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esalgado@uniandes.edu.com

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Berggrun, Luis; Jaramillo, Fernando
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PERFORMANCE PERSISTENCE: THE CASE OF COLOMBIA'S PENSION AND SEVERANCE PAY FUNDS

PERSISTENCIA EN EL DESEMPEÑO: EL CASO DE LOS FONDOS DE PENSIONES Y CESANTÍAS DE COLOMBIA

Luis Berggrun

Universidad Icesi, Cali, Colombia

lberggru@icesi.edu.co

Fernando Jaramillo

Universidad Icesi, Cali, Colombia

fjarami@yahoo.com

ABSTRACT

This paper studies performance persistence for mandatory, voluntary and severance pay funds in Colombia. We test for persistence in terms of raw and style-adjusted returns for consecutive and multiple periods. This document also explores whether an investor following strategies based on persistence can attain statistical and economically significant excess returns. Our results indicate the presence of performance persistence for some funds in the very short run. However, investors pursuing portfolio strategies based on this sort of predictability would have been unable to obtain significant excess returns. More importantly, these findings support the notion of weak-form market efficiency.

Key words: Persistence, pension funds, severance pay funds, performance, portfolios.

RESUMEN

Este documento estudia la persistencia en el desempeño de fondos de pensiones obligatorias, voluntarias y de cesantías en Colombia. Analizamos persistencia para retornos simples y ajustados por estilo tanto para períodos consecutivos como múltiples. Se explora además si un inversionista siguiendo estrategias basadas en persistencia puede obtener retornos en exceso significativos estadística como económicamente. Hallamos persistencia en el desempeño de algunos fondos en el muy corto plazo. Sin embargo, inversionistas que hubiesen seguido estrategias de inversión basadas en esta clase de predictibilidad no hubiesen podido obtener rentabilidades en exceso significativas. Más importante, estos hallazgos apoyan la eficiencia de mercado débil.

Palabras clave: persistencia, fondos de pensiones, fondos de cesantías, desempeño, portafolios.

1. Introduction

The importance of studying pension and severance pay funds is undeniable both for investors and scholars. Given the role of pension funds as major investors in Colombia's financial markets, it is unsurprising that this phenomenon has sparked pronounced interest in academia. For example, Reveiz and Leon (2008a and 2008b), Leon and Laserna (2008), Jara, Gomez and Pardo (2005), and Jara (2006) have studied the impact of investment limits and minimum return requirements on portfolio allocation decisions of mandatory pension funds, while Jara (2006) and Martinez and Murcia (2008) analyzed the impact of the current fee structure (fees of mandatory pension funds are based on contributions and not on portfolio returns) on performance and how this structure incentives attracting new clients instead of maximizing investments' returns. Yet, little research has been conducted on voluntary and severance pay funds in Colombia.

Though research topics are far reaching, one topic that has attracted interest and debate in the international literature is the issue of persistence in funds' returns. On the one hand, some authors find persistence in that past returns convey valuable information on future returns. Hendricks, Patel and Zeckhauser (1993) and Elton, Gruber and Blake (1996) find persistence for U.S. mutual fund returns, while Muga, Rodriguez and Santamaria (2007) report persistence for Mexican mutual funds in the sense that high historical return funds portfolios beat low return portfolios in a post-formation period. Evidence on long-term persistence is provided by Grinblatt and Titman (1992) for a sample of growth and aggressive growth funds. In addition, Carhart (1997) reports short term persistence, and attributes it to common factors and investment expenditures rather than to extraordinary stock picking abilities or information differentials. Correcting for the effect of end-of-period and look-ahead biases, Carhart, Carpenter, Lynch and Musto (2002) also provide evidence of persistence in mutual funds.

On the other hand, a group of authors finds less definitive evidence of persistence. Malkiel (1995) finds evidence of persistence during the

1970s but not in the 1980s, "Over the whole period of the 1980s, it is hard to conclude that there is much predictability in mutual fund returns" (p.560). Detzel and Weigand (1998) find mild evidence of persistence and recommend to look beyond past returns and more into fund characteristics when picking a fund. Though Brown and Goetzmann (1995) find evidence of relative performance persistence (i.e., versus industry peers), they report evidence of reversals as well. Agarwal and Naik (2000) find evidence of persistence for hedge funds in a two period setting, reaching a maximum and a minimum at the quarterly and yearly level respectively. In a multi-period persistence test, they still find persistence but of a lower magnitude to that of a two period horizon. Analyzing hedge fund returns, Baquero, ter Horst and Verbeek (2005) document persistence for a quarterly horizon for raw and style-adjusted returns which then vanishes at a yearly horizon.

As for pension funds, Ippolito and Turner (1987) report underperformance for some U.S. pension funds relative to the S&P 500 and mutual funds. Lakonishok, Shleifer and Vishny (1992) find relative persistence (e.g. some managers are able to consistently outperform average managers) especially for biannual and triennial ranking periods, but not for absolute persistence; past performance cannot be used to pick managers to beat an index, net of management fees. Brown, Draper and McKenzie (1997) rank a sample of British pension funds against each other rather than against some benchmark index. Based on results of transition matrices, they find little evidence of relative persistence for raw and mean adjusted returns. Finally, Tonks (2005) reports persistence being stronger for British pension funds at a yearly horizon, and then diminishing as the horizon widens. This decrease of long-term persistence may be because individual managers switch jobs at a high rate, consequently, causing persistence to vanish quickly.

Research has tended to focus, then, on mutual and hedge funds rather than on pension or severance pay funds. Moreover, to the best of our knowledge, no evidence has been

presented on the issue of persistence in Colombia. This article therefore contributes to the existing literature by describing and analyzing performance persistence for pension and severance pay funds in Colombia.

