Identifying differences in the performance persistence of pension plans

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Abstract This paper examines performance persistence over the period 2001–2005 in the two most important investment categories of the Spanish pension market: fixed-income and equity pension funds. There is a rising trend for research into performance persistence to focus on mutual funds; however, a small number of studies are looking at this issue in relation to pension plans, especially in the Spanish market, one of the most emerging pension fund industries in the European Union. By using a nonparametric approach, clear evidence of persistence phenomenon is found in fixed-income plans, with results indicating that their returns are dependent and thus past returns are a good indicator of future investment decisions. The conclusions regarding equity plans are, however, not so clear.

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Introduction

The purpose of this paper is to analyse the persistence phenomenon in depth in two different investment categories: fixed-income and equity pension funds. Different patterns for this phenomenon have been provided in other markets; Kahn and Rudd¹ and Hallahan² provide

evidence for weaker persistence in equity portfolios.

Performance persistence is an interesting issue since, if this phenomenon exists, plans that have performed well in the past should be an attractive investment choice. For this reason, and owing to its implications for market efficiency, this issue has been widely analysed in the financial literature, with varying results.

Such studies have traditionally focused on investment funds; however, there are some interesting papers that analyse performance

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persistence in relation to pension funds, such as Brown *et al.*,³ who find limited evidence of performance persistence for UK pension plans, and Blake *et al.*,⁴ who also examine the persistence of pension funds with a sample of funds that retain the same fund manager. They find evidence of persistence in fund returns for UK equity portfolios at the one-year horizon. Nevertheless, the specification of the database in the aforementioned studies could lead to survivorship bias.

Using a large sample of UK pension funds, Tonks⁵ finds strong evidence of persistence in abnormal returns generated by fund managers over one-year time horizons but weaker evidence over longer horizons.

Hence, there is still a significant lack of empirical evidence for persistence phenomenon in other European pension fund industries when compared to the number of studies conducted in more developed markets, a gap that we intend to fill.

Very little research has looked at this issue in relation to pension funds, especially in the Spanish pension fund industry, an emerging industry in the European Union. Hence, this paper provides an original angle by applying this issue to Spanish pension plans. Moreover, the improvement of nonparametric methodology by using more sophisticated statistical tests and 4×4 contingency tables make the study appealing, with an array of potential conclusions.

Pension funds are experiencing rapid growth and they have become an important investment vehicle for individual investors in Spain. In 2005, these investment instruments represented 5.5 per cent of family savings, a significant percentage that reveals the importance of pension funds for the promotion of stable and long-term savings. Thus, their performance and persistence is an important topic.

A total of 73,546m euros were managed by more than 1,200 Spanish pension funds in 2005. Over 9 million investors put their money into these portfolios, with annual growth of over 13.8 per cent. One of the most important reasons behind this exceptional growth over the last few years is the tax break granted to individuals investing in these instruments.

In 2005, total investment in pension funds and insurance schemes accounted for 26 per cent of Spain's gross domestic product. This percentage is a long way off British, French and Dutch indices, but is similar to those in Finland, Norway and Austria.

These figures show that it is worth studying an emerging industry heading towards maturity, which is the case of the Spanish pension fund market, and shedding light on the persistence phenomenon in the two main investment categories of Spanish pension funds.

By applying several tests — some of which have not been used in previous literature — as well as contingency tables of different dimensions, performance persistence is found to be higher in fixed-income plans than in equity plans, showing that their returns are more dependent.

Furthermore, closer examination of the plans that prompt this phenomenon, through the analysis of residuals, reveals that both the best and worst managed plans yield these results.

The remainder of the paper is organised as follows: the next section describes the database; the further sections contain the methodology and the empirical results; and the last section reflects the main conclusions of the paper.

Database

The dataset includes the monthly returns obtained by all Spanish fixed-income and equity personal pension plans registered in *Dirección General Seguros y Fondos de Pensiones (DGSFP)*. The time period runs from January 2001 to December 2005.

