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A multifactor test to probe the homogeneity and lack of competitiveness of type 4 *SIEFOREs*

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Resumen: En el presente trabajo realizamos un análisis del desempeño de las SEIFOREs tipo4 al realizar una regresión multivariada de los rendimientos pagados por las SIEFORES tipo 4 contra un índice de desempeño de las SIEFOREs tipo 4 y uno de todo el sistema de pensiones. Hemos realizado esto con el fin de probar la presencia d homogeneidad en los resultados de desempeño de las SIEFOREs estudiadas. Con el mismo encontramos evidencia econométrica que demuestra que no existen incentivos para pagar mayores rendimientos, así como la presencia de rendimientos estadísticamente iguales. Con nuestro análisis sugerimos y damos guías que permiten suponer que la política de inversión es la causa potencial de esta homogeneidad y que la misma es la causa potencial de la falta de competitividad entre SIEFOREs que lleva a una decisión desinformada y ruidosa por parte de los ahorradores.

Palabras clave: Fondos de pensiones, Decisión informada, Selección de portafolios, Competitividad, homogeneidad en el desempeño.

Abstract: In the present paper we test the performance of type 4 SIEFOREs by performing a multifactor analysis of the returns paid by this pension funds against a type 4 SIEFORE benchmark and an "all" SIEFORE performance benchmark. We do this in order to test the presence of homogeneity in the management of the studied SIFOREs and we found Econometric evidence that show that there is no performance incentives and statistically equal returns paid by these SIEFOREs. Whit this analysis, we suggest and give guidelines to note the investment policy as a potential cause of this result and we note that this homogeneity is also the potential cause of the lack of competitiveness that contributes to noisy and uninformed investment decisions among pension savers.

Keywords: Pension funds, Informed decision, Portfolio selection, Competitiveness, Performance homogeneity.

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Introduction

The Mexican pension fund system was a defined benefit one until, in the decades of 1980 and 1990, the Mexican Government had financial pressures from three main sources: first from the age composition among active and retired workers, second the liability of pension payments that increased from a 40% of the minimum wage to 100% in 1995 and a small contribution from the workers of 8.5% compared to the 23.3% needed[2], third, the suggestions made by the IMF and World Bank in order to have financial aid during the 1994 Mexican financial crisis.

In order to solve this pressure the Mexican government changed its State pay as you go system into a defined benefit one with personal pension savings accounts and a warranted pension if the worker reach at least 1,250 weeks as active worker. With this reform in mind, all the retirement liabilities were reduced dramatically and the personal pension savings accounts are now managed as mutual funds, known as SIEFOREs[3]. They are managed by external or third party portfolio managers known as AFORES (the acronym of Administradora de FOndos para el REtiro). This reform is similar to the one made by the Chilean government in the decade of 1980 and it is intended to create one of the main savings vehicle in Mexico by investing the pension proceedings in fixed income and money market instruments, along with stocks and commodities.

Since 1997, the Mexican pension fund system and its investment policy have been supervised by the regulatory authority: the CONSAR[4]. At March 2008 the CONSAR allowed the SIEFORES to work in a "*life cycle*" scheme where 5 type of SIEFOREs were managed with investment policy that allow to invest in Mexican and foreign securities, such as equities, real state investment trusts and commodities. Finally, in 2013 the five types of SIEFOREs were reduced to 4 with the investment policy given in table 1.

[2] For a more detailed review fo the causes that lead to pension system reform, please refer to Sales et. al. (1998).

[3] The acronym in Spanish of pension savings mutual fund or "Sociedad de Inversión Especializada en FOndos para el REtiro" (SIEFORE).

[4] Acronym of "Comisión Nacional del Sistema del Ahorro para el Retiro" o "National Pension Savings Comossion"

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Table 1. The investment policy allowed by CONSAR.