The aim of this paper is to explore whether affiliates or potential investors may be able to identify funds that consistently outperform their peers. Likewise, this document strives to determine if these investors can economically profit from feasible investment strategies centered on persistence. The article presents evidence on persistence in both raw and style-adjusted returns for consecutive periods, as well as on persistence of winning and losing funds. We also analyze persistence in a multi-period setting. The study of the incidence of this type of persistence is important for investments that involve locking up resources for a considerable period of time. In addition, the article examines performance of relative strength portfolios from investments in voluntary pension funds. The analysis of these portfolio returns sheds light on the economical significance of persistence.

2. Background of Colombia's pension and severance pay system

Colombia has both mandatory and voluntary pensions. In the former, affiliates of the pension system receive a pension, after making compulsory contributions (16.5% of monthly wages) during their working years, by means of pension fund administrators (AFPs, in Spanish), and/or by the Social Security Institute (ISS, in Spanish). In the voluntary pensions, which are of recent introduction in Colombia, affiliates, in order to supplement their income during retirement years make contributions (which complement those mandated by the law) through the affiliate's life cycle in a discretionary manner.

Under the mandatory system there are two affiliation alternatives, the first known as Individual Savings (e.g. defined-contribution) with a Solidarity Regime in which affiliates have the option of early retirement if the accumulated capital in their accounts is able to finance monthly payments equivalent to 110% of the minimum monthly wage. This type of affiliation

is administered through individual accounts by private AFPs. Four AFPs are owned by foreign groups, but the largest AFPs are controlled by local financial conglomerates.

Pensions administered by AFPs rely on the capital contributed as well as the yields on these investments. By law, private AFPs are obliged to secure a minimum return, determined by Colombia's Financial Superintendence, for its affiliates and if there is any extra return, this is completely for the affiliates' benefit and not the AFPs'. AFPs invest in a variety of financial assets under some regulatory constraints. Roughly two thirds of contributing employees are affiliated through AFPs. Though the number of retired workers under this system is small, this number is expected to increase sharply in the future. Thus, the welfare of a large share of Colombia's future retired population will depend on the ability of mandatory pension funds to generate adequate returns on investments to fund retirement needs of an ageing working force.

The second affiliation type is a defined-benefit system (administered by the public sector through the I.S.S.) to which an affiliate must contribute for a minimum number of years and must comply with age requirements to be entitled to receive a pension. In particular, reforms to the system from 1993 onwards have increased the number of minimum contributing years from 20 (in 1993) to 26 years (in 2015) and the legal age to be eligible for a pension increased from 60/55 years for men and women to 62/57 respectively during the same period of time.

Voluntary pension funds can be administered by AFPs, trust companies, or insurance companies. As at September 2008, AFPs dominated 84.6% of the market (by fund value), while trust and insurance companies had a 13.5% and 1.9% market share respectively. Administration commissions vary from 1 to 3% per year depending on the account balance. Investors opt for a voluntary pension plan mainly for three reasons. The first one deals with an increase of personal savings to enjoy a larger pension, and the second is related to taking advantage of the non-taxation (or tax deferral) of income that is deposited in the voluntary pension fund for

at least five years. The third reason deals with the ability of affiliates to choose from a series of investments or alternatives offered by voluntary pension funds, which better suit their age, individual needs and diversification concerns. In contrast, affiliates of mandatory and severance pay funds are unable to make portfolio allocation decisions by themselves.

According to current regulations, employees are entitled to receive severance pay from employers. This pay, equivalent to a one-month salary per year of service, is settled annually or when the work contract expires. In Colombia there are six non-government funds in charge of managing severance pay contributions. These funds, as well as mandatory pension funds, are obliged to guarantee minimum returns to their affiliates, and are able to invest in a series of financial assets under allocation constraints (similar to those of mandatory funds). All severance pay funds charge a 4% annual commission based on account balances.

Growth in savings managed by mandatory pension funds in Colombia has been impressive. By January 2004, the total fund value administered by mandatory pension funds had reached US\$7.6 billion, whereas in December 2008 it reached US\$26 billion after having peaked in May of that year at nearly US\$31.1 billion. The number of affiliates in the system has followed a similar path increasing from 5.2 million affiliates in 2004 to a level of 8.6 million by the end of 2008. Arango and Melo (2006) show evidence of a direct link between the number of affiliates, and both the positive real rates of return offered by the funds and increases in employment. According to the International Federation of Pension Fund Administrators (FIAP, in Spanish), Colombia is the fourth largest market in Latin America in terms of funds managed after Chile, Mexico and Argentina. Growth has also been seen in savings managed by Colombian voluntary pension funds, which have increased by a factor of three in these five years beginning from US\$1.16 billion in 2004 and reaching US\$3.35 billion in 2008. In the same period, more than 300,000 new affiliates joined these funds.

Severance pay funds doubled the size of their managed portfolios from US\$0.9 billion in 2004 to US\$1.8 by the end of 2008, while the number of affiliates grew from 2.9 to 4.5 million. Though the rise in the number of affiliates is significant, the increase in portfolio value is lower than that of mandatory and voluntary pension funds. A possible explanation may be that affiliates to severance pay funds are able to make (free of charge) partial withdrawals from their savings to cover education and housing expenses.

As at December 2008, the combined value of the portfolios managed by pension and severance pay funds represented 12.8% of Colombia's GDP. In the 2004-2008 period, both mandatory and voluntary pension funds shared a similar increasing trend in the value of their funds, while severance pay funds show a less decisive trend in this period. From the second quarter of 2005 onwards, voluntary pension funds surpass severance pay funds in terms of portfolio value.

