the lowest f. They maximise consumption in the first period, because their individual rate of discount is too high. Their indifference curves (dotted lines) will have a high slope (MRS). In the extreme, they are indifferent to IRR, they only care about f as a bad and therefore choose point A.[4]

Figure 1

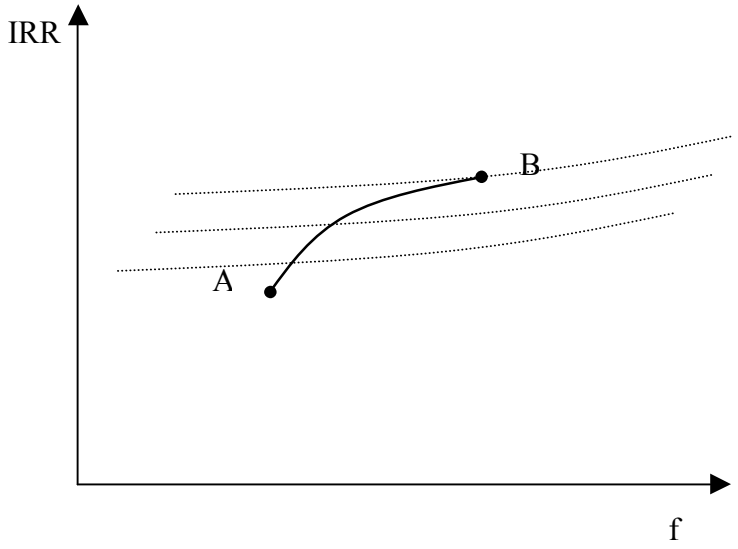


Individuals with very low marginal utility of current consumption, which may be the case in absence of suitable instruments for long-term savings, will have indifference curves

[3] The shape of this locus is explained in appendix 1.

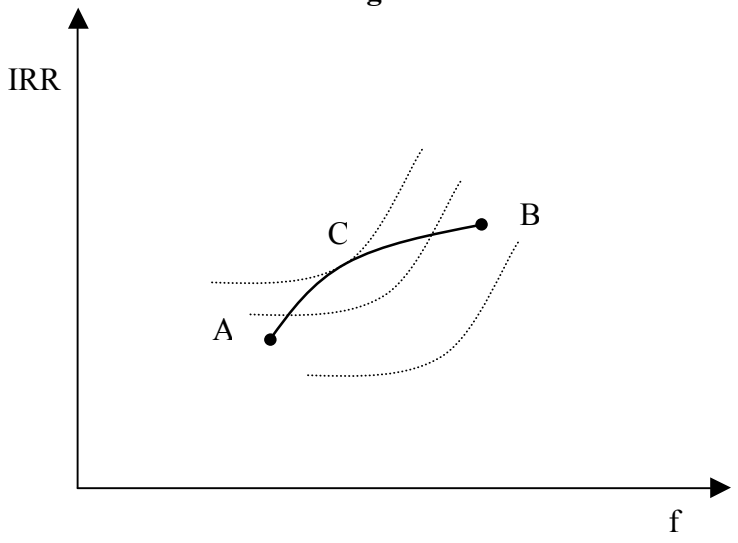
with a slope close to zero. They will be willing to pay a higher fee for a marginal increase in IRR, choosing point B.

Figure 2



If the individual's subjective rate of discount is somewhere closer to the IRR offered by PFMCs, there will be a point C along the locus AB that will better satisfy the individuals preferences.

Figure 3



Different preferences would make individuals to choose different points along the available combinations of f and IRR (continuous AB). Thus, with heterogeneity of

[4] It can easily be seen that indifference curves with a high enough slope shall also lead to point A. I have

preferences, diversity may generate welfare gains, so long as the costs of maintaining it are lower than its associated benefits.

Nevertheless, there is a multiplicity of factors that can make it difficult for individuals to take appropriate advantage of diversity. First of all, changes in the combinations of f and IRR offered by PFMCs will shift the locus AB and, for the same preferences, the best choice can change each time this occurs. Hence, optimal choice would only be possible for individuals who are permanently well informed.[5]

In the real world, gathering the necessary information on the hypothetical locus AB is a rather complex exercise. Once a worker has joined a PFMC, s/he will have a clear idea on the fees s/he pays but may find it costly to keep informed about alternative companies. Besides this minor difficulty (this arguments applies to many other products), there is the problem of gathering IRR. It is evident that data on current and past returns are just one of the elements that a rational forward-looking agent would like to consider. Even this data is nor easy to gather. Moreover, a rational consumer should consider the risk involved in PFMCs portfolios (according to her/his risk aversion). Besides, the impact of f and IRR on a worker's income pattern depends on individual characteristics such as the level and frequency of contributions and age. At the very least, most people would need some type of advice and/or assistance in order to make their choice.