Personal plans are the most important category in the pension plan industry, representing approximately 60 per cent of the money managed by the industry and over 82 per cent of investors. Furthermore, this paper looks at fixed-income and equity plans that represent the two most different and important investment categories.

Following the official criteria of the data provider, *Asociación de Instituciones de Inversión Colectiva y Fondos de Pensiones (INVERCO)*, Spanish equity pension plans must invest over 75 per cent of their portfolios in stocks whereas this investment strategy is forbidden in fixed-income plans.

Table 1: Summary statistics of the pension plan samples

	2001	2005
<i>Fixed-Income pension plans</i>		
Number of plans	69	176
Annual mean return (%)	3.373	1.721
<i>Equity pension plans</i>		
Number of plans	90	138
Annual mean return (%)	-13.387	19.051

The top section of the table shows information about Spanish fixed-income pension plans sample whereas the bottom section reflects the figures for the equity sample. These data refer to the beginning and end of the sample period.

Since, all existing plans between 2001 and 2005 are under consideration, the empirical conclusions are free from survivorship bias. This bias was firstly discarded by Grinblatt and Titman.⁶ Subsequently, certain studies analysed its impact on the persistence phenomenon.⁷⁻⁹

A minimum of two consecutive years of data for each plan are required in order to apply the contingency table methodology. Table 1 reflects the cross-sectional summary statistics of several features of both pension plan categories and shows that the number of pension plans has sharply increased in both categories.

Methodology and statistical tests

The study applies nonparametric methods in order to test performance persistence, checking the idea that the best and worst managed pension plans will continue to be so in the future.

First, 2×2 contingency tables are applied; the analysis is then extended to 4×4 tables for a more exhaustive confirmation of the phenomenon.

Using 2×2 contingency tables, performance rankings are compared over two consecutive investment periods, establishing two categories for each period: *Winner* plans and *Loser* plans depending on whether the plans have higher or lower returns respectively, for this purpose the median criterion is used.

The number of plans that are *winners* (or *losers*) in two consecutive periods are denoted by *WW* (*LL*), whereas *WL* (*LW*) represents the number of plans that were *winners* (or *losers*) in the first period, then *losers* (or *winners*) in the consecutive performance ranking.

By using 4×4 contingency tables, performance rankings are compared over two consecutive investment periods, establishing four categories for each period, using quartiles. Therefore, Q_i is the subset of plans included in the i^{th} quartile of the rankings analysed, where i takes values from 1 to 4.

Once the different subsets of plans (*Winners*, *Losers* or Q_i depending on the analysis) have been worked out, the statistical significance of the persistence can be obtained using the Z-test, the odds ratio, the chi-square test and Cochran's test in the case of 2×2 contingency tables and using the chi-square test and the analysis of residuals in the case of 4×4 contingency tables.

Statistical tests

— The Z-test for repeat winners applied by Malkiel:¹⁰

$$Z = \frac{Y - np}{\sqrt{np(1-p)}} \quad Z \approx N(0, 1) \quad (1)$$

where Y is the number of winner plans in two consecutive periods (*WW*), n the total number of winner plans in the first period (*WW*+*WL*), p the probability that a winning plan will also be a winner in the following period. Using the median criterion and assuming no relationship between the two periods, p would be 0.5.

— The Odds Ratio (OR) applied by Brown and Goetzmann:¹¹

$$OR = \frac{WW \times LL}{WL \times LW} \quad (2)$$

This expression is the ratio of plans that display persistence to those that do not. Using the median criterion, if the ratio is equal to one, it implies that each category has a quarter of the total number of plans and that there is no persistence; hence the null hypothesis (no persistence) cannot be rejected.