Asset type investment levels (min/max)	***Type 1 SIEFORE (SB1)***	***Type 2 SIEFORE (SB2)***	***Type 3 SIEFORE (SB3)***	***Type 4 SIEFORE (SB4)***
Mexican Government Fixed Income securities	(51%/100%)	(0%/100%)	(0%/100%)	(0%/100%)
Mexican corporate sacurities	(0%/100%)	(0%/100%)	(0%/100%)	(0%/100%)
Mexican equity market	(0%/5%)	(0%/25%)	(0%/30%)	(0%/40%)
Sovereign and corporate global bonds (including Mexican UMS)	(0%/100%)	(0%/100%)	(0%/100%)	(0%/100%)
Global equity markets	(0%/5%)	(0%/25%)	(0%/30%)	(0%/40%)
Commodities	0%	(0%/5%)	(0%/10%)	(0%/10%)
Foreign securities investment levels	(0%/20%)	(0%/20%)	(0%/20%)	(0%/20%)

Source: *CONSAR (2016).*

As noted, the investment policy (since the beginning of the reform in 1997) suggested the presence or induction of a sort of "homogeneity" in the performance of the SIEFOREs that could translate into a lack of competitiveness. Since the inception of this new pension system in Mexico, several studies have been made in order to test the historical origins of the aforementioned reform and also to tests the improvements that could be made to enhance the economic impact and welfare of pension savers. Among all these that will be mentioned in detail in the literature review section, we want to note the aforementioned one of Calderon-Colín et. al. (2009) who found, as previously told, that the pension investment decision (i.e. the SIEFORE selection) is noisy and uninformed, leading to fund demand inelasticity that is the key concept that motivates this paper. With their results and tests, they observe that Mexican pension savers decide to invest in a pension fund (SIEFORE) not because it is among the best performers (in a return or risk-return profile); but by the influence of big marketing efforts or "institutional issues" like the fact that the selected SIEFORE is part of a big financial institution or an insurance company (suggesting "*back to back*" practices).

This last result is the one that inspires the current research along with the one of Guillen (2011). Here we want to check if there are SIEFOREs type 4 that outperform the other ones in the market

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by paying positive and statistically significant alpha against their investment style peers or against all the SIEFOREs in the market. If we don't find evidence of positive alphas, there would be proofs that the SIEFORES have homogeneous performance and therefore, there are no incentives to change of SIEFORE (i.e. an inelastic demand).

Once that we have presented our main research aim, we structured the paper as follows: in the next section we present a non-exhaustive literature review of the studies related to the Mexican pension fund system and some other related studies to the present one. After this, the third section describes the data selection and processing and also presents our main findings. Finally we continue with our conclusions and main suggestions for further research in the subject.

Literature review

As one of the first studies in Mexico Sales et. al. (1998) made a review of the Mexican pension reforms and suggest the strongest causes that lead to it. Once these reforms were made, Albo et. al. (2007) made their mathematical projections (with actuarial models) and studied the replacement rate. Their analysis leads them to suggest six key actions to enhance the financial stability of the Mexican pension system:

1. To create a universal pension system that substitutes the actual one made of a set of pension plans that includes the studied IMSS one and also the private ones, the ones given by public universities, the army and so forth.
2. To increase the contributions to the pension plan in two ways: first with a higher contribution form the base salary and, second, by extending the coverage to other non-formal workers (workers in businesses that do not pay taxes and social security) and also to independent entrepreneurs such as merchants, doctors, business owners and alike.
3. To strengthen the participation of workers in the IMSS pensions system by reducing the 1,250 week to have a guaranteed or defined pension to 900. This with care of the financial health of the pension plan by guaranteeing a 50% pension if the worker has 900 weeks.
4. To make a solidary extra contribution from the Mexican State to the retirement account i.e. The Mexican state must contributite *vís a vís* the retirement amount with the worker in her pension savings account (today it happens only with some of the social security ex-pension savings contributions).
5. To increase the performance i.e. the return paid by SIEFORES by allowing a more flexible investment policy (one that allows proper but more flexible risk limits).

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6. To increase a financial culture among pension savers, leading to a higher contribution from them and a more informed investment decision of their proceedings.
7.

Among these, the last two are the ones of interest for us by the fact that a higher degree of competitiveness among SIEFOREs (due a proper informational efficiency between SIEFOREs and savers) could guarantee a better performance, better return for pension savers and, as a final result, more stability to the financial and economic stability of Mexico.

Following Albo et. al. (2007), we found the work of Calderon-Colin et. al. (2009) that, as previously stated in the introduction section, is the one that motivates the present one. As we stated previously, these authors found evidence of a lack of demand elasticity, given a noisy and uninformed investment decision made by pension savers and also a lack of performance incentive. This last result motivates our paper by the fact that we want to find evidence of homogeneous performance (lack of alpha) between all the SIEFOREs as porrf of the lack of competitiveness among funds.

