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SCALE ECONOMIES IN THE PENSION FUND MANAGERS INDUSTRY IN MEXICO: A SEMI PARAMETRIC APPROACH

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Abstract

It has been widely accepted that reforms on pension schemes have led to improvements in the financial viability of the systems. Nevertheless, at the same time it has been shown that fees charged by pension fund managers (PFM) are very high, implying high mark-ups for them and lower expected pensions for the participants. The presence of economies of scale has been suggested as one main reason for the high fees. In this paper we argue that previous studies that have found economies of scale in the case of Mexico were based on cost curves that were empirically not well specified. We estimate a semi parametric cost curve which allows us to conclude that if there exists economies of scale, minimum efficient scales are low, being reached by almost all PFM. The presence or not of economies of scale is highly important to surveillance authorities, since it can lead to different regulatory actions aiming at lowering fees.

Key words: costs, pension funds, semiparametric method.
Classification JEL: C14, D24, L11.

Introduction

In the last decade, many countries have conducted reforms of their pension systems, switching from a defined benefit scheme to a defined contribution system, with private firms competing for the administration of the funds. It has been suggested that these reforms may lead to positive macroeconomic effects. For example, Corbo and Schmidt-Hebbel (2003), for the case of Chile, show that the pension reform in Chile has contributed to the rate of growth observed in the economy. A study of Gill et al. (2004) estimates that the explicit debt of the pension system (in 2050)

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was reduced from almost 95 per cent of GDP to 45 per cent in Mexico, and some analysts have suggested that the investments of assets under management (AUM) has helped to reduce interest rates in the country.

However, there is also evidence that competition has not been as strong as thought and that the fees charged by Pension Fund Managers (PFM), especially in Mexico, are unnaturally high (Whitehouse, 2000, Aguilera, 2004). These high fees may reduce in the long run replacement rates, and thus the benefits that workers affiliated with the system will have. In addition, in countries like Mexico, where there is a minimum guaranteed pension, low accumulation rates may have a negative impact on the fiscal position of governments.

Two main reasons have been given to explain the high fees and the concentration of the industry. On the demand side, it has been said that the elasticity of demand is very low due to a lack of interest of the consumers for a product that they are obliged to buy, that they will eventually (because many people can opt for the benefits under the Law of 1973) use many years from now (Madero and Mora, 2006), and because it is very difficult to understand the pricing scheme and returns, and thus to observe which PFM is the one that provides the best net return.

On the supply side, it has been argued that the industry is characterized by the presence of economies of scale which produces a concentration of the industry by a small number of firms. Previous work has found the presence of economies of scale. García and Rodríguez (2003) and Meléndez (2004) for the case of Mexico, and Apella and Maceira (2004) for the case of Argentina.

The presence or not of economies of scale is very important for public policy decisions. If there are economies of scale, few PFM should exist and all fees should be regulated as proposed by Meléndez (2004). If there are not economies of scale, new firms could enter the market and compete to attract customers from other PFM. In this case, the authorities should work to eliminate any barriers to entry that may exist, and make it easier for consumers to transfer their account to any PFM they want and to improve the decision-making process of workers by more and better information (Aguilera, 2004) or to develop a system in which informed and prepared people decide on behalf of the workers the specific PFM that will best suit their profile (Valdés, 2004).

However, in the last three years many small firms have entered the market, which raises some doubts about the presence of economies of scale. This study will investigate the presence of economies of scale in the PFM industry for the case of Mexico but by estimating a translog semi parametric cost function, which is a more flexible form of the cost function than the one used in previous studies. We use monthly data from May 1997 to September 2006 of Mexican PFM.

The results show, that even if the average cost curve presents an L shape, the minimum efficient scale is reached with approximately 12,000 million pesos or 500,000 affiliates. These numbers are well below those found in the studies of García and Rodríguez and Meléndez. With our results, practically all firms in Mexico have reached the minimum efficient scale.

This paper is organized as follows. The next section briefly describes the Mexican system and reviews the articles that have analyzed the presence of economies of scale for the case of Mexico. The third section explains the methodology used in this study and the results obtained. Conclusions are then entered to summarize.