Based on this ratio, a Z-test is calculated.

$$Z = \frac{\ln(OR)}{\sigma_{\log}(OR)} \quad Z \approx N(0, 1) \quad (3)$$

The χ^2 -statistics applied by Kahn and Rudd:¹²

$$\chi^2 = \sum_{i=1}^n \sum_{j=1}^n \frac{(O_{ij} - E_{ij})^2}{E_{ij}} \quad \chi^2 \approx \chi^2_{(r-1)(c-1)} \quad (4)$$

where $O_{ij}(E_{ij})$ is the actual (expected) frequency in the i^{th} row and the j^{th} column in the table and $r(c)$ is the number of rows (columns) in the contingency table.

Therefore, this distribution presents one degree of freedom in the 2×2 contingency tables and nine in the 4×4 contingency tables.

— Cochran's test:¹³

The above expressions determine performance persistence over consecutive periods. To confirm whether persistence exists for the whole period analysed, Cochran's test has been applied.

This method is really of use to detect small systematic differences in the proportions of the contingency tables. As far as we know, this is one of the first studies to apply this approach.

$$Y = \frac{\sum_{i=1}^g w_i d_i}{\left(\sum_{i=1}^g w_i P_i Q_i \right)^{1/2}} \quad Y \approx N(0, 1) \quad (5)$$

where

$$P_i = \frac{n_{i1} P_{i1} + n_{i2} P_{i2}}{(n_{i1} + n_{i2})} \quad (6)$$

$$Q_i = (1 - P_i) \quad (7)$$

$$d_i = (p_{i1} - p_{i2}) \quad (8)$$

$$w_i = \frac{n_{i1} n_{i2}}{(n_{i1} + n_{i2})} \quad (9)$$

n_{i1} (n_{i2}) is $WW+WL$ ($LL+LW$) in each contingency table, p_{i1} (p_{i2}) is the relationship

between $WW(LW)$ and n_{i1} (n_{i2}) and g is the number of 2×2 tables analysed.

— Haberman's analysis of residuals:¹⁴

This procedure is applied in 4×4 contingency tables and identifies the categories responsible for a significant chi-square value. Therefore, it is necessary to examine the standardised residuals, e_{ij} :

$$e_{ij} = \frac{n_{ij} - E_{ij}}{\left(\sqrt{E_{ij}} \right)} \quad (10)$$

where E_{ij} (n_{ij}) is the expected (observed) frequency in the i^{th} row and the j^{th} column of the table.

An estimate of the variance of e_{ij} is given by the following expression:

$$v_{ij} = \left(1 - \frac{n_{i.}}{N} \right) \left(1 - \frac{n_{.j}}{N} \right) \quad (11)$$

where $n_{i.}$ ($n_{.j}$) is the total number of observations in the i^{th} (j^{th}) category of the row (column) variable.

Thus, for each cell in the contingency table, an adjusted residual d_{ij} can be calculated, where

$$d_{ij} = \frac{e_{ij}}{\sqrt{v_{ij}}} \quad d_{ij} \approx N(0, 1) \quad (12)$$

Empirical results

The analysis of 2×2 contingency tables applied to test performance persistence is shown in Table 2.

Panel a in Table 2 shows that all the statistical tests applied reveal evidence of significant persistence for all the annual periods analysed. Panel b provides evidence of significant annual performance persistence for certain periods (2001–2002 and 2003–2004). In the remaining periods, the number of plans that repeat as winners or losers exceeds the number of plans that change category, but with no statistical significance.

Table 2: Spanish pension plan persistence in 2x2 contingency tables

	WW	WL	LW	LL	Z-test	Odd ratio	χ^2 -test	Y-test
<i>Panel a</i>								
2001–2002	23	11	11	24	2.058*	2.937**	9.087**	10.945**
2002–2003	34	18	18	34	2.219*	3.086**	9.846**	
2003–2004	59	17	17	59	4.818**	6.393**	46.421**	
2004–2005	70	18	18	70	5.543**	7.268**	61.455**	
<i>Panel b</i>								
2001–2002	30	15	15	30	2.236*	3.100**	10.000**	5.251**
2002–2003	34	26	26	35	1.033	1.540	2.405	
2003–2004	49	21	20	50	3.347**	4.747**	24.057**	
2004–2005	37	32	32	37	0.602	0.851	0.725	

This table is divided into two panels: the information provided in panel a relates to fixed-income plans, whereas the information in panel b refers to equity pension plans. The first column of this table indicates the consecutive annual periods analysed. The next four columns show the 2x2 contingency tables obtained, and the last four columns reflect the results of the statistical tests applied.

