

# PERFORMANCE OF CHILEAN PENSION FUNDS INVESTMENTS ABROAD 2010-2014

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# ABSTRACT

Considering the high volatility generated from the financial crisis of 2008 and low returns in the years 2011, 2013 and 2014, we analyzed the performance of the Chilean Pension Funds. We use Jensen, Sharpe and Treynor indices to evaluate the funds. The comparison is made on a monthly basis for the period 2010 - 2014. We conclude that diversification of pension funds in foreign equities generated a performance similar to global Morgan Stanley All Country World Index, but failed to deliver a return per unit of risk above the average yield on US Treasury bonds. When total risk is segregated into systematic and idiosyncratic components, the difficulty to eliminate unsystematic risk is confirmed. Conclusions suggest that restrictions imposed by the regulations in Chile allow them to achieve a return similar to a passive portfolio, but with a substantial increase in overall risk.

**JEL:** C01, C12, C20, G15, G23, G32

KEYWORDS: Diversification, Return, Volatility, Risk, Systematic, Idiosyncratic

# **INTRODUCTION**

This paper investigates the efficiency level reached by Chilean Pension Funds based on the portion of equity assets invested in foreign markets. We measure efficiency by Jensen, Sharpe and Treynor indices. Also we examine the systematic and idiosyncratic risk components of these portfolios, to verify the hypothesis that diversification of pension funds in global markets has been achieved with a risk level similar to a benchmark of selected foreign mutual funds. We examine monthly data for the period 2010 - 2014.

The total assets managed by pension funds in Chile has steadily increased from 118 billion dollars at the end of 2009 to 165 billion dollars in December 2014. This amount represents approximately sixty percent of the country gross domestic product. The importance of overseas equity allocation is reflected by the high proportion of total funds invested internationally. Overseas equity amounts to 38,270 million dollars in December 2009 and 49,250 million dollars in late 2014. It is significant to mention that about 30 percent of the total funds are invested in foreign equities.

Efficiency in an active asset allocation strategy means achieving higher yields than those obtained with a passive strategy. Passive strategies involve investing in a well diversified stock index or alternatively, generating a per risk unit return in excess of a fixed rate reference yield. To perform this analysis we examine the following hypotheses of study: First, performance of pension funds abroad over the last five years has been similar to a global index, such as the Morgan Stanley All Country World Index (MSCI- ACWI). Second, pension funds average yield per unit of risk has not been lower than that reached by US Long Term Treasury Bonds. Third, diversification of pension funds in global markets has been achieved with a risk level similar to a representative sample of mutual funds that channeled a proportion of its investment abroad.

In connection with the third hypothesis we note that most Chilean Pension Funds foreign investment is diversified through stock mutual funds operating in the capital markets of North America, Europe and Asia. For this reason it seems relevant to measure and compare the performance of both types of funds. In this context, the period of high volatility in global capital markets generated by the financial crisis of 2008 and alternate cycles of high and low returns have deteriorated the performance of international mutual funds, in turn affecting a sizable portion of Chilean Pension Funds. The literature reports several studies on the performance of the pension funds as a whole, but none focuses on a particular type of financial instrument. Our purpose is to assess how Chilean Pension Funds' return depends on the performance of its overseas variable income instruments.

This document consists of a Literature Review containing an overview of the 2008 Financial Crisis, a summary on pension funds in Chile, recent studies on pension funds performance and advances on empirical analysis in measurement of systematic risk and idiosyncratic risk. Next is a description of the methodology applied and identification of data source used to measure the efficiency achieved by foreign pension fund investements. Finally we present results and conclusions of this research.

## LITERATURE REVIEW

## The 2008 Financial Crisis

The 2008 crisis, triggered by the collapse of US subprime mortgages, threatened the viability of many financial institutions and eroded the stability of the global financial system. In the peak of the crisis, right after the September 2008 bankruptcy of Lehman Brothers, the US Federal Reserve Bank intervened, by means of "liquidity injections", which ultimately resolved the panic created worldwide.

Mendoza and Quadrini (2010) point out that this crisis was preceded by 20 years of sustained indebtedness growth in the US economy, as result of low interest rates. They suggest that increasing integration of capital markets, including emerging economies, caused their transmission via contagion. Didier et al. (2010) analyzed transmission channels of the crisis and concluded that countries with liquidity and greater financial integration with the United States experienced greater joint volatility. They recommend that risk derived from this integration should be managed through appropriate regulation and supervision.

Raddatz and Schmukler (2012) studied the role of institutional investors and global mutual funds managers. They pointed out that, as global savings are largely administered through these institutions, their managers are subjected in times of crisis, to pressures that force them to act pro-cycle whereby they sell when markets are down, thus exacerbating the crisis. In particular, they state that institutional investor roles did not contribute to stabilize the markets at the peak of this crisis.

## Pension Funds in Chile

The current pension fund system history in Chile began in the 1970s. Piñera (1991) points out that falling birth rates and the gradual increase in life expectancy, were fostering an imbalance between the proportion of active workers and pensioners, so that continuing with the Defined Benefit Pension System (Pay As You Go), prevailing at that time, would end up in a budget crisis.