1. Description of the System and Previous Studies

1.1 Description of the system

In 1997, following the experience of other countries in Latin America, the Mexican pension system for the workers of private sector companies was reformed. A defined benefit scheme was substituted by a defined contributions one, with a solidarity element in the form of a minimum guaranteed pension and a government contribution.[1] The management of individual accounts was contracted out to private PFM. The reform had, among others, the following objectives: i) to improve the financial viability of the system; ii) to increase the long term savings rate of the economy; and iii) to make the system more actuarially fair, that is, to improve the link between benefits and contributions. The goal of this higher link was to produce higher replacement rates for those workers who opted for a longer participation in the formal labor market. See Sales et al. (1997) for a more comprehensive explanation of the reform.

Today, there are approximately 36 million workers affiliated to the system, although only around 40 percent are active workers. The assets of the system now reach 650 billion pesos. After 9 years of the reform, the system has reached positive results in several macroeconomic variables: the assets under management (AUM) are now equivalent to more than 7% of the country's GDP, and the explicit debt of the pension system in 2050 was reduced from almost 95 to 45 per cent of the PIB (Gill et al., 2004). See Table 1.

Although the system is very young, there is some positive evidence on microeconomic terms for Mexico. Aguila (2005) has shown that low income workers have benefited from the reform. The author finds that workers earning up to 5 minimum salaries have a positive effect in the pensions relative to the former system. Roldán et al. (2006) have calculated that in the absence of the reform 13.2 million out of 26.5 million workers upon retirement would not have any rights to receive any benefits in the former system; with the reform these workers can receive some funds during retirement. Finally, James et al. (2005) have proven that in relation to men, women also gained from the reform because despite their own annuities being lower than those of men in the new system, women are now recipients of net public transfers and receive joint pensions.

However, the system has been criticized because the fees which workers pay for account management are very high and, thus, are reducing the expected benefits.[2] Meléndez (2004) argues that the charges made by Mexican PFM are higher than what it would have cost the *Instituto Mexicano del Seguro Social* (IMSS), the public agency responsible for managing pensions in the former benefit system, to handle pension insurance. Aguilera (2004) shows that in 2004 several Mexican PFM were among the most expensive ones in the countries analyzed by the author: Mexico, Chile, Colombia and Peru. CONSAR (2005) shows that with the recent reduction of charges in most of the PFM, the relative situation of the country is being improved, but this situation has not benefited people as much, since general fees in Mexico are still higher than in Colombia, and

[1] The government contributes with a social quota equivalent to 5.5% of the minimum wage of 1997 indexed by inflation.

[2] There is also evidence of high charges for the case of Chile (Valdés 2004).

Table 1
Evolution of the System

	1998	1999	2000	2001	2002	2003	2004	2005	2006 (3)
Assets under management [(1)(2)]	83.63	142.43	199.23	291.08	358.46	429.55	487.62	580.39	648.93
AUM/GDP [(2)]	1.30%	2.08%	2.74%	4.05%	4.72%	5.40%	5.64%	6.41%	7.38%
Affiliates [(2)(4)]	13.8	15.5	17.8	26.5	29.4	31.4	33.3	35.3	36.5
Number of PFM [(5)]	17	14	13	13	12	12	13	15	17
Market share of the biggest [(2)(6)]	16.10%	15.91%	16.07%	14.10%	17.91%	17.87%	17.48%	16.13%	15.31%
HHI [(2)(6)]	0.111	0.111	0.11	0.093	0.11	0.109	0.103	0.096	0.092
Average fee [(2)(7)]	1.47%	1.58%	1.71%	1.78%	1.72%	1.59%	1.55%	1.37%	1.25%

Notes: (1) Billions of Pesos in January 2006 (2) Data for December (3) Data for September (4) Millions (5) yearly average (6) Calculated using affiliates (7) Five year equivalent fee.
Source: www.consar.gob.mx and www.banxico.org.mx.

some PFM charge more than any Chilean PFM. Finally, it is well known that the PFM are among the most profitable companies in Mexico.[3]

This situation has spurred a lot of opinion. In the Mexican Congress, some believe that fees should be regulated, as in the case of Colombia, where a maximum fee exists. Others argue that the State should have its own PFM with very low charges to increase competition.

From a theoretical perspective, high prices can be explained from the supply and demand side. Demand side factors are associated to the inelasticity of demand due not only to the fact that people are not interested in a product they are forced to buy, and which will be consumed in a distant future, but also because people find quite difficult to understand the pricing scheme and returns, which makes in practice, decisions consumers make complicated. This difficulty of identifying prices and returns have make consumers more prone to choose based on sales efforts and publicity. With, Meléndez (2004) identifying the case for Mexico, and Berstein and Ruiz (2003) for that of Chile.

