

**Performance of Publicly Mandated Private Pension Funds in
Mexico: Simulations with Transactions Cost**

(or, My Pension Fund is Better than Yours: Lies, Damn Lies and Statistics)

Tapen Sinha

Seguros Comercial America Chair Professor
of Risk Management and Insurance
Departamento Academico de Actuaría y Seguros
Instituto Tecnológico Autónomo de México (ITAM)
Rio Hondo No. 1, Tizapan, San Ángel
Mexico DF 01000
MEXICO
email: tapen@gauss.rhon.itam.mx
Phone (52) 5 628 4083
Fax (52) 5 628 4086

Felipe Martínez

CBI Financial Services and ITAM

Constanza Barrios-Muñoz

Grupo Nacional Provincial and ITAM

Abstract:

On July 1 1997, a new privatized but compulsory retirement system came into effect in Mexico. The new system has a complex web of contributions by employers, employees and by the government. The retirement funds also have a complex web of charges applied to the funds. Some funds charge on the flow of contributions, others charge on total balance, and yet others charge on the real rate of return earned. Thus, it is difficult to determine which fund performs the best from the point of view of these individual retirement account holders. We carefully analyze these complex cases to find out which funds perform the best.

In order to perform the analysis, we develop a model of future value calculation recursively. The usual calculation of standard future value formula does not apply for the following reasons. (1) Charges do not apply to contributions to the fund at a flat rate, the rate varies with the number of years in the fund. (2) Charges on the balance of funds do not apply at a flat rate either. (3) Charges applying on the real rate of return of the fund depends on the nominal rate of return as well (for example, if the nominal rate of return is equal or below the inflation rate, there are no charges). (4) Charges do not apply to government contribution to the retirement fund (which is in turn tied to the consumer price index with a lag of three months).

We show through simulations that the optimal strategy for individual retirement account holder is not to stay with one fund throughout the working life. Instead, the best option is to switch at some point. The switching point depends on a number of factors: (1) wage rate of the workers (and also on the growth rate of wages), (2) real interest rate, (3) inflation rate.

1. Introduction

On July 1, 1997, a new privatized but government mandated system of retirement program came into existence in Mexico. This system has private companies operating pension funds. Each company operating a pension fund is called an Administradora de Fondos de Retiro or an AFORE. The investment fund, run by the company is independent of the parent company, is called a SIEFORE (Sociedad de Inversion en Fondos de Retiro). Each worker will have an account with an AFORE. Funds will be generated by accumulation of contributions by the individual and by the yield generated by investment by the AFORE. Thus, the contribution and the performance of the fund will solely determine each person's pension benefit. In this sense, the new system is fully funded. This individual pension scheme stands in sharp contrast with the existing pay-as-you-go scheme run directly by a specific division of the Mexican government: Instituto Mexicano del Seguro Social (IMSS).

The purpose of the paper is to assess the potential performance of the funds under various scenarios. From these results, we can ascertain if there is a "best" fund. In the process of this evaluation, we modify the standard future value formula. We show that we need a recursive formula to evaluate fund performance. This formula can easily be implemented in standard spreadsheet packages.

The rest of the paper is organized as follows: first we discuss the necessity of the new system. In section 3, we set out the basic facts about the new system. In section 4, we discuss the investment regime under which the new system will operate. In section 5, we discuss the so-called four pillars of retirement program and where the new system fits into it. In section 6, we set out our basic model. In section 7, we discuss various issues

on simulation in our model. In section 8, we discuss the results and lessons from the simulation exercise. In conclusion, we discuss advantages and disadvantages of alternative models of privatized pension schemes.

2. Why the New System?

Why did the Mexican government decide to institute these changes in the current retirement system? It was estimated that without any reform, under current regime, *current revenue for the IMSS in 1999 would have fallen short of the current cost in 1999.*

The new system has spawned many AFOREs. So far, 17 AFOREs are operating (although four are merging). Mexican companies (mainly by banks) (wholly) own some. Others have large (although not majority) foreign shareholders (see the next section). They also have a bewildering variety of charges (see section 6). Therefore, except for sophisticated investors, it is difficult to disentangle the effects of various charges and determine which fund offers the best rate of return.

In some ways, the AFOREs had a precursor. In 1992, the government introduced a smaller but privatized scheme called *Sistemas de Ahorro para el Retiro (SAR)*.

The Mexican government has also set up a separate division to oversee the activities of the AFOREs: *Comisión Nacional del Sistema de Ahorro para el Retiro (CONSAR)*. CONSAR has the critical role of overseeing all the activities of the AFOREs. For example, to clarify the roles of the AFOREs, CONSAR has set out general rules of operation of the AFOREs.

The objectives of these institutions will include:

- 1) Open, administer and manage the individual retirement accounts in agreement with provisions in social security laws. Regarding housing-promotion sub-accounts, the AFOREs will register each worker's contributions, and the interest paid thereon, based on information provided by social security institutions.
- 2) Receive, from social security institutions, the contributions made, in accordance with the law, by the government, employers and workers, as well as voluntary contributions by workers and employers.
- 3) Itemize the amounts received periodically from social security institutions and deposit them into each worker's individual retirement account, as with the returns obtained on the investment of these funds.
- 4) Provide administrative services to mutual investment funds. (Banco de Mexico, 1996).

3. Privatized Individual Retirement Plans: Basic Facts about AFOREs

CONSAR, the regulatory body of the AFOREs in Mexico, have issued 17 licenses by the end of 1997. These AFOREs are listed in Table 1.