Therefore, it can be expected a great influence of vendors, who can help (or misguide) individuals in making their decision. In this way, vendors services and other resources spent by PFMCs in order to attract new customers may be welfare expanding so long as they help individuals to complete their optimal decision problem.[6] However, they can also be welfare reducing, if their influence obscures the relevant information for workers to make an optimal decision.

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taken the extreme case.

[5] If we consider optimal choice in the context of costs-benefit analysis, allowing for information and decision costs will make consumers react to big changes rather than to small changes in the parameters. The model below captures this feature.

Firms

Each PFMC is assumed to maximise the present value of its profits. Let us consider j to be the representative firm, maximising

$$PV(p_j) = \int_{s=t}^{\infty} p_{js} e^{-rs} ds \qquad (7)$$

Where: p_{jt} are profits of firm j at time t.

r is the relevant discount rate.

Current profits at t can be specified in terms of current revenues and costs:

$$p_{jt} = f_{jt} N_{jt} - TC_{jt} \qquad (8)$$

Where

N_{jt} is the number of (active and retired) workers affiliated to firm j at time t.

f_{jt} is the fee charged by the firm j at time t. (assumed to be the same for active and retired members)

TC_{jt} is total costs of the firm j at time t.

I shall separate total costs into four items:

$$TC_{jt} = C(N_{jt}, \Theta_{jt}, \Phi_{jt}) + S(V_{jt}, \Theta_{jt}) + MK_{jt} + SA_{jt} \qquad (9)$$

Where

$C(\chi)$ is the operational costs function

$S(\chi)$ is the selling costs function

MK_{jt} is marketing costs, which value is decided by the firm

SA_{jt} is security analysis costs (analysis made to improve financial investments), which value is also decided by the firm.

Q_{jt} is the number of new members, incorporated in t

F_{jt} is the number of customers leaving the company in t.

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[6] Provided that the implied costs are lower than the benefits.

V_{jt} is the number of vendors (selling personnel) hired by the firm.

Naturally, the number of customers of a PFMC varies over time according to:

$$\dot{N}_{jt} = \frac{\partial N_{jt}}{\partial t} = \Theta_{jt} - \Phi_{jt} \qquad (10)$$

Which is an endogenous result of companies' decisions on *f*, *SA*, *V* and *MK*. Following the discussion on consumer preferences above, we may expect Θ_{jt} to be determined by the number of vendors, marketing expenditure incurred by, fees and the expected performance of PFMCs' investment portfolios. All of this should incorporate some element of comparison, between values for a single company and values of alternative companies (or the market). In addition, changes in fees are assumed to have an increasing marginal effect on Θ_{jt}. (as in a curved demand schedule). Finally, changes in the number of vendors and the marketing expenditure are assumed to have a diminishing marginal effect on Θ_{jt}. Considering these elements, I will assume the following particular expression of Θ_{jt} to further represent the solution of this model:

$$\Theta_{jt} = q_0 + q_f f_{jt}^{\,2} + q_{\tilde{i}} \cdot \tilde{i}_{jt} + q_V \ln V_{jt} + q_{MK} \ln MK_{jt} + q_{\bar{f}} \cdot \bar{f}_t^{\,2} \qquad (11)$$

Where :

$\tilde{i}_{jt}$ accounts for the relative performance of a PFMC investment portfolio

and $\bar{f}_t$ accounts for the average fee charged by PFMCs.

Similarly, the number of customers leaving a PFMC, Φ_{jt}, may be represented by:

$$\Phi_{jt} = f_0 + f_f f_{jt}^{\,2} + f_{\tilde{i}} \cdot \tilde{i}_{jt} + f_{MK} \ln MK_{jt} + f_{\bar{V}} \ln \sum_{i \neq j} V_{it} + f_{\bar{f}} \cdot \bar{f}_t^{\,2} \qquad (12)$$ [7]

[7] The number of vendors of the company does not appear, as vendors are confined to attract new customers (not to retain existing ones). Instead, the number of vendors of other companies, $\sum_{i \neq j} V_{it}$, has been introduced. Marketing expenditure *MK* is still expected to help retaining customers.

Finally, I assume that each firm can exploit financial market imperfections, such that the $\tilde{i}$ is (stochastically) determined by *SA* according to the following expression:

$$\tilde{i}_{jt} = \alpha_j + \beta_j (\bar{i}_{jt} - r_t) + \gamma_{SA} \ln SA + \gamma_F F_{jt} \qquad (13)$$ [8]

Where:

$\bar{i}$ is the average investment performance in the market

F_{jt} is the size of the managed pension fund

Thus, an individual fund is expected to perform better as it allocates more resources to SA, but worse as the size of the fund increases (due to restrictions and limits on investments fixed by the authority).