Supply side factors are related to the presence of economies of scale which leads to a concentration of the industry in a few firms, thus softening competition. The presence of economies of scale has been found by García and Rodríguez (2003) and Meléndez (2004) in the case of Mexico, as we will see in detail within the next subsection.

It is true that until 2004 we observed in Mexico a decrease in the number of firms and a concentration of the industry. In Table 1 we can observe that the number of firms in the industry decreased from 17 in 1999 to 13 in 2004. During the same period, the market share of the biggest PFM increased while the HH index decreased.[4] Table 2 presents mergers that have occurred in the

[3] The *Comisión Federal de Competencia* (CFC) (2006) calculated that between 2000 and 2005 the Return Over Equity of the PFM in Mexico was 35.6%.
[4] There exists an upper limit to the market share on affiliates equal to 20%. Nevertheless, CONSAR, the surveillance authority, can allow any PFM to have a higher market share upon request.

Table 2
History of Mergers

Seller	Date of purchase	AUM	Market share	Buyer	Market share before the purchase	Market share after the purchase
Previnter	May-98	305.6	2.30%	Profuturo GNP	11.90%	14.10%
Génesis	July-98	141	0.90%	Santander Mexicano	13.60%	14.50%
Atlántico Promex	September-98	78	0.60%	Principal	2.20%	2.20%
Capitaliza	September-98	31.3	0.20%	Inbursa	2.30%	2.70%
Garante	February-02	2,220.10	8.30%	Banamex	10.10%	18.50%
Zurich	April-03	801.5	2.90%	Principal	4.90%	7.70%
Tepeyac	August-03	935	3.20%	Principal	7.50%	10.70%

Source: www.consar.gob.mx..

industry. Whether there exist economies of scale that can influence the market structure is the object of this study.

1.2 Previous studies

As mentioned before, there are two studies that estimate the cost curve of the PFM industry for Mexico, García and Rodríguez (2003) and Meléndez (2004). Both of which conclude that there are economies of scale.[5] However, we believe the papers are empirically mis-specified and thus their conclusions should be questioned. Moreover, the regulatory changes that occurred in the last three years (which we will discus later) may have changed the cost structure in the industry. For these reasons we believe it is worth re-estimating the cost structure in the industry trying to overcome some of the misspecifications of previous work and using more recent data.

García and Rodríguez (2003) estimate a function in which total costs (the dependent variable) is equal to fixed costs (estimated as the constant of the regression), plus the number of affiliates in a quadratic fashion. They also include the number of "traspasos" (the change of the account from one PFM to another) and the excess rate of return as control variables. This cost function was also used by Chisari et al. (1998). The use of a quadratic cost function, directly estimated or using a transformed translog function, can only have one turning point, hence the typical U-shape of the average cost curve. But, as Humphrey and Vale (2004) have said, imposing the quadratic cost

[5] As mentioned in the introduction, similar results have been found for other countries. See for example Apella and Maceira (2004) for the case of Argentina.

function "can in many cases be considered an artifact" (p. 1673). This reason is enough to question the results of the authors and to look for some new specifications. Meléndez (2004) also points out other limitations of the estimation of García and Rodríguez, including the fact that the prices of the inputs were not included in the cost function.

Meléndez (2004) estimates a translog function. This function has been widely used to estimate cost functions of financial institutions, especially banks.[6] However, some studies such as McAllister and McManus (1993), and Humphrey and Vale (2004), have pointed out the limitations of this functional form when the financial institutions have a different size and product mix, and have stressed the need to use more flexible cost functions in empirical estimations. Since the translog cost function was originally developed as a local approximation to some unknown "true" underlying

Table 3
Summary of Previous Studies

Author	Cost function	Other control variables	Sample	Variable of production: affiliates or AUM	Number of affiliates at which minimum point is reached	AUM at which minimum point is reached
García and Rodríguez (2003)	Linear in fixed cost and quadratic in the production level	Number of "Traspasos" and excess rate of return (from the mean)	Bimonthly II/98 – VI/02	Affiliates	1,081,000	Not estimated
Meléndez (2004)	Translog multiproduct	Prices of inputs, number of "Traspasos", marketing weight in cost, net return (from charges), dummy for relation to a bank. In linear, quadratic and with several interactions	Quarterly IV/98 – II/03	Affiliates and AUM	1,050,000 (1)	180 billions of pesos of 2004 (1)
						250 billions of pesos of 2004 (2)
					1,150,000 (2)	

Notes: (1) For PFM that do not belong to a financial conglomerate, (2) For PFM that belong to a financial conglomerate.
Source: García and Rodríguez (2003) and Meléndez (2004).