Table 1: AFOREs authorized by the CONSAR and their compositions

AFORE	Main Shareholders with percentage holding
ATLÁNTICO PROMEX	Banca Promex 50, Banco del Atlántico 50
BANAMEX	Grupo Financiero Banamex-Accival 100
BANCOMER	Grupo Financiero Bancomer 51, Aetna Internacional, Inc. 49
BANCRECER-DRESDNER	Grupo Financiero Bancrecer 51, Dresdner Pension Fund Holdings 44, Allianz México, S. A. 5
BITAL	Grupo Financiero BITAL 51, ING America Insurance Holding, Inc. 49

CAPITALIZA	General Electric Capital Assurance Co. 100
CONFIA-PRINCIPAL	Abaco Grupo Financiero 51, Principal International 49
GARANTE	Grupo Financiero Serfin 51, Grupo Financiero Citibank 40, Hábitat Desarrollo Internacional 9
GÉNESIS	Seguros Génesis, S. A. 100
INBURSA	Grupo Financiero INBURSA 100
PREVINTER	Boston AIG Company 90, The Bank of Nova Scotia 10
PROFUTURO GNP	Grupo Nacional Provincial 51, Banco Bilbao Vizcaya-México, S. A. 25, Provida Internacional, S. A. 24
SANTANDER MEXICANO	Grupo Financiero Invermexico 75, Santander Investment, S. A. 25
SIGLO XXI	Instituto Mexicano del Seguro Social 50, IXE Grupo Financiero 50
SÓLIDA BANORTE	Grupo Financiero Banorte
TEPEYAC	Seguros Tepeyac
ZURICH	Zurich Vida, Compañía de Seguros 77, Gabriel Monterrubio Guasque 10

Note: No mention is made of shareholders with equity participations under 5 percent of the total capital of the respective AFORE

Some of these AFOREs are fully owned by Mexican companies. Other AFOREs are partly owned by foreign companies. For example, AFORE Bancomer is 51% owned by the second largest banking group in Mexico and the rest 49% is owned by Aetna, one of the largest insurance companies in the United States. Garante has the most interesting ownership structure. It has the majority shareholding by a Mexican group, it is partly owned by Citibank and partly by a pension fund from Chile, AFP Habitat. On one hand, the Mexican government was keen to have foreign companies participate in this sector, because foreign participation usually signals a faith in the system. On the other, the government was also keen on keeping the majority shareholding within the country for political reasons. Three of the AFOREs are already on the verge of merging with others. Atlantico has been sold to Confía, Genesis has been sold to Santander and Previnter has been sold to Profuturo.

The ownership question has been clearly dealt with by the Diario Oficial as follows:

The capital of the AFOREs will be made up of Series "A" shares, representing at least 51 percent of said capital. The remaining 49 percent may be made up, singly or jointly, of Series "A" and "B" shares.

Series "A" shares can be acquired exclusively by Mexican individuals and Mexican legal entities whose control and majority of shares are held by Mexicans, whereas Series "B" shares can be bought by Mexicans and foreigners alike. No foreign legal entity carrying out functions of authority may participate in any way in the capital of the AFOREs. Foreign financial institutions may participate, directly or indirectly, in the capital of the AFOREs in accordance with provisions established in applicable international treaties and agreements, and in observance of regulations established by the Ministry of Finance and Public Debt. The last clause gives a definite advantage to the countries of the North American Free Trade Agreement (NAFTA) and to Chile.

It is curious to note that although the CONSAR is clear on ownership rules, it has been ambiguous on the issue of prevention of monopoly rule. It states:

The CONSAR will establish procedures to prevent absolute or relative monopolistic practices resulting from the behavior of individual market participants or due to market concentration. In doing so, the CONSAR will abide by the Economic Competition Federal Act. Accordingly, *no single AFORE may have more than 20 percent of the retirement saving system's market.* Subject to prior authorization from its

Consultative and Surveillance Committee, the CONSAR may authorize greater market concentration ratios, as long as this does not harm workers' interests.

At first, the rule did not specifically state what it meant by "no more than 20% of the market". Later, CONSAR ruled that it meant 20% of the total number of individual accounts (rather than 20% of the market share in terms of value). CONSAR also left the question of some AFORE operating with more than 20% of all individual accounts open by adding the phrase "as long as this does not harm workers' interests."

4. All AFORES are Created Equal: But some are more equal Than Others

At present, AFORES do not have much freedom in choosing their investment portfolios. Basically, all of their investments have to be in the form of government bonds called CETES and price indexed linked bonds (like UDIBONOS).

CETES (Certificados de la Tesorería de la Federación) are peso-denominated money market instruments issued by the Mexican Treasury in 28-day, 91-day, 182-day, 364-day, and occasionally 728-day, maturity. CETES are considered to be the short-term interest rate benchmark in Mexico and, with rare exceptions, are auctioned on a weekly basis. CETES are similar to U.S. Treasury bills, and the two instruments have several important characteristics in common. The market for CETES is the most important capital market instrument available in Mexico. It is also one of the few Mexican capital market instruments with an active futures market: CETES futures are traded in the Chicago Mercantile Exchange.

As a consequence, CONSAR has chosen CETES to be the first instrument for the AFOREs. Because there are CETES of differing maturity, it is possible to get different rates of return on CETES, as the term structure of interest rates does not stay constant over time.

About 35% of total investment by AFOREs has been in CETES. Another 48% in five year inflation indexed government bonds called Bonde91 with 10% in convertible bonds called Udibonos.

Performance of the first six months of operation of the AFOREs has just been published. The second column in Table 2 gives the annualized percentage rate of return of the fund. Given that funds can only invest in a few instruments, it is not surprising that the rates of return are very similar. However, there are two caveats: (1) Inflation rate has been 15.5% and (2) the table does not include any transaction fees that people incur.

Table 2: Fund Performance during the second half of 1997

AFORE	
Atlántico-Promex	20.1
Banamex	19.6
Bancomer	22.0
Bancrecer	14.1
Banorte	23.5
Bitel	21.6
Capitaliza	20.1
Confía-Principal	19.2
Garante	18.9
Génesis	21.3
Inbursa	20.7
Previnter	19.8
Profuturo GNP	21.6
Santander Mexicano	20.8
Tepeyac	21.6
XXI	19.0
Zurich	19.3

Source: CONSAR

Restrictions on the use of financial instruments by the AFOREs have reduced the variability in the before-charges rates of return of the funds. Even then, we observe a range of rates of return.

5. A Brief Review of the "old" system of Government Pensions

To understand the new system, it is necessary to review the existing system of pensions because the contribution rates and the many other aspects of the new system rely on the old. Moreover, the new system only partially replaces the old system.

Before July 1, 1997, Mexico had the old system run by the IMSS (the Mexican Social Security Institute). There were four pillars of this system: (1) Disability, Old Age, Severance and Life Insurance, (2) Maternity and Health Insurance, (3) Workplace Insurance, (4) Child Care Centers. Among these four pillars, only a part of the first pillar is being privatized through the AFOREs. The other three pillars are still going to be operated by the IMSS. In our discussion here, we will not consider the other three pillars of the IMSS at all (see, Banco de Mexico (1996) for further discussions on reform carried out in the other three pillars).