With this brief literature review, we want to test whether there is homogeneity in Mexican pension funds' performance and to signal this as a possible cause of a lack of competitiveness. With this in mind we will review the performance of the SIEFOREs type 4 by the fact that they have the most diversified and risky investment parameters of all. A situation that should lead to a clear heterogeneity.

Methodology

Data processing

In order to test if there is homogeneity in the performance and also a cause of noisy investment decision in the Mexican pension funds, we will use the historical data of the price of the stocks of the SIEFOREs type 4. By the fact that some of the SIEFOREs have merged with another ones we will use the historical daily price of the SIEFOREs shown in table 2 from February, 24 2005 to November, 30 2016 in order to avoid survivor bias and time series with heterogeneous length.

Table 2. List of SIEFORES in the Sample.

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Azteca	Inbursa	Principal	XXI Banorte
Banamex	Invercap	Profuturo GNP	
Coppel	Metlife	SURA	

Source: CONSAR (CONSAR, 2016).

Following this, we found in CONSAR (CONSAR, 2016) the historical value of the performance index of each SIEFORE calculated given the net asset value of the existing SIEFOREs in each type of SIEFOREs and a performance benchmark of the net asset value of all the SIEFOREs. For the benchmarks of each SIEFORE type we denoted the specific SIEFORE type 4 benchmark as SB4. For the benchmark of all the SIEFOREs we simply labeled it as the "all" benchmark in our analysis. We decide to use these benchmarks, in contrast to De la Torre et.al. (2015 a; 2015 b) who use the minimum variance, the Max Sharpe or the target position portfolios. Our decision is based by the fact that these net-asset value benchmarks measure the net performance of the SIEFOREs and not the theoretical portfolio. As previously stated, our first aim is to test the homogeneity in the observed results among SIEFOREs instead of testing the performance of each against a theoretical portfolio.

We also tested, in a second factor model, the performance of each SIEFORE of each type against "all" SIEFOREs (by using the "all" SIEFOREs benchmark) because this last benchmark incorporates the performance of all the pension funds in the system. We perform this last test because we want to go in line with Martínez and Venegas (2014) who found underperformance of the type 2 SIEFORES if they incorporate skewness and ARCH effects in the volatility. Finally we wanted to test, in a third model, each SIEFORE against both benchmarks (the SIEFORE type and the all one) to see if there is alpha generation by tacking into account the homogeneity given by the investment policy of each SIEFORE and to check if there is alpha generation, given the potential homogeneity between SIEFOREs in each type and in all the system.

In order to process the data we used the historical stock-market prices of the SIEFORES and the historical values of the benchmarks. With this data, we calculated their continuous-time price variation at time t with the next expression:

$$r = \Delta\%\left(P_{i,t}\right) = \log\left(P_{i,t}\right) - \log\left(P_{i,t-1}\right) \quad (1)$$

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Once that we calculated these return values, we ran the three aforementioned factor models. The first one that explains the relation and influence of the SIEFORE type benchmark, the second one with the all benchmark and a third one with both benchmarks as stated in the next functional forms:

$$\Delta\%\left(P_{i,t}\right)=\alpha+\beta\Delta\%\left(SB1_{t}/SB2_{t}/SB3_{t}/SB4_{t}\right)+\varepsilon_{i,t} \quad (2)$$

$$\Delta\%\left(P_{i,t}\right)=\alpha+\beta\Delta\%\left(All\right)+\varepsilon_{i,t} \quad (3)$$

$$\Delta\%\left(P_{i,t}\right)=\alpha+\beta_{1}\Delta\%\left(SB4_{t}\right)+\beta_{2}\Delta\%\left(All_{t}\right)+\varepsilon_{i,t} \quad (4)$$

In the previous expressions, $\Delta\%\left(SB4_{t}\right)$ is the continuous-time return of the SIEFORE type benchmark, is the continuous-time return $\Delta\%\left(All_{t}\right)$ of the "all" SIEFOREs benchmark, β_{1} and β_{2} their corresponding sensitivities or systemic risk indicators[5] and $\varepsilon_{i,t}$ is the residual or continuous-time variation attributed to unexplained factors in (2), (3) or (4)[6].