3. Data

This study uses a survivorship-bias free database of weekly (after-fee) unit values in Colombian pesos of seven mandatory pension funds (AFPs) which as at September 2008, comprised the whole mandatory system (Individual Savings with Solidarity) in Colombia. We also use data on unit values of five severance pay funds which represented 97.75% of total market share (by fund value), as well as on unit values of five, thirteen, and twenty three investment alternatives or portfolios offered by Porvenir, Protección, and Skandia respectively. These portfolios comprise investments in fixed income and equities both local and foreign. By September 2008, these three voluntary pension funds (Porvenir, Protección and Skandia) represented a 72.37% of total market share.¹

The data on mandatory and severance pay funds was provided by ASOFONDOS (Colom-

¹ Some of Colombia's voluntary pension funds are not open to the public but only to specific investors. We were unable to get information from these funds.

bian Association of Severance Pay and Pension Fund Administrators), while the data of the three voluntary pension funds was obtained from their websites. The information on voluntary pension funds was double checked for errors or discrepancies with information provided by ASOFONDOS. We also obtained information on the inter-bank rate from Bancolombia. From Reuters, we gathered information of equity indices such as the IGBC (Índice General de la Bolsa de Valores de Colombia), S&P500, MSCI Japan, MSCI EAFE (Europe, Africa and the Far East), as well as bond indices (Barclays Bond Composite Global). From Corficolombiana, we gathered information of the IDP (Índice de Deuda Pública), a total return index representative of investments in the Colombian fixed income market.

Table 1 shows the different beginning and ending dates for the funds in the sample, the majority of which are from 2004 to 2008. None of the funds disappeared during the period. This fact rules out survivor bias (Brown, Goetzmann, Ibbotson & Ross, 1992; Carpenter & Lynch, 1999; or ter Horst, Nijman & Verbeek, 2001) and look ahead bias; funds disappearing in a non-random way during ranking periods may induce a bias (Baquero et al., 2005). The Table also shows the mean of the mean (or grand mean) of funds' returns. It is seen that mandatory and severance pay funds had higher means or (grand) medians than those of the three voluntary pension funds. Focusing on the standard deviation of weekly returns, voluntary pension funds were, on average, roughly twice as risky as mandatory and severance pay funds.

4. Two-period persistence in pension and severance pay funds

The literature analyzes both absolute and relative performance persistence. The former indicates a special ability or differential information of some portfolio managers to beat the market (or a benchmark portfolio) in a consistent fashion, while the latter signals that some managers are able to reliably outperform their peers. This paper focuses on relative persistence, which is motivated by the different, numerous, and changing investment restrictions that pension and severance pay funds face, so making it very difficult to identify a unique benchmark for all the funds.

We use both raw and style-adjusted returns (Sharpe, 1992). To estimate style-adjusted returns, we construct benchmark portfolios for each of the funds (e.g., we construct seven benchmark portfolios for the seven mandatory funds in the sample) using the following factors: the interbank rate, the IDP index as well as the Barclays Bond Composite Global, to represent both local and foreign investments in fixed income. For local and foreign investment in equities we use the IGBC and S&P500 index as well as the MSCI Japan. In our analysis, we opted for a parsimonious model that adequately represents the type and location of investments conducted by mandatory, severance pay and voluntary funds. We dropped the MSCI EAFE index from the model due to its high correlation (> 0.8) with the S&P500 index and the MSCI Japan.

To get the benchmark portfolio weights, we solve a quadratic optimization problem

TABLE 1. Descriptive statistics

Fund	Start	End	Total funds	Dead funds	Mean	Median	STD
Mandatory Funds	2004/09	2008/09	7	0	0.22	0.29	0.70
Severance Pay Funds	2004/09	2009/01	5	0	0.17	0.20	0.61
Porvenir Funds	2003/06	2008/06	5	0	-0.06	-0.05	1.17
Protección Funds	2004/10	2008/10	13	0	-0.02	0.06	1.86
Skandia Funds	2004/09	2008/10	23	0	-0.01	0.05	1.69

Note: This table reports descriptive statistics of the funds in the sample. Start and end refer to the beginning and end of the sample (in yyyy-mm format). The mean, median, and standard deviation (STD) are estimated from weekly logarithmic returns (in percent).

in which we use in a regression as the dependent variable the returns of a particular fund (R_i) and as independent variables the factors' returns. The objective is to minimize the standard error of a regression, allowing the weights (or regression coefficients) to vary from zero to one (disallowing short positions), and with the condition that the sum of weights should add up to unity. Then, with the returns of the benchmark portfolio (R_B) we conduct the following time-series regression (time subscripts omitted):

$$R_i = \alpha_i + \beta_i R_B + \varepsilon_i,$$

The intercept (α_i) from this regression constitutes our estimate of the style-adjusted return. Style-adjusted returns are usually interpreted as those additional returns from investing in a fund instead of investing in a passive or benchmark portfolio that closely tracks a fund's performance.

Using quarterly, semesterly and yearly returns we test for persistence by applying the non-parametric test proposed by Agarwal and Naik (2000).² Initially, for each period, we classify funds as winners (W) if their average returns are above the average returns of the median fund, and as losers (L) if returns are below of those of the median fund. If no persistence is present in the data, a fund has the same probability (50%) of ending up as winner or as a loser in a given period. Next, we construct contingency tables to count the number of funds that remain winners or losers from one period to the other (WW and LL), or switch from being winners (losers) in one period to being losers (winners) in the following period (WL and LW). For the overall persistence results, we aggregate the information for all mandatory, severance, Porvenir, Protección and Skandia funds in each time period.