Table 3: Sources of financing the IMSS

Type	% of payroll
Disability, Old Age, Severance and Life Insurance	8.5*
Maternity and Health Insurance	12.5*
Workplace Insurance	2.5**
Child Care Centers	1.0**
Total	24.5

*Each of these divisions require the government, employer and worker to pay: 70% employer, 25% worker and 5% Federal Government

**Fees are paid by employer only

The new system is obligatory to people who enter the workforce on or after July 1, 1997. For people who have already contributed to the old system have a choice: they can still opt for the benefits under the old scheme or they can get benefits from the new scheme whichever is larger. It turns out that for the majority who have contributed to the old system for at least twenty years, will be better off under the old scheme. For others, it depends critically on the rates of return that the new scheme will earn. Thus, there will be additional cost incurred for the people during transition. The cost will rise to up to 4% of GDP during the early part of the next century (see Sales-Sarrapy et al (1996)).

6. Calculating Future Value of AFORE in Presence of Transactions Costs

Developing the model

Essentially, individual retirement benefits are calculated by using a future value formula. However, the simple future value formulas we find in Kellison (1991) or other similar treatment does not deal with some of the complexities we find in the Mexican system: (1) Government contribution to the individual account does not apply every month, and the indexing is also not applicable monthly. (2) Commissions come in three basic flavors (a) commission over the flow of funds, (b) commission over the account balance and (c) commission over the *real* rate of return. In addition, some companies charge commission by combining (a), (b) and (c) (3) In addition, the commissions mentioned in (2) do not stay constant over time. They vary with the number of years one stays in the fund. (4) Income of each individual does not stay constant during his/her working life. Such changes have to be taken into account. For these reasons, the following discussion will be based on a recursive development of the formula for calculating retirement benefits.

What is the right measure of cost?

Because charges apply to different parts of the AFORE, it is not easy to compare charges across AFORES. If we look at the system as a whole, there is a problem of charges when the system starts up. Charges appear too high! In Chile, for example, in 1984, charges amounted to 9% of wages or 90% of contributions to the retirement system (Edwards (1996), p. 17). However, the costs have come down to about 15% of contributions in 1990, (see, World Bank, (1994), p. 224).

For individual AFORES, it makes it difficult to compare across funds. For example, suppose we want to compare the charges for Inbursa and Banamex. Since Banamex charges 26.15% of total contribution up-front but Inbursa charges nothing up front, it may seem like charges for the AFORE run by Banamex is very high. However, charges for Inbursa are complicated because their charges apply to the *real rate of return*, over the long run, it adds up. Thus, it makes little sense to calculate charges as a percentage of total assets in a system that just starts up.

There are several ways to look at the charges: (1) operating costs as a percentage of total annual contribution, (2) operating costs as a percentage of average total assets, (3) operating costs as a percentage of covered annual wages, (4) operating costs as a percentage of affiliates times per capita income.

There are two components of the new system: (1) contribution by the worker, (2) contribution by the government. The contribution by the worker is 6.5% of his or her base wage. The contribution by the government is 5.5% of the minimum salary *indexed*

to the rate of inflation. There are two additional complications: (1) interest rate is calculated for every account every *two* months and (2) indexation of the government contribution takes place every *three* months.

Therefore, we can write the accumulated value in the AFORE as follows in a recursive formula in the simplest case:

$$S_k = \begin{cases} (6.5\% * BW * 2 + GC) * (1 + i_k^{(12)}) & k = 1 \\ S_{k-1} * (1 + i_k^{(12)}) & k = 2i \quad i = 1, 2, \dots, \frac{CP}{2} \\ (S_{k-1} + (6.5\% * BW * 2 + GC)) * (1 + i_k^{(12)}) & k = 2i + 1 \quad i = 1, 2, \dots, \frac{CP}{2} \end{cases}$$

where, the government contribution GC, also called Social Contribution, can be written as follows:

$$GC = \begin{cases} SocC = 5.5\% * MW & k = 1 \\ SocC = SocC * (1 + \pi^{(12)}) & k = 3i \quad i = 1, 2, \dots \end{cases}$$

where MW is the minimum wage and $i_k^{(12)}$ is the nominal interest rate and CP is the contribution period.

There is one peculiar aspect of the formula above: calculation of benefit account uses a *simple interest* rate for the adjustment for one month's rate of return to a bimonthly rate. Therefore, we get the factor BW.2 in the above equation.

Some AFOREs have charges on contribution as a percentage of wages (for example, for Banamex). Others have charges on the balance in the AFORE account

(such as Bancrecer). Still others have charges on the real interest rate (such as Inbursa).

Let CW be the charge on wage (rate). [See Table 4]

Table 4: Fee structure of AFORES

AFORES	Charges on flow each year (% of wages)	Charge on account balance	Charge on real rate of return
Atlantico Promex	1.40%		20.00%
Banamex	0.002 in 1997 0.85% in January 1998 1.70% in March 1998 onward		
Bancomer	1.70%		
Bancrecer Dresdner		4.75%	
Banorte	1.00%	1.50%	
Bital	1.68%		
Capitaliza	1.60%		
Confia Principal	0.90%	1.00%	
Garante	1.68%		
Genesis	1.65%		
Inbursa			33.00%
Previnter	1.55%		
Profuturo GNP	1.70%	0.50%	
Santander	1.70%	1.00%	
XXI	1.50%	0.99%	
Tepeyac	1.17%	1.00%	
Zurich	0.95%	1.25%	

Changing the Formula: Charges

Let CB be the charge on balance. We need to modify the above formula as follows:

$$S_t = \begin{cases} \left(6.5\% * BW * 2 * \left(1 - \frac{CW}{6.5\%} \right) + GC \right) * (1 + i_t)^{2i} * \left(1 - \frac{CB}{12} \right) & k = 1 \\ S_{t-1} * (1 + i_t)^{2i} & k = 2i \quad i = 1, 2, \dots, \frac{CP}{2} \\ \left(S_{t-1} + \left(6.5\% * BW * 2 * \left(1 - \frac{CW}{6.5\%} \right) + GC \right) \right) * (1 + i_t)^{2i} * \left(1 - \frac{CB}{12} \right) & k = 2i + 1 \quad i = 1, 2, \dots, \frac{CP - 2}{2} \end{cases}$$

There is a third element of charges. For two funds (Inbursa and Atlantico) charges apply to the real rate of return. Thus, we need to modify the formula to incorporate that element.