The private Chilean Pension Funds System, which corresponds to a Defined Contribution Pension System, began in 1981 and is based on a compulsory 10% monthly contribution, payable during the entire working life. Funds are capitalized in individual accounts and managed by private companies, called Administrators of Pension Funds (AFP), solely devoted to this purpose. Initially each AFP managed a single fund, invested only in fixed income instruments issued in Chile. In 1985 they were allowed to diversify with domestic equity instruments. In the nineties, further diversification was permitted, including investment in foreign

fixed and variable income instruments. Since its inception the industry has been ruled under strict supervision of a government agency called the Superintendence of Pension Funds.

Corbo and Schmidt-Hebbel (2003) emphasize the private pension system has contributed significantly to greater financial depth in the Chilean capital market, noting that in the 1981-2001 period, pension funds accounted for 31% to 46% of monetary aggregates growth in relation to GDP. In late August 2002 it began to operate a new pension savings mode. From that date on the AFP offered five types of funds ("A", B", "C", "D", "E") in which to invest their affiliates' savings. The funds differ in the proportion of variable income and fixed income securities that managers should invest. All affiliates must choose a type of pension fund (or a combination of types) according to their willingness to take risk; age and the time horizon that they intend to maintain the funds until retirement.

According to information provided by the Superintendence of Pension Funds, each fund type is characterized as follows: "A", the riskiest type fund, diversifies its portfolio into equities, according to current regulations, in a range between 40% and 80%. This type of fund has earned in the last 12 years, since its operations began, an industry real annual average rate of return of 6.91% measured in Chilean pesos. The real annual average return is reduced to 4.11% over the five year period analyzed in this research which was affected by high volatility and low returns.

The Type "B" fund, with a range of diversification in equities between 25% and 60%, earned a real annual average return of 5.82% over the last 12 years. This return is reduced to 4.06% when considering only the last five years. Type "C" fund, which accounts for the highest proportion of administered resources, invests in equities in the range of 15% to 40%. It earned a real annual average return of 5.38% over the last 12 years, which falls to 4.66% when considering only the years associated with this research. Type "D" and type "E" funds were the least affected by low returns and high volatility in the last five years, with returns of 4.77% and 5.20% respectively. These funds are less risky, support up a maximum equity of 20% and 5% respectively. They have obtained a real annual average return of 4.91% and 4.19% respectively since the multi system began, in September 2002.

In December 2014 the Chilean industry is composed of six AFP which manage a total fund amounting to USD 165,432 million and belonging to 9,737,853 private pension savings affiliates (Data released by the Superintendence of Pensions (http://www.safp.cl/portal/informes/581/articles-10679 recurso 1.pdf)

## Performance of Pension Funds

Recent studies on pension fund performance have been carried out in collaboration between the Organization for Economic Cooperation and Development (OECD) and the World Bank. Antolin (2008) summarizes the results of comparative performance analysis made of private pension funds operating in Latin America and Europe and highlights the need to develop a future international standard, to effectively compare results across countries. He specifically refers to Walker and Iglesias (2007), who analyze the performance of pension funds based on the Sharpe Ratio, following Lo (2002). They conclude that in general, pension funds in several countries have had good performance when compared to a risk-free short term asset, but this situation does not occur when the benchmark used is a risk-free long term bond. Antolin also refers to Tapia (2008), study which concludes that Latin American pension funds have underperformed when comparing their actual returns with a hypothetical portfolio, tailored ex-post to optimize the risk-return relationship. It is suggested that investment restrictions imposed by the regulations of different countries have had a negative impact on the performance of pension funds.

When measuring efficiency indices, it must be kept in mind various restrictions imposed by pension funds regulations, which limit diversification by the issuer to a maximum, as a percentage of the issuer's total equity as well as of the total fund value. In the particular case of Chile, Bernstein and Chumacero (2003)

argue that the restrictions imposed by pension legislation represented a significant loss in wealth to contributors to these funds (10% at the time of the study).

## Systematic Risk vs. Idiosyncratic Risk

According to financial theory, a well diversified investment portfolio should have an idiosyncratic risk near zero —Ross, Westerfield and Jaffe (2010). The CAPM assumes that investors can eliminate all risks, except those associated with the covariance of its returns with a return index representing the market, which is non diversifiable - Copeland and Weston (1979).

If  $\sigma_c^2$  represents the overall risk of the portfolio C, it can be decomposed into its systematic risk  $\beta_c^2 \sigma_M^2$  and its idiosyncratic risk  $\sigma_{\epsilon}^2$  as expressed in the following equation:

$$\sigma_c^2 = \beta_c^2 \cdot \sigma_M^2 + \sigma_\varepsilon^2 \tag{1}$$

We propose that  $\sigma_{\epsilon}^2$  be expressed as the fraction  $(1 - [\rho_{CM}]^2)$  of the total risk  $\sigma_c^2$ , where  $\rho_{CM}$  represents the correlation coefficient between the returns of the C portfolio and a market index, then concluding that a  $\rho_{CM}$  greater than 0.995 it is achieved with  $\sigma_{\epsilon}^2$  representing less than 1% of  $\sigma_c^2$ .