To test for the null of independence (or no persistence), the cross product ratio (CPR) test statistic is computed as follows:

$$CPR = \frac{WW * LL}{LW * WL}$$

If the CPR statistic takes the value of one, it indicates no persistence since the frequency of funds remaining as winners or losers would match the frequency of non-persistent funds. If the ratio is above one it indicates that the number of persistent funds surpasses the number of non-persistent funds, whereas if it is below one, it refers to the opposite case. The standard deviation of the log of the CPR can be expressed as (Christensen, 1990)

$$\sigma_{CPR} = \sqrt{\frac{1}{WW} + \frac{1}{WL} + \frac{1}{LW} + \frac{1}{LL}}$$

Then, under the null hypothesis of no persistence the statistic $z = \frac{\log(CPR)}{\sigma_{\log(CPR)}}$ follows a standard normal distribution.

As a robustness check, we also estimate the test for two-period persistence suggested by Carpenter and Lynch (1999) that compares expected to observed frequencies of WW, WL, LW and LL using a Chi square test. The Chi square statistics (with one degree of freedom and critical value of 3.84) is computed as

$$\chi^2 = \frac{(WW - D_1)^2}{D_1} + \frac{(WL - D_2)^2}{D_2} + \frac{(LW - D_3)^2}{D_3} + \frac{(LL - D_4)^2}{D_4}$$

Where

$$\begin{aligned} D_1 &= \frac{(WW + WL) * (WW + LW)}{N}; \\ D_2 &= \frac{(WW + WL) * (WL + LL)}{N}; \\ D_3 &= \frac{(LW + LL) * (WW + LW)}{N}; \\ D_4 &= \frac{(LW + LL) * (WL + LL)}{N}. \end{aligned}$$

However, the previous two tests do not indicate the source of persistence; whether it origi-

² The short sample length prevented us from conducting parametric tests (e.g., regression-based tests as those applied in Agarwal and Naik, 2000) of persistence.

nates from persistent winning or losing funds. To identify the source of persistence, we apply a binomial test³ in which we count in each period the number of funds that begin as winners (losers) and continue as winners (losers) in the following period. If the observed number of persistent (winner or loser) funds is different from the expected number of persistent funds (as indicated by a 95% confidence interval based on the binomial distribution) this would provide evidence of persistence.

Panel A of Table 2 shows two-period persistence tests results of raw returns for mandatory, severance pay, and voluntary pension funds. The null hypothesis of independence is not rejected for mandatory and Porvenir funds. There is evidence of persistence for severance pay funds only at a quarterly frequency. For Protección and Skandia voluntary pension funds, the null of independence is rejected for quarterly and semesterly data. For these two funds, quarterly

persistence seems to be stronger for Protección while semesterly persistence tends to be stronger for Skandia funds. Persistence diminishes in intensity as the time span increases to become nonexistent when dealing with yearly data. This evidence suggests that persistence in Colombia's voluntary pension funds holds for the very short run. Panel B of Table 2 shows similar results when analyzing style-adjusted returns.⁴

Table 3 presents the results of the binomial test for persistence of winner and loser funds. The table shows the number of funds that remained as winners or losers in a following period (quarterly, semesterly or yearly) and shows if this number is different from the expected number of persistent funds. Persistence seems to be of a symmetrical nature; winner funds are more likely to remain as winner funds in the following period and loser funds tend to remain below the median fund in the subsequent period. Using both raw and

TABLE 2. Two-period persistence tests (raw and style-adjusted returns)

Panel A. Raw weekly returns

Fund	Quarterly returns		Semiannual returns		Yearly returns	
	Z	Chi-Square	Z	Chi-Square	Z	Chi-Square
Mandatory Funds	-1.26	1.60	0.85	0.72	-1.47	2.29
Severance Pay Funds	2.29*	5.44*	1.06	1.15	-0.78	0.63
Porvenir Funds	1.57	2.51	0.00	0.00	-1.13	1.33
Protección Funds	5.39*	31.22*	3.52*	13.26*	0.53	0.28
Skandia Funds	3.13*	9.93*	4.42*	20.60*	0.88	0.77

Panel B. Style-adjusted returns

Fund	Quarterly returns		Semiannual returns		Yearly returns	
	Z	Chi-Square	Z	Chi-Square	Z	Chi-Square
Mandatory Funds	1.13	1.29	1.34	1.84	0.28	0.08
Severance Pay Funds	2.80*	8.32*	0.32	0.10	0.00	0.00
Porvenir Funds	-0.33	0.11	2.08*	4.64*	1.34	1.89
Protección Funds	2.32*	5.42*	2.79*	8.11*	0.86	0.75
Skandia Funds	3.41*	11.80*	4.57*	22.06*	-0.63	0.40

Note: This table reports two-period persistence tests results for raw (panel A) and style-adjusted (panel B) quarterly, semiannual and yearly returns. * Denotes significance at the 5% level.

3 Because of small sample constraints, we do not apply a test based on the standard normal distribution.

4 We obtain the same results using Spearman correlation tests. As an additional robustness check, we also conducted Fisher's exact tests (these tests are especially designed for small samples, see Agresti, 1992). Results are qualitatively identical to those reported in this section. These results are available from the authors upon request.