Therefore, if we include charges on the real interest rate, the formula becomes

$$S_t = \begin{cases} \left(6.5\% * BW * 2 * \left(1 - \frac{CW}{6.5\%} \right) + GC \right) * \\ \left((1 + i^{(12)}) * \left(1 - \frac{CB}{12} \right) - \left(\frac{i^{(12)} - \pi^{(12)}}{1 + \pi^{(12)}} \right) * CY \right) & k = 1 \\ S_{t-1} * \left((1 + i^{(12)}) * \left(1 - \frac{CB}{12} \right) - \left(\frac{i^{(12)} - \pi^{(12)}}{1 + \pi^{(12)}} \right) * CY \right) \\ k = 2i \quad i = 1, 2, \dots, \frac{CP}{2} \\ \left(S_{t-1} + \left(6.5\% * BW * 2 * \left(1 - \frac{CW}{6.5\%} \right) + GC \right) \right) * \\ \left((1 + i^{(12)}) * \left(1 - \frac{CB}{12} \right) - \left(\frac{i^{(12)} - \pi^{(12)}}{1 + \pi^{(12)}} \right) * CY \right) \\ k = 2i + 1 \quad i = 1, 2, \dots, \frac{CP - 2}{2} \end{cases}$$

where $\pi^{(12)}$ is the monthly interest rate, and CY is the charge on the real interest rate and $iR(12)$ is the real interest rate

$$i_r^{(12)} = \frac{(i^{(12)} - \pi^{(12)})}{1 + \pi^{(12)}}$$

One assumption made here is that the charges remain fixed for the total life of the system. Charges for each company depends on the number of years a person has been in the AFORE. For example, AFORE Banamex charges 1.70% of wages up to year 4. However, for a person who stays with it for the fifth year gets a reduction in charges.

Thus, year 5 charge becomes 1.68% of wages, year 6 charge becomes 1.66% of wages and so on. This process continues until year 39 with the AFORE with a reduction of 0.02% of wages for every additional year. Hence, our formula needs to take such a reduction into account.

$$S_k = \begin{cases} \left(6.5\% * BW * 2 * \left(1 - \frac{CW * (1-f_i)}{6.5\%} \right) + GC \right) * \\ \left((1+i)^{12k} * \left(1 - \frac{CB * (1-f_i)}{12} \right) - \left(\frac{i^{12k} - \pi^{12k}}{1+\pi^{12k}} \right) * CY * (1-f_i) \right) & k = 1 \\ S_{k-1} * \left((1+i)^{12k} * \left(1 - \frac{CB * (1-f_i)}{12} \right) - \left(\frac{i^{12k} - \pi^{12k}}{1+\pi^{12k}} \right) * CY * (1-f_i) \right) \\ k = 2i \quad i = 1, 2, \dots, \frac{CP}{2} \\ \left(S_{k-1} + \left(6.5\% * BW * 2 * \left(1 - \frac{CW * (1-f_i)}{6.5\%} \right) + GC \right) \right) * \\ \left((1+i)^{12k} * \left(1 - \frac{CB * (1-f_i)}{12} \right) - \left(\frac{i^{12k} - \pi^{12k}}{1+\pi^{12k}} \right) * CY * (1-f_i) \right) \\ k = 2i + 1 \quad i = 1, 2, \dots, \frac{CP - 2}{2} \end{cases}$$

However, f_k is not the same for all funds. For example, AFORE Bancomer offers a rising discount rate starting with 0.01% of wages up to 0.05% of wages.

A More Realistic Representation

There is still one realistic element missing in our formula: growth in wages. In Chile, the average wage rate has grown at a rate of 6% per year over the last twenty years. But, the rise in average wage rate is not important here as it represents the average across many individuals at a given point of time. For individuals, the more meaningful number is the growth of wage rate longitudinally. Therefore, we need to modify our formula thus:

$$S_i = \begin{cases} \left(6.5\% * BW * 2 * \left(1 - \frac{CW * (1-f_i)}{6.5\%} \right) + GC \right) * \\ \left((1+i^{(12)}) * \left(1 - \frac{CB * (1-f_i)}{12} \right) - \left(\frac{i^{(12)} - \pi^{(12)}}{1 + \pi^{(12)}} \right) * CY * (1-f_i) \right) & k = 1 \\ S_{i-1} * \left((1+i^{(12)}) * \left(1 - \frac{CB * (1-f_i)}{12} \right) - \left(\frac{i^{(12)} - \pi^{(12)}}{1 + \pi^{(12)}} \right) * CY * (1-f_i) \right) \\ k - 2i \quad i = 1, 2, \dots, \frac{CP}{2} \\ \left(S_{i-1} + \left(6.5\% * BW * (1 + \Delta s^{(6)}) * 2 * \left(1 - \frac{CW * (1-f_i)}{6.5\%} \right) + GC \right) \right) * \\ \left((1+i^{(12)}) * \left(1 - \frac{CB * (1-f_i)}{12} \right) - \left(\frac{i^{(12)} - \pi^{(12)}}{1 + \pi^{(12)}} \right) * CY * (1-f_i) \right) \\ k = 2i + 1 \quad i = 1, 2, \dots, \frac{CP - 2}{2} \end{cases}$$

where $\Delta s^{(6)}$ is the bimonthly growth rate of wage rate of an individual worker over his or her lifetime. Here, we are assuming that the growth rate is constant. However, because of the recursive nature of the formula, it is easy to incorporate non-linear growth rate in wages. In some countries (Chile, South Korea), the average wage rates have risen by more than 6% in real terms per year. In others (Mexico), the average real wage rate has fallen over the past decade. However, here we should be looking at wage rate for each individual *longitudinally* and not the average wage for the population.