Once that we made these analysis, we calculated (3) in a recursive manner with data from February 24, 2005 as t_{0} and an increasing monthly time window with T=February 28, 2006. With this recursive analysis we check for the robustness of the alpha generation and our findings related to the potential homogeneity in the performance of pension funds (independently of their investment style or risk-return trade off). We also observed historical values of $p(\alpha)$ and β_{2}. Once that our data-processing method is given, we will proceed to review the results of type 1 SIEFOREs.

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[5] This definition is consistent with the multifactor models that are an extension of the classical (mono-factor or hole market factor) CAPM models (please refer to Merton (1987) or Bodie et. al. (2014)). β_{1} measures the specific type SIEFORE systemic risk for the market of the specific SIEFOREs (such as type 4 SIEFOREs) and β_{2} measures the performance of all the SIEFOREs of all the types in the market of SIEFOREs. That's why we say that β_{1} and β_{2} are systemic risk factors. The first measures the systemic risk corresponding to the SIEFORE type subset and the second one the all system risk (of all the subsets or types together).

[6] It is important to mention that $\varepsilon_{i,t}$ is different in equations (2) to (4) despite the fact that they are the term for the residual or the stochastic part of the equation. A simple and light review of these equations denotes that $\varepsilon_{i,t}$ in (4) has a more "clean" or white noise behavior because the residual is due to external factors and it incorporate the influence of the all SIEFORE system influence and the one of the specific type (or specific SIEFORE type investment policy). In (2) or (3) $\varepsilon_{i,t}$ is also the residual but it includes either $\Delta\%\left(All_{t}\right)$ or $\Delta\%\left(SB1_{t}/SB2_{t}/SB3_{t}/SB4_{t}\right)$ respectively. Therefore the values of $\varepsilon_{i,t}$ in (2) to (4) are different by the fact that (2) and (3) are specific cases of (4).

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Data analysis

In table 3 we present the results of the factor models made with (1) to (3). In panel a) of that table we show the values of α, β_1 and β_2, along with their respective probabilities. As noted, only two SIEFOREs (Invercap and Metlife) had a significant but negative α. Also Inbursa shows a significant and positive value but, in general its historic performance has been low as figure 1 suggests. As noted in that figure, the performance of Inbursa suggest a behavior of a "fixed income" instrument with very low volatility, given a low beta (only 0.1807) and a possible lack of competitiveness in this specific case, given a low attachment to the investment policy as the R-squared value suggest (0.1551 against a mean value of 0.7172 of all this type of SIEFOREs).

Therefore, with the exception of Inbursa who had a different performance than all the studied SIEFOREs and also a lower volatility (as the box plot of figure 1 shows), practically all the SIEFOREs had a similar performance, suggesting a factual homogeneity in their behavior and a lack of alpha generation. This result shows that there is practically a similar performance in all the SIEFORES even if, in the short term, some present over-performance (please compare the performance of this SIEFORE type benchmark –black doted line- against the SIEFOREs and also against the "all" system benchmark).

This sort of homogeneity can be advised in the β_1 values i.e. the β values of each SIEFORE against their competitors. The mean value is **1.4477** with significant values surrounding 1. So if we find homogeneous values, we attribute this finding to a lack of incentive to enhance performance. So, the SIEFORES in this case are no competitive and the selection by investors is not made by means of a good performance but due to other external and different factors than the return paid. A potential cause could be the investment policy allowed by CONSAR.

Table 3. Performance results of the type 4 SIEFOREs in the three factor models.

SIEFORE type 4 benchmark factor model								
SIEFORE	***a***	***b1***	***b2***	***p(a) %***	***p(b1) %***	***p(b2) %***	***s(e)***	***Adj. R-Squared***
Azteca	(0.0455)	1.1774		32.6707	0.0000		0.0458	0.8528
Banamex	(0.1945)	1.6133		12.0988	0.0000		0.1942	0.7840
Inbursa	0.3999	0.1807		0.0000	0.4601		0.3987	0.1551
Invercap	(0.5337)	2.1308		1.6189	0.0000		0.5324	0.7393
Metlife	(0.2411)	1.6089		1.3242	0.0000		0.2406	0.8266