*Persistence statistically significant at 5%.

**Persistence statistically significant at 1%.

Table 3: Fixed-income pension plans persistence in 4x4 contingency tables

	Q1	Q2	Q3	Q4	χ^2
2001–2002					
Q1	9 (3.120)**	4 (−0.122)	4 (−0.122)	0 (−2.822)**	25.662**
Q2	6 (1.175)	4 (−0.122)	0 (−2.716)**	7 (1.632)	
Q3	2 (−1.419)	5 (0.526)	6 (1.175)	4 (−0.277)	
Q4	0 (−2.822)**	4 (−0.277)	7 (1.632)	7 (1.439)	
2002–2003					
Q1	12 (3.047)**	10 (1.679)	3 (−1.830)	1 (−2.876)**	40.332**
Q2	3 (−1.722)	9 (1.162)	8 (0.784)	6 (−0.261)	
Q3	0 (−3.312)**	5 (−0.904)	13 (3.399)**	8 (0.784)	
Q4	10 (1.987)*	3 (−1.937)	2 (−2.353)*	11 (2.353)*	
2003–2004					
Q1	27(7.570)**	10 (0.216)	1 (−3.677)**	0 (−4.110)**	108.84**
Q2	5 (−1.947)	17 (3.244)**	13 (1.514)	3 (−2.812)**	
Q3	1 (−3.677)**	8 (−0.649)	18 (3.677)**	11 (0.649)	
Q4	5 (−1.947)	3 (−2.812)**	6 (−1.514)	24 (6.273)**	
2004–2005					
Q1	24 (5.226)**	15 (1.608)	2 (−3.618)**	3 (−3.216)**	87.455**
Q2	14 (1.206)	17 (2.412)*	7 (−1.608)	6 (−2.010)*	
Q3	2 (−3.618)**	12 (0.402)	20 (3.618)**	10 (−0.402)	
Q4	4 (−2.814)**	0 (−4.422)**	15 (1.608)	25 (5.628)**	

The first column of this table indicates the consecutive annual periods analysed ($t, t+1$) and the different quartiles (Q1, ..., Q4), where Q1 includes the best performing funds and so on. Columns 2–5 contain the 4x4 contingency tables obtained when comparing the performance rankings, as well as the results of the analysis of residuals, shown in parentheses. As explained above, these figures identify the categories responsible for a significant chi-square value; this statistic is presented in the last column of the table.

* Persistence statistically significant at 5%.

** Persistence statistically significant at 1%.

Cochran's test is statistically significant in both investment categories, which indicates that the persistence phenomenon exists for the whole period 2001–2005. This phenomenon is stronger in Fixed-Income pension plans.

The results for the Spanish fixed-income pension plans and the equity pension plans using 4x4 contingency tables are presented in Tables 3 and 4, respectively.