Some Observations on Commissions

Most often in Mexico, commissions are expressed as a percentage of wages and not as a percentage of contribution. Thus, if a person earns 1,000 pesos a month, the actual contribution will be 6.5% of 1,000 pesos or 65 pesos. Hence the charges in some cases will be a straight percentage of that 65 pesos. Out of the 17 AFOREs, 15 charges on the flow of wages. In fact, 8 of them charge only on the wages and nothing else. These companies, therefore, do not have schemes based on

performance of the funds. Regardless of the performance of the fund, charges apply. Clearly, it is easy to make a comparison across those funds: all we have to do is to choose the fund with the lowest charges. In this case, the winner is Previnter with 23.85% of contribution. Note that by international standard even this is very high.

Table 5: Commissions as percentages of contribution

AFORE	Commissions as a % of wage	Charges as a % of contributions
Banamex	1.70%	26.15%
Bancomer	1.70%	26.15%
Profuturo	1.70% plus others	26.15% plus others
Santander	1.70% plus others	26.15% plus others
Bitel	1.68%	25.85%
Garante	1.68%	25.85%
Genesis	1.65%	25.38%
Previnter	1.55%	23.85%
XXI	1.50% plus others	23.08% plus others
Capitaliza	1.50%	23.08%
Atlantico	1.40%	21.54%
Tepeyac	1.17% plus others	18.00% plus others
Banorte	1.00% plus others	15.38% plus others
Zurich	0.95%	14.62%
Confia	0.90% plus others	13.85% plus others
Bancrecer	Charges on balance	Charges on balance
Inbursa	Charges on real return	Charges on real return

7. Issues for Simulation

Several issues need to be addressed before we could go ahead with the simulation exercise. (1) What should be the appropriate rates of return for an AFORE? In this context, we have to make guesses about the rate of inflation and the real rate of return separately because two of the seventeen AFOREs have charges on *the real* rate of return (Inbursa and Atlantico). (2) We have to specify the time path for growth of wage rate for an individual. (3) We have to guess some evolutionary time paths of charges.

Guessing the Evolution of Rates of Return in Mexico

It is a daunting task to predict inflation and interest rates for a country that has seen triple digit inflation rates and negative real interest rates over number of years in the last twenty years (see Figure 1 and Figure 2). Very few forecasters are brave enough to predict these rates past three years (even the Central Bank of Mexico is reluctant to venture into such an exercise!). However, pension schemes are meant for long run benefits. Most workers who are contributing into the system now will not see the benefits until several decades later. Thus, it is essential to work out some possible future paths of rates of return on investment. CONSAR has stipulated that all investment must be made in CETES (short-term government bonds) for now. Even though it is never stated explicitly, most people expect that the rules for investment will be relaxed in the future.

Figure 1: Annualized Monthly Inflation Rates in Mexico 1950-1997

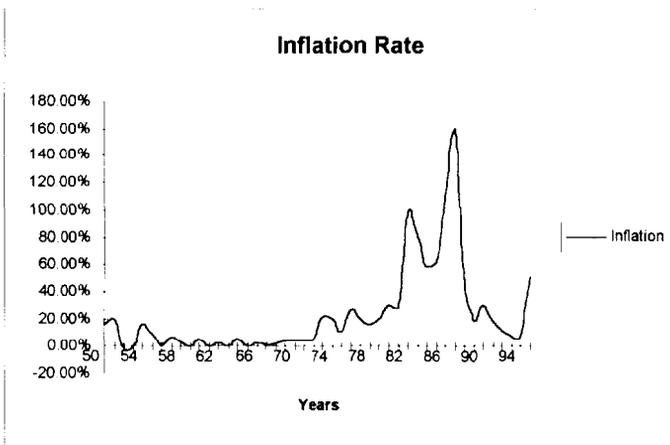
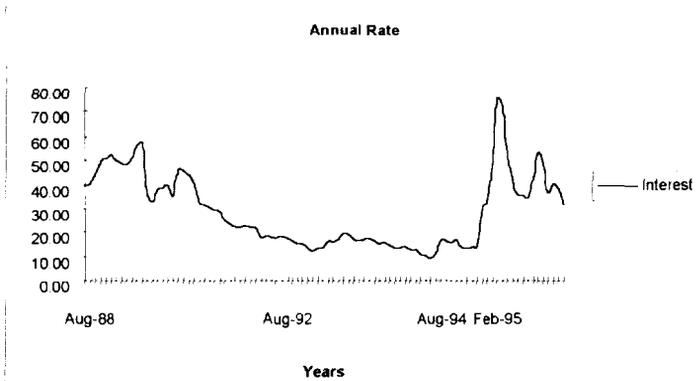


Figure 2: Annualized Rates of Return for CETEs 1988-1997



Source: Banco de Mexico

Scenarios

We decided to run the simulations under three sets of scenarios: fixed interest rate, stochastic but time independent interest rates, and stochastic and time dependent interest rate. Fixed interest rate scenario gives us some benchmark. However, it is unrealistic to expect that the (nominal) interest rate and the inflation rate are not going to change over the next decades in Mexico. A more realistic approach is to assume a stochastic interest rate. To do this, we need to make some assumption about the distribution of the rate of inflation and/or the rate of nominal interest rate. In our simulations, we posit two sets of assumptions: truncated normal distribution and a truncated uniform distribution. We felt that it was unrealistic to assume normal distribution without any modification because the nominal interest rates would not take very large positive or negative values. A study of month to month changes in the (nominal) interest rate shows that they are not independent. There is clear first order autocorrelation. Therefore, we build a model with first order autocorrelation (we use a

model of the following form: $x_t = 0.7x_{t-1} + 0.15 + \varepsilon$, where ε is subject to choice: ε is normally distributed with mean zero and some chosen variance). It is also possible to restrict the maximum and minimum of the distribution in a similar vein discussed earlier.

8. Lessons from Simulations

Discussion of the results

Broadly, the results show that for most income levels, Inbursa performs the best at the beginning. How long does the performance of Inbursa continue? That depends on two primary factors: (1) the real interest rate, (2) the level of income, (3) the inflation rate.

Impact of real interest rate: If the real interest rate is high and stays high (for example, more than 6%), the charges of Inbursa begins to bite within five to ten years. If the real interest rate is low (say, 3%), the performance of Inbursa stays at the top for twenty years.

Impact of income level: If the income level rises, the benefit from staying with Inbursa rises. For example, for people earning the minimum wage, the benefits from Inbursa erodes after ten years. But, for people earning ten times the minimum wage, the benefits from staying with Inbursa stays for twenty years.