Principal	(0.1651)	1.4448	5.0843	0.0000	0.1648	0.8427
Profuturo GNP	(0.1772)	1.6657	16.4490	0.0000	0.1771	0.7761
SURA	(0.1981)	1.6663	13.4837	0.0000	0.1979	0.7694
XXI Banorte	(0.1971)	1.5114	1.8672	0.0000	0.1967	0.8440
Mean values	(0.1634)	1.4777	6.4907	0.0575	0.2628	0.7172

"All" SIEFOREs benchmark factor model

SIEFORE	***a***	***b1***	***b2***	***p(a) %***	***p(b1) %***	***p(b2) %***	***s(e)***	***Adj. R-Squared***
Azteca	0.0806		0.8500	7.1175		0.0000	0.0805	0.9249
Banamex	(0.0659)		1.2403	16.0453		0.0000	0.0659	0.9642
Inbursa	0.3916		0.1777	0.0000		0.0004	0.3904	0.3122
Invercap	(0.3589)		1.6296	0.5899		0.0000	0.3580	0.8998
Metlife	(0.0916)		1.2005	5.0438		0.0000	0.0914	0.9576
Principal	(0.0258)		1.0694	31.8632		0.0000	0.0260	0.9607
Profuturo GNP	(0.0404)		1.2735	32.0690		0.0000	0.0407	0.9441
SURA	(0.0719)		1.2923	16.0212		0.0000	0.0718	0.9630
XXI Banorte	(0.0544)		1.1238	13.9353		0.0000	0.0544	0.9710
Mean values	(0.0397)		1.1259	14.4460		0.0000	0.1373	0.8716

SIEFORE type 4 benchmark and "All" SIEFOREs benchmark factor model

SIEFORE	***a***	***b1***	***b2***	***p(a) %***	***p(b1) %***	***p(b2) %***	***s(e)***	***Adj. R-Squared***
Azteca	0.0473	0.2191	0.7086	24.3740	8.8252	0.0000	0.0474	0.9286
Banamex	0.0104	(0.5025)	1.5645	38.1223	0.0001	0.0000	0.0110	0.9738
Inbursa	0.4627	(0.4681)	0.4798	0.0000	0.0029	0.0000	0.4614	0.4438
Invercap	(0.2719)	(0.5728)	1.9992	0.6053	3.7722	0.0000	0.2713	0.9065
Metlife	(0.0742)	(0.1144)	1.2743	10.9208	23.6140	0.0000	0.0741	0.9581
Principal	(0.0241)	(0.0108)	1.0763	35.1677	39.6618	0.0000	0.0244	0.9607
Profuturo GNP	0.0271	(0.4439)	1.5600	36.4497	0.2867	0.0000	0.0275	0.9511
SURA	0.0251	(0.6383)	1.7041	30.2339	0.0000	0.0000	0.0253	0.9772
XXI Banorte	(0.0444)	(0.0661)	1.1665	18.9344	33.0275	0.0000	0.0444	0.9712
Mean values	0.0176	(0.2886)	1.2815	21.6453	12.1323	0.0000	0.1096	0.8968

Source: *Data from our analysis and SIEFOREs' prices from CONSAR (2016).*

Finally, when we reviewed the performance of the type 4 SIEFOREs against "all" the SIEFOREs in the market independently of their type we noted a notable result that will motivate our conclusions

