Financial Performance of Mandatory Pension Funds in Colombia

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Mandatory pension fund (MPF) affiliates in Colombia do not have a great deal of information to gauge the financial performance of pension fund managers (PFM). At present, each PFM publishes a monthly report on average profitability for the preceding 36 months (tri-annual yield). However, this measure is softened and limits a situation analysis of the yield on those funds. A variance approach that adds a portfolio-risk measurement to the available data would allow for a better assessment of MPF financial performance. If those who contribute to these funds have access to more robust measurements of financial performance, they can choose their MPF on the basis of more complete criteria, as opposed to only tri-annual measurements of profitability.

The studies done in Colombia concentrate on evaluating the efficiency of pension funds and on showing the portfolio of these investors is being managed in a financially inefficient way (Jara, Gómez and Pardo, 2005).[1] The primary reason for that inefficiency, according to Jara (2006b), lies with the definition of minimum profitability and the way commissions are structured. These works suggest that pension fund managers lack incentives to perform more efficiently, and propose the application of measures that include MPF portfolio risk. The Sharpe ratio[2] and the information ratio[3] are two examples

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1 Given a return, an efficient portfolio is one with as little variance as possible.

2 This is the ratio of excess return on the "riskless" rate of a portfolio to its risk, measured by the variance in those returns.

3 This measure of performance involves expected returns and the risk implicit in a portfolio.

In addition to tri-annual figures on profitability, the National Superintendent of Financial Institutions (SFI) requires all MPF in Colombia to valuate the risk posed by a sudden change in asset prices, based on a value-at-risk (VaR) measurement calculated daily. However, it does not require maximum levels for this measurement, nor release of the respective information. This is contrary to the situation with profitability, which must be above a required minimum determined quarterly by SFI.

The purpose of this article is to assess the long-term financial performance of pension funds, not only with a profitability analysis, but also with risk measurements.[4] It proposes that performance indicators such as the Sharpe coefficient and the Jensen equation be calculated, and analyzes the variance in MPF portfolios, based on their primary risk factors. The indicators examined herein point to very different deductions when risk considerations are included. This suggests that MPF performance analysis should not be limited to measurements of profitability alone. Despite the relative stability of MPF returns in recent years, the risk indicators for the same period have increased, undermining the measurements of long-term financial performance. This increase in portfolio volatility was exhibited by the six MPF in Colombia, mainly because their portfolios are focused heavily on assets with a high positive mutual correlation.

What explains the increased variance in returns and stable profitability of MPF in recent years? On the one hand, current regulations do not limit the risk indicators a MPF may adopt. On the other, the commission charged by these funds for their services is calculated according to the contributions received each month. This offers no incentive to secure better profits for their affiliates. Publishing risk-based performance measurements can help to reduce the growing variance in MPF returns. However, better risk policies would limit portfolio volatility without necessarily improving the returns on MPF. Aligning incentives for these funds to obtain better returns for their affiliates depends on the provisions in Law 100, which does not allow them to charge a commission based on the profitability or value of the fund (which is generally how investment fund management commissions are charged).

This article is divided into three parts. Two measurements that consider the risk/return ratio are described and calculated in the first section. These are the Sharpe ratio to measure MPF performance and the Jensen equation to compare MPF financial performance to a benchmark portfolio. In the second, the increase in MPF portfolio risk is examined on the basis of risk factors. The last section contains conclusions and recommendations.

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[4] By long-term, we mean tri-annual indicators.

I. Financial Performance Measurements

In this section, the Sharpe ratio and the Jensen equation are calculated for the MPF portfolio. Both these indicators are among the measurements described by Zurita and Jara (1999) to analyze the financial performance of pension funds in Chile. Based on the Sharpe indicator, we propose a MPF performance measurement that includes risk considerations. With the Jensen equation, the objective is to compare MPF excess return and risk to that of a reference portfolio, which, in this instance, is the PFM portfolio. In both cases, the end result underscores the necessity of adopting risk measurements to assess the financial performance of mandatory pension funds.

A. The Sharpe Ratio

The Sharpe ratio is a return-to-risk quotient commonly used to measure the financial performance of portfolios. It also offers the possibility of comparing pension funds without having to depend on an asset valuation model or market portfolio identification. The higher the return-to-risk ratio, the better the fund's performance. In this section, we show that the Sharpe ratio for all mandatory pension funds is not correlated to the tri-annual return. In other words, as a measure of financial performance that includes portfolio risk, the Sharpe ratio contains different information than what is provided by the measurement of tri-annual return. The Sharpe ratio (S_{it}) for pension fund i at moment t is defined as:

$$(1) \qquad S_{it} = \frac{r_{it} - r_{ft}}{\sigma_{it}}$$

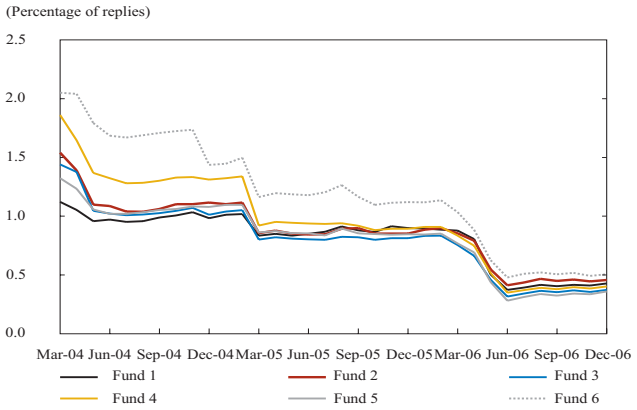
where the numerator or excess return on the riskless rate is constructed with the difference between the tri-annual return on each fund (r_{it}) and the risk-free rate (r_{ft}). The Banco de la República minimum expansion rate[5] is used for this variable. The denominator is a portfolio risk measure calculated as the standard deviation of the monthly returns in a three-year period (σ_{it}). Therefore, it is not a current measure of portfolio risk, but of historical volatility.