[6] See for example Berger and Humphrey (1991) and Noulas et al. (1990). Berndt (1991), and Greene (2003) offer a review of the translog function.

cost function, the argument follows, when extrapolating the local approximation to global data, the translog function may behave poorly when the global behavior of the approximated function differs from its local behavior.

McAllister and McManus (1993) have argued out that the reason why the literature on economies of scale in the banking industry has found different results is due to choice of the range of bank size, and its resulting consequence on the use of the translog function.[7] They show that while the translog gives the usually U-shaped average cost curve, the kernel, fourier and spline estimations give, as the translog cost function, increasing returns to scale for small banks, but contrary to the translog estimates, constant return to scale for large banks. Humphrey and Vale (2004) show that when they use the translog cost function for the Norweigan banking industry, the translog forms and effectively yields an L-shaped average cost curve, while the linear spline and the fourier forms give an M-shaped curve. In fact, McAllister and McManus (1993) concluded that "the globally fitted translog cost function systematically misrepresents cost for certain types of banks, resulting in a specification bias that contributes substantially to the traditional conclusion of decreasing returns to scale among banks above the midpoint of the size range studied" (p. 390).

The problems of the translog cost function that McAllister and McManus have found in the banking system can be present in the estimation of Meléndez.[8] In the sample the different PFM are of very different size and have different strategies that lead to different input mix. Bancomer, the biggest PFM in his sample had 58.9 billion pesos of AUM and 2.6 million affiliates; Capitaliza, the smallest one in the sample, had 182 thousand pesos in AUM and only 61 thousand affiliates. Notice then, as we can see in Table 3, that Meléndez finds that the minimum point of the average cost curve, if measured as affiliates, equals approximately 1 million and fifty thousand accounts for a PFM without a bank (and 1 million, one hundred and fifty thousand for PFM with a bank). The average number of affiliates in the sample of the author is 1,022,000 affiliates for PFM without a bank and 1,540,000 for PFM with a bank. That is, Meléndez results check with the conclusion pointed out by McAllister and McManus that the minimum efficient scale will be close to the average of the range studied.

Finally, it seems troubling that the lowest point of the average cost curve, when measured as AUM in the estimation of Meléndez, equals approximately 17.4 billion dollars (180 billion pesos in 2004). Given also the fact that in several studies for the banking industry in the United States, an industry with higher fixed costs, the authors conclude that the minimum point reached is between 500 million and 10 billion in assets (see for example, Noulas et al., 1990, and McAllister and McManus, 1993).

In addition to the potential estimation problems described above, there has been in the last few years, technological and regulatory changes that have also put in doubt the existence of economies of scale.

[7] Other reason is the fact that the studies ignored the financial capital, an important input required for the intermediation process.

[8] McAllister and McManus (1993) argue that product mix varies across bank size and thus the input mix. It is the use of different input mix by different bank the argument used by the author to criticize estimations with translog specification. PFM do not have different product mix but indeed the have different input mix. For example, small PFM does not have important sales force, while big PFM base most of their acquisition effort in the sales force.

Madero and Mora (2006) describe the regulatory changes that could have affected the cost structure and the demand side. In the past, the PFM had to face high fixed cost of entry associated with the financial requirements to start a PFM. These financial requirements were due to the investment in technology needed to manage the accounts and the investments and because of the large fees paid by the PFM to the government in order to participate in the industry.

The authors mention that the restructuring of the federal rights for supervision and the changes in the corporate governance of PROCESAR - the agency in charge of managing the main process of the system - that occurred in 2004, may have provoked a decrease in the average cost of the industry. In the past, PROCESAR paid a significant amount to the federal government as rights, an amount that was carried over to the PFM as a fixed quota. Moreover, the PFM used to pay directly to the government a fixed quota and a variable one in terms of the number of accounts administered. With the reform, the quota stipulated what they had to pay PROCESAR was reduced significantly and changed to a variable quota. The rights to be paid by PFM, being done so directly to the federal government, maintained its structure with a fixed and a variable quota, but now the latter element is based on the AUM. The authors calculate that the proportion of the payments linked to a fixed quota was reduced from 36% in 2004 to 26% in 2005.

In 2001 and 2002 CONSAR started to assign the cheapest PFM the accounts of people who, at the time of enrollment, had not chosen a manager. This regulatory change allowed the PFM that were willing to have charges among the cheapest users of the system, get an important number of accounts without incurring important promotion expenditures.