Impact of inflation rate: Except for Inbursa, all other funds charge regardless of how well the funds are performing (Atlantico charges on the real rate and the contribution). Therefore, if the inflation rate is equal to the nominal rate of return on the funds, Inbursa will not charge anything. This is not the case for any other fund.

Therefore, variable inflation rate puts a floor value on the charges of Inbursa, but not for the others.

The simulation results show another interesting aspect of the situation: After ten to twenty years (depending on the level of income), it is optimal to switch to a different fund. Which fund to shift to? The answer again depends mainly on the level of income and the level of real interest rate.

Table 6: Different Scenarios with the Real Interest Rate: 3%

Real Rate 3%
 Initial Wage 10 Min Salaries
 Min Salary 768.5

<i>Rates</i>		<i>Time (In years)</i>						
<i>Nominal</i>	<i>Inflation</i>	5	10	15	20	25	30	35
3%	0%	Inbursa	Inbursa	Inbursa	Inbursa	Inbursa	Inbursa	Zurich
		Bancrecer	Bancrecer	Bancrecer	Bancrecer	Bancrecer	Zurich	Inbursa
		Confia	Confia	Confia	Zurich	Bancrecer	Bancrecer	Banamex
9%	6%	Inbursa	Inbursa	Inbursa	Inbursa	Inbursa	Inbursa	Zurich
		Bancrecer	Bancrecer	Bancrecer	Zurich	Zurich	Zurich	Banamex
		Confia	Confia	Confia	Bancrecer	Bancrecer	Banamex	Inbursa
15%	12%	Inbursa	Inbursa	Inbursa	Inbursa	Inbursa	Zurich	Zurich
		Bancrecer	Bancrecer	Bancrecer	Zurich	Banamex	Inbursa	Banamex
		Confia	Confia	Zurich	Bancrecer	Banamex	Banamex	Previnter
21%	18%	Inbursa	Inbursa	Inbursa	Inbursa	Inbursa	Zurich	Zurich
		Bancrecer	Confia	Zurich	Zurich	Zurich	Inbursa	Banamex
		Confia	Bancrecer	Confia	Banamex	Banamex	Banamex	Previnter

Real Rate 3%
 Initial Wage 1 Min Salaries
 Min Salary 768.5

<i>Rates</i>		<i>Time (In years)</i>						
<i>Nominal</i>	<i>Inflation</i>	5	10	15	20	25	30	35
3%	0%	Inbursa	Inbursa	Inbursa	Inbursa	Zurich	Zurich	Zurich
		Confia	Confia	Zurich	Zurich	Banamex	Banamex	Banamex
		Bancrecer	Zurich	Confia	Banamex	Inbursa	Previnter	Previnter
9%	6%	Inbursa	Inbursa	Inbursa	Banamex	Banamex	Banamex	Banamex
		Confia	Confia	Banamex	Previnter	Previnter	Previnter	Previnter
		Bancrecer	Banamex	Previnter	Inbursa	Zurich	Capitaliza	Capitaliza
15%	12%	Inbursa	Inbursa	Inbursa	Banamex	Banamex	Banamex	Banamex
		Confia	Banamex	Banamex	Previnter	Previnter	Previnter	Previnter
		Zurich	Confia	Previnter	Capitaliza	Capitaliza	Capitaliza	Capitaliza
21%	18%	Inbursa	Inbursa	Inbursa	Banamex	Banamex	Banamex	Banamex
		Confia	Banamex	Banamex	Previnter	Previnter	Previnter	Previnter
		Zurich	Previnter	Previnter	Capitaliza	Capitaliza	Capitaliza	Capitaliza

Bases:	Real Rate	3%
	Initial Wage	100 Min Salaries
	Min Salary	768.5

Rates		Time (In years)						
Nominal	Inflation	5	10	15	20	25	30	35
3%	0%	Inbursa	Inbursa	Inbursa	Inbursa	Inbursa	Inbursa	Inbursa
		Bancrecer	Bancrecer	Bancrecer	Bancrecer	Bancrecer	Bancrecer	Zurich
		Confia	Confia	Confia	Zurich	Zurich	Bancrecer	Bancrecer
9%	6%	Inbursa	Inbursa	Inbursa	Inbursa	Inbursa	Inbursa	Zurich
		Bancrecer	Bancrecer	Bancrecer	Bancrecer	Zurich	Zurich	Inbursa
		Confia	Confia	Confia	Zurich	Bancrecer	Banamex	Banamex
18%	12%	Inbursa	Inbursa	Inbursa	Inbursa	Inbursa	Inbursa	Zurich
		Bancrecer	Bancrecer	Bancrecer	Zurich	Zurich	Zurich	Inbursa
		Confia	Confia	Confia	Bancrecer	Banamex	Banamex	Banamex
21%	18%	Inbursa	Inbursa	Inbursa	Inbursa	Inbursa	Inbursa	Zurich
		Bancrecer	Bancrecer	Bancrecer	Zurich	Zurich	Zurich	Inbursa
		Confia	Confia	Zurich	Bancrecer	Banamex	Banamex	Banamex

A quick look at the table above tells us the story about the best performing AFORES when the real interest rate is 3%. For example, the first box in the top left hand corner says that Inbursa is the best performing fund (when the nominal interest rate is 3% and inflation is 0% and a person with income equivalent to one minimum salary leaves his or her money in the AFOR for 5 years). In fact for investment for 5, 10 and 15 years, Inbursa turns out to be the best. However, the scenario changes dramatically after 25 years. Then, the best AFOR with 0% inflation turns out to be Zurich but Banamex leads in other scenarios. This scenario was chosen because the National Development Plan, the Mexican government is projecting a long-term real rate of 3% in Mexico.