In this way, each firm controls *f*, *SA*, *V* and *MK* in order to maximise its long run profits. The solution of this (dynamic) maximisation problem, for each firm, can be obtained by using the following current value Hamiltonian function, where N is the state variable.

$$H = \pi_{jt} + \mu [\dot{N}_{jt}] \qquad (14)$$

Considering the information contained in equations (8) to (13), the four optimality conditions are:

i) $\dfrac{\partial H}{\partial f} = 0$

[8] For example, $\tilde{i}_{jt} = i_{jt} - r_t$, that is to say the excess return obtained by the fund j above the free-risk return r, would make this specification to resemble the used in the Jensen's technique to test for market performance (see Carhart 1997).

$$\Rightarrow f^* = \frac{N}{(C_\Theta + S_\Theta - m)\cdot q_f + (C_\Phi + m)\cdot f_f} \tag{15}$$

Where C_Θ, S_Θ and C_Φ are the first derivatives of the relevant function with respect to the subscript, assumed to be constants.

ii) $\frac{\partial H}{\partial SA} = 0$

$$\Rightarrow SA^* = (-C_\Theta - S_\Theta + m)\cdot q_{\tilde{i}} g_{SA} - (C_\Phi + m)\cdot f_{\tilde{i}} g_{SA} \tag{16}$$

iii) $\frac{\partial H}{\partial V} = 0$

$$\Rightarrow V^* = \frac{(-C_\Theta - S_\Theta + m)\cdot q_V}{S_V} \tag{17}$$

iv) $\frac{\partial H}{\partial MK} = 0$

$$\Rightarrow MK^* = (-C_\Theta - S_\Theta + m)\cdot q_{MK} - (C_\Phi + m)\cdot f_{MK} \tag{18}$$

The multiplier equation is:

iv) $\dot{m} = rm - \frac{\partial p}{\partial N} - m\frac{\partial[\Theta - \Phi]}{\partial N}$

Taking the first derivatives from equations (8), (11) and (12): [9]

$$\Rightarrow \dot{m} = rm - f + C_N(N) \qquad (19)$$

Where $C_N(N)$ is a marginal cost function (operational costs in terms of members), which shape depends on the extent of economies of scale.[10]

Replacing f by the expression for f* in equation (15):

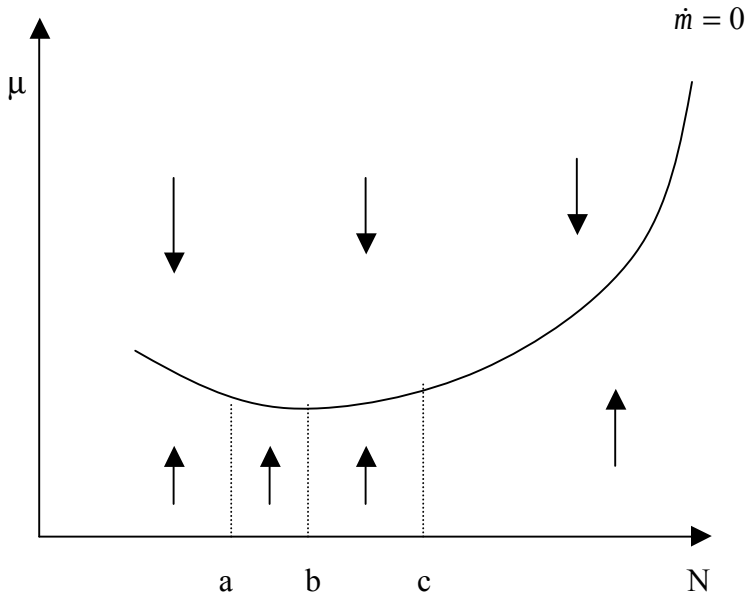
$$\dot{m} = rm - \frac{N}{k_1 + k_2 m} + C_N(N) \qquad (20)$$

With $k_1 = (-C_\Theta - S_\Theta)q_f + C_\Phi f_f > 0$

and $k_2 = -q_f + f_f > 0$

Therefore, the diagram of phase for $\dot{m} = 0$ has the following shape:

Figure 4



[9] $\frac{\partial p}{\partial N} = f - C_N(N)$ and $m\frac{\partial[\Theta - \Phi]}{\partial N} = 0$.

[10] I am effectively assuming separability of the arguments of the C(·) function.