Many studies have been conducted related to this issue. Campbell et al. (2000) highlight the increased volatility at the level of individual assets compared to the level of market volatility. This caused a decrease in the explanatory power of the market to the degree of correlation between assets. This study also notes that it has increased the number of shares required to achieve a well-diversified portfolio. Bennett and Sias (2010) highlight the current empirical difficulties of build portfolios with diversifiable risk next to zero and suggest that the reason for this anomaly would be price bubbles that arbitrators have not been able to eliminate.

Of interest in our analysis is to measure how well diversified the portion of the Chilean pension funds invested abroad is, and how it compares its idiosyncratic risk with the risk associated to portfolios of mutual funds channeling part of its investments.

# METHODOLOGY AND DATA SOURCE

A common practices in countries with developed capital markets is the measurement of financial performance in companies that manage third party funds. To rank the performance of capital markets it is not sufficient to measure the rate of return. Indeed, the assessment should also consider the level of risk embodied in the investment portfolio.

On the other hand, we must keep in mind the restrictions on diversification and portfolio construction imposed by the regulatory framework. In this case, the pension fund legislation. One way to measure financial performance is to compare similar risk investment funds through indices that are indicative of the level of efficiency obtained. Along with the development of modern finance various indices have emerged. Those used in our research are: Jensen index, the index of Sharpe and Treynor, which are explained below.

## Jensen Index

This index, known as "Jensen's alpha" Jensen (1968, 1969), is an absolute measure of portfolio performance based on the CAPM (Sharpe, 1964, Lintner, 1965, Mossin 1966). It emanates out of an analysis of linear regression between the excess return of a portfolio over the return of a risk free debt instrument ( $R_{Ct} - R_{Lt}$ ) and the excess return of a market index over the risk free asset ( $R_{Mt} - R_{Lt}$ ), in a given period of time.

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The following regression equation was estimated to identify determinants of R<sub>Ct</sub> - R<sub>Lt</sub>:

$$R_{Ct} - R_{Lt} = \alpha_C + \beta_C \cdot (R_{Mt} - R_{Lt}) + \varepsilon_{Ct}$$
<sup>(2)</sup>

Where  $R_{Ct}$  represents the C portfolio return in the period (month) t.  $R_{Lt}$  represents the return of the risk free debt instrument for the period (month) t.  $R_{Mt}$  represents the return of an index associated with the average market behavior in period (month) t.  $\varepsilon_{Ct}$  represents the error in measuring the return of the C portfolio, obtained in the period (month) t when performing the linear regression. Finally  $\alpha_C$  and  $\beta_C$  represent the intercept and slope of the regression respectively.

In the CAPM,  $\beta_C$  is interpreted as the covariance between the returns of C portfolio and market returns divided by the variance of market returns, a measure related to the risk of the C portfolio.  $\alpha_C$  should not be significantly different from zero, provided that the C portfolio is efficient. Were  $\alpha_C$  significantly greater than zero, it follows that the portfolio was managed so that an above than average market return was achieved. On the other hand if  $\alpha_C$  significantly less than zero indicates that portfolio management was not efficient in the period analyzed.

#### Sharpe Index

This index ( $S_C$ ) is constructed based on the capital market line and is calculated by dividing the expected excess return of a portfolio C over the expected value of risk-free return for a number of periods (N), by the amount of risk assumed for such return. Risk is represented by the standard deviation of the C portfolio returns (Sharpe, 1966).

$$S_C = \frac{[E(R_C - R_L)]}{\sigma_{R_C}}$$
(3)

This index measures relative efficiency in the administration of a portfolio C, by correcting the excess return per unit of total risk of the portfolio. This indicator is widely used to compare relative efficiencies between portfolios and to make comparisons against a representative portfolio of market behavior in a number of periods (e.g.:  $S_C$  vs.  $S_M$ ). Alternatively, the risk-free return variability in time could be considered in constructing this index:

$$S_{(C-L)} = \frac{[E(R_C - R_L)]}{\sigma_{(R_C - R_L)}}$$
(4)

Lo (2002) develops a methodology to determine whether this index is significantly different from zero and explains that if it is not, it would mean the portfolio returns analyzed are equivalent to the risk-free asset. As a result, he developed a method used to check whether the C portfolio has an associated reward per unit of risk above the debt instrument reference yield. Assuming the excess return of the C portfolio over the risk free asset is independent and identically distributed (i.i.d.), then the standard error (SE) of the estimator of the Sharpe index is determined by:

$$SE(\widehat{S_{(C-L)}}) = \sqrt{\frac{[1+S^2_{(C-L)}/2]}{N}}$$
 (5)

#### Treynor Index

This performance indicator  $(T_C)$  is similar to the Sharpe ratio. The difference lies in the denominator. Treynor corrects the excess return on the C portfolio over the risk free asset by dividing by the beta portfolio

parameter, obtained from the CAPM model (Treynor, 1965). The efficiency level is then determined by comparing  $T_{C}$  between different portfolios.

$$T_C = \frac{[E(R_C - R_L)]}{\beta_C} \tag{6}$$

This index normalizes returns by considering only the systematic risk component of risk ( $\beta_c$ ). Therefore it is more appropriate to use when portfolios are well diversified (eliminated idiosyncratic risk).

