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On the relationship between concentration and competition: evidence from the Chilean private pension system

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I use Panzar and Rosse (1987) methodology to estimate the degree of competition among Pension Fund Administrators (PFAs) in the Chilean private pension system for the period 1996 to 2008. The results indicate that the industry can be described as a cartel (or monopoly) during this period. There is evidence that in this industry there is a negative, and statistically significant, correlation between concentration and competition.

Keywords: Panzar and Rosse; concentration; competition; pension system

JEL Classification: D40; G23; L11; O16

I. Introduction

During the last decade, the number of competing firms in several industries of the Chilean economy has drastically decreased. The Chilean private pension system has not been isolated from this trend, and as such it has witnessed a drop in the number of Pension Fund Administrators (PFAs) in the system and an increase in concentration levels. By March of 1996, 15 PFAs were operating in the industry, and this number reduced to 5 by the end of 2008. And while in 1996, the three major PFAs administrated about 54% of the system's funds, by the end of 2008, the three major PFAs administrated about 78% of those funds.

Rising concentration levels have placed the Chilean private pension system under the scrutiny of market analysts and politicians alike. Some reforms have been proposed to mitigate the rising levels of concentration and to increase competition in this industry, such as allowing commercial banks to become players in the system and the creation of a state-owned PFA.

Created in 1981, the private pension system has played a crucial role in the Chilean economy.

According to Corbo and Schmidt-Hebbel (2003), since its creation, the new system has increased national savings by about 2.3% of Gross Domestic Product (GDP). They estimated that 5% of 2001's Chilean GDP level is due to the new system.

Thus, it is relevant to address the issue of competition in the sector, since low levels of competition and efficiency in the system may permanently hinder the economy's growth ability.

This study addresses the issue of PFAs concentration and competition in the Chilean private pension system during the period 1996 to 2008. I investigate whether the PFAs industry concentration has negatively impacted the degree of competition in that sector. I quantify market concentration by using the Herfindhal–Hirschman (*HH*) and 3-Firm Concentration (C_3) indexes and obtain a measure of competition by using the Panzar and Rosse (1987) *H*-statistic. To the best of my knowledge this is the first study using the Panzar and Rosse (1987) method in a private pension system. This is the main contribution of this article: expanding to a new industry a methodology that has been mainly applied to banking systems.

This article continues with a review of the literature on concentration and competition. Section III offers an overview of the Chilean private pension sector during the period. Section IV briefly explains the Panzar and Rosse (1987) methodology. Section V outlines the econometric strategy. Section VI shows the data and results. Section VII concludes.

II. Literature Review

Historically, the level of concentration in a sector has been associated with the level of competition in it. Empirically, the use of indicators such as the *HH* index, the number of firms in an industry and the different measures of market concentration respond to this logic; by measuring concentration I can infer the degree of competition.

Although concentrated markets have been thought to be less competitive, from a theoretical point of view the link between concentration and competition is less than clear. To explain the structure–conduct–performance paradigm, the literature offers two avenues: (i) the Baumol *et al.* (1982) theory of contestable markets argues that it is not the number of incumbents in an industry that determines competition, but the existence of potential entrants; (ii) the efficiency hypothesis (Demsetz, 1973) argues that concentrated industries may not be the result of collusion or lack of competition, but of more efficient firms growing at the expenses of less efficient ones. That is, concentrated industries may be more efficient and thus more competitive than fragmented industries.

Since the theoretical answer to the relationship between competition and concentration is ambiguous, the answer has to come case by case. To do that, Bresnahan (1982) and Panzar and Rosse (1987) derived methods from microeconomic foundations to study competition. Shaffer (1993) applied this approach to study the Canadian banking sector for the 1965 to 1989 period and found that although the system has concentrated, the competition has increased during the period.

Most of the applications of the Panzar and Rosse (1987) approach are focused on banking systems around the world. For instance, see Claessens and Laeven (2003) and Schaeck *et al.* (2009).