Madero and Mora (2006) also point out that important efforts were made, which were aimed at increasing the sensibility of the demand to fees and returns, and to increase the returns. The interventions were: i) an important informational effort, which included, seminars given in the workplace, and massive advertising campaigns, among others; ii) changes to easing the comparison of fees and returns; and iii) deregulation of “traspasos”.

Zepeda and Roldán (2005) mention that in the past only PFM that belonged to a financial conglomerate could exploit the economies of scale in the processes of the system: enrollment, management of accounts, and management of the funds. Today some PFM, specially the small and new ones, outsource some of these processes to firms which allow economies of scale to be exploited and the PFM to make their cost more variable since they pay for the service for the number of processes or AUM administered.

Since 2003, several new smaller PFM have entered the market. As of today there are eleven new PFM since 2002. Only in 2006 have there been five newly authorized PFM (See Table 4). Together with the entry of new PFM, we observe a decrease in the HHI and in the charges as can be seen in Table 1.

2. Empirical Analysis

The potential bias associated to the translog, or any other quadratic parametric estimate of the cost function, and the importance of the confirmation or not of economies of scale for regulatory reasons oblige us to re estimate a cost function for the Mexican PFM with a flexible form. We use a kernel regression technique which comes “closest to the goal of letting the data speak for themselves” (McAllister and McManus, 1993 p. 395).

Table 4
New Entrants to the Market and Market Share
(percent)

New PFM	Date of authorization	Market share as of September 2006	
		Enrollees	AUM
Azteca	February, 2003	3.6	2.3
Actinver	February, 2003	3.1	1.2
IXE	June, 2004	0.5	0.3
Metlife	December, 2004	0.3	1.5
InverCap	December, 2004	1.6	1
Afirme-Bajio	October, 2005	0.6	0.2
De la Gente	February, 2006[1/]	n.a.	n.a.
Coppel	February, 2006	0.2	0
Scotia	August, 2006[1/]	n.a.	n.a.
Ahorra Ahora	June, 2006	0	0
Argos	October, 2006	n.a.	n.a.

Notes: n.a.: not available. 1/ It is expected that they will initiate at the end of 2006.
Source: www.consar.gob.mx.

2.1 A semi parametric model of cost function

We estimate an unrestricted semi parametric translog cost function of the form[9]

$$\log(TC/Y) = f(\log(Y)) + \alpha_1\log(w) + \alpha_2\log(r) + 1/2\,\alpha_{11}\log^2(w) + 1/2\,\alpha_{22}\log^2(r) + \alpha_{12}\log(w)\log(r) + \alpha_{31}\log(Y)\log(w) + \alpha_{32}\log(Y)\log(r) + \alpha_4\log(\text{promotores}) + \delta D + \varepsilon \quad (1)$$

where *TC* are total costs which include the administrative, operating and sales costs, the depreciation and amortization, and the opportunity cost of the invested capital (calculated as the invested capital times the weighted cost of the sources of financing); *w*, and *r* are the prices of labor and capital respectively, and *Y* represents the level of production, which can be the number of affiliates or the AUM. We assume smoothness of the function *f*. In this specification, the output variable Y enters non-parametrically through *f* and parametrically through the interaction terms between output and the price variables.

[9] This type of cost function has been estimated in other studies of economies of scale. See Yatchew (2000).

The model includes also the number of salesmen and one dummy variable for 2003, 2004, 2005, and 2006.[10] The number of salesmen is included to account for the fact the sales cost can change the shape of the cost function (Meléndez, 2004, Braberman, Chisari and Quesada, 1999). The dummy is introduced to test for the regulatory changes that occurred in the system.

As mentioned, the variable *Y* represents the level of production, which can be the number of affiliates or the balance in the pension accounts of each PFM. García and Rodríguez use affiliates, while Meléndez uses AUM and affiliates. The choice of the relevant variable to measure the production level is not innocuous. In theory, it is possible to find no economies of scale in terms of affiliates, but economies of scale in terms of AUM. If most of the variable cost is driven by affiliates, performing the estimation using AUM, which grow at the rate of return for each affiliate and the net contributions,[11] can lead to an scenario in which the cost per affiliate is constant but the cost per dollar administered is declining over time, thus leading to the conclusion that there are economies of scale. The idea of possible economies of scale with AUM but no economies of scale when using affiliates was advanced by Whitehouse (2000).