#### Source of Data and Preliminary Analysis

The data for this research was built from nominal dollar returns on a monthly basis, for each fund type, obtained from the Report of Investment and Profitability (http://www.safp.cl /portal/informes/581/w3-propertyvalue-5975.html). Data were created according to the following procedure. First, the contribution of foreign equity instruments to the monthly real return (paragraph 2.1 of the Report of Investment and Profitability) was divided by the fraction invested in foreign variable rate securities (item 4 of the Report of Investment and Profitability). The result corresponds to the monthly real return of foreign equity instruments, expressed in Chilean pesos.

Second, the monthly real return of foreign equity instruments expressed in Chilean pesos was transformed into nominal Chilean pesos by multiplying by the correction factor based on the consumer price index, lagged by one month UF index (www.bcentral.cl/estadisticas-economicas/series-indicadores/index.htm). The result corresponds to the nominal return in Chilean pesos. Third, the nominal return in Chilean pesos was transformed into dollars by dividing by the observed Exchange rate factor according to: (http://www.bcentral.cl/estadisticas-economicas/series-indicadores/index.htm).

It is noteworthy that in recent years the upper percentage limit of funds allowed to be invested abroad has expanded. This information is detailed in Appendix 2. Appendix 3 breaks down the data by geographical area. Table 1 shows the evolution of diversification, at the aggregate level, in foreign equities for different types of funds. Starting December 2009, all funds follow a gradual reduction of diversification, reaching a minimum diversification in 2011 which is the year with the lowest yield on equities for all series analyzed. From 2012 until December 2014 there were increases in diversification of equities abroad in all types of funds.

Month	Type A Fund	Type B Fund	Type C Fund	Type D Fund
dec-09	61.5	41.1	22.6	10.5
dec -10	57.5	37.2	19.2	8.8
dec -11	56.0	34.8	17.3	6.7
dec -12	58.4	38.1	21.8	10.4
dec -13	63.9	42.5	25.3	13.6
dec -14	64.5	43.3	26.6	14.5
Average	60.3	39.5	22.1	10.8

Table 1: Foreign Equity Diversification in Percentage

This table does not include type E Fund due to its low weight. Total foreign equity investment as of December 2009 amounted USD 38,270 million, as of December 2014 it amounted USD 49,795 million. Source: Superintendence of Pensions.

Table 2 shows annualized monthly returns expressed in a nominal dollar basis. Note that returns from investments in foreign equities were strongly affected by political and economic conflicts associated with Europe.

Year	Type A Fund	Type B Fund	Type C Fund	Type D Fund	20 Year US Treasury bonds
2010	22.0	26.5	24.9	21.5	3.3
2011	-16.6	-17.7	-20.1	-18.9	2.5
2012	23.9	22.2	21.9	19.2	2.9
2013	7.4	6.5	8.4	10.5	3.1
2014	1.5	2.1	-1.8	0.0	3.0
Average	6.6	6.8	5.4	5.4	3.0

Table 2: Foreign Equity Arithmetic Average Return, Annualized, in Percent	tage
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Returns are nominal and expressed in percentage form. Independent of the type of fund, we verified a strong swing in returns. For comparison purposes the last column includes the average return of US Treasury bonds. Source: Superintendence of Pensions, Central Bank of Chile and Treasury.gov/resource-center USA.

Indeed, the financial crisis in the Eurozone during the years 2010-2011 negatively impacted the overall returns in equities in 2011. Funds recovered in 2012, but in late 2013 the Ukrainian conflict, compounded with the slowdown in the Chinese economy, and the slow sub-prime post crisis recovery in America have resulted in diminishing returns for the 2013-2014 period.

Equity mutual funds are the main vehicles for investment abroad used by Chilean AFP. At the aggregate level during the last five years between 65% and 80% was channeled through more than 400 mutual funds, authorized by a local Risk Rating Agency. As an additional performance analysis we include a comparison of the pension funds with samples of 10, 20 and 40 mutual funds. Appendix 4 contains a list of selected foreign mutual funds.

The sample of mutual funds used corresponds to the sample used by (Balbontín, 2014) covering the years 2007-2012. The criteria for selecting these 40 funds was basically to identify those funds that are most traded by pension funds. The selected portfolio with 10 and 20 mutual funds correspond to subsets of the previous selection; as a profitability ranking based on monthly average return obtained in the last five years, (https://www.spensiones.cl/safpstats/stats/inf\_estadistica/cinvAFP/2014/09/cinv201409.html)

Table 3 includes the nominal yearly return for different selections of mutual funds, expressed dollars. For the portfolios of 10 and 20 selected mutual funds we observed, in general, a higher annual average return than that associated with pension funds. On the other hand, mutual funds also show a smaller swing in their returns.