III. The Chilean Private Pension System, 1996–2008

In 1981 Chile replaced its pay-as-you-go system for a system based on individual private retirement accounts, where from each worker's salary an amount

is deducted which is deposited in an individual account. These defined contributions are collected and managed by PFAs, which invest them in fixed-income and variable-income securities. Each worker has an individual account and may voluntarily make deposits to the account in order to increase his/her retirement income.

Each PFA charges fees and commissions to each worker for managing the account. Although the law regulates the general structure of the fees and commissions, each company, under the premise that workers can freely choose their PFA, freely sets these.

During the 1996 to 2008 period, the industry witnessed several mergers and exits. By the beginning of this period there were 13 PFAs operating in the industry managing funds for about 11 billion Chilean pesos, which represented about 37% of the country's GDP in that year, and by the end of 2008 the system was composed of 5 PFAs managing funds of about 46 billion Chilean pesos, which represented about 52% of Chile's GDP in 2008 (see Table 1).

The mergers, combined with some exits, have increased concentration levels in the industry. Figure 1 displays the evolution of the *HH* index during the period.

I also calculate the C_3 concentration index, which is shown in Fig. 2.¹

Both the *HH* index and the C_3 concentration index show the same picture: the Chilean industry of PFAs has concentrated during the period under analysis. What is less clear though is whether competition has been hurt because of this trend. Valdes (2005) argued that Chilean PFAs do not compete in prices (fees and commissions) because of government regulation that

Table 1. Number of PFAs and funds managed by the system, 1996–2006

Year	Number of PFAs	Total funds' assets (in million of Chilean \$ of each year)
1996	13	11, 693, 770.46
1997	13	13, 554, 369.21
1998	9	14, 713, 480.33
1999	8	18, 287, 873.81
2000	8	20, 586, 186.90
2001	7	23, 219, 361.79
2002	7	25, 521, 620.58
2003	7	29, 505, 951.33
2004	6	33, 889, 084.67
2005	6	38, 312, 676.38
2006	6	47, 186, 674.98
2007	6	55, 173, 151.91
2008	5	46, 750, 342.20

Source: Data from the Superintendent of PFAs.
Note: PFAs, Pension Fund Administrators.

¹ The C_n index measures concentration by adding up the n biggest market shares in the industry.

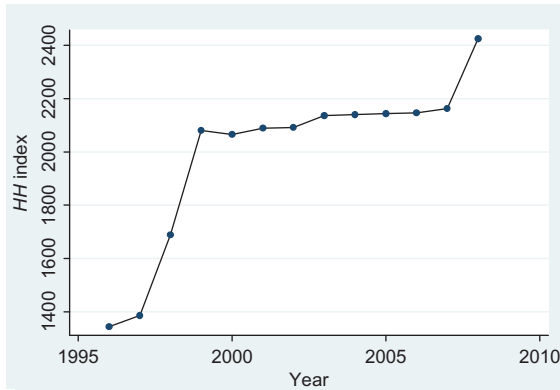


Fig. 1. Herfindhal-Hirschman (HH) index

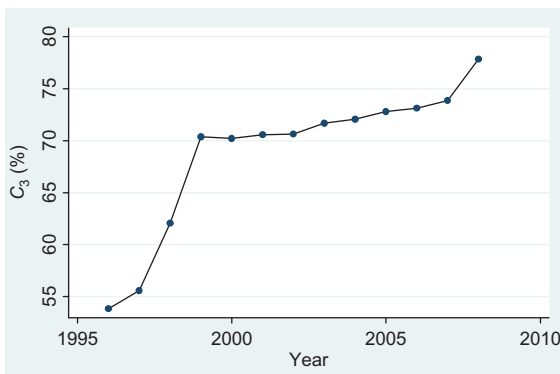


Fig. 2. 3-Firm concentration (C₃) index
 Note: C₃ measures the share of an industry's assets (funds in this case) held by the three largest firms.

does not provide help in comparing among different institutions. Olivares (2008) showed that PFAs tend to replicate asset allocations to exhibit similarities in returns. He argued that the obligation on fund managers to attain a minimum guaranteed return causes them to herd and thus decreases competition.