On the other hand, not all members are the same, they differ in the account balance, in their wages (and thus their contributions), and in the density of contributions; different PFM focus in different market segments. Using AUM will have the same logic as in the banking sector, to make comparable to clients. We estimate both models.

We estimate the model in three steps following Chevalier and Ellison (1997) and Robinson (1988). First we estimate the coefficients α, then we estimate δ and finally we estimate the function *f*. For the first stage, we can gain consistent estimates of a α for each of the two groups of data (before and after 2003) performing kernel regressions of *TC* and each of the regressors on *y* ,and then regressing the residuals on the residuals. The estimate $\hat{\alpha}$ that we use is the weighted average of the α estimated for each category, with the weights given by the sample size.

In the second step, for the sub sample of 2002 and before, we perform a kernel regression of $tc - \hat{\alpha} x$ on *y*, we define this variable as $\hat{g}^0$, and $\hat{g}^1$ representing the kernel regression for the sub sample of 2003 and afterwards. It is possible to calculate consistent estimates of δ using these two functions. In this case we do it by calculating $\hat{\delta} = \hat{g}^1(x_0) - \hat{g}^0(x_0)$ for any point (x_0).

Finally, to get the estimate $\hat{f}$ of the function *f*, we perform a kernel regression of $\hat{y} = tc - \hat{\alpha} x - \hat{\delta}$ on *y*. In this and all kernel regressions we use the kernel Epanechnikov. The standard errors were estimated by performing repetitions.

[10] We also estimated the model replacing the dummy variable with a dummy with the value of one, for the PFM that entered since 2003. Results did not change significantly. Meléndez (2004) differentiated between PFM who belong to and PFM that do not belong to a financial group. We don't complete this, as mentioned by Zepeda and Roldán (2005) the new regulatory changes reduced significantly the possible advantages in terms of economies of scale of PFM, that belong to a financial group.

[11] Net of fees.

2.2 Data

We use monthly data for each PFM that has operated in Mexico. Data comes from the web page of CONSAR, the surveillance authority in Mexico. Data from wages comes from the manufacturer sector published by Secretaria del Trabajo y Previsión Social (Ministry of Labor). For the cost of capital we use the CAPM:[12]

$$r_{it} = rf_t + \beta_i (rm_t - rf_t) \qquad (2)$$

where:

r_{it} represents the cost of capital

rf is the risk free rate. It was approximated by 28 days Cetes.

rm is the monthly market return, approximated by the rate of growth in the price index of the Mexican Stock Exchange.

Unfortunately, there are two missing variables r_{it} and β_i. A usual practice to calculate r_{it} when there is not public information, is to use an estimate of β_i from a firm in an industry with similar characteristics. In doing this it must be recognized that β reflects the leverage level of the firms. Thus, the β should be adjusted to reflect the leverage level of the firm we want to calculate the return. Since in Mexico PFM are not allowed to issue debt the leverage is zero and the β does not vary across PFM. Intuitively this means that all PFM face the same cost of capital. As done by other authors such as García and Rodríguez (2003) we use the β from a telecommunication company and we adjusted it to account that PFM have zero leverage.[13]

The sample goes from May 1999 to September 2006. All variables were indexed to pesos of January 2006 using the Consumer Price Index. The total number of observations was 827.

2.3 Findings

We begin by describing the shape of the estimated curve. As we can observe, there seems to be economies of scale, but these are exhausted quickly. In terms of AUM, the results indicate that economies of scale are almost exhausted at 12,000 million pesos. If measured by affiliates, the estimates display increasing returns to scale, up to values of 500 thousand affiliates and constant returns to scale for larger PFM. See Figures 1a, and 1b.

[12] PFM in Mexico are not allowed to issue debt.

[13] This is the reason why we have just one price of capital for all PFM in equation (1). The beta also coincides with the beta for the life insurance industry in the United States, which we know have been used by some PFM to make the financial projection needed to get authorization by CONSAR to participate in the market.