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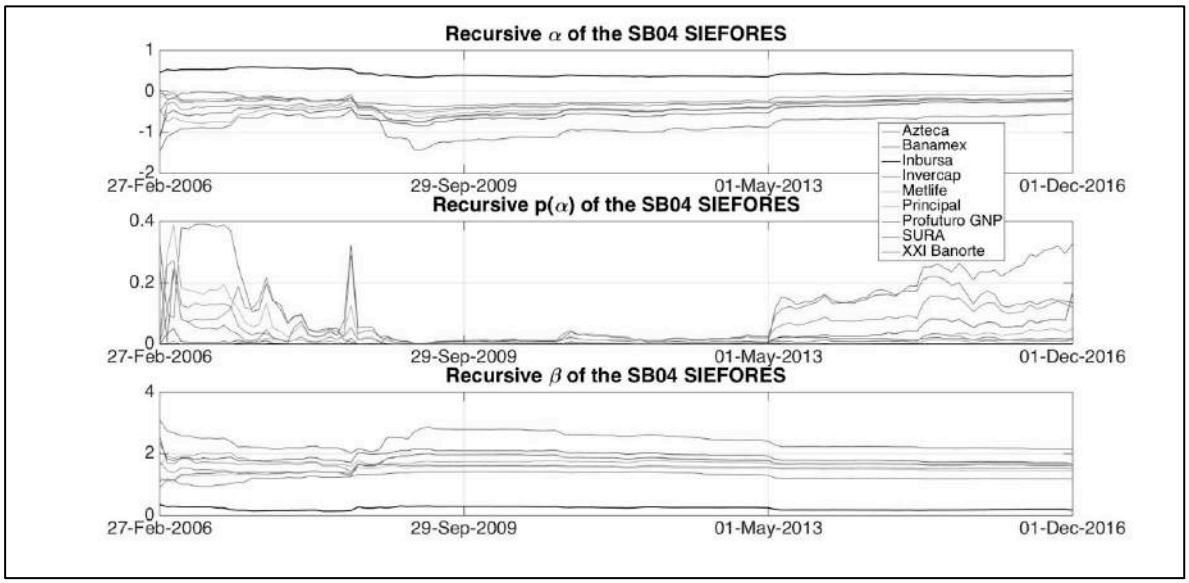
presented next: the mean value of β_2 i.e. the influence of a systemic behavior in the individual performance has an average value of 1.2815. This situation suggest us that the performance of the studied type 4 SIEFOREs is due to factors different from the riskier investment policy. More specifically is due more to market momentum and performance homogeneity than to manager skills or riskier investment restrictions.

Finally and in order to check for the robustness of our results, we present the monthly recursive values α, β_1 and $p(\alpha)$ of (3) in figure 2. As noted, the values of these parameters are in line with our expectations and suggest no alpha generation and a homogeneous value in the β_1 values.

Figure 1 The historical performance observed in type 4 SIEFOREs and their boxplot compared with the type 1 SIEFORE benchmark and the "all" system benchmark.



Source**:** own elaboration with data from CONSAR (2016*)*.

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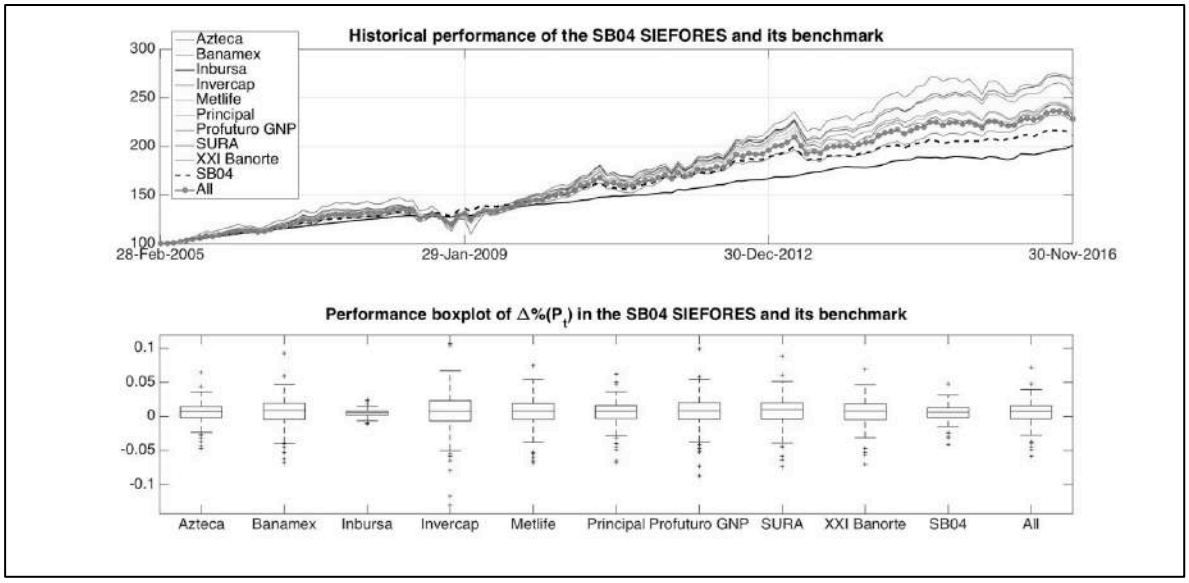
Figure 2 The monthly recursive parameters of the type 4 SIEFORES against the "all" SIEFORES benchmark.