Year	40 Selected MF	20 Selected MF	10 Selected MF	MSCI – ACWI	20 Year US Treasury bonds
2010	22.4	25.0	26.1	12.6	3.3
2011	-14.2	-9.4	-3.9	-8.0	2.5
2012	16.4	18.2	13.6	14.4	2.9
2013	2.0	8.9	16.7	20.7	3.1
2014	-4.7	4.8	8.9	2.4	3.0
Average	3.6	8.9	11.9	8.0	3.0

Table 3: Foreign Mutual Funds Arithmetic Average Return, Annualized, in Percentage

In addition to 40, 20 and 10 selected foreign mutual funds, this table includes the average returns of global MSCI-ACWI and 20 Year US Treasury bonds. When comparing pension funds and the selection of foreign mutual funds against the returns of the overall index (MSCI-ACWI) we conclude that only the selection of 10 mutual funds had a significantly higher performance. Source: Bloomberg and Treasury.gov/resource-center USA.

The other variable whose evolution must be carefully analyzed is volatility. Table 4 and Table 5 show the evolution of this variable, as measured by the standard deviation of returns for pension funds, selected mutual funds and the global Morgan Stanley All Country World Index (MSCI-ACWI). Increasing volatility of Chilean pension funds is confirmed when comparing these figures. A pattern of similar behavior in the

evolution of volatility in future years is highlighted. All funds analyzed reach top volatilities in 2011, except for the choice of 10 MF who managed to minimize losses in return that year, with lower volatility than the associated for 2010.

#### Number of Observations and Frequency Used

This research was conducted using data collected on a monthly basis, for the period 2010-2014, thus totaling sixty observations associated with the monthly returns of each of the four Pension Fund types (A, B, C and D) and three selected Mutual Funds (10 MF, 20 MF and 40 MF). Also in this analysis we include sixty figures associated with monthly returns of the MSCI global index-ACWI and US long term Treasury bonds. We used a data base consisting of 540 return percentages in total, to perform linear regressions, as detailed later.

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Year	Type A Fund	Type B Fund	Type C Fund	Type D Fund
2010	6.6	6.6	6.6	7.0
2011	8.1	8.2	8.3	8.5
2012	6.1	6.1	5.9	5.9
2013	3.8	3.8	3.6	3.7
2014	2.8	2.7	2.6	2.4
Average	5.7	5.8	5.8	5.9

This table shows the average volatility of pension fund as measured by the standard deviation of monthly returns. To be highlighted the high level of volatility during 2011, congruent with a period of negative returns. A downward trend in volatilities is observed from 2011 hereon, despite the significant fluctuation in returns that has occurred in recent years. Source: Authors'own calculations.

Table 5: Mutual Funds and MSCI-ACWI Volatility Index, Monthly Base, in Percentage

Year	40 Selected MF	20 Selected MF	10 Selected MF	MSCI - ACWI
2010	5.5	5.3	5.3	5.9
2011	6.5	6.0	5,7	5.3
2012	4.8	3.8	3.4	4.0
2013	3.5	3.0	2.9	2.7
2014	3.8	2.7	2.4	2.5
Average	4.9	4.3	4.1	4.2

This table shows the average volatility of 40, 20 and 10 selected foreign mutual fund and the MSCI-ACWI index, all measured by the standard deviation of monthly returns. On average, volatilities of lesser magnitude are observed when compared with those for the Chilean pension funds. Source: Authors' own calculations.

#### Linear Regressions

Seven linear regressions were performed for the period 2010-2014, to calculate the performance indices, as stated in equation (2). The regressions were designed based on nominal returns in dollars, four pertaining to pension funds type A, B, C, D, and three associated with foreign mutual fund portfolios (40, 20 and 10 selected mutual funds). The independent variable was represented by the excess market return over the risk free asset ( $R_{Mt} - R_{Lt}$ ); where  $R_{Mt}$  corresponds to the monthly nominal returns based on the global equity index MSCI-ACWI, Bloomberg (code MXWD: IND) and  $R_{Lt}$  corresponding to the returns on the 20-year US Treasury bond benchmark, see: http://www.treasury.gov/resource-center/data-chart-center/interest-rates/Pages/TextView.aspx?data=longtermrateYear&year=2015

The dependent variable in each of the seven regressions was represented by the excess return of each of the portfolios analyzed over the risk-free asset  $(R_{Ct} - R_{Lt})$ .

Testing for heteroskedasticity and autocorrelation of the residuals were performed. No problems in the pension funds and the selection of portfolios of mutual funds analyzed were found. From each regression, an unbiased estimate for Jensen's alpha, the intercept of the fitted line and the beta of each portfolio (slope of the line) were obtained.

#### RESULTS

Table 6 shows the values associated with Jensen alpha parameter according to Equation 2. It follows that all portfolios of pension funds underperformed the market average. In any case yields were not significantly different from that associated with the global index MSCI-ACWI.