Points a, b and c indicate some referential levels of membership. Up to the scale of membership indicated by point a, $C_N(N)$ is decreasing. Between points a and b, $C_N(N)$ increases but the increase in f* is higher (they increase equally at point b, and $C_N(N)$ increases more than f* after point b). Point c indicates a hypothetical point where economies of scale are exhausted.

It is finally important to note that the position of the $\dot{m} = 0$ curve is *independent* of others firms decisions.

State equation:

v) $\dot{N} = \Theta - \Phi$

In terms of equations (11) and (12):

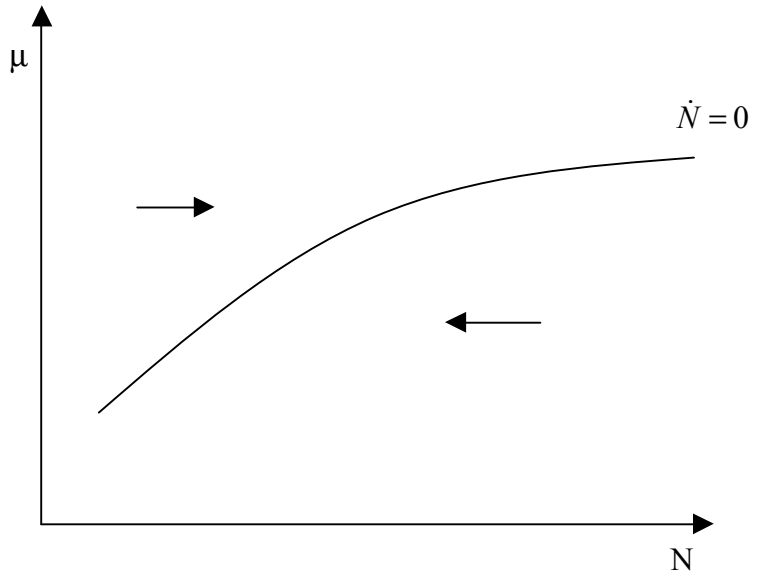
$$\dot{N} = (q_0 - f_0) + (q_f - f_f) f_{jt}^{\,2} + (q_{\tilde{i}} - f_{\tilde{i}})\tilde{i}_{jt} + q_V \ln V_{jt} + (q_{MK} - f_{MK}) \ln MK_{jt} + (q_{\bar{f}} - f_{\bar{f}})\bar{f}_t - f_{\bar{V}} \ln \sum_{i \neq j} V_{it} \qquad (21)$$

Incorporating equations (15) to (18), the unambiguous results is that $\dot{N}$ depends positively on both μ and N (figure 5)

It can be seen that the slope of the $\dot{N} = 0$ curve will be flatter (steeper) if the functions contained in equations (15) to (18) are more (less) sensitive to μ and less (more) sensitive to N. This in turns depends on the way consumers actually make their choices of PFMC, captured by the θs and ϕs parameters in these equations.

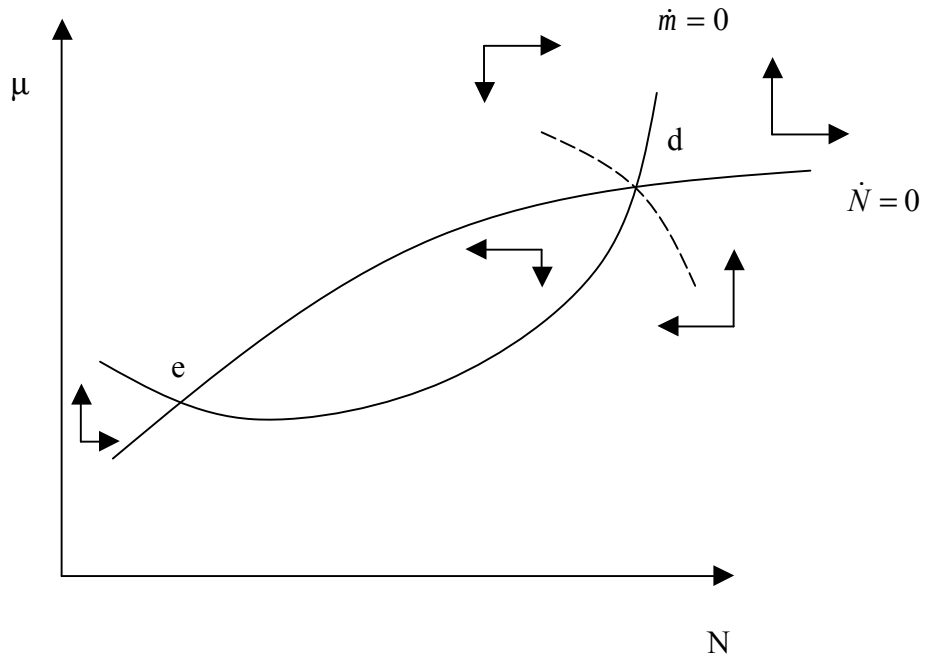
Finally, it is important to note that this curve will shift downwards (upwards) if competitors increase (decrease) the number of their vendors or decrease (increase) fees.