Source: own elaboration with data from CONSAR (2016).

With this observed result and with the studies presented here, we found evidence that suggest "homogeneity" in the performance of SIEFOREs type 4 in Mexico. One of the potential counter-arguments to our review is that the alpha generation should be expressed in terms of the observed return or turnover in the SIEFORE (r_i) related with the β of that SIEFORE and the observed turnover or return in the SIEFORE type benchmark or the "all" benchmark by following this expression:

$$\alpha_{\text{expost}} = r_i - \left(\beta_i \cdot \left[\Delta\%\left(SB4_t\right) / \Delta\%\left(All_t\right)\right]\right) \tag{5}$$

Table 4. Corollary of b results and ex-post alpha generation.

Type 4 SIEFOREs expost attribution analysis with the SIEFORE type benchmark and "all" benchmark							
SIEFORE	***Turnover***	***Type 4 benchmark turnover***	***"all" benchmark turnover***	***b_1***	***b_2***	***Type 1 benchmark expost a***	***"all" benchmark expost a***
Azteca	126.0571	138.5144	128.3094	1.1774	0.8500	(37.0237)	16.9996

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Banamex	153.1748	138.5144	128.3094	1.6133	1.2403	(70.2846)	(5.9619)
Inbursa	101.2904	138.5144	128.3094	0.1807	0.1777	76.2547	78.4840
Invercap	131.7815	138.5144	128.3094	2.1308	1.6296	(163.3661)	(77.3098)
Metlife	136.9233	138.5144	128.3094	1.6089	1.2005	(85.9369)	(17.1123)
Principal	133.2287	138.5144	128.3094	1.4448	1.0694	(66.9015)	(3.9848)
Profuturo GNP	170.4031	138.5144	128.3094	1.6657	1.2735	(60.3213)	6.9977
SURA	162.6161	138.5144	128.3094	1.6663	1.2923	(68.1882)	(3.1933)
XXI Banorte	134.3184	138.5144	128.3094	1.5114	1.1238	(75.0360)	(9.8817)
Mean values	138.8660			1.4444	1.0952	(61.2004)	(1.6625)

Source: *Data from our analysis and SIEFOREs' prices from CONSAR (2016).*

In order to give answer to this issue, we present the results of the alpha generated by each SIEFORE given (5) in table 7. The last two columns show, respectively, the alpha generation in each SIEFORE against the turnover of the type benchmark and also the "all" benchmark. As expected, the generation of alpha (ex-post alpha) is negative in almost all the SIEFORES for the type 1 group and starts to increase in type 4 SIEFOREs i.e. even though the SIEFORES paid a higher nominal turnover, their theoretical expected value given the β_i is higher than the observed one.

Conclusions

The competitiveness of public pension funds, especially those who fit in the "Defined benefit" plan classification, is a very important issue that must be taken into account nowadays. The main reason of it is the fact that a higher return paid to investors will lead to a better pension at retirement. A better income for retired people will lead to a sustainable consumption and GDP creation, given the changing population conditions and the increase of the mean dead age in almost all the countries. In order to give more guidelines of the necessary tasks needed to enhance pension plans (specifically in the Mexican case), we have followed the line opened by Calderón-Colín et.al. (2009) who study the informational efficiency in the pension fund selection (the former) and the competitiveness of these to generate value to investors (the latter). We made a performance attribution test in order to detect if there is a connection between the performance and the decision making process that is "noisy and uniformed".

One of the first places that we suggest as a potential cause is the investment policy by the homogeneity in the performance that we found in all the SIEFOREs. We suspect that the investment policy generates homogeneity in the performance not only in the SIEFOREs of similar risk-return profiles and target age profiles (i.e. in the same type of SIEFORE) but also between SIEFORES of different groups (The Mexican public pension funds or SIEFOREs are public funds that work as life-cycle mutual funds). Our rationale (to be tested in future research) is that if there is no heterogeneity between SIEFOREs of the same type and among SIEFOREs of different groups or types, there is no real competition between funds and the investment decision is made by external factors such as the ones suggested by Calderón-Colín et.al. (2009).

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