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Multi-funds in the Chilean Pension System

Soledad Hormazábal

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Overview

This work describes the development of the multi-fund scheme in Chile, as well as its key features and results. It includes simulation exercises designed to model the returns and volatilities of the different types of Chilean pension funds over a 50-year horizon. It shows how the trend is for increasing returns and that the average expected return of the pension funds is greater as the percentage invested in equity increases, although the volatility is also higher. The considerable risk premium associated with investment in shares would justify the adoption of a greater risk when the investment horizon is longer. This does not mean that the risk is limited over time, but rather that the volatility of the equity assets provides periods of exit opportunities with significant returns.

1. The Chilean Pension System

The Individual Capitalization Pension System was introduced in Chile in 1981 by Decree Law No. 3500 on December 6, 1980. This reform radically altered the foundations of the Chilean pension system by replacing the previous pay-as-you-go defined-benefit system with an individual capitalization scheme based on obligatory individual savings accounts, defined contribution and private administration. The new system, effective since May 1981, standardized and streamlined contributions and benefits for the Chilean population. Basically, under the system workers are required to contribute 10% of their taxable income to individual savings accounts. These are administered by the AFPs (pension fund administrators), which invest them in the financial markets. AFPs are private institutions whose sole objective is to administer the individual savings accounts and invest the pension funds. In return for these services, they have the right to charge a variable fee expressed as a percentage of the contributor's taxable income.

The system has a poverty-prevention pillar that provides government assistance to individuals who have not been able to self-fund sizeable pensions; and a third voluntary saving pillar with tax incentives. These savings may be contributed to pension funds administered by the AFPs, to mutual funds for housing and investment set up by financial institutions, or to life insurance companies. All of them are regulated by the Securities and Insurance Superintendency.

Starting in 1981, affiliation in the new system was made mandatory for all new salaried workers entering the labor market for the first time, while for those who were already affiliates of the former system the transfer was voluntary. To create incentives for workers to transfer, affiliates moving to the individual capitalization system had a lower contribution rate than the pay-as-you-go system, and the government also gave "recognition bonds" to compensate workers for their contributions to the old system.

Under this scheme, the State had a subsidiary role limited to supervision as the final guarantor of the system, and also to the provision of welfare support for the poorest workers. An independent, specialized public body was set up with this aim. The AFP Superintendency (now called Pension Superintendency) is the regulatory institution responsible for supervising the system, safeguarding affiliates' rights and overseeing compliance by the AFPs with the investment rules.

A new pension reform was introduced in 2008 to enhance the 1981 system. The Chilean pension system continued to be based on three pillars: a public solidarity pillar, a contributory pillar (mandatory) and a voluntary pillar. In essence, the reform strengthened the poverty-prevention pillar by introducing a basic non-contributory welfare pension financed from national budget. It also improved the benefits and access conditions for government assistance to contributory pensions for the lowest-income segments. In addition, the reform incorporates a variety of other corrective measures relating to gender, young people and competition, makes the rules for investment more flexible, and regulates conflicts of interest, among other matters.

1.2. Multi-funds

The individual-capitalization system began mostly with young contributors, so there was a long period during which the accumulation stage was the most important. As a result, pension funds quickly accumulated a large volume of assets. Starting with zero in 1981, by 1995, pension fund investments represented 39% of GDP; in 2010 the figure was over 60%.

Initially there was only one type of fund in which affiliates had to accumulate their savings. This scheme did not take into consideration that the optimum level of risk taken by an individual with his pension fund investments may vary significantly according to personal characteristics. Variables such as the individual's age, level of wealth and degree of risk aversion will result in several investment decisions with different risk-return combinations. Since there was only one type of fund, the system could not adequately respond to these differing requirements.