Table 7: Different Scenarios with the Real Interest Rate: 6%

Real Rate 6%
 Initial Wage 10 Min Salaries
 Min Salary 768.5

Rates		Time (In years)						
Nominal	Inflation	5	10	15	20	25	30	35
8%	0%	Inbursa	Inbursa	Bancrecer	Bancrecer	Zurich	Zurich	Zurich
		Bancrecer	Bancrecer	Inbursa	Zurich	Bancrecer	Bancrecer	Banamex
		Confia	Confia	Confia	Confia	Confia	Banamex	Previnter
12%	6%	Inbursa	Inbursa	Inbursa	Zurich	Zurich	Zurch	Zurch
		Bancrecer	Bancrecer	Bancrecer	Bancrecer	Banamex	Banamex	Banamex
		Confia	Confia	Confia	Confia	Previnter	Previnter	Previnter
18%	12%	Inbursa	Inbursa	Inbursa	Zurich	Zurich	Zurich	Zurich
		Bancrecer	Bancrecer	Zurich	Banamex	Banamex	Banamex	Banamex
		Confia	Confia	Bancrecer	Previnter	Previnter	Previnter	Previnter
24%	18%	Inbursa	Inbursa	Inbursa	Zurich	Zurch	Zurch	Banamex
		Bancrecer	Confia	Zurich	Banamex	Banamex	Banamex	Zurich
		Confia	Bancrecer	Confia	Previnter	Previnter	Previnter	Previnter

Real Rate 6%
 Initial Wage 1 Min Salaries
 Min Salary 768.5

Rates		Time (In years)						
Nominal	Inflation	5	10	15	20	25	30	35
8%	0%	Inbursa	Inbursa	Zurich	Zurich	Zurich	Zurich	Banamex
		Confia	Confia	Previnter	Banamex	Banamex	Banamex	Zurich
		Bancrecer	Zurich	Banamex	Previnter	Previnter	Previnter	Previnter
12%	6%	Inbursa	Inbursa	Banamex	Banamex	Banamex	Banamex	Banamex
		Confia	Confia	Previnter	Previnter	Previnter	Previnter	Previnter
		Bancrecer	Banamex	Capitaliza	Capitaliza	Capitaliza	Capitaliza	Capitaliza
18%	12%	Inbursa	Inbursa	Banamex	Banamex	Banamex	Banamex	Banamex
		Confia	Banamex	Previnter	Previnter	Previnter	Previnter	Previnter
		Zurich	Previnter	Capitaliza	Capitaliza	Capitaliza	Capitaliza	Capitaliza
24%	18%	Inbursa	Banamex	Banamex	Banamex	Banamex	Banamex	Banamex
		Confia	Previnter	Previnter	Previnter	Previnter	Previnter	Previnter

Bases:

Real Rate	6%
Initial Wage	100 Min Salaries
Min Salary	768.5

Rates Nominal	Inflation	Time (In years)						
		5	10	15	20	25	30	35
8%	0%	Inbursa	Inbursa	Bancrecer	Bancrecer	Zurich	Zurich	Zurich
		Bancrecer	Bancrecer	Inbursa	Zurich	Bancrecer	Bancrecer	Banamex
		Confia	Confia	Confia	Confia	Confia	Banamex	Previnter
12%	6%	Inbursa	Inbursa	Inbursa	Bancrecer	Zurich	Zurich	Zurich
		Bancrecer	Bancrecer	Bancrecer	Zurich	Bancrecer	Banamex	Banamex
		Confia	Confia	Confia	Confia	Banamex	Previnter	Previnter
18%	11%	Inbursa	Inbursa	Inbursa	Zurich	Zurich	Zurich	Zurich
		Bancrecer	Bancrecer	Bancrecer	Bancrecer	Banamex	Banamex	Banamex
		Confia	Confia	Confia	Inbursa	Previnter	Previnter	Previnter
24%	18%	Inbursa	Inbursa	Inbursa	Zurich	Zurich	Zurich	Zurich
		Bancrecer	Bancrecer	Bancrecer	Inbursa	Banamex	Banamex	Banamex
		Confia	Confia	Zurich	Banamex	Previnter	Previnter	Previnter

What happens if we choose a different scenario? Does the ranking change? The answer

is yes. Once again, Inbursa does well for short time periods such as five or ten years.

However, Banamex rules for all the long horizon scenarios. We have also included other

funds in the top three positions. For example for 6% nominal interest rate and 0%

inflation rate, if you keep your money in your AFOREs for ten years, Confia comes out at the top, followed by Zurich and Banamex.

If the real interest rate stays high (say 9%) for a number of years, the advantage of Inbursa erodes quickly as the next set of results show.

Table 8: Different Scenarios with the Real Interest Rate: 9%

Bases

Real Rate 9%
 Initial Wage 10 Min Salaries
 Min Salary 768.5

Rates		Time (In years)						
Nominal	Inflation	5	10	15	20	25	30	35
9%	0%	Inbursa	Bancreecer	Bancreecer	Bancreecer	Zurich	Zurich	Zurich
		Bancreecer	Inbursa	Confia	Zurich	Bancreecer	Banamax	Banamax
		Confia	Confia	Zurich	Confia	Banamax	Previnter	Previnter
18%	9%	Inbursa	Inbursa	Bancreecer	Zurich	Zurich	Zurich	Zurich
		Bancreecer	Bancreecer	Zurich	Banamax	Banamax	Banamax	Banamax
		Confia	Confia	Confia	Previnter	Previnter	Previnter	Previnter
27%	18%	Inbursa	Inbursa	Zurich	Zurich	Zurich	Banamax	Banamax
		Bancreecer	Confia	Confia	Banamax	Banamax	Zurich	Zurich
		Confia	Bancreecer	Banamax	Previnter	Previnter	Previnter	Previnter

Bases

Real Rate 9%
 Initial Wage 1 Min Salaries
 Min Salary 768.5

Rates		Time (In years)						
Nominal	Inflation	5	10	15	20	25	30	35
9%	0%	Inbursa	Confia	Zurich	Zurich	Zurich	Banamax	Banamax
		Confia	Zurich	Banamax	Banamax	Banamax	Zurich	Previnter
		Bancreecer	Banamax	Previnter	Previnter	Previnter	Previnter	Zurich
18%	9%	Inbursa	Banamax	Banamax	Banamax	Banamax	Banamax	Banamax
		Confia	Confia	Previnter	Previnter	Previnter	Previnter	Previnter
		Zurich	Previnter	Capitaliza	Capitaliza	Capitaliza	Capitaliza	Capitaliza
27%	18%	Inbursa	Banamax	Banamax	Banamax	Banamax	Banamax	Banamax
		Confia	Previnter	Previnter	Previnter	Previnter	Previnter	Previnter
		Zurich	Capitaliza	Capitaliza	Capitaliza	Capitaliza	Capitaliza	Capitaliza