Figure 5



Equilibrium is straightforward. The two lines representing $\dot{m} = 0$ and $\dot{N} = 0$ have two interceptions, marked by points d and e:

Figure 6



Point d is a stable equilibrium. The scale of membership (N) necessary to achieve this point depends on the extent of economies of scale.[11] [12]

The model suggests an important role for the extent of economies of scale, the way consumers make their choices and strategic interaction of firms. The next sections will provide new evidence on all of these points.

3. Data

The data used in this study have multiple sources. First, accounting costs were obtained from a compilation of monthly accounting reports by 12 Chilean PFMCs. Other data series on these PFMCs, such as membership, number of vendors, and so on where provided by the companies themselves. Data on pension funds values and performance have been provided by the Chilean superintendence of PFMCs, the government agency in charge of PFMCs regulation. Finally, data on financial indicators have been provided by the Central Bank of Chile.

The resulting panel consists of monthly data, from 1996 to 2001, for 12 representative companies. The periods in which companies are in operation differ, and therefore the panel is unbalanced. Companies have been selected as to represent the market (system) during this period.

From the costs reported by PFMCs it has been possible to construct series for operational costs (oc), selling costs (sc) and marketing costs (mc).

[11] The stability of point e is ambiguous. It actually depends on the slope of the $\dot{m} = 0$ curve at the interception, which in turns depends on the $C_N(N)$ function. An interesting case is when $C_N(N)$ decreases rapidly, in which case e becomes a point of explosive oscillation.

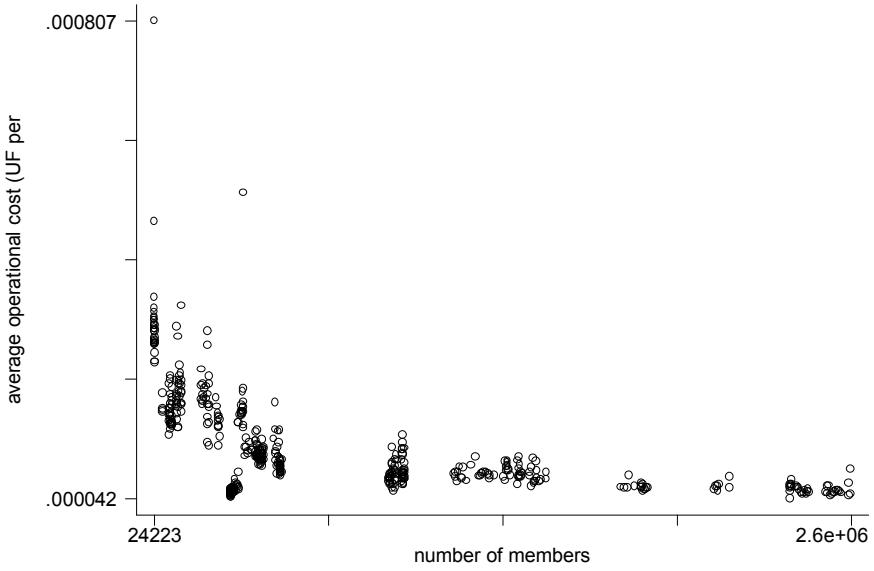
Table 1 describes the original data variables, and table 2 describes the variables as they are used for the regressions (after transformations). Table 3 summarises the basic descriptive statistics for the latter.

4. Results

The available data allows running regressions on some of the central equations of the model presented above. In particular, it will be of interest to explore the possibility of economies of scale in the provision of pension services. If they exist, there are enormous policy implications ranging from the inconvenience of promoting competition to the possibility of reconsidering unified provision, either privately managed or by the state.[13]

Having obtained a series of operational costs, a straightforward plot of average operational costs (per member) against the number of members shows preliminary support for the hypothesis of economies of scale.

Figure 7



[12] It also depends on other companies' strategic variables such as the number of vendors and marketing expenditures

[13] I discuss political economy implications in the next section.