The Sharpe ratio shows a downward trend in all MPF during the period from January 2004 to December 2006 (Graph 1). When analyzing the Sharpe components, we found the decline in the indicator is related more to the increase in portfolio variance (Graph 2) than to portfolio performance, with there being

[5] It was 7.5% in December 2006.

GRAPH 1

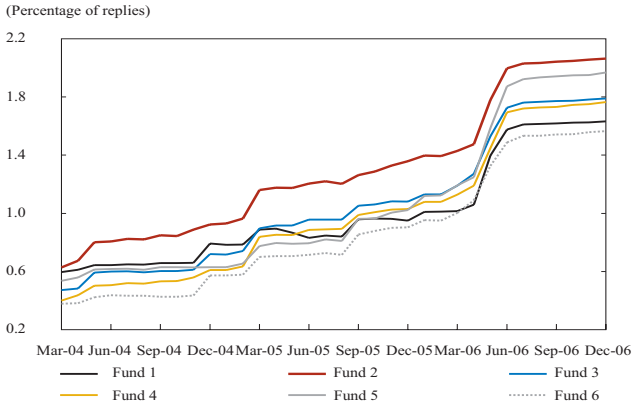
THE SHARPE RATIO



Source: Office of the National Superintendent of Financial Institutions and the authors' calculations.

GRAPH 2

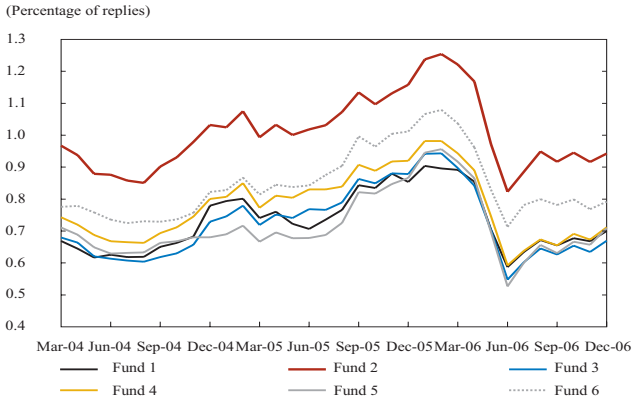
RISK POSED BY TRI-ANNUAL AVERAGE MONTHLY RETURNS ON MPF



Source: Office of the National Superintendent of Financial Institutions and the authors' calculations.

GRAPH 3

EXCESS TRI-ANNUAL AVERAGE MONTHLY RETURNS ON MPF



Source: Office of the National Superintendent of Financial Institutions and the authors' calculations.

no definite trend in returns (Graph 3). On average, the excess return during January 2004 was 0.72% for MPF, which is very similar to what it was in December 2006 (0.75%). However, the variance in monthly returns reported by the six MPF during the last three years has been increasing since January 2004 and, by the end of 2006, was four times higher than at the start of the sample.

The drop in the Sharpe ratio shows a different level of performance than the one obtained with the tri-annual profitability analysis, which shows no evidence of an upward trend in recent years. The correlation coefficient between actual profitability and the Sharpe ratio was calculated for each of the funds to statistically justify the difference between the two series. We worked with the simple correlation (Pearson) and the Spearman correlation, determining the significance level in both cases (Graph 4).[6]

The calculations of the Pearson and Spearman correlations are shown in Table 1, in addition to the *p-value* associated with the significance of this correlation. The results show there is no statistical association between actual profitability and the Sharpe ratio. The null hypothesis that the correlation between the two series is equal to zero, at a 5% significance level, cannot be rejected for any of the pension funds. Therefore, including a risk component in the analysis of MPF financial performance will provide information in addition to what can be obtained with a tri-annual profitability analysis alone.

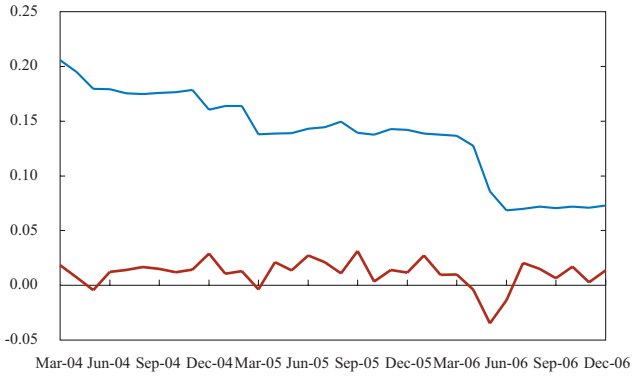
B. The Jensen Equation

The Jensen equation enables us to compare the performance of MPF portfolios to a benchmark portfolio.

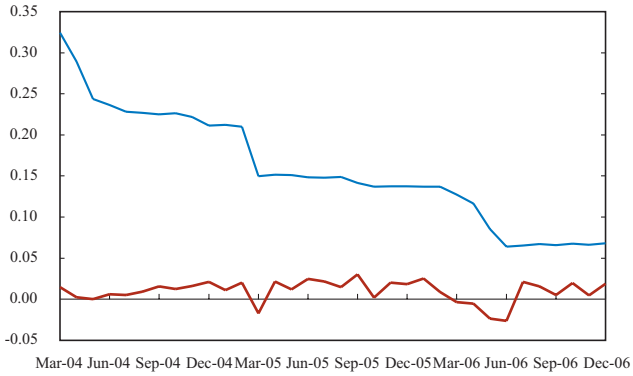
[6] When calculating the simple correlation (Pearson) and its significance level, several assumptions are made about the distribution of data and errors. The Spearman correlation was calculated to avoid assumptions of this type. Being a non-parametric statistic, it does not assume any distribution in the observations.