TABLE 3. Two-period persistence tests for winner and loser funds (raw and style-adjusted returns)

Panel A. Raw weekly returns

Fund	Quarterly returns		Semiannual returns		Yearly returns	
	WW	LL	WW	LL	WW	LL
Mandatory Funds	15*	18	10	10	3	2
Severance Pay Funds	17	18	5	8	3	1
Porvenir Funds	17	19	8	6	2	2
Protección Funds	57*	62*	28*	27	9	9
Skandia Funds	93	93	51*	50*	18	17

Panel B. Style-adjusted returns

Fund	Quarterly returns		Semiannual returns		Yearly returns	
	WW	LL	WW	LL	WW	LL
Mandatory Funds	21	23	11	11	4	4
Severance Pay Funds	17	20	4	8	3	2
Porvenir Funds	19	12*	9	10	5	4
Protección Funds	49	49	26	25	10	9
Skandia Funds	96*	92	53*	49*	15	14

Note: This table reports if persistence is due to winner or losing funds in terms of raw and style-adjusted quarterly, semiannual and yearly returns. WW (LL) is the number of funds that start as winners (losers) and continue as winners (losers) in the following period.

* Denotes significance at the 5% level.

style-adjusted returns, we find that voluntary pension funds tend to present persistence of both winner and loser funds, though the effect appears stronger for Skandia funds.

The results indicate that information on past returns may be valuable for potential investors in most of the voluntary pension funds in Colombia. However, this sort of information on past returns provides little guidance on future returns for mandatory and severance pay funds. A possible explanation for the difference in persistence patterns between mandatory as well as severance pay funds and voluntary pension funds can originate from the number of funds in these markets. While the number of funds in the mandatory and severance pay system is low (seven and five funds respectively), the number of funds offered by voluntary pension funds is higher (thirteen funds by Protección and twenty three funds by Skandia), a fact that can drive a more pronounced competition among peer funds. This intensified competition can lead funds to differentiate from one another in terms of returns, which can result in persistence in performance.

Furthermore, evidence presented in section 2 suggests that mandatory as well as severance pay funds are obligated to provide minimum return guarantees in an oligopolistic market and as the bulk of incentives is tilted towards attracting new affiliates instead of generating higher returns, these funds may have little incentive to compete with each other in terms of performance (since returns above the minimum benefit solely the affiliate and not the fund). However, voluntary pension funds face a sort of internal competition between both local and foreign portfolio managers.⁵ These managers are compensated internally (by the headquarters) according to their performance; consequently, this kind of competition between portfolio administrators promotes rivalry in which portfolio managers with superior skills are able to differentiate themselves from their peers. This is especially true for foreign portfo-

5 For instance, some of Skandia voluntary funds are managed by local (in-house) portfolio managers and some by foreign managers (e.g. JP Morgan, Goldman Sachs, Templeton, among others).

lio managers that run the risk of losing a client if performance is disappointing.

Another possible explanation for the relative lack of persistence for severance pay funds can be in line with Berk and Green (2004) as they argue that persistence returns is competed away by investors in search of superior investments. Since hurdles to quick and cheap movement of capital in severance pay funds are weaker than for voluntary funds (these funds apply lockup periods that vary from 45 days to six months and affiliates lose tax benefits if they withdraw the money), one might expect to see more persistence for voluntary than for severance pay funds. Furthermore, as lockup periods in voluntary pension are starting to relax, a likely result is that persistence would tend to vanish in the future.

Finally, we discard a commission-based explanation of persistence (see Carhart, 1997) in the voluntary pension market because both Protección and Skandia charge investors the same management fee across all of the funds they manage (for example, Protección charges to most of its clients a 3% yearly commission based on account balance).

5. Three - period persistence in pension and severance pay funds

The analysis so far has concentrated on a two-period framework. An interesting issue is to explore if persistence extends to a longer period in a multi-period setting. Since Elton, Gruber, Das and Hlavka (1993) publication, several authors have studied this type of persistence. In this section we test for three-period persistence. In other words, we test for the prevalence of paths such as WWW and LLL to verify if there is a difference between the actual numbers of funds being winners (losers) three times in a row, to the expected number of funds following these paths.

Following Ciriaco and Santamaría (2005), the Chi Square statistic to test the null of independence can be expressed as

$$\chi^2 = \frac{(WWW - N/8)^2}{N/8} + \frac{(WWL + WLW + WLL - 3N/8)^2}{3N/8} + \frac{(LLW + LWL + LWW - 3N/8)^2}{3N/8} + \frac{(LLL - N/8)^2}{N/8}$$

Panels A and B of Table 4 presents the results for three-period persistence for both raw and style- adjusted returns and they highlight four interesting findings. Firstly, results in terms of raw and style- adjusted returns tend to coincide, though with some exceptions (e.g. using semesterly returns for severance pay funds). Secondly, all voluntary pension funds evidence three-period persistence for quarterly and semesterly returns. This result is a bit surprising for Porvenir funds. However, this finding can be driven by the limited number of funds offered by Porvenir and by the fact that only one fund (BALCON) had positive mean returns during the period at a much lower level of risk (standard deviation) than peer funds. Thirdly, comparing two-period (Table 2) and three-period persistence results (Chi-square values) for Protección and Skandia funds, we find that the level of three-period persistence is higher for quarterly data but for semesterly data results are mixed. Finally, the level of three-period persistence diminishes as the time interval lengthens; the level of persistence is higher for quarterly rather than for semesterly horizons and vanishes for yearly periods. This result strengthens the idea that persistence in Colombian funds is of a very short-term nature.

To sum up, three-period persistence results tend to mirror those obtained in a two-period setting and reinforce the idea that investors (especially those of voluntary pension funds) may benefit from knowledge (or a certain degree of predictability) of a fund's past returns. We explore this issue in the next section.