Regressions on the following equation, which accounts for the C(·) function in equation (9), show strong support to the hypothesis of economies of scale.

$$oc_{jt} = a_0 + a_1 \cdot contributors_{jt} + a_2 \cdot cont2_{jt} + a_3 \cdot m_{jt} + a_4 \cdot m2_{jt} + a_5 \cdot rfund + a_6 \cdot rfund2 + a_7 \cdot newmembers_{jt} + a_8 \cdot out_{jt} + e_{jt} \quad (22)$$

The α_2, α_4 and α_7 coefficients represent the slope of the average marginal cost curves. There are economies of scale when the sign is negative. Significance of these coefficients indicates rejection of the hypothesis that there are no economies of scale.

The variables "m" and "rfund" have been incorporated to the model to allow for different quality of membership. The current specification allows estimating marginal costs with respect to contributing members, non-contributing members, and the size of the managed pension fund.[14]

Table 4 displays the results of 3 models of regressions, estimated by using OLS and the Prais-Winsten regression to correct for first-order serially-correlation.[15]

The results obtained show that economies of scale are significant, although they relate more to the number of non-contributing members than to the number of contributing members. These economies of scale can only be assumed, however, within the observed range of membership.

The square of "m" produces better results than the square of total members and the square of contributors. The coefficients of the variables "newmembers" and "out" are insignificant (even with lags). When they approach to significance levels they show negative coefficients. Inclusion of the variable "rfund", measuring the size of the managed pension fund, and its square (rfund2) show significance in a OLS regression,

[14] The variable m is generated as total members minus contributing members.
[15] Serial correlation can be expected since operational costs are the result of ex-ante decisions.

and approach significance while using the Prais-Winsten approach, suggesting that there may also be economies of scale in fund management.

Selling costs

The following regression model accounts for the S(·) function in equation (9), and the assumptions of constant marginal costs made in equations (15) to (18).

$$sc_{jt} = b_0 + b_1 \cdot vendors_{jt} + b_2 \cdot newmembers_{jt} + m_j + u_{jt} \qquad (23)$$

Where the error m_j is an individual effect, included to accounts for different incentive structures for vendors in different PFMCs.[16]

The obtained results are consistent with the model. Table 5 displays two regression models, which have been estimated by both OLS and random-effects GLS regressions.[17]

These obtained estimates on the (average marginal) cost on vendors and newmembers are important, as they allow tracing figures on the costs associated to the rotation of members between PFMCs, and the potential savings associated to a reduction in this rotation.

New members

The final equation that has been possible to estimate with the available data concerns the affiliation of new members. From equation (11), the model of regression is:

[16] For the effects of regressions, this has been assumed to be a random effect, both because the panel is a representative sample, randomly chosen, and because the consideration of a market of vendors makes it suitable the central assumption of the between effect.

[17] These costs are mainly an ex-post result of the independent variables. Therefore, the use of Prais-Winsten regressions would not be appropriate.

$$newmembers = \gamma_0 + \gamma_1 \cdot f2 + \gamma_2 \cdot lv + \gamma_3 \cdot lmc + \gamma_4 \cdot apfee2 + \nu_{jt} \qquad (24)$$

Table 6 shows the results of the various models, estimated by running Prais-Winsten and OLS regressions.[18] Only model (1) correspond to equation 24 and is estimated by both regression methods.[19]

The performed regressions report high statistic significance for the variable lv (log of vendors), while a weak significance for the rest of the variables. These findings support the hypothesis that, in making their decisions, consumers are more sensitive to the likelihood of being approached by a vendor than to the relevant financial information.[20]

The fact that vendors are more effective than information on prices and relative performance have enormous implications on the behaviour of PFMCs and social efficiency in the context of private management.

5. Political economy implications and Conclusions

The empirical results obtained in this study provide evidence of economies of scale in the Chilean privately managed pension system. They also suggest predominance of vendors' influence on how workers choose their PFMC. They finally provide estimates of the average marginal selling cost, associated to the incorporation of new members to an individual PFMC.

[18] Auto-correlation can also be expected as the result of unobserved serially correlated variables, such as the productivity of marketing campaigns.
[19] Models (2) to (5) are specific for one or the other regression method, and are reported to show the effect of eliminating insignificant variables.
[20] Note that the information on current fees and relative performance are only proxies to the relevant information set to make a rational decision on the more convenient pension scheme.

The existence of economies of scale cast doubts on the desirability of promoting competition amongst PFMCs. The existence of a natural monopoly (or oligopoly) has to be contrasted with the benefits of diversity associated to competition.

However, the predominance of vendors' influence on workers choice of PFMC indicates that the potential benefits of such diversity are not clearly transmitted to consumers. Moreover, diversity could also be implemented by allowing the natural monopoly (oligopoly) to manage multiple funds. It is most likely that consumers would receive better quality of guidance in order to choose their best fund within a company rather than between companies.