In December 1997, the single type of fund was 27.45% invested in equity and 72.46% in fixed income. This was the situation when the Asian crisis struck. The real average return of the system was -1.14% in 1998. The need for at least a second type of pension fund with less investment in equity instruments became obvious. In October 1999, Act No. 19641 introduced a new fund: the most conservative Fund E, which was composed exclusively of fixed-income investments. The new fund began to operate in May 2000. It was meant to be a safe haven for those contributors close to retirement age and pensioners on programmed retirement schemes (whose savings continue to be invested in pension funds), for whom

it is very costly to face a high variation in the value of their savings, as their investment horizon would not allow them to recover possible losses.

In February 2002, Act No. 19795 introduced three new types of funds into the system: two more aggressive funds and one conservative fund. Thus, since August 2002, there have been five types of funds for capitalizing obligatory savings: the riskiest Fund A; the risky Fund B; intermediate Fund C (the original, which has been maintained since the launch of the system); conservative Fund D; and the most conservative Fund E. The basic difference between the five funds is the maximum and minimum limits of investment in equity instruments. The AFPs are required by law to offer the four least aggressive funds, while the riskiest Fund A is voluntary. Historically, all the AFPs have offered the five types of funds under the Law.

The creation of the multi-fund scheme was based on the premise that investment in equity has a greater expected return, but also a higher risk compared with fixed-income investment. Therefore the multi-fund scheme would increase the system's efficiency by increasing the expected value of pensions, while at the same time limiting the exposure to market risk for older contributors (with a shorter investment horizon).

The multi-fund system also allows contributors to exercise their preferences in terms of the risk-return combinations of their pension investments and thus increases the overall welfare of contributors. Increasing the range of funds to satisfy contributors' risk-return preferences may, ultimately, result in the optimum design being to offer as many funds as there are contributors in the system, but the administration costs on the supply side and information costs on the demand side in practice limit the number of alternatives that can be offered efficiently.

Contributors may freely choose the fund in which to deposit their savings, as well as transfer the balance of their contributions between funds[1]. However, as can be seen in Chart 1, participants who are pensioners and those who are close to pension age are not permitted to choose the riskiest funds. If contributors have their savings in a fund that is not authorized for their age band, their funds will then begin to be gradually transferred. Thus if a contributor who is 10 years away from legal retirement age (50 years for women and 55 years for men) has his savings in the riskiest Fund A, his balance will begin to be transferred to the fund immediately below (the risky Fund B) at a rate of 20% per year. In four years, the participant will therefore no longer have any mandatory savings invested in the riskiest fund. The transfer from risky Fund B to intermediate Fund C when the contributors reach pension age follows the same dynamic, at 20% per year, so it is also completed within four years.

Model 1

Alternative fund types according to age of the affiliates

Fund Type	Men up to 35 years. Women up to 35 years	Men between 36 and 55 years. Women between 36 and 50 years	Men over 56 years, women over 51 years, retirees
Fund A "Riskiest"	Yes	No	No
Fund B "Risky"	Yes	Yes	No
Fund C "Intermediate"	Yes	Yes	Yes
Fund D "Conservative"	Yes	Yes	Yes
Fund E "Most conservative"	Yes	Yes	Yes

Source: BBVA Research

The reason for limiting the participants' option to choose any type of fund is based on the State's role as guarantor. Excessive variation in the funds of contributors who are close to retirement age and pensioners increases the probability and the amount of public spending on pensions due to the welfare pension programs.

The system also includes a default option for those participants who do not choose a type of fund. The default option assigns the obligatory savings to funds according to their age, so that men and women under 35 years of age will have their savings in the risky Fund B; their funds will then begin to be transferred at a rate of 20% per year to the intermediate Fund C; when women reach 50 years of age and men 55, their balances are transferred once again (at a rate of 20% per year) to the conservative Fund D.

1: When the balance in the capitalization account is transferred from the fund more than twice a year, the AFP has the right to charge an extra fee (which may not be discounted from the fund).