TABLE 4. Three-period persistence tests (raw and risk-adjusted returns)

Panel A. Raw weekly returns

Fund	Quarterly returns	Semiannual returns	Yearly returns
	Chi-Square	Chi-Square	Chi-Square
Mandatory Funds	1.97	1.13	0.67
Severance Pay Funds	13.62*	3.52	1.11
Porvenir Funds	2.89	4.53*	2.89
Protección Funds	62.77*	7.85*	0.27
Skandia Funds	11.06*	26.00*	0.53

Panel B. Style-adjusted returns

Fund	Quarterly returns	Semiannual returns	Yearly returns
	Chi-Square	Chi-Square	Chi-Square
Mandatory Funds	7.81*	1.90	0.78
Severance Pay Funds	14.22*	3.86*	1.11
Porvenir Funds	6.67*	10.15*	2.00
Protección Funds	20.15*	7.15*	1.33
Skandia Funds	36.90*	28.36*	0.53

Note: Chi-square estimates for three-period persistence tests for raw and style-adjusted quarterly, semiannual and yearly returns.

* Denotes significance at the 5% level. $P(\chi^2 < 3.84) = 0.95$.

6. Persistence of voluntary pension funds' portfolios

This study has shown evidence in terms of persistence, especially for voluntary pension funds, as did Muga et al. (2007) for Mexican mutual funds. We now examine whether investors may benefit from these persistence patterns. The question we tackle is if persistence is economically significant: Is it possible to devise strategies involving buying voluntary pension funds that produce excess returns as previously shown in the literature (Tonks, 2005)?

To this end, we follow Jegadeesh and Titman's (1993) methodology and recreate a momentum strategy. We sort at the beginning of each week all voluntary funds (within Protección and Skandia families⁶) based on their mean returns

in the preceding J weeks (or formation period, in particular, we use 13, 26, and 52 weeks) and allocate them to three equally-weighted portfolios. The third (loser) portfolio includes the funds with the lowest returns while the first (winner) portfolio comprises the best performing funds. In a zero-cost momentum strategy an investor holds a long position in the winner portfolio (P1) and a short one in the loser portfolio (P3). We examine the returns of this strategy over the following K weeks (e.g., 13, 26, and 52 weeks) or holding period. Holding period returns are computed as an equally weighted average of returns from this week's strategy and similar strategies that began during the previous $k - 1$ weeks. For instance, weekly returns using a one-year holding period are calculated as the average of each of the fifty one preceeding weeks in which this (J, K) strategy was in place and this week's returns.

Panel A of Table 5 shows raw returns for a momentum strategy. Since short sale restrictions apply in Colombia's voluntary pension

6 We exclude from this analysis mandatory and severance pay funds due to the lack of persistence, as reported in the previous sections and more importantly, because most of the affiliates in these funds in Colombia are enrolled in one fund only. In addition, the switchover rate across mandatory pension funds is low (1.1% in 2005, see Rudolph and the World Bank, 2007). However, affiliates in voluntary pension funds are able to choose from a vari-

ety of funds offered by a "family" fund (see the Appendix for details).

TABLE 5. Raw and style-adjusted returns of momentum portfolios

Panel A. Raw weekly returns

	Protección Funds			Skandia Funds		
	P1	P3	P1-P3	P1	P3	P1-P3
J = 13, K = 13	0.137 [0.198]	-0.188 [0.175]	0.325* [0.022]	0.064 [0.430]	-0.146 [0.297]	0.210 [0.167]
J = 26, K = 13	0.129 [0.255]	-0.144 [0.320]	0.273 [0.088]	0.040 [0.637]	-0.147 [0.318]	0.187 [0.198]
J = 52, K = 13	0.097 [0.472]	-0.150 [0.345]	0.247 [0.150]	0.098 [0.318]	-0.229 [0.182]	0.327 [0.050]
J = 13, K = 26	0.183 [0.088]	-0.228 [0.111]	0.411* [0.004]	-0.019 [0.837]	-0.031 [0.811]	0.012 [0.934]
J = 26, K = 26	0.170 [0.137]	-0.188 [0.177]	0.358* [0.021]	0.064 [0.452]	-0.191 [0.200]	0.255 [0.071]
J = 52, K = 26	0.061 [0.659]	-0.185 [0.226]	0.246 [0.147]	0.019 [0.861]	-0.160 [0.315]	0.179 [0.236]
J = 13, K = 52	0.037 [0.799]	-0.138 [0.293]	0.175 [0.137]	-0.143 [0.328]	-0.005 [0.962]	-0.138 [0.259]
J = 26, K = 52	-0.023 [0.874]	-0.020 [0.883]	-0.003 [0.983]	-0.085 [0.471]	-0.011 [0.938]	-0.074 [0.575]
J = 52, K = 52	-0.078 [0.634]	-0.086 [0.538]	0.007 [0.961]	-0.146 [0.315]	-0.009 [0.952]	-0.137 [0.368]