TRY-ANNUAL YIELD AND SHARPE RATIO OF THE MOF

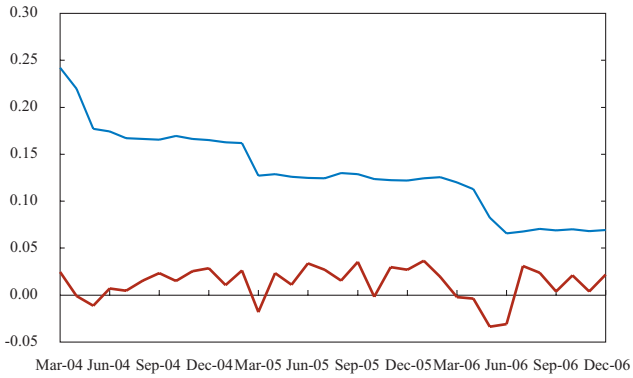
A. FUND 1



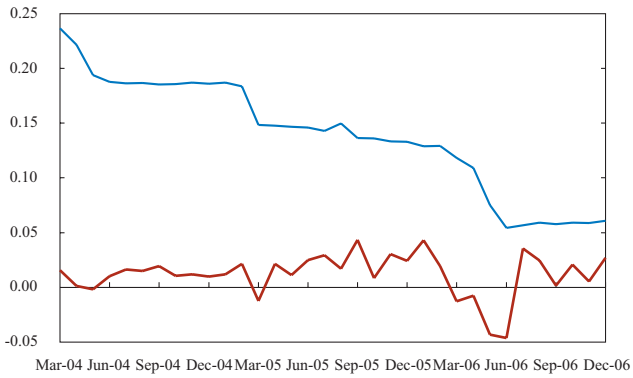
B. FUND 2



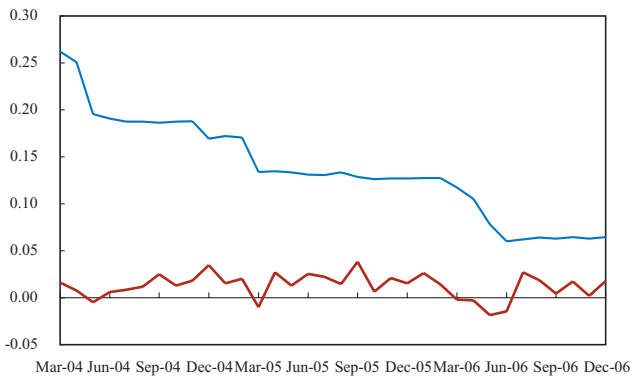
C. FUND 3



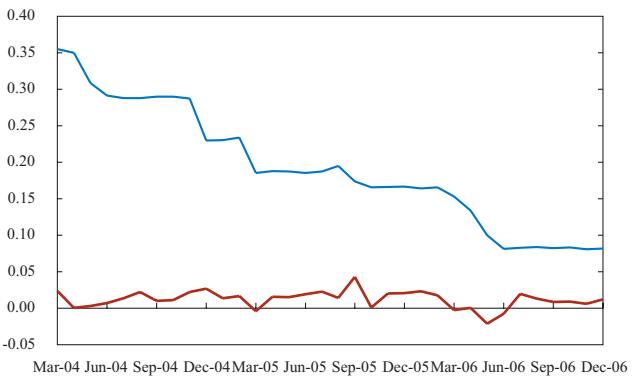
D. FUND 4



E. FUND 5



F. FUND 6



Sharpe/10 — Tri-annual yield

Source: Office of the National Superintendent of Financial Institutions and the authors' calculations.

TABLE 1

PEARSON AND SPEARMAN CORRELATIONS

Fund	Pearson	*p-value*	Spearman	*p-value*
1	0.2862 *	0.0906	0.2456	0.1489
2	0.1827	0.2861	0.0680	0.6937
3	0.1474	0.3908	0.0546	0.7519
4	0.0957	0.5787	-0.0234	0.8921
5	0.1589	0.3545	-0.0942	0.5847
6	0.2449	0.1499	0.2927 *	0.0832

Number of observations: 36
Quarterly sample: January 2004 to December 2006

* Significance: 90%.
Source: Authors' calculations

The profitability of funds comprised of PFM's own capital was used as the benchmark. The results show a close relationship between excess returns on MPF and the selected benchmark portfolios. However, the non-diversifiable risk is greater for MPF than PFM, implying more exposure for these portfolios.

Jensen (1968) focuses on evaluating the line of a defined portfolio, which is given by the following expression:

$$(2) \qquad r_{pt} - r_{lt} = \alpha_p + \beta_p \left(r_{mt} - r_{lt} \right) + \varepsilon_{pt}$$

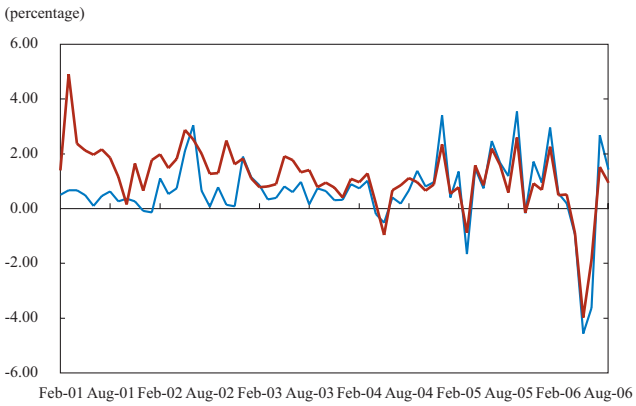
where r_{pt} is the return on portfolio p in period t; r_{lt} is the riskless rate in period t; and r_{mt} is the return on the benchmark portfolio in period t. Coefficient α_p captures the presence of an imbalance or margin in the portfolio with respect to the benchmark. If this parameter is above zero, the performance of the analyzed portfolio would show more average excess return than the benchmark portfolio. Coefficient β_p shows the ratio of excess return on the analyzed portfolio to that of the benchmark portfolio in terms of their covariance. In other words, this coefficient expresses the non-diversifiable risk of the analyzed portfolio. A coefficient above 1 implies more risk for the analyzed portfolio with respect to the benchmark. Finally, ε_{pt} is a random error that is assumed to be independent and distributed normally.