Bases

Real Rate 9%
 Initial Wage 100 Min Salaries
 Min Salary 768.5

Rates		Time (In years)						
Nominal	Inflation	5	10	15	20	25	30	35
9%	0%	Inbursa	Bancreecer	Bancreecer	Bancreecer	Zurich	Zurich	Zurich
		Bancreecer	Inbursa	Confia	Zurich	Bancreecer	Banamax	Banamax
		Confia	Confia	Zurich	Confia	Confia	Bancreecer	Previnter
18%	9%	Inbursa	Inbursa	Bancreecer	Zurich	Zurich	Zurich	Zurich
		Bancreecer	Bancreecer	Confia	Bancreecer	Banamax	Banamax	Banamax
		Confia	Confia	Zurich	Confia	Previnter	Previnter	Previnter
27%	18%	Inbursa	Inbursa	Zurich	Zurich	Zurich	Zurich	Zurich
		Bancreecer	Bancreecer	Bancreecer	Banamax	Banamax	Banamax	Banamax
		Confia	Confia	Confia	Previnter	Previnter	Previnter	Previnter

What do we learn from the simulations?

From the simulations, one fact emerges very clearly: There is no single "winning" AFORE under all possible alternatives. However, we can see that under most cases, *there are two or three AFOREs that top the list. Does that mean that an optimal strategy would be to stay with one fund for a number of years and then switch?* In fact, this intuition is borne out by the results. In some cases it requires two or three switches depending on the scenario and the number of years one stays in the system of AFOREs.

9. Conclusions

In this paper, we have compared the performance of funds under various scenarios and showed that the optimal strategy for individuals is to switch funds. The point of switching depends on the assumptions about the scenarios. Moreover, in some scenarios, the optimal strategy is to switch more than once. It is interesting to note that the same model can be used for assessing the impact of taxes if the tax rate varies over the years.

Why did Mexico adopt this model?

Alternatives to the system: The Mexican model is not the only model of privatized pension scheme in the world. In some sense, Mexican model can be viewed as an adaptation of the Chilean model. The Chilean model is the most decentralized model of pension plans in the world. In some sense, it has succeeded in delivering many benefits that privatized pension plans are supposed to. Most policy makers in Mexico are also familiar with the system in Chile and are influenced by it the most. Economists

because of its high transaction cost (see, for examples, Diamond (1994), have criticized the Chilean system. In some ways, the high growth rate in real wages and high real rates of return have obscured high transactions cost for Chile.

When do transactions costs not matter for fund members?

There are two circumstances in which transactions cost or low rate of return becomes obscure: (1) when the wage is growing rapidly, (2) when the contribution rate is increasing rapidly.

In case of Chile, high transactions cost was obscured by the fact that wage rate there grew very rapidly. In addition, the real rates of return on the funds were also very high. Therefore, in a sense, account holders ignored costs because the growths in AFPs balances have been very high.

In case of Singapore, similar growth in funds were observed but for different reasons. There, the rate of contribution grew rapidly (from 11% of salary to 45% of salary) over a period of 25 years. The rates of return on the funds have been low. But, account holders did not protest as their balances grew. In the late 1980s, real wage rate in Singapore grew rapidly. Once again, the low rates of return were masked.

Alternatives to Decentralized Model of Pension

The model adopted by Mexico is not the only model available. Other models have been tried successfully in different countries. Two most cited alternatives are the

Singaporean Central Provident Fund (CPF) model and the employer based Australian-Swiss model (some researchers have lumped all of these models in one basket, for example, Vittas (1994)).

Model 1: One Size Fits All

As the name suggests, CPF model has only one fund. This fund is centralized and totally controlled by the government. The investment by the CPF has been mainly in foreign government bonds and some foreign stocks. The real rate of return for the fund has been less than 3% per year over a period of 25 years. At the same time, the transactions cost has been very low as well. To implement the Singaporean model, people have to have faith in government. Unfortunately, in Mexico (and in other parts of Latin America), the population had very little faith in government. In the past, governments in these countries have not been efficient or open. Therefore, implementing a model with a central and crucial role for the government was not really a viable option.

Model 2: Employer Based Fund

The second model is to adopt the Australian-Swiss model. In this case, each employer (rather than each employee) chooses a fund. Every employee for the employer is then assigned the same fund. In this case, the transactions cost is low. Funds do not have to seek out each account holder. They can concentrate on a few thousand employers rather than millions of employees. Therefore, the costs of getting additional accounts are significantly lower. Actually, in these systems of pension, there is some choice by the superannuation account holders. Each pension fund is floated as a separate entity. In

each entity, the employees (mostly through the unions) choose half of the members of the board of directors, and the employer chooses the rest. Hence, it is possible for workers to have (at least) indirect influence on the fund. However, from the complaints received by the Commissioner of Superannuation in Australia, it seems that many people are deeply dissatisfied with the lack of choice. As a result, new legislation are being considered which would force each superannuation fund to have a menu of at least five separate funds for the employees.

References

- Banco de Mexico (1996) **The Mexican Economy**, Mexico, D.F., Mexico.
- Diamond, Peter (1994) "Privatization of Social Security: Lessons from Chile," **Revista de Análisis Económico** 9 (June): 21-34.
- Edwards, Sebastian (1996) *The Chilean Pension Reform: A Pioneering Program*, National Bureau of Economic Research Working Paper 5811.
- Kellison, Stephen (1991) **The Theory of Interest**, Second Edition, Irwin, Homewood, IL, USA.
- Sales-Sarrapy, Carlos, Fernando Solis-Soberón and Alejandro Villagómez-Amerzcua (1996), *Pension System Reform: The Mexican Case*, Paper presented for the NBER Project on Social Security, June.
- Vásquez, Ian (1997) Two Cheers for Mexico's Pension Reform, **Wall Street Journal**, June 27, 1997.
- Vittas, Dimitri (1994) *Sistema Swiss Chilapore, ¿El Camino Hacia Una Reforma de las Pensiones?* En Antonio Ruezga Barba (ed.) **Administracion Publica y Privada de Los Seguros Sociales en America Latina**, Conferencia Interamericana de Seguridad Social, Mexico DF.
- World Bank (1994) **Averting the Old Age Crisis**, Cambridge University Press.
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