IV. The Panzar and Rosse (1987) Approach

Panzar and Rose (1987) proposed a test of competitive structure based on the following intuition: under perfect competition and long-run equilibrium, an increase in a variable input's price generates an increase in marginal costs and total revenue of the same magnitude; however, if the market is dominated by a monopoly, the increase in the price of the input will make the total revenue decrease because the monopoly operates

in the elastic part of the demand curve. Thus, Panzar and Rosse (1987) measured the degree of competition based on the impact of a cost's increase on total revenue. If increases in costs are associated with drops in total revenue, the industry behaves like a monopolist. On the contrary, if a change in costs is translated into a change of the same magnitude in total revenue, then the industry is competitive. Panzar and Rosse (1987) developed a test, the *H*-test, which can be econometrically estimated and summarizes this intuition. This approach does not need marginal costs; it only needs changes in costs at the aggregate. Data needed to perform such a test are usually found in the financial statements of firms.

Empirically, Panzar and Rosse (1987) approach consists in estimating the factor price elasticities of a firm's reduced-form revenue equation. The sum of those elasticities, the *H*-statistic, permits a quantitative assessment of the competitive structure of a market. If $H \leq 0$ then the market can be described as a monopoly or as a cartel; if $0 < H < 1$ the market is described by monopolistic competition; and if $H = 1$ the market is described by perfect competition.

V. Methodology

Using panel data at the firm level, most authors estimate a static fixed effect model to obtain the *H*-statistic. However, Goddard and Wilson (2009) show that if the adjustment towards market equilibrium is partial and not instantaneous as it is implicit in a static fixed effect model, then the estimation of *H* suffers from misspecification bias. Using simulations, they demonstrate that a 'dynamic formulation of the revenue equation is required for accurate identification of the *H*-statistic'. Thus, I use the following dynamic panel regression:

$$\Delta \ln(R_{i,t}) = \delta_1 \Delta \ln(w_{1,i,t}) + \delta_2 \Delta \ln(w_{2,i,t}) + \delta_3 \Delta \ln(w_{3,i,t}) + \phi \Delta \ln(R_{i,t-1}) + \Delta \eta_{i,t} \tag{1}$$

where Δ represents a first-difference transformation. By doing that, one can eliminate the individual firm effect; $R_{i,t}$ represents fees and commissions revenue of PFA *i* at time *t*; ² $w_{1,i,t}$ is the ratio of disability and survivorship insurance expenses to pension funds' assets; $w_{2,i,t}$ represents personnel expenses as a fraction of total assets; $w_{3,i,t}$ represents other operating and administrative expenses as a fraction of total assets; and $\eta_{i,t}$ is a random error term.

² Most studies use total revenues divided by total assets (or another scale variable) as the dependent variable. Bikker *et al.* (2006) showed that scaling the dependent variable causes misleading results.

I use the log of equity over total assets ($\ln(e/a)$) as a control variable.³

I estimate Equation 1 through the Arellano and Bond (1991) Generalized Method of Moments (GMM) estimator.

In this setup, the estimator of the H -statistic is given by $\hat{H} = (\hat{\delta}_1 + \hat{\delta}_2 + \hat{\delta}_3) / -(1 - \hat{\phi})$.

VI. Data and Results

Data come from the Chilean Superintendent of Pensions Funds. I have annual financial statements of PFAs for the period 1996 to 2006. Table 2 summarizes the data.

I have a total of 101 observations which after the first-difference transformation results in 71 panel observations available for the estimation of Equation 2. Table 3 shows the results.

The estimated H -statistic is $\hat{H} = -0.2287$ ($p = 0.06$). The null of $H \leq 0$ (monopoly or cartel) cannot be rejected at conventional levels; however, the null that $H > 0$ (monopolistic competition) is easily rejected.

These results indicate that the Chilean private pension industry acted like a cartel during the period under analysis.

I then obtain the H -statistic in an accumulated annual basis in order to observe the evolution of competition during the period. Figure 3 displays the evolution of H obtained in this way.