Panel B. Style-adjusted returns

	P1	P3	P1-P3	P1	P3	P1-P3
J = 13, K = 13	0.000 [0.822]	-0.002* [0.024]	0.002 [0.428]	-0.000 [0.747]	-0.001 [0.157]	-0.009 [0.301]
J = 26, K = 13	0.000 [0.879]	-0.001 [0.136]	0.001 [0.719]	-0.000 [0.471]	-0.001 [0.107]	0.000 [0.856]
J = 52, K = 13	0.000 [0.624]	-0.001 [0.164]	0.001 [0.479]	0.000 [0.599]	-0.002 [0.070]	0.002 [0.366]
J = 13, K = 26	0.001 [0.424]	-0.002* [0.002]	0.003 [0.311]	-0.001 [0.203]	-0.000 [0.445]	-0.001 [0.273]
J = 26, K = 26	0.001 [0.578]	-0.002* [0.026]	0.002 [0.413]	-0.000 [0.726]	-0.002* [0.045]	0.001 [0.587]
J = 52, K = 26	0.000 [0.898]	-0.001* [0.032]	0.002 [0.383]	-0.000 [0.897]	-0.001 [0.071]	0.001 [0.576]
J = 13, K = 52	0.000 [0.589]	-0.001* [0.028]	0.001 [0.520]	-0.001 [0.277]	-0.000 [0.204]	-0.002 [0.120]
J = 26, K = 52	-0.000 [0.721]	-0.000 [0.604]	-0.001 [0.284]	-0.001 [0.287]	-0.000 [0.670]	-0.002 [0.183]
J = 52, K = 52	-0.000 [0.497]	-0.001* [0.020]	-0.001 [0.418]	-0.001 [0.245]	-0.000 [0.340]	-0.002 [0.143]

Note: This table reports raw (in percent) and style-adjusted returns (α). * Denote statistical significance at the 5% level.

P1 = Portfolio 1 (winners), P3 = Portfolio 3 (losers), and P1 - P3 = Momentum portfolio. P-values using.

Newey-West (heteroskedasticity and autocorrelation) standard errors computed with four lags are reported in brackets.

fund market, it is worthwhile to initially focus our attention on winner portfolios. We see that for the majority of periods, winner portfolios

from Protección funds had higher average returns than those from Skandia funds. For P3 portfolios, we do not observe such pattern.

Nonetheless, all returns to winner and loser portfolios were statistically nil. We then observe for Protección and Skandia returns both positive and negative returns to momentum portfolios. Negative returns tend to be more prevalent using longer holding periods. In addition, the vast majority of returns to a P1-P3 portfolio turned out to be statistically insignificant.

Thus far, our results have not controlled for risk and style investing. In the bottom panel of Table 5, we show alphas or style-adjusted returns from winner, loser, and momentum portfolios. To obtain benchmark portfolios and to better track returns on the calculated portfolios we estimate 22 models (using combinations of regression models with 4, 5, and 6 factors) and pick the model with the lowest standard deviation of errors for a particular portfolio, formation, and holding period.⁷ Returns in this panel tend to mirror those of the upper panel of the table. Importantly, style-adjusted returns are not statistically significant neither for winner nor momentum portfolios.

In addition, we examine the adjusted R^2 (not shown) for the models reported in the bottom panel of Table 5. These statistics for winner portfolios varied from 0.47 to 0.85 and from 0.24 to 0.78 for Protección and Skandia funds respectively. Adjusted R^2 tends to increase in models with longer holding periods. In addition, we obtain a better fit for momentum portfolio returns from investments in Protección rather than Skandia funds.

In unreported results, we conducted the same analyses using four instead of three portfolios and obtained similar results in terms of the non-significance of momentum returns. In a robustness check, we split all the available funds of the three mutual fund families into two groups related to two basic asset classes or styles (i.e., equity and fixed income funds) as is perhaps more common in the international literature. We again notice no clear cut patterns in terms of the sign of winner portfolios and more importantly, raw or style-adjusted returns of momentum portfolios remain insignificant.

⁷ We obtain similar results when applying the same six-factor model to all portfolios and all formation and holding periods.

In agreement with weak-form market efficiency, we find no evidence that investors could earn excess returns (alphas) following reasonable strategies based on persistence. Though we document predictable patterns in quarterly and semesterly data in voluntary pension funds, an investor pursuing strategies based on these patterns would not have obtained significant yields.

Overall, these results do not support the existence of superior knowledge or skilled portfolio managers consistently beating their competitors and more importantly of investors attaining economically significant returns relying on portfolio managers' skills. Furthermore, reviewing the portfolio composition of some funds investing in foreign equities through overseas portfolio managers, one notices a certain propensity to invest in shares of large and growth companies (instead of investing in small and value companies). Particular examples are the funds ACCASIFS, ACCUSACM, ACCE and ACCRFD. Growth companies are those that usually had recent stellar performances reflected in high market valuations (high market to book, price earnings ratio and other valuation indicators) implying high market expectations while the value companies represent the contrary. Nevertheless, empirical international evidence (Fama & French, 1998) seems to support investments in small and value companies (over investments in large and growth companies), especially in the long run.

7. Conclusions

This paper examines performance persistence for mandatory and voluntary pension funds as well for severance pay funds in Colombia from 2003 to 2009. This document analyzes persistence both in a consecutive and a multiperiod framework and whether persistence originates from winner or losing funds. We document performance persistence in the very short run (using quarterly or semesterly data) for voluntary pension funds. For mandatory and severance pay funds, we find little evidence of persistence.

Perhaps the current regulations of oligopolistic markets in which mandatory and

severance pay funds are required to deliver minimum returns and any additional returns (above this minimum) benefit the affiliate and not the fund, can explain these results. In other words, performance rankings are unstable since mandatory and severance pay funds do not concern much about their competition in terms of delivering higher returns but in terms of incorporating new affiliates since the bulk of current incentives is directed toward that goal (funds' commissions are set as a percentage of monthly contributions to the fund and are not linked to performance).

We argue that a sort of internal competition within voluntary pension funds may explain our two and three period persistence results. Since voluntary pension funds manage some of the funds internally and some through hired foreign portfolio managers, this sort of competition between internal and external portfolio managers promotes an environment in which portfolio managers with superior skills try to differentiate themselves from their peers. This is quite true for foreign portfolio managers since their ability to retain the voluntary funds as their clients is linked to performance.