Model 2

Default option. Assignment by age for affiliates who do not choose the fund type

Fund Type	Men up to 35 years. Women up to 35 years	Men between 36 and 55 years. Women between 36 and 50 years	Men over 56 years, women over 51 years, retirees
Fund A "Riskiest"			
Fund B "Risky"	■		
Fund C "Intermediate"		■	
Fund D "Conservative"			■
Fund E "Most conservative"			

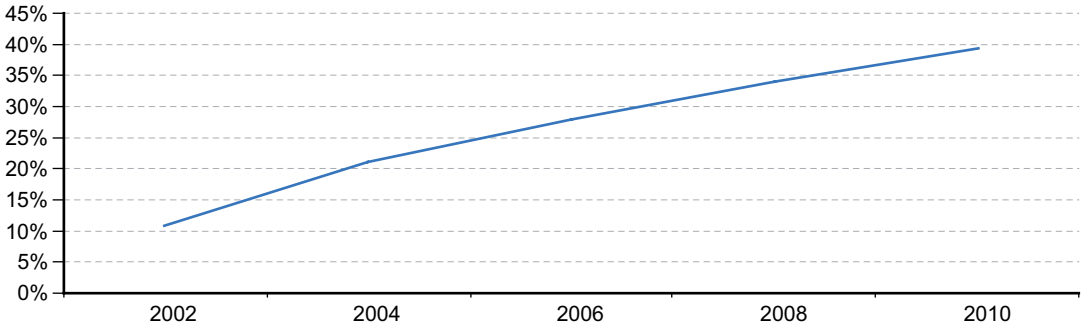
Source: BBVA Research

Contributors may maintain the assets they have accumulated under different categories of saving in different types of funds[2]. They may also maintain a balance in more than one type of fund and define the proportion of savings that should be kept in each. New contributions may be paid into one or both types of funds in which assets are kept. Allowing an account to be divided into more than one type of fund opens up many new portfolio alternatives with different combinations of risk and return within the range provided by extreme funds (the riskiest Type A and the most conservative Type E).

The riskiest Fund A and most conservative Fund E only include the savings of those who have exercised their right to choose, as these funds are not included in the default option. As of March 2010, more than 3.8 million contributors had chosen the type of fund for themselves. This represents 39% of the total number of contributors in the system. Chart 1 shows that the percentage of participants who choose the type of fund has been increasing since the creation of the multi-fund system in 2002.

Chart 1

Percentage of affiliates that choose fund type



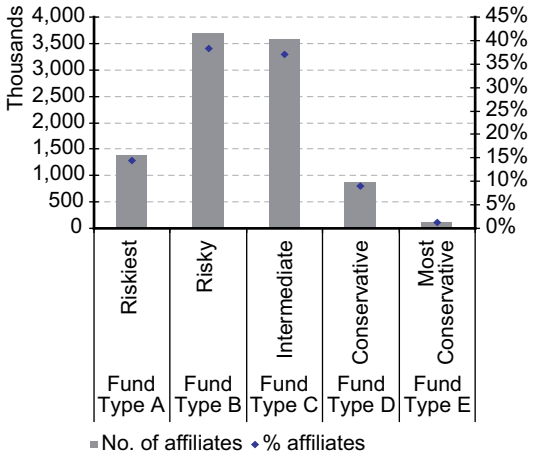
Source: Pension Superintendency

The distribution of contributors by type of fund is given in Chart 2. It shows a major concentration of affiliates in the risky Fund B and intermediate Fund C, which altogether amount to 75.3% of the total contributors to the system. Chart 3 shows the distribution of accounts in the different types of funds. The fund with the most assets is the intermediate Fund C, with over USD 45 billion.

2: The balances from obligatory contributions, voluntary savings and agreed deposits may be maintained in different types of funds. Only the unemployment savings account must be in the same type of fund as the obligatory contributions.