For the period 1996 to 1998 through the 1996 to 2002 period, the estimated H is not statistically different from 0. Then from the 1996 to 2003 period through the 1996 to 2008 period it becomes negative. Thus, through time, competition in this industry has decreased. It should be reminded that during the same period, concentration in this industry has intensified. The Pearson's correlation coefficient between the annual estimated H and the C_3 concentration

Table 3. Arellano and Bond one-step dynamic panel GMM estimation, 1996–2008

$\Delta \ln(R_t)$	Coefficient	p -Value
$\Delta \ln(w_1)$	0.0291	0.605
$\Delta \ln(w_2)$	0.1199	0.032**
$\Delta \ln(w_3)$	-0.2662	0.000***
$\Delta \ln(R_{t-1})$	0.4878	0.001***
$\ln(e/a)$	0.0667	0.294
Observations/groups	71/9	
Wald test	59.80	
H -statistic	-0.2287	
p -Value null ($H = 0$)	0.062*	
p -Value null ($H \leq 0$)	(0.969)	
p -Value null ($H > 0$)	(0.031)**	

Notes: GMM, Generalized Method of Moments.

*, ** and ***Significant at the 10%, 5% and 1% levels, respectively.

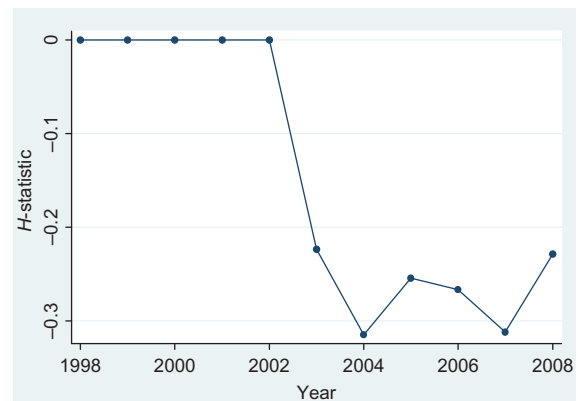


Fig. 3. Estimated (annual) H -statistic

index is -0.6220 ($p = 0.04$), and between the annual estimated H and the HH concentration index is -0.5313 ($p = 0.09$).

To complement this, I run an Ordinary Least Squares (OLS) regression with the annual H -statistic as the dependent variable and the C_3 (HH)

Table 2. Data summary (Chilean pesos) of 101 observations

	Average	SD	Minimum	Maximum
Revenue	4.46×10^7	4.07×10^7	350 097	2.00×10^8
ROA	0.1230	0.2093	-0.8048	0.4732
w_1	0.0039	0.0011	0.0006	0.0079
w_2	0.3243	0.2274	0.0746	1.1789
w_3	0.1770	0.1229	0.0385	0.6798
e/a	0.7208	0.1547	0.1103	0.9457
Pension fund assets	3.75×10^9	3.85×10^9	7.35×10^7	1.7×10^{10}

Note: ROA, Return on Assets.

³ The OLS estimation is $H_t = 1.517 - 0.0232 C_{3,t}$ and $H_t = 0.7922 - 0.0004 HH_t$, respectively. The p -value for null hypothesis of the coefficient being zero is 0.041 for the coefficient on C_3 and 0.093 for the coefficient on HH .

concentration index as the independent variable. In both cases the results indicate a negative correlation. Therefore, in this industry concentration seems to be negatively correlated with competition.

VII. Conclusions

By using the Arellano and Bond (1991) GMM dynamic panel estimation I estimate the Panzar and Rosse (1987) H -statistic to measure competition in the Chilean private pension system during the period 1996 to 2008. The estimated H indicates that the competitive structure of the system can be described as a cartel. I then estimate the same measure in an accumulative annual fashion and find that the degree of competition in the Chilean private pension system has decreased during the same period. Besides, the correlation between the annual H -statistic and two different concentration indexes is negative and statistically significant at conventional levels.

These results corroborate what other authors, for instance, see Valdes (2005), argue about the low levels of competition in the system.

As data prior 1996 become available, this investigation should be expanded in order to improve the robustness of the findings.

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