A graphic analysis comparing the monthly excess returns on MPF portfolios [7](Graph 5) to the monthly excess return of their respective PFM[8] shows

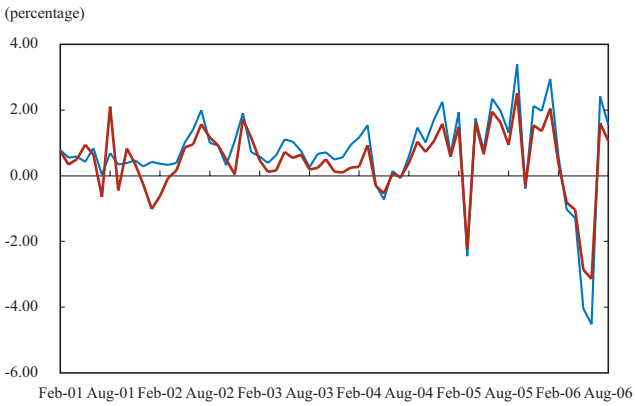
[7] Monthly figures on MPF profitability are not available from SFI. The ratio of returns published for each month to the total balance of the fund presented the preceding month was calculated to estimate monthly profitability (according to Jara, 2006).

COMPARISON BETWEEN PENSION FUND AND PFM PROFIT MARGINS

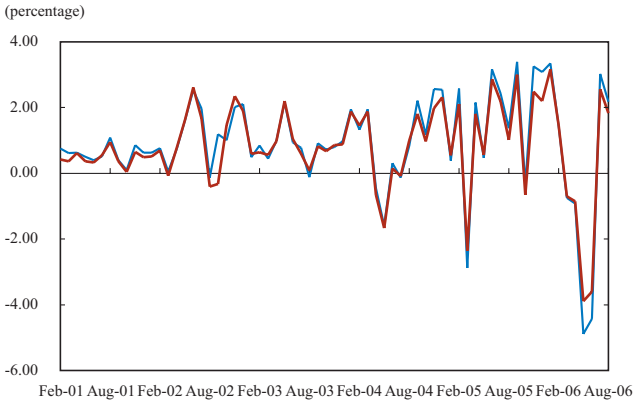
A. FUND 1



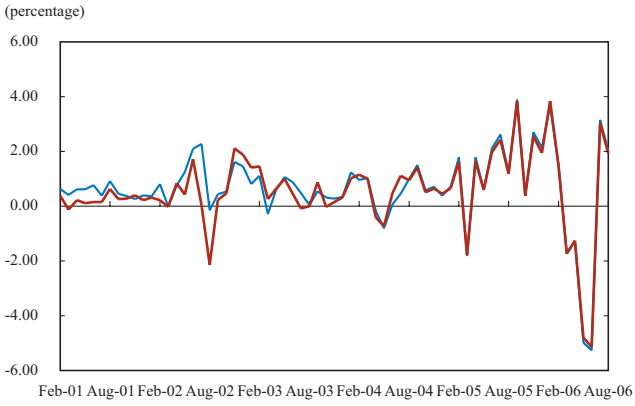
B. FUND 2



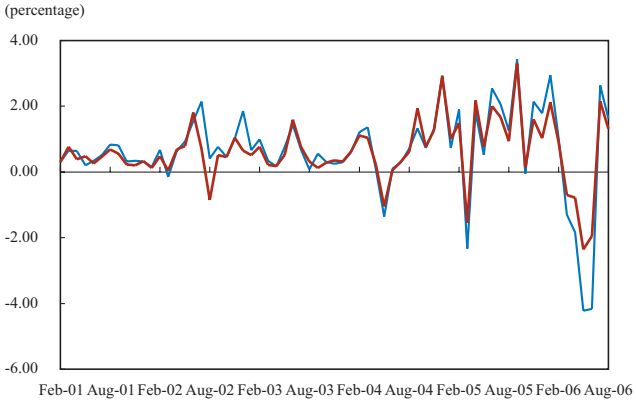
C. FUND 3



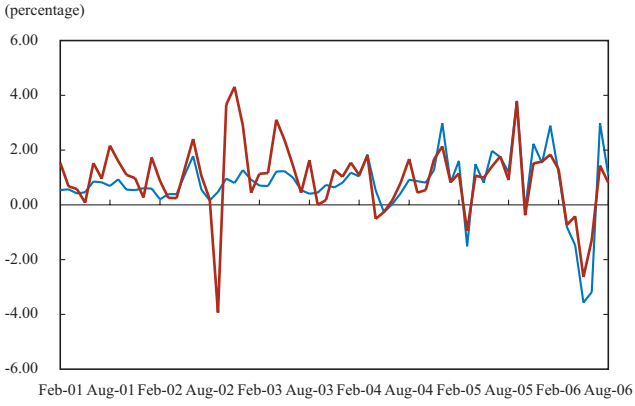
D. FUND 4



E. FUND 5



F. FUND 6



MPF PFM

Source: Office of the National Superintendent of Financial Institutions and the authors' calculations.

the following. i) There is a high correlation between PFM and MPF returns, especially during the most recent period. ii) On average, the extent of excess return for PFM and MPF is quite similar. iii) Excess return on MPF shows more pronounced increases and declines than excess return on the PFM portfolio, suggesting different degrees of risk aversion.

The Jensen equation was estimated by ordinary least squares (OLS). In most cases, the results show the difference between the two portfolios is not large with respect to average excess return. The coefficient for three of the funds was statistically not different from zero, and was very small in magnitude for the others (Table 2). In short, MPF and PFM are quite similar in terms of average excess return.

An analysis of non-diversifiable risk, based on the β regression coefficient, found several statistically significant coefficients in each case. This indicates a great deal of association between the spread in MPF portfolio returns and the spread in PFM portfolio returns. In the case of three pension funds, this coefficient is statistically greater than one, which means MPF face more portfolio risk than PFM in terms of these funds. The risk is virtually the same in only one case ($\beta = 1$); in the other two, the risk to MPF is statistically

[8] Again, to calculate excess return, Banco de la República's expansion rate was used as the riskless rate.