	Type A Fund	Type B Fund	Type C Fund	Type D Fund
Jensen's alpha	-0.0020	-0.0018	-0.0029	-0.0030
Alpha std. dev.	0.0032	0.0034	0.0034	0.0034
Beta	1.2288***	1.2132***	1.2218***	1.2446***
Beta std. dev.	0.0750	0.0811	0.0795	0.0810
R square	0.819	0.791	0.799	0.799

Table 6: Pension Funds Regression - Descriptive Statistics

\*\*\*, \*\* and \* significant at 1%, 5% and 10% respectively. Descriptive statistics of alpha and beta are for the lines associated with the regressions for each pension fund. We conclude that for all funds, it was not possible to reject the null hypothesis of Jensen's alpha equal zero, i.e. pension funds had a similar passive portfolio represented by the MSCI ACWI-rate performance. Given the higher betas than 1.0 it follows that all funds analyzed have an above average market risk. Source: Authors'own calculations.

Table 7 with the values associated with Jensen's alpha parameter for foreign mutual funds, shows that only the 10 selected mutual funds portfolio outperformed the MSCI-ACWI index, with a level of significance of 10%.

	40 Selected MF	20 Selected MF	10 Selected MF
Jensen's alpha	-0.0037	0.0009	0.0033*
Alpha std. dev.	0.0025	0.0021	0.0018
Beta	1.0671***	0.9497***	0.9077***
Beta std. dev.	0.0587	0.0485	0.0429
R square	0.848	0.866	0.883

Table 7: 40, 20 and 10 Selected Mutual Funds Regression - Descriptive Statistics

\*\*\*, \*\* and \* significant at 1%, 5% and 10% respectively. Descriptive statistics of alpha and beta of the lines associated with the regressions for each mutual fund. We conclude that it is not possible to reject the null hypothesis of Jensen's alpha equal zero, the exception is the selection of 10 mutual funds whose return has been higher than a passive portfolio represented by the MSCI ACWI-index with a significance level 10%. To be highlighted the high level of representativeness of the regressions associated with their respective R square. Values lower than than 1.0 beta, for the selection of 10 and 20 mutual funds, are indicative of slightly less than the average market risk. Source: Authors'own calculations.

For both pension funds and mutual funds, it is noteworthy the high level of representativeness of the regressions associated with their respective R square. Given the lower betas than 1.0 in the case of the 10 and 20 selected mutual funds portfolios, it is concluded that these have an associated risk slightly below the market average.

From Table 8 and Table 9, the values associated with the Sharpe index, according to Equation 4 for pension funds and mutual funds analyzed; do not reveal a higher return per unit of risk as compared to the performance of the long term American Treasury bond. Positive signs exist in the Sharpe and Treynor ratios, for all pension funds and also for all selected mutual funds. Only the 10 and 20 selected mutual funds portfolios outperformed the MSCI- ACWI index.

	Type A Fund	Type B Fund	Type C Fund	Type D Fund	MSCI-ACWI
$E(R_{C}-R_{L})$	0.0029	0.0031	0.0020	0.0020	0.0040
Standard Deviation (R <sub>C</sub> - R <sub>L</sub> )	0.0574	0.0576	0.0577	0.0588	0.0423
Sharpe Index	0.051	0.053	0.034	0.034	0.094
Sharpe Index Standard Deviation	0.1292	0.1292	0.1291	0.1291	0.1294
Treynor Index	0.002	0.003	0.002	0.002	0.004

#### Table 8: Pension Funds Descriptive Statistics for Sharpe and Treynor Indices

\*\*\*, \*\* and \* significant at 1%, 5% and 10% respectively. The values associated with Sharpe and Treynor indices are positive in all pension funds analyzed. Similarly, the MSCI ACWI-index is also positive but in greater magnitude. Given the level of significance in each of the cases analyzed, a per unit of risk prize significantly higher than the average yield of US Treasury bonds long term is not achieved. Source: Authors' own calculations.

Table 9: Descriptive Statistics of Sharpe and Treynor Indices for Mutual Funds

	40 Selected MF	20 Selected MF	10 Selected MF	MSCI-ACWI
$E(R_{C}-R_{L})$	0.0005	0.0047	0.0070	0.0040
Standard Deviation (R <sub>C</sub> - R <sub>L</sub> )	0.0490	0.0431	0.0408	0.0423
Sharpe Index	0.010	0.108	0.170	0.094
Sharpe Index Standard Deviation	0.1291	0.1295	0.1300	0.1294
Treynor Index	0.000	0.005	0.008	0.004

\*\*\*, \*\* and \* indicate significance at 1%, 5% and 10% respectively. Balues associated with Sharpe and Treynor ratios indicate that the selection of foreign mutual funds analyzed are all positive, but failed to deliver a per unit of risk return significantly higher than the average yield of the long term US Treasury bonds. The 10 and 20 selected mutual funds outperformed the MSCI ACWI Index Values. Source: Authors'own calculations.

#### Systematic Analysis of Risk vs. Diversifiable Risk (Third Hypothesis under Study)

Table 10 compares the diversifiable or idiosyncratic risk associated with pension funds with those of selected mutual funds and shows that the latter can reduce an average level of approximately 50% of that achieved by the former, thus concluding that the selected mutual funds are better diversified. Nevertheless, this analysis confirms recent studies regarding the difficulty of achieving well-diversified portfolios eliminating the idiosyncratic risk.