Figure 1a
Fitted Average Cost Curve, When Product Is Measured As AUM

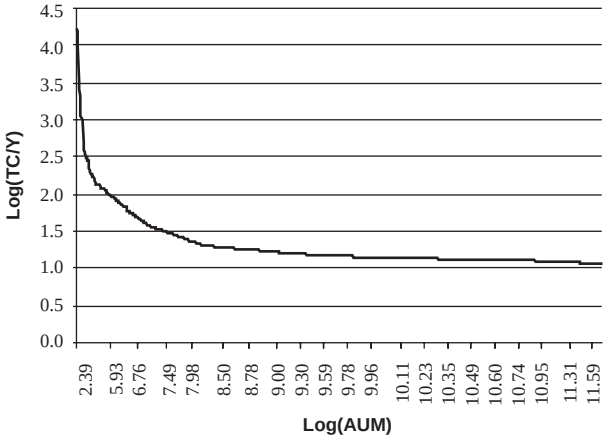
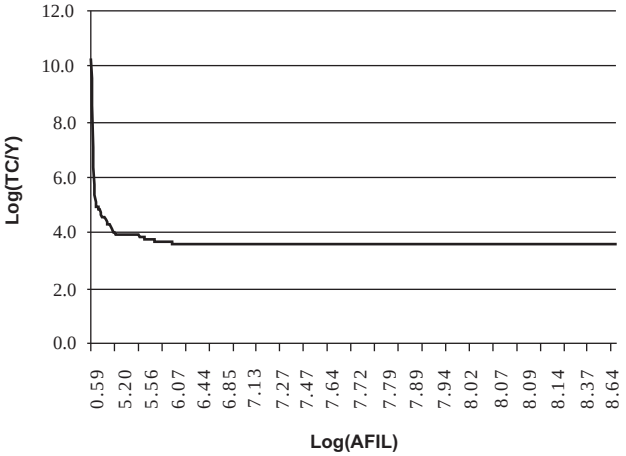


Figure 1b
Average Fitted Total Cost Curve, When Product Is Measured As Affiliates



The results based on the number of affiliates as the production variables are quite different from those of García and Rodríguez (2003) and Meléndez (2004). The results based on AUM contrast even more with the results of Meléndez (2004) in terms of the point where further reduction in average cost is not significant. Under Meléndez estimates, none of the PFM has reached the efficient point. Under our results the minimum efficient scale is reached with approximately 2% of the market share, and only the very new PFM have not reached this point. See Tables 4 and 5.

Our estimates are more consistent with the fact that new small PFM are entering the market.

In order to see if the method of estimation matters, we have also computed a parametric model. Figures 2a and 2b present the average cost curve of the parametric and semi parametric models. As we can observe, the parametric estimates present larger economies of scale. In the case we use affiliates as the production variable it is clear that while the semi parametric results present an L-shaped curve, the parametric model show declining average costs.

Table 5
Number of Affiliates and AUM per PFM as of September 2006

AFORE	Affiliates	Market share (%)	AUM (millions of pesos)	Market share (%)
Actinver	1,138,862	3.12	7,802.17	1.18
Afirme Bajío	229,133	0.63	1,090.90	0.17
Ahorra Ahora	2	0	0.04	0
Azteca	1,311,075	3.6	15,198.63	2.3
Banamex	5,580,375	15.31	122,995.66	18.61
Bancomer	4,186,052	11.48	110,887.84	16.77
Banorte Generali	3,181,130	8.73	43,923.04	6.64
Coppel	58,104	0.16	144	0.02
HSBC	1,766,505	4.85	27,788.44	4.2
Inbursa	3,646,523	10	81,124.65	12.27
ING	2,326,708	6.38	48,503.07	7.34
Invercap	565,777	1.55	6,567.43	0.99
IXE	183,214	0.5	2,253.89	0.34
Metlife	110,110	0.3	9,879.96	1.49
Principal	3,338,429	9.16	29,598.49	4.48
Profuturo GNP	3,438,001	9.43	69,211.54	10.47
Santander Mexicano	3,018,047	8.28	44,556.25	6.74
XXI	2,380,976	6.53	39,533.23	5.98
TOTAL	**36,459,023**	**100**	**661,059.24**	**100**

Source: www.consar.gob.mx.