TABLE 2

RESULTS OF THE OLS ESTIMATE OF THE JENSEN EQUATION FOR EACH OF THE FUNDS

Fund	*Alfa*			*Beta*		
	Coefficient	***t-test***	***p-value***	**Coefficient**	***t-test***	***p-value***
1	0.000	0.062	0.950	0.731 *	8.646	0.000
2	-0.001	-1.182	0.237	1.123 *	41.650	0.000
3	-0.003 *	-3.123	0.002	1.267 *	21.485	0.000
4	0.001	0.997	0.319	1.158 *	20.974	0.000
5	0.002 *	2.635	0.008	0.954 *	26.314	0.000
6	0.004 *	2.750	0.006	0.579 *	7.205	0.000

Number of observations: 71
Monthly sample from February 2001 to December 2006.

* 90% significance
Source: authors' calculations.

less than the risk implicit in the portfolio of their respective PFM. This is no surprise, as both these agents have different objectives. The duration of MPF portfolios and, consequently, their sensitivity to interest rate changes, is greater than for PFM (which is consistent with the nature of their liabilities).

Mandatory pension funds are limited to the types of assets they can invest in and the maximum percentage of their portfolio represented by each type of asset.[9] This is intended to avoid an increase in portfolio volatility attributed to the addition of highly volatile assets and/or little diversification in investments. Nevertheless, our findings show the portfolio volatility of a fund without these restrictions, such as the PFM fund, is less than MPF portfolio volatility in most cases. This means the current restrictions on MPF have not translated into less risk, when compared to a portfolio like that of PFM.

In short, there is no difference in the average excess return on both portfolios. However, MPF portfolio management, in terms of non-diversifiable risk, is not equal to the PFM portfolio. The increased relative volatility of the MPF portfolio, despite current restrictions on admissible investments, underscores the need to disseminate and monitor risk indicators such as the ones proposed in this article.

II. Reasons for the Increase in MPF Volatility

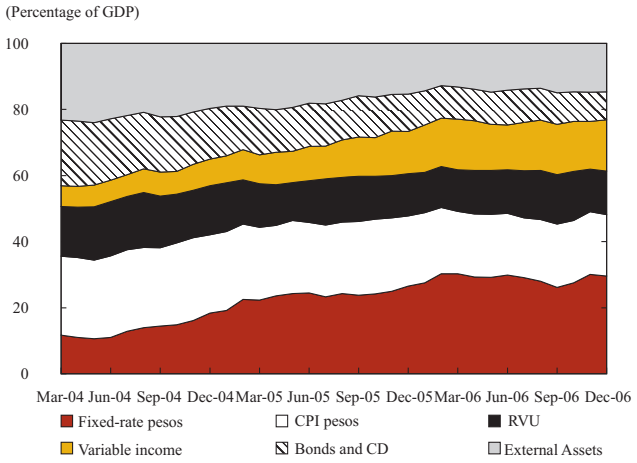
The estimates of the Sharpe ratio for mandatory pension funds show a drop in this measurement of efficiency (Graph 1), which is linked closely to the increase in the risk indicator (Graph 3). This rise in volatility has not brought higher returns with respect to the risk-free rate. Therefore, the increased variance in portfolio returns does not appear to reflect a decision by PFM to make these funds more profitable. This prompts us to depart from our analysis of returns and to concentrate on explaining the increase in portfolio volatility. Therefore, the objective in this section is to examine the possible reasons why the returns on MPF portfolios have made them more volatile.

In terms of construction, portfolio variance should reflect the interaction between volatility and the correlations of the main factors that comprise it. Information on the make-up of MPF portfolios was used to calculate the portion of the fund exposed to each of five factors: fixed-rate pesos,

[9] SFI has minimum classification requirements (External Circular 034/2005) that limit the assets MPF may invest in. It also imposes limits on principal risk factors as a share of the portfolio (the public debt position is limited to 50% and the uncovered position in foreign currency may account for no more than 20%).

GRAPH 6

MPF COMPOSITION, BY EXPOSURE FACTOR



Source: Office of the National Superintendent of Financial Institutions and the authors' calculations.

CPI and RVU pesos, CD and bonds, variable income, and external and derivative assets.

The proportion of the portfolio exposed to each of these five risk factors is shown in Graph 6 for the aggregate MPF. The aggregate MPF portfolio leans heavily towards fixed-rate securities in pesos and CPI and RVU-indexed securities. This proportion was 64% in December 2006 for MPF as a whole. The rest of the portfolio is comprised increasingly of variable income positions, while bonds, certificates of deposit and external and derivative assets have become less important. The six funds essentially reflect this make-up, although Skandia and Porvenir have a larger share of external and derivative assets.

The volatility each of these factors can add to the portfolio was calculated with the profitability indexes for each type of exposure. For fixed-rate securities denominated in pesos, a monthly price index was calculated with the transaction-value-weighted clean price of traded peso TES.[10] A monthly price index was calculated in a similar way, using CPI and RVU-indexed TES for the second factor. In the case of variable income and external assets, we used the IGBC and the peso S&P 500, respectively.[11] Finally, the price of a one-year bond with a domestic rate of return (DRR) equal to the average fixed-term deposit rate (DTF in Spanish) was used as a price indicator associated with bonds and certificates of deposit. Graph 7 shows the tri-annual monthly profitability of these indexes (first column) and the tri-annual volatility of these returns (second column) for the five factors.