Table 10: Breakdown of Total Risk between Systematic Risk and Idiosyncratic Risk

	Total Risk	Systematic Risk	Idiosyncratic Risk	Systematic Risk (%)	Idiosyncratic Risk (%)
Type A Fund	0.0033	0.0027	0.0006	82.2	17.8
Type B Fund	0.0033	0.0026	0.0007	79.4	20.6
Type C Fund	0.0033	0.0027	0.0007	80.3	19.7
Type D Fund	0.0035	0.0028	0.0007	80.3	19.7
40 Selected MF	0.0024	0.0020	0.0004	85.0	15.0
20 Selected MF	0.0019	0.0016	0.0002	86.8	13.2
10 Selected MF	0.0017	0.0015	0.0002	88.5	11.5

According to Equation 1, a well-diversified portfolio should have an idiosyncratic risk close to zero. The values obtained are indicative that pension funds entail a higher level of idiosyncratic risk, about 50% greater than that associated with 40, 20 and 10 selected foreign mutual funds. Source: Authors'own calculations.

#### CONCLUSIONS

The goal of this research is to investigate the efficiency level reached during recent years by the portion of the equity assets invested in foreign markets by Chilean Pension Funds. We also verify the hypothesis that the idiosyncratic risk is eliminated in a well diversify portfolio. Three hypotheses were formulated in the introduction of this investigation. The first and second hypotheses relate to performance evaluation of the proportion invested abroad by Chilean pension funds. The third hypothesis relates to the current level of systematic risk in these funds, when compared with the risk associated with samples of foreign mutual

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funds. These mutual funds are the main AFP vehicles for investing abroad. The evaluation took place in a market environment characterized by low returns and high volatility.

To test these hypotheses we conducted various statistical analysis considering a collection of sixty monthly observations, for the period 2010-2014, namely the real monthly return for the four types of Pension Funds (A, B, C and D), the three selected Mutual Funds return (10 MF, 20 MF and 40 MF), the monthly return of the MSCI global index-ACWI and the US long term Treasury bonds return. The data is composed of 540 percentage returns in total.

The first hypothesis referred to performance evaluation. We conduct a linear regression between the excess return of a portfolio over the return of a risk free debt instrument and the excess return of a market index over the risk free asset. It was not possible to reject the first hypothesis. It was confirmed that pension funds returns behave similarly to the overall index MSCI ACWI. This was validated through absolute rates (Jensen's alpha) that were not significantly different from zero for all pension funds.

We used the Sharpe and Treynor indices as methodological tools to test the second hypothesis. This hypothesis must be confirmed, since booth indices were positive for all types of funds. The standard deviation associated with the Sharpe ratio were in all cases indicative of a, per unit of risk prize, no greater to the performance of US Treasury bonds. It proved to be more appropriate to apply the Sharpe ratio, standardized by dividing the return of each fund by the total portfolio risk. For all funds analyzed, only if the idiosyncratic risk would have been close to zero, the Treynor index would have gained prominence.

The third hypothesis is rejected, since the level of idiosyncratic risk associated with pension fund foreign investments as stated in Equation 1, has been achieved with a risk level much higher (in fact 50% higher) than associated with selected foreign mutual funds. Additionally, none of the analized portfolios achieves an idiosyncratic risk close to zero. One might suggest this conclusion is related to restrictions imposed by the Chilean pension legislation, thus confirming the empirical evidence in relation to current difficulties concerning elimination of unsystematic risk through diversification.

In the future, if there is availability of overseas returns for each of the six AFP, we recommended performing this type of analysis for the six administrators in the pension fund industry in Chile. The present investigation was carried out in a period of abnormal returns characterized by high volatility. Future research, might rethink this study and perform the comparative analysis once returns stabilize in global capital markets, for foreign equity instruments and all categories of instruments, domestic and foreign.

# ANNEXES

Year	Type A Fund	Type B Fund	Type C Fund	Type D Fund
2010	11.64	11.38	9.34	7.08
2011	-11.13	-7.52	-3.79	0.06
2012	6.06	4.88	4.61	3.81
2013	6.79	4.33	4.68	5.42
2014	8.86	8.27	9.00	7.68
Average	4.11	4.06	4.66	4.77

Appendix 1: Pension Funds Real Yearly Return, Geometric Mean Calculation, Based in Chilean Pesos (Figures in Percentage)

This table shows the negative impact of 2011 on the average return of the 2010-2014 years, considering reinvestment pertaining to geometric calculations. The Type D Fund, with its smaller proportion invested in equity, achieved the highest return in the period. Source: Authors'own calculations, based on data provided by Superintendence of Pensions.