Chart 2

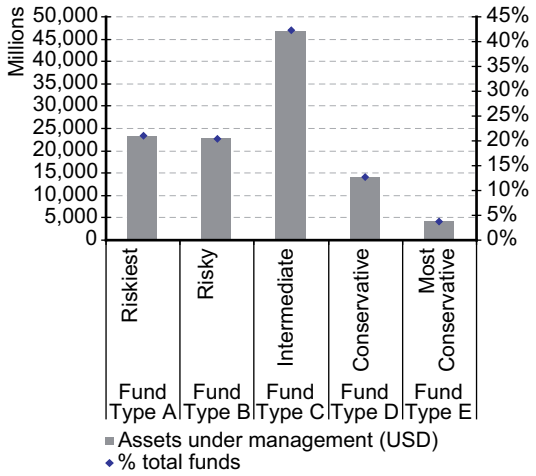
Afiliates by type of fund (March 2010)



Source: Pension Superintendency

Chart 3

Assets under management by type of fund (May 2010)



Source: Pension Superintendency

The distribution of affiliates and assets under management by type of fund does not match because the latter are not distributed at random. As is to be expected, the riskier funds maintain a greater proportion of young people and the conservative Fund D has a larger proportion of older contributors. It is worth noting that affiliates in the most conservative Fund E show a fairly similar distribution among the different age groups.

Table 1

Proportion of affiliates by type of fund and age group, March 2010

	Fund Type A	Fund Type B	Fund Type C	Fund Type D	Fund Type E
Age	**Riskiest**	**Risky**	**Intermediate**	**Conservative**	**Most Conservative**
Under 30 years	45%	48%	2%	1%	12%
From 31 to 45 years	40%	46%	48%	3%	39%
From 46 to 55 years	14%	3%	42%	28%	26%
Over 56 years	1%	2%	8%	68%	23%
	100%	100%	100%	100%	100%

Source: BBVA Research

As of August 2010, the AFPs are permitted to offer their contributors a contract for future transfers between the multi-funds according to their age. Contributors who take up this contract will have their balances transferred from the capitalization account in accordance with Model 3.

Model 3

Transfer contract according to the age of the affiliates

Fund Type	**Men and women up to 30 years**	**Men and women from 31 to 35 years**	**Men between 36 and 55 years. Women between 36 and 50 years**	**Men between 56 and 60 years. Women between 51 and 55 years**	**Men over 61 years and women over 56 years**
Fund A "Riskiest"					
Fund B "Risky"					
Fund C "Intermediate"					
Fund D "Conservative"					
Fund E "Most conservative"					

Source: Pension Superintendency

Contributors can choose the transfer contract and decide if it should begin to operate immediately, or they can stipulate that it take effect at a later date. Contributors may always revoke or terminate the contract. The AFP, in turn, is required to advise each contributor of the transfer from one type of fund to the other in the immediately preceding four-month period.

1.3. Regulatory framework of investments in pension funds

The Chilean State is the guarantor of the pension system. It also imposes on workers the obligation to save part of their wages with private pension fund administrators. For both reasons, the State has the right and the duty to ensure that the system operates properly, which implies overseeing and regulating it.

Investments in pension funds have always been regulated, with an established range of instruments available and limits on the type of assets. This implies that pension fund assets may only be invested in securities specifically authorized by the Law or investment rules. In addition, the instruments available should be investment-grade, meaning they have to be authorized by the Risk Rating Commission.

When the system was first set up, the funds could only be invested in domestic fixed-income securities. As the volume of assets in the pension fund increased, domestic financial markets developed and confidence in the system grew, new types of instruments were permitted. In 1985, investment of up to 30% was allowed in certain types of shares. Then in 1989, still within the maximum limit of 30% for investment in equity, the acquisition of shares in concentrated companies and real estate companies was permitted.

Circular 621 of 1990, which was in force until 2002, authorized participation in investment funds, with a maximum limit of 20% for these instruments. This raised the total limit for investment in equity to 50% of the fund. This Circular also authorized investment of part of the fund assets abroad for the first time, and delegated the responsibility for setting the maximum limits to the Central Bank. In January 1992, it was established that only 2.5% of the fund may be invested abroad, and only in fixed-income instruments. This limit increased to 3% in October 1992 and to 6% in 1995. In May 1995, investment of up to 4.5% of the fund in foreign equity was authorized, and the total limit for investment in foreign instruments was established at 9%. The limits have continued to be extended gradually. In April 1999, the maximum ceiling was set at 10% for investment in foreign equity, and at 20% for investment in foreign instruments as a whole.