Dispersion in the returns on these factors between 2004 and 2006 (Column Two, Graph 7) has not increased on par with the variance in MPF returns (Graph 2). Only the volatility levels associated with the CPI-RVU and IGBC factors rose appreciably. In the case of fixed-rate pesos, the variance in returns at the end of 2006 was quite similar to what it was at the beginning of 2004. The most stable factor with respect to yield has been the CD; its returns have reduced its limited variability between 2004

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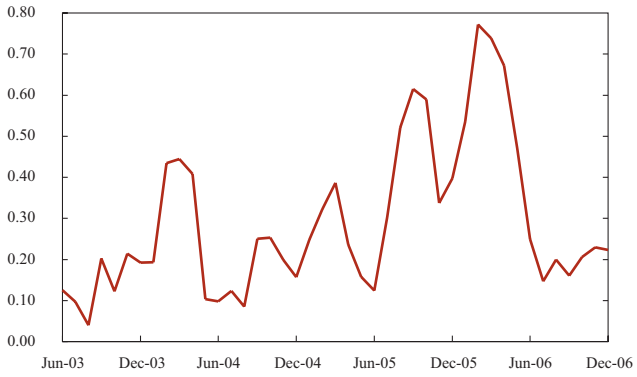
[10] The clean price of a TES does not include the effect of coupon payment proximity. It is, therefore, a more exact measure of the bond's transaction value and is calculated as $P_L = P_S - 100\left[(1+c)^A - 1\right]$, where P_s is the dirty price, c is the coupon and A is the annualized time since the last coupon payment.

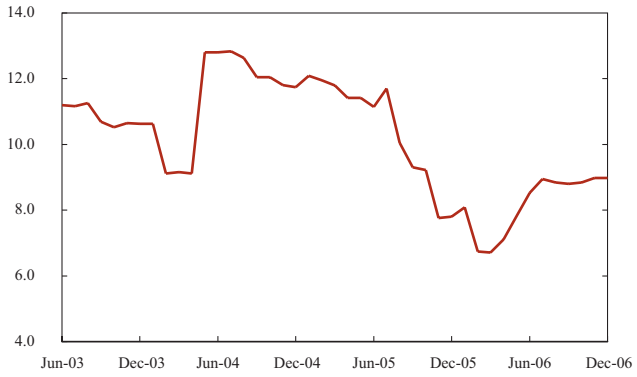
[11] The peso S&P500 is a measure of external stock market yield in pesos that considers the exchange rate. The results presented herein would not vary if the representative market rate of exchange (TRM in Spanish) were used as the yield index for external and derivative assets. This factor assumes that portfolio assets denominated in foreign currency are uncovered; it does not take into account that a portion might be covered for exchange risk.