Though we report performance persistence for voluntary pension funds, an investor following several investment strategies based on this predictability would have been unable to obtain significant excess returns. In particular, an investor buying a portfolio of recent winner funds would not have done statistically better than an investor purchasing a portfolio of recent loser funds. Thus, claims of superior knowledge or skilled portfolio managers consistently beating their peers and more importantly of investors attaining economically significant returns relying on portfolio managers' skills are not borne by the data. In consequence, our results support the notion of weak-form market efficiency in Colombia's voluntary pension funds.

Finally, as a topic for future research we leave the issue of reviewing the sensitivity of money flows to fund performance to detect whether investors are consistently attracted to winner funds or they avoid pouring money into badly performing funds.

Luis Berggrun Preciado

Profesor asociado de la Universidad Icesi (Colombia). Ph. D. in Business Administration (con énfasis en finanzas) de Tulane University (Estados Unidos) y máster in International Finance de la Universidad de Amsterdam (Holanda). Sus intereses de investigación se relacionan con las finanzas corporativas, el riesgo financiero y los portafolios de inversión.

Fernando Jaramillo Recio

Profesor hora cátedra de la Universidad Icesi. Ingeniero electricista de la Universidad del Valle, con maestría en Finanzas en la Universidad Icesi; experiencia profesional de treinta años en la empresa privada y experiencia académica en diversas universidades. Asesor financiero y empresarial con interés investigativo en temas de inversión y optimización de portafolios.

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Appendix. Voluntary Pension Funds' descriptions

Funds offered by Porvenir

Fund name	Abbreviation	Investment profile
Balanced fund	BALCON	Investments in cash and substitutes, short to medium-term investment horizon.
Emerging debt	BEMER	Fixed income in Emerging Markets
Fixed income in USD	RFUS	Medium to long- term fixed income in USD
International fixed income	RFINTL	Foreign medium to long-term fixed income
International equities	ACCINTL	International equities, investment funds or stock indices

Funds offered by Protección

Fund name	Abbreviation	Investment profile
High liquidity fixed income	RFPAL	Short-term fixed income investments, mostly in pesos
Long-term fixed income	RFLP	Domestic and foreign fixed income, medium and long- term
Long-term fixed income in USD	RFDLP	Long-term fixed income investments, in USD
Short-term fixed income	RFDLP	Short-term fixed income investments, in USD
Short-term fixed income in euros	RFECP	Short-term fixed income global investments, in euros
Colombian equities	ACCP	Equities listed in Colombia, in pesos
USD denominated equities	ACCD	Equities that trade in the main U.S. stock markets
Euro denominated equities	ACCE	Equities of European companies, including the U.K.
Equities of tech companies	ACCDTEC	Equities of global tech companies, in USD
Emerging markets equities	ACCME	Equities of companies in emerging markets
Equities in Japan	ACCJP	Equities of Japanese firms.
Equities and fixed income in USD	ACCRFD	Bonds, cash and mostly equities around the world
Diversified fund	PRODIV	Domestic and foreign assets with optimal risk & return

Funds offered by Skandia

Fund name	Abbreviation	Investment profile
Ac.As_SKChina	ACCCHI	Equities in China, Hong Kong, and Taiwan
Ac.As_SKFState	ACCASIFS	Equities in the Pacific region, managed by First State
Ac.Eur_SKGoldm	ACCEGO	Equities in Europe, managed by Goldman Sachs
Ac.Eur_SMCpTemp	ACCESMT	Equities in small and medium sized European companies, run by Templeton
Ac.Glo_SKJPM	ACCGLO	Global equities, managed by JP Morgan
Ac.Jap_SkJPM	ACCJAP	Equities of Japanese companies or companies that operate in Japan
Ac.Usa_SKGamco	ACCUSATG	Equities in US, managed by GAMCO
Ac.Usa_SKMars	ACCUSACM	US growth equity fund, managed by Marsico
BA.Col_SkInvCol	BACCCOL	Colombian fixed income and equities
Bn.Col_SkLiqdz	BCPCOL	Short-term fixed income in pesos
Bn.Col_SkMnged	BMPCOL	Medium-term fixed income and equities in pesos
Bn.Col_SkYankee	BMPYAN	Medium-term fixed income in USD
Bn.Glo.SkEq USD	BGLOUSD	Short-term fixed income in the USD Reserve Fund
Bn.Glo_SKEMkt	BGLOME	Long-term fixed income in emerging markets
Bn.Glo_SKWelli	BGLOWE	Global long-term fixed income, managed by Wellington

Appendix. Voluntary Pension Funds' descriptions *(continued)*

Fund name	Abbreviation	Investment profile
Bn.Usa_SKBlack	BUSAB	Fixed income in USD managed by Black Rock
Bn.Usa_SkHQ\$	BUSAHQ\$	Global medium-term fixed income
Bn.Usa_SKPimco	BUSAMEP	Fixed income in emerging markets, managed by Pimco
Dinámico COP	DINAMCOP	Fixed income, equities and structured assets with currency hedging
Dinámico USD	DINAMUSA	Fixed income, equities and structured assets without currency hedging
Estabilidad USD	ESTABUSD	Global fixed income in USD with a conservative profile
Extremo COP	EXTRECOP	Global fixed income, equities and structured assets with currency hedging
Extremo USD	EXTREUSA	Global fixed income, equities and structured assets without currency hedging

Note: The difference between dynamic (dinámico) and extreme (extremo) portfolios is that the latter is more aggressive in its investment policy. The last five diversified portfolios can be ordered according to their risk beginning with the lowest (ESTABUSD), medium (DINAMCOP and DINAMUSA) and highest risk funds (EXTRECOP and EXTREUSA).