As with the 2x2 analysis, a global trend can be observed for annual performance

Table 4: Equity pension plan persistence in 4x4 contingency tables

	Q1	Q2	Q3	Q4	χ^2
2001–2002					
Q1	15 (5.054)**	6 (0.212)	2 (–2.037)*	0 (–3.257)**	41.534**
Q2	4 (–0.912)	5 (–0.216)	6 (0.355)	7 (0.775)	
Q3	3 (–1.475)	9 (2.067)*	3 (–1.357)	7 (0.775)	
Q4	1 (–2.703)**	2 (–2.037)*	11 (3.024)**	9 (1.730)	
2002–2003					
Q1	13 (2.712)**	7 (–0.214)	4 (–1.676)	6 (–0.813)	20.752*
Q2	10 (1.249)	4 (–1.676)	11 (1.737)	5 (–1.295)	
Q3	1 (–3.139)**	9 (0.762)	8 (0.274)	12 (2.081)*	
Q4	6 (–0.813)	10 (1.116)	7 (–0.331)	8 (0.028)	
2003–2004					
Q1	20 (5.071)**	6 (–1.240)	3 (–2.592)**	6 (–1.240)	60.457**
Q2	8 (–0.338)	16 (3.268)**	10 (0.563)	1 (–3.493)**	
Q3	5 (–1.690)	5 (–1.690)	16 (3.268)**	9 (0.113)	
Q4	2 (–3.043)**	8 (–0.338)	6 (–1.240)	19 (4.620)**	
2004–2005					
Q1	7 (–0.844)	8 (–0.283)	12 (1.533)	8 (–0.394)	12.401
Q2	9 (0.171)	13 (2.120)*	8 (–0.173)	4 (–2.099)*	
Q3	9 (0.171)	8 (–0.173)	8 (–0.173)	9 (0.171)	
Q4	10 (0.505)	5 (–1.645)	6 (–1.191)	14 (2.304)*	

*Persistence statistically significant at 5%.

**Persistence statistically significant at 1%.

persistence. This phenomenon, however, is more robust in fixed-income pension plans, as demonstrated by the different tests applied.

So, the chi-square test is significant for all annual periods in fixed-income plans whereas in equity plans this statistic is not significant in the last period (2004–2005).

The next step is to study the residuals in order to identify the quartiles responsible for these results. This analysis yields some interesting findings. Generally speaking, the plans assigned to the first and fourth quartiles (Q1 and Q4) are statistically significant, indicating that the best and worst managed pension plans persist over time.

In addition to Q1 and Q4, there is also statistical significance in the main diagonal values in certain periods, meaning that it is highly probable that a pension plan will remain in the same category. Moreover, it is worth highlighting that there are negative and significant values when two extremely different categories are compared, indicating that it is unlikely that a plan will change from Q1 to Q4 and vice versa.

Hence, all the analyses point to the existence of performance persistence. As expected however, this phenomenon is stronger in fixed-income plans, indicating that the returns in these plans are more dependent.

This result is in line with other studies in the financial literature, as mentioned above (eg Kahn and Rudd). One possible explication of this finding is the fact that plans that charge lower (higher) fees to investors repeat as winners (losers) during consecutive periods, thus increasing persistence. This idea is also reinforced by the fact that, in general, fixed-income plans invest their portfolio in the same kinds of securities, so differences in returns are mainly due to differences in fees.

These results imply that past performance is a good indicator of future returns when it comes to investing in a Spanish fixed-income pension plan. In an equity pension plan however, the investor must take additional information into account, as well as past performance. An index equity pension plan might be a good option, since they usually perform better than average and charge lower fees.

Conclusions

This paper examines the persistence phenomenon in depth for Spanish fixed-income and equity pension plans over the period 2001–2005. This empirical analysis presents the following main conclusions:

Firstly, the persistence phenomenon is weaker in equity pension plans than in fixed-income plans, demonstrating that returns in equity plans are less dependent and the management of equity is more complex due to the higher volatility of the stocks and the wide range of investment alternatives. Hence, fees do not determine the returns obtained by investors so clearly.

Secondly, the clear existence of performance persistence in fixed-income plans should indicate that past performance is a good indicator when it comes to making future investment decisions. Moreover, this persistence can be explained by the different fees charged by these plans.

Thirdly, since fixed-income plans are especially aimed at investors who are close to retiring, the persistence phenomenon is of paramount importance to enable these investors to choose the best fixed-income plan for them.

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