YIELD AND VARIANCE OF RETURNS ON EXPOSURE FACTORS

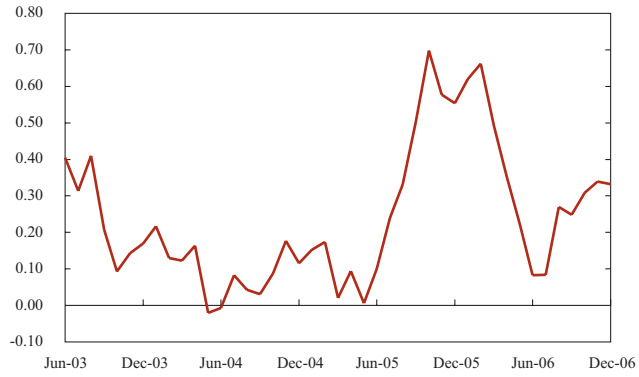
A. IPTES-PESO RETURNS



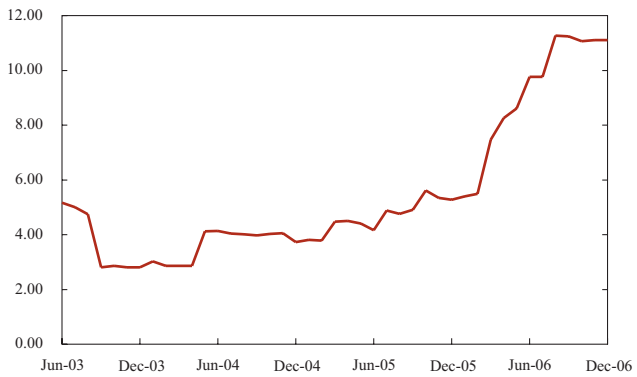
B. VOLATILITY OF IPTES-PESO RETURNS



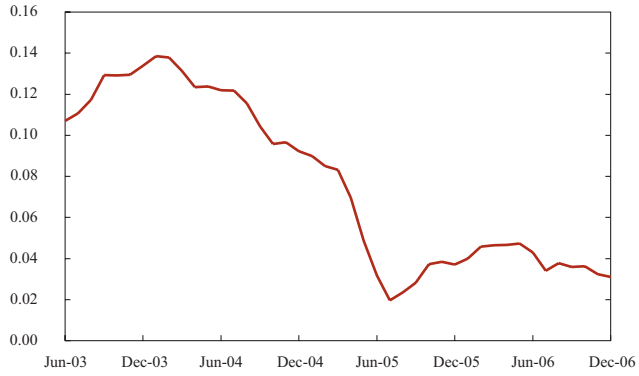
C. IPTES-CPI-RVU RETURNS



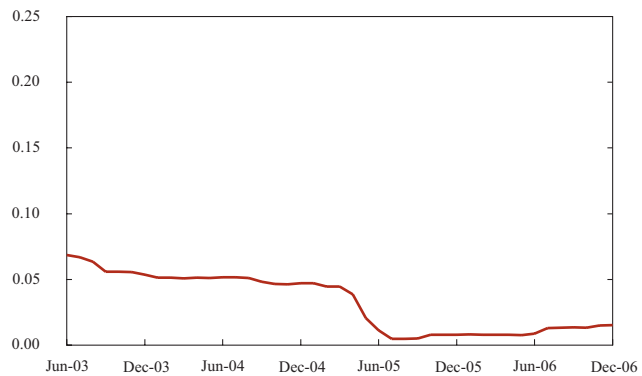
D. VOLATILITY OF IPTES-CPI-RVU RETURNS



E. RETURNS ON DTF AND BONDS

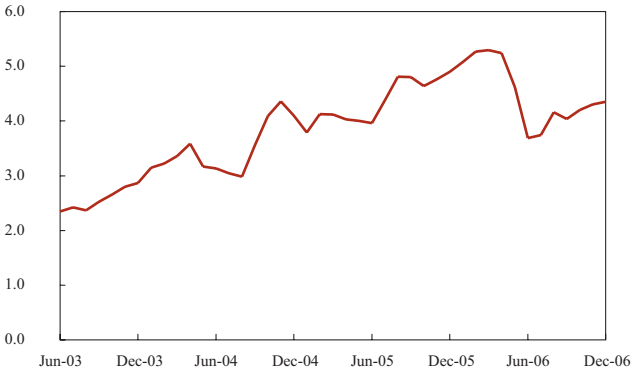


F. VOLATILITY OF RETURNS ON DTF AND BONDS

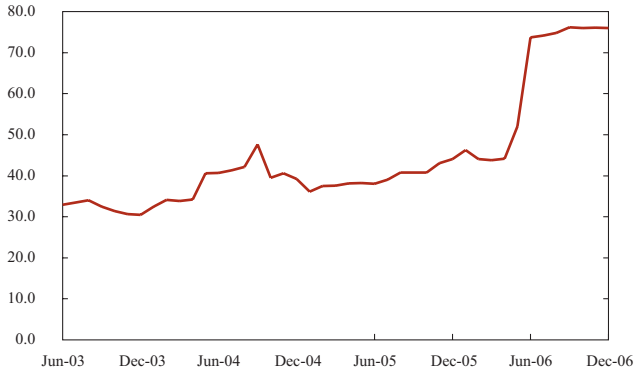


YIELD AND VARIANCE OF RETURNS ON EXPOSURE FACTORS

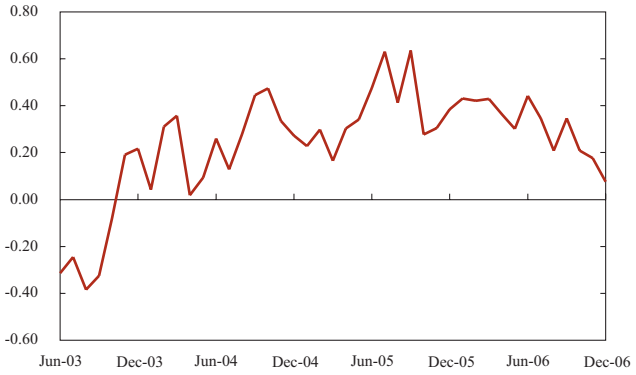
G. IGBC RETURNS



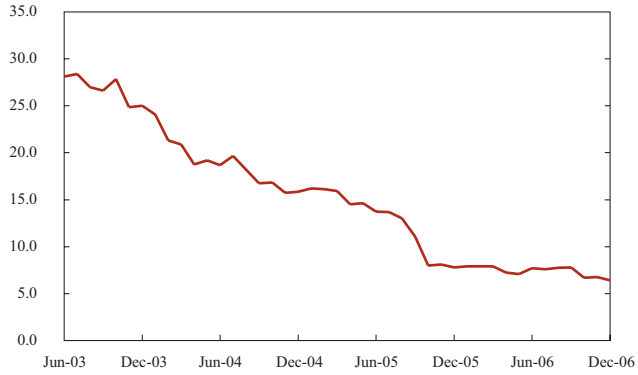
H. VOLATILITY OF IGBC RETURNS



I. PESO S&P500 RETURNS



J. VOLATILITY OF PESO S&P500 RETURNS



Note: The return of each factor is calculated as the tri-annual average of the monthly geometric yield * 100. Volatility is the variance of this yield.
Source: Bloomberg and the Colombian Stock Exchange. Authors' calculations

and 2006. The uncertainty associated with the yield on external assets declined during the same period. Therefore, the increased volatility in portfolio returns (Graph 2) is not the result of higher risk levels for all the factors that make up the portfolios.

The approximate variance of each MPF portfolio over time was calculated to include the correlations between these factors in the analysis:

$$\sigma^2_{Port,t} = \omega_t \,' \Sigma_t \omega_t = \sum_{i=1}^{5}\sum_{j=1}^{5} \omega_{i,t}\omega_{j,t}\sigma_{ij,t} \quad (3)$$

where $\omega_{i,t}$ is the weight of factor *i* in the portfolio; $\sigma_{ij,t}$ is the covariance between the returns on factors *i* and *j*; ω_t is the weight vector; $\sum_t$ is the variance and covariance matrix, and $\sigma^2_{Port,t}$ is the portfolio variance. The calculations of this approximate variance for the six funds in 2004-2006 appear in Graph 8.[12]

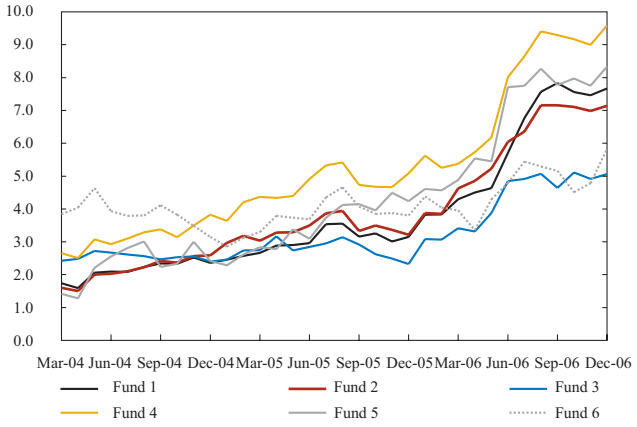
The portfolio variance for all MPF shows an upward pattern consistent with the one reported in Graph 2. MPF portfolio volatility more than tripled between January 2004 and December 2006. This is not due to increased profitability on the part of PFM (Graph 2) or more dispersion of all returns on the exposure factors (Column 2, Graph 7), but because of the limited diversification of these factors in the portfolio. Up to three-fourths of all MPF are concentrated in fixed-rate securities denominated in pesos, CPI and RVU-indexed securities in pesos, and variable-rate securities (IGBC). There are positive historical correlations above 0.5 among these factors, which have increased in the course of time, particularly in May 2004 and May 2006 (Graph 9). The rise in portfolio volatility is the result of concentration on assets with high and positively correlated returns.