Fund Type	dic-09	dic-10	dic-11	dic-12	dic-13	dic-14
Type A	75	80	100	100	100	100
Type B	60	70	90	90	90	90
Type C	50	60	75	75	75	75
Type D	30	30	45	45	45	45
Type E	20	25	35	35	35	35

Appendix 2: Evolution of Maximum Foreign Investment Allowed, as a Percentage of the Total Value of Each Fund

Global Maximum: Fixed Income plus Equities. Percentage figures. Source: Superintendence of Pensions. Available in p. 39 Cuadro A a.2 Website: http://www.spensiones.cl/portal/regulacion/582/articles-10257\_recurso\_1

Zone	Month	Type A fund	Type B fund	Type C fund	Type D fund
North America	dic-09	20.4	23.7	25.1	29.6
	dic-14	38.8	36.0	33.9	35.1
Europe	dic-09	9.3	8.6	11.7	14.5
	dic-14	10.8	10.5	12.6	15.8
Asia Pacífic	dic-09	10.7	9.8	8.5	5.7
	dic-14	16.8	17.0	15.9	13.9
Emerging Asia	dic-09	24.3	23.1	21.7	16.3
	dic-14	19.7	21.3	19.4	12.2
Latin America	dic-09	22.5	22.6	19.6	20.3
	dic-14	7.7	8.1	8.3	11.7
Emerging	dic-09	7.4	6.8	7.6	6.9
Europe	dic-14	1.8	1.7	3.0	3.7
Others	dic-09	5.4	5.4	5.8	6.7
	dic-14	4.4	5.4	6.9	7.6

Asia Pacific include: Australia, Japan, Hong Kong and Singapore. Emerging Asia includes China, Korea, India, Indonesia, Malaysia, Thailand and Taiwan. Latin America including Brazil and Mexico. Emerging Europe includes Hungary, Poland, Russia and Turkey. Figures in percentage. Source: Superintendence of Pensions, available in http://www.safp.cl/portal/informes/581/articles-10662 recurso 1.pdf

Foreign Mutual Fund Name	<b>Bloomberg</b> Code		
Aberdeen Global - Asia Pacific Equity Fund - A2 (2)	ABEAPIA:LX		
Baring International Umbrella Asia Growth Fund (2)	BRGOCPI:ID		
BlackRock Global Funds - Latin America Fund	MERLTAI:LX		
BNP Paribas Equity Russia	FORERIC:LX		
BNY Mellon Investments Funds - Newton Oriental Fund - Institutional GBP (2)	NEORINA:LN		
Capital International Emerging Markets Fund	CAPAUSD:LX		
Deka Convergenceaktien	DED2:GR		
Dfa Emerging Markets Small Cap Portfolio (2)	DEMSX :US		
Dfa Emerging Markets Portfolio Institutional	DFEMX:US		
Dfa Emerging Markets Value Portfolio	DFEVX:US		
Dfa Investment Dimension Group Inc. US. Large Cap Value Portfolio (1)	DFLVX:US		
Dfa Investment Dimension Group Inc. US. Small Cap Value Portfolio (1)	DFSVX:US		
Dfa Investment Dimension Group Inc. US. Targeted Value Portfolio (1)	DFFVX:US		
Dws Invest - Dws Invest Chinese Equities	DWSCEFC:LX		
Dws Osteuropa	DWSPSEU:LX		
Fidelity Funds - Asean Fund (1)	FIDLAEI:LX		
Fidelity Funds - Asian Special Situations Fund - A\$ (2)	FIDASSI:LX		
Fidelity Funds - China Focus Fund (2)	FIDFDFO:LX		
Fidelity Funds - Indonesia Fund (1)	FIDINDI:LX		
Fidelity Funds - Korea Fund – A	FIDFKLI:LX		
Fidelity Funds - Latin America Fund – A	FIDLLAI:LX		
Fidelity Funds - South East Asia Fund (2)	FIDLSEI:LX		
Franklin Templeton Investment Funds Templeton China Fund	TEMCHIA:LX		
Franklin Templeton Investment Funds Templeton Asian Growth Fund – A (2)	TEMFAIA:LX		
Franklin Templeton Investment Funds-Templeton Latin America Fund – A	TEMLAIA:LX		
Henderson Gartmore Fund - Latin America Fund - REUR ACC	GALATDD:LX		
Investec Global Strategy Fund Asian Equity Fund (1)	GUIASIA:LX		
JP Morgan Funds - Russia Fund	JPMRUSI:LX		
Mellon GLO F PLC-M Asian Equity Portfolio (2)	NEWANNA:LN		
Morgan Stanley Investment Funds - Asian Property Fund (2)	MOPLU:LX		
Parvest Equity Latin America	PARLAIN:LX		
Parvest Equity Brazil	PARBRIC:LX		
Pioneer Funds - Global High Yield - A Non - Distributing (1)	PIGHYLI:LX		
Pioneer Funds Emerging Markets Equity A\$ distributing	PIOEMAD:LX		
Robeco Capital Growth - Emerging Markets Equities - I	ROEMMKE:LX		
Schroder Int Sel F-Pacific Equity (1)	SCHPFCA:LX		
Schroder International Selection Fund - BRIC - A	SCHBRAC:LX		
Schroder International Selection Fund - Latin American - A1	SCHLACA:LX		
The Growth Fund Of America (1)	AGRBX:US		
Vanguard Institutional Index Fund – Institutional (1)	VINIX:US		

Appendix 4: Selected Foreign Mutual Funds and their Respective Bloomberg Codes (1): 10 Selected Foreign Mutual Funds; (2): 20 Selected Foreign Mutual Funds

Chilean Pension Funds can not hold more than 5% of a certain Foreign Mutual Fund. Source: Bloomberg and Superintendence of Pensions.

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