Figure 2a
Fitted Average Cost Using AUM: Semi parametric and Parametric

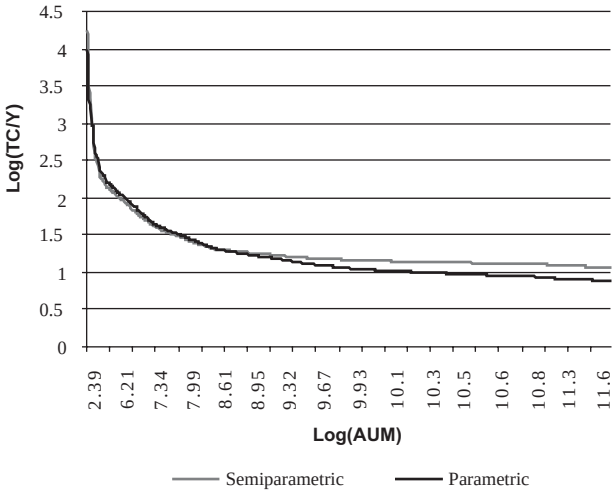
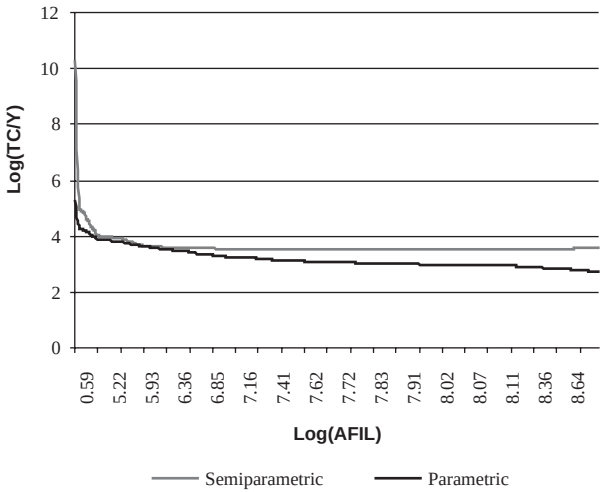


Figure 2b
Fitted Average Cost Using Affiliates: Semi parametric and Parametric



Tables 6a and 6b present the results obtained for the control variables and the standard errors estimated by repetition. The coefficients of wages and price of capital are positive as expected, however only the coefficient of price of capital when the dependent variable is affiliates is statistically significant.[14] The coefficient of AUM*w when product is measured using AUM is negative and significant. The coefficients w*r and affiliates*r when we measure production as affiliates are also significant. In general, we can reject that the cost function is loglinear and homothetic. With respect to the dummy variable introduced in the model, this is negative, implying that average cost since 2003 is lower.

Table 6a
Estimated Coefficients with AUM as Production Variable

Coefficient	Value	Standard errors
W	0.2351	0.20793
R	0.0403	0.03603
½ w^2	0.0822	0.06838
½ r^2	-0.0777	0.06231
w*r	0.0168	0.01442
AUM * w	-0.0625	0.0161
AUM * r	0.0036	0.00369
Salesmen	0.068	0.02527
Dummy 2003	-0.7598	0.07816

Table 6b
Estimated Coefficients With Affiliates as Production Variable

Coefficient	Value	Standard errors
W	0.3349	0.2145
R	0.1475	0.0441
½ w^2	0.1161	0.077
½ r^2	0.003	0.0782
w*r	0.055	0.0126
Affiliates * w	0.0151	0.0233
Affiliates * r	0.0188	0.0042
Salesmen	0.1939	0.0353
Dummy 2003	-0.7657	0.0933

[14] If the coefficients of $Y*w$, and $Y*r$ are zero, the cost function is homothetic. If in addition the coefficients of w^2, r^2, and w*r are zero, then we have a loglinear function.

3. Conclusions and Policy Recommendations

This paper investigates the presence of economies of scale in the PFM industry in Mexico. We estimate a semi parametric model that allows a more flexible form of the cost function, contrary to previous studies that imposed the structure of it.

The results show that when we use AUM as the production variable, economies of scale are almost exhausted with 12,000 million pesos, although marginal cost is always decreasing. When we use affiliates as the production variable, the minimum efficient scale is reached, with around 500,000 affiliates. These numbers are below those found in the studies of García and Rodríguez (2003) and Meléndez (2004). With our results, practically all PFM in Mexico have reached the minimum efficient scale. It is also important to acknowledge that several regulatory changes occurred in the last three years, which may have reduced the average cost as results show.

The existence or not of economies of scale is highly important to surveillance authorities since it can lead to different regulatory actions aiming at lowering charges. If there are no economies of scale, the proposition, based on supply side arguments, that in Mexico we should eliminate the ceiling that a firm cannot have more than 20 per cent of the market, and instead regulate the charges is less convincing. On the contrary, no economies of scale suggest that authorities should work harder to develop more sensible consumers and/or to regulate more directly the process of changing/choosing PFM. Several actions in this line have been suggested by Whitehouse (2000), Valdés (2004), and Aguilera (2004).

The results of this study should encourage more research on this topic. We believe that the estimations that have been completed for the case of Chile and Argentina can be redone using more flexible specifications of the cost structure.

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