At the light of the obtained results, an additional disadvantage of competition is represented by the following prisoner's dilemma type situation in which PFMCs are likely to engage. If vendors are the most relevant variable to attract customers, PFMCs are forced to match other companies selling efforts in order to maintain the number of members. In other words, if the influence of the relevant financial variables to make an optimal decision is low, the rotation of members is likely to be faster than the socially optimal level, with the consequent social costs. Figures on these costs and potential savings of a reduction on the rotation of customers associated to an alternative set of rules can be traced from the estimates on average marginal selling costs provided by this study.

The results presented in this chapter cast doubts on the possibilities of the current Chilean system to perform efficiently under its current specification. A features that appears to be particularly critical in the light of our findings is the promotion of competition between PFMCs while restricting these companies to the management of two pensions funds.[21] Although the analysis of concrete changes has not been part of this study, our analysis provides support to the idea of allowing PFMCs to manage multiple funds. At a more fundamental level, evidence of inefficiency in the context of private management casts also doubts on the social convenience of privatising state-managed pension systems.

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[21] The possibility of managing a second fund (and of members to freely opt between the first or the second one) is one of the most recent modifications to the system. The second fund is of lower risk, with the idea of offering a more secure investment portfolio for workers close to retirement age.

Table 1: Description of original series

Variable name	Variable label
operational	operational costs
selling	selling costs
marketing	marketing costs
disandsurv	disbility and survival insurance premium
vendors	number of vendors
return	monthly profitability rate
percfee	percentual fee
allvendors	number of vendors in the system
allmarketing	system's marketing expenditures
contributors	number of contributors
members	number of members
newmembers	number of new members
fund	pension fund balance (nominal)
uf	UF (deflating unit)
safereturn	free risk rate of return (nominal)
areturn	average return (nominal)
apercentfee	average percentual fee

Table 2: description of variables used in the regressions

Variable name	Variable label
oc	operational costs (in UF)
sc	selling costs (in UF)
mc	marketing costs (in UF)
lmc	log of marketing costs
ri	real monthly return
contributors	number of contributors
cont2	square of contributors
members	number of members
memb2	square of members
m	member no contributors
m2	square of m
newmembers	number of new members
out	Number of leaving members
percfee	percentile fee
apercentfee	average percentile fee
vendors	number of vendors
lv	log of vendors
allvendors	number of vendors in the system
rfund	pension fund balance (in UF)
rfund2	square of rfund
rr	real free risk rate of return
rai	real average return

Table 3: Summary of basic descriptive statistics for variables to be used in the regressions

Variable	Obs	Mean	Std. Dev.	Min	Max
oc	482	60.9	42.5	6.8	230.9
sc	482	37.1	30.5	1.7	221.7
mc	482	3.7	4.2	0.0	27.4
lmc	482	0.55	1.47	-3.68	3.31
ri	509	0.50	1.70	-5.40	5.36
contributors	627	330,851	318,037	16,961	1,312,080
cont2	627	2.10E+11	3.52E+11	2.88E+08	1.72E+12
members	627	675,971	672,079	24,223	2,626,043
memb2	627	9.08E+11	1.60E+12	5.87E+08	6.90E+12
m	627	345,120	362,259	5,472	1,440,610
m2	627	2.50E+11	4.52E+11	2.99E+07	2.08E+12
newmembers	620	8,444	8,880	-	43,603
percfee	612	2.8%	0.30%	2.1%	3.7%
apercentfee	864	2.7%	0.25%	2.4%	3.2%
vendors	625	1,030	879	82	3,824
lv	625	6.57	0.88	4.41	8.25
allvendors	864	9,392	6,778	2,435	20,542
rfund	485	155.6	115.1	11.9	454.0
rfund2	485	37406	46928	142	206151
rr	852	0.53	0.16	0.25	1.36
rai	852	0.46	1.68	-4.72	4.85

Table 4: Best regressions corresponding to equation (22)