The narrow supply of long-term instruments suited to the investment timeline of a mandatory pension fund, coupled with the limited development of capital markets, make portfolio diversification difficult to achieve on the basis of domestic market assets. The profitability of these funds and their risk situation during the second quarter of 2006 is proof of their vulnerability to price changes for the principal factors. Portfolio concentration on domestic assets with highly correlated returns tripled the risk or volatility of portfolio returns for almost all MPF. Although an increase in portfolio risk of this sort is a cause for concern, as the long-term savings of affiliates are at stake, it is even more surprising that the added risk taken by these funds has not made them more profitable.

GRAPH 8

MPF PORTFOLIO VARIANCE
BASED ON ITS FACTORS

(Percentage of replies)

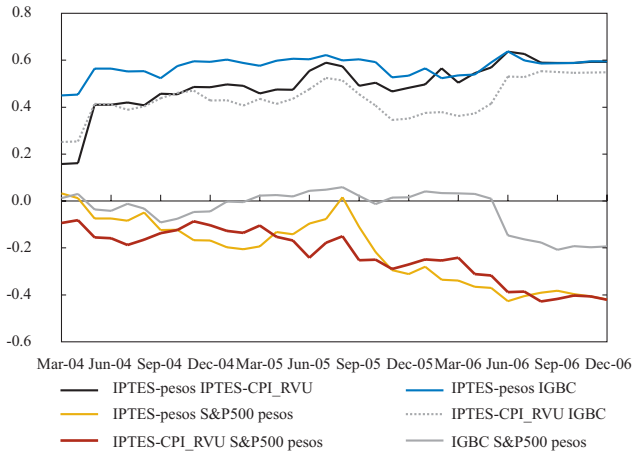


Source: Office of the National Superintendent of Financial Institutions and the authors' calculations.

GRAPH 9

HISTORICAL CORRELATIONS
AMONG THE PRINCIPAL FACTORS

(Percentage of replies)



Source: Office of the National Superintendent of Financial Institutions and the authors' calculations.

[12] All the components of matriz Σ were calculated as historical variances and covariances of the tri-annual monthly returns for each factor. In all the calculations, Σ is a positive semi-defined matrix. This guarantees a positive portfolio variance.

The question is: Why does MPF volatility increase while returns remain stable? It is important to point out that current regulations do not consider MPF portfolio risk management; they merely restrict investment to assets that are not high risk. The VaR calculations these funds present to SFI have no regulatory implications that might impose a maximum for this measurement. Better risk indicators that use daily information on portfolio composition and/or include a risk factor in the analysis would contribute to the measures needed to regulate portfolio volatility. Although better risk policies would limit the volatility of these portfolios, they would not necessarily enhance their returns.

Given the incentives currently available to MPF, pension fund managers concentrate more on finding new affiliates than on increasing the profitability of these funds, much less reducing their volatility. The commission charged to manage pension funds is calculated as 3% of the wage subject to contributions each month (approximately 22% of the monthly contribution). This was a good way to bring people into the system initially, but does not encourage PFM to make the portfolio more profitable. They are more interested in maintaining a good flow of contributors than in building the fund's stock or value. The requirement in the stabilization provision, which indicates that 1% of the value of the fund must come from the manager's own resources, is designed to guarantee resources in the event minimum profitability is not achieved. This requirement offers PFM no incentive to improve yields.

Investment fund managers other than PFM generally charge a commission in proportion to the fund's value or stock. With this system, the aim of generating more returns also is relevant for the manager. His commission will increase insofar as profitability increases and is reinvested in the fund (adding to its size and, hence, to the manager's commission). However, when the commission is not a percentage of the managed amount, PFM have no incentive to increase the value of their affiliates' savings. How can the current system be changed to one where both the PFM and those who contribute to the fund will benefit from an increase in its profitability? Article 104 of Law 100 authorizes SFI to set caps and conditions for the commissions charged to manage funds. However, Article 101 of the same law does not allow commissions on MPF to be calculated according to the profitability or return on amounts contributed by their affiliates. It states specifically that "all yield obtained through the management of pension funds shall be credited to the individual pension accounts of affiliates, in proportion to the amounts accumulated in each account and the duration of those amounts during the respective period."

III. Conclusions and Recommendations

Affiliates do not have a great deal of information to assess the financial performance of mandatory pension funds. Tri-annual profitability, which is the only regulatory requirement, has been stable of late. However, when taking into account indicators that include risk considerations (measured as the distribution of returns), one sees the financial performance of MPF has declined. The increased volatility of returns can be explained by the concentration in assets that are highly and positively correlated. Moreover, a comparison of excess MPF return to a benchmark portfolio showed less financial performance for most MPF. Despite average returns similar to those of the benchmark portfolio, the variability of these funds was greater.

The use of financial performance indicators that include risk considerations is recommended. As the domestic capital market grows and tax distortions among certain assets are eliminated, an increase in the presence of long-term instruments will lead to asset positions that are more consistent with the flow of future obligations.[13] The incentives for PFM will have to be aligned to make MPF more profitable. Although the current system of commissions was consistent with the initial aim, which was to increase the number of affiliates, it affords PFM no incentive to make these funds more profitable. Given an acceptable level of risk, the latter is desirable from the standpoint of future pensioners.

[13] Long-term securities, such as those derived from mortgage portfolio securitization (TIPS and TECH), are not sought after by MPF. The yield on these investments is income-tax exempt. However, MPF pay no income tax, so they have no incentive to purchase these securities, as the tax benefit is included in their implicit rate.

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