Independent variable: **oc**

	PRAIS	**PRAIS**	**PRAIS**	**OLS**	**OLS**	**OLS**
	(1)	(2)	(3)	(1)	(2)	(3)
contributors	0.000113 (6.18)	0.000117 (6.44)	0.000125 (11.27)	0.000122 (8.16)	0.000135 (9.37)	0.000134 (18.24)
m	6.19E-05 (4.77)	6.86E-05 (5.4)	5.46E-05 (4.17)	0.000053 (5.45)	5.88E-05 (6.14)	4.55E-05 (5.5)
m2	-4.42E-11 (-4.29)	-5.70E-11 (-9.07)	-4.96E-11 (-6.44)	-3.78E-11 (-4.90)	-5.56E-11 (-12.53)	-4.88E-11 (-10.32)
rfund	0.087291 (1.73)	0.029277 (0.91)		0.092567 (2.30)	0.002033 (0.08)	
rfund2	-0.00019 (-1.54)			-0.00026 (-2.82)		
constant	0.271499 (0.11)	1.828103 (0.76)	9.896048 (4.47)	0.489721 (0.25)	2.950277 (1.70)	9.54192 (6.92)
Number of obs	393	393	482	393	393	482
F	406.16	479.38	384.22	787.65	965.32	1017.02
Prob > F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R-squared	0.8399	0.8317	0.7069	0.9105	0.9087	0.8646
Adj R-squared	0.8379	0.8300	0.7050	0.9094	0.9077	0.8637

PRAIS: Prais-Winsten AR(1) regression
iterated estimates

OLS: OLS Regression

Table 5: Best regressions corresponding to equation (23)

Independent variable: **sc**

	RE	RE		OLS	OLS
	(1)	(2)		(1)	(2)
vendors	0.013144			0.012385	
	(8.28)			(8.26)	
vendors (3 lags)		0.012757			0.012493
		(8.94)			(9.21)
newmembers	0.001389			0.002075	
	(7.27)			(13.02)	
newmembers (1 lag)		0.001478			0.00203
		(8.53)			(13.78)
constant	13.32689	11.89813		10.64813	9.492892
	(5.33)	(4.92)		(8.00)	(7.24)
Number of obs.	476	473	Number of obs.	476	473
Number of groups	12	12	**F(k,N-k-1)**	376.4	417.69
Obs. per group:			**Prob. > F**	0.0000	0.0000
Min	12	12	**R-squared**	0.6141	0.64
Average	39.7	39.4	**Adj. R-squared**	0.6125	0.6384
Max	60	60			
Wald chi2(2)	374.15	424.35			
Prob > chi2	0.0000	0.0000			
R-sq: within	0.4089	0.4396			
Between	0.8501	0.8732			
Overall	0.6085	0.6366			

RE: Random effects GLS regression [22]

OLS: OLS regression

[22] For the effects of testing significance, brackets provide z values.

Table 6: Estimates of equation (24).

Independent variable: **newmembers**

	PRAIS (1)	***PRAIS*** (2)	***PRAIS*** (3)	**OLS** (1)	**OLS** (4)	**OLS** (5)
f2	-7266407 (-1.51)	-1.1E+07 (-2.39)	-6710414 (-1.97)	-5772611 (-2.08)	-6868684 (-3.88)	-6703888 (-3.74)
dr	9.732437 (0.10)			193.794 (1.4)	226.3604 (1.52)	
lv	6764.815 (7.34)	5706.572 (6.15)	5544.227 (7.18)	8081.571 (12.37)	8664.429 (28.64)	8622.013 (28.5)
lmc	195.1408 (0.78)	152.4319 (0.7)		-152.735 (-0.58)		
apfee2	2969250 (0.39)	3587161 (0.46)		-5892079 (-1.23)		
dr (2 lags)						399.676 (2.71)
_cons	-32385.3 (-7.69)	-24020.7 (-5.59)	-22886.1 (-4.34)	-35421.9 (-13.61)	-42194.1 (-20.41)	-42054.6 (-20.27)
Number of obs	408	476	606	408	494	480
F(k,N-k-1)	36.6	31.94	33.86	115.47	279.4	275.31
Prob > F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R-squared	0.3128	0.2134	0.1010	0.5895	0.6311	0.6344
Adj R-squared	0.3043	0.2067	0.0980	0.5844	0.6288	0.6321

PRAIS: Prais-Winsten AR(1)
regression
iterated estimates

OLS: OLS Regression

Appendix 1

Equation (13) captures the notion of a diminishing effect of SA on $\tilde{i}$, to account for exploitable financial market imperfections.

Let us consider $\tilde{i}$ = IRR – r

where IRR = the internal rate of return offered by a PFMC

and r = risk-free return

Since IRR is related to SA (cost of security analysis), there is a similar long-run relationship between IRR and f (fees).

In the short-run, firms might be able to finance an increase in SA with an increase in the number of members (who should be attracted by a higher IRR). However, the number of members of each company would be given in a long-run equilibrium (a la Hotelling) for the firm and the industry. Therefore, other things equal the distribution of offered combinations of IRR and f will consider a linear relationship between f and SA.

Thus, in the long-run higher fees would allow the firm to increase SA and hence IRR. Since the relationship between f and SA is linear in the long-run, the convexity of the locus AB in page 5 is due to the diminishing effect of SA on IRR.

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