With the establishment of the multi-fund system in 2002, the eligible assets and limits by type of instrument were set in a different way for each type of fund. In the case of investment abroad, an overall limit was maintained, which was initially established at 15% for equity and 20% for fixed income. Since then, the limits on foreign investment have continued to be extended. Currently, the maximum overall limit on investment in foreign securities stands at 60% of total pension fund assets, and the individual limits by type of fund reach up to 80%, as can be seen in Table 2.

Table 2

Maximum investment limit abroad, since 2008

	Fund Type A	Fund Type B	Fund Type C	Fund Type D	Fund Type E
	Riskiest	Risky	Intermediate	Conservative	Most Conservative
Maximum investment limit abroad	80%	70%	60%	30%	25%
Maximum investment limit in foreign currency without foreign exchange hedging	50%	40%	35%	25%	15%

Source: Pension Superintendency

With the introduction of multi-funds, Circular No. 1216 came into force in August 2002, establishing the eligible instruments and their limits for each of the five types of funds. Table 3 shows some of the main maximum limits established and Table 4 depicts the minimum investment limit in equity instruments. As stated above, the basic difference between the different types of funds is the maximum and minimum investment limit in equity instruments.

Table 3
Maximum investment limit by type of fund

	Fund Type A	Fund Type B	Fund Type C	Fund Type D	Fund Type E
Type of security	**Riskiest**	**Risky**	**Intermediate**	**Conservative**	**Most Conservative**
Government securities	40%	40%	50%	70%	80%
Term deposits, bonds and other securities representing issues by financial institutions	40%	40%	50%	70%	80%
Securities guaranteed by financial institutions.	40%	40%	50%	70%	80%
Letters of credit issued by financial institutions	40%	40%	50%	60%	70%
Public and private corporate bonds	30%	30%	40%	50%	60%
Public and private corporate convertible bonds	30%	30%	10%	5%	-
Shares in publicly traded corporations and publicly traded real-estate corporations	60%	50%	30%	15%	-
Shares in publicly traded corporations, units in investment funds and units in mutual funds that do not require approval from the Risk Classification Commission	3%	3%	1%	1%	-
Units in domestic investment funds and mutual funds.	40%	30%	20%	10%	-
Commercial paper issued by companies with a maturity of no more than one year, non-renewable	10%	10%	10%	20%	30%
Investment in foreign currency without foreign exchange hedging	40%	25%	20%	15%	10%

Source: Pension Superintendency

Table 4
Minimum investment limit by type of fund

	Fund Type A	Fund Type B	Fund Type C	Fund Type D	Fund Type E
Type of security	**Riskiest**	**Risky**	**Intermediate**	**Conservative**	**Most Conservative**
Shares in publicly traded corporations, units in investment funds and mutual funds	40%	25%	15%	5%	-

Source: Pension Superintendency

Currently, the maximum and minimum investment limits in equity for each of the funds are higher than when the multi-funds were first introduced. Table 5 shows the limits in force today. It is also important to point out that, despite the overlaying of the limits, the funds offered by AFPs are clearly differentiated. The riskiest A Fund always has a greater proportion invested in equity than the risky B Fund, and so on, until the most conservative E Fund, with the lowest proportion invested in equity. Table 3 shows the proportion invested in fixed-income and equity for each type of fund in April 2010.

Table 5
Multi-funds and their investment limits in equity in 2010

	Fund Type A	Fund Type B	Fund Type C	Fund Type D	Fund Type E
Limit	**Riskiest**	**Risky**	**Intermediate**	**Conservative**	**Most Conservative**
Maximum	80%	60%	40%	20%	5%
Minimum	40%	25%	15%	5%	-

Source: Pension Superintendency

Until the pension reform of 2008, Decree Law 3500 regulated the details of investment in pension funds. This regulatory structure was highly complex and rigid, so, to better serve the contributors, it was decided to provide the system with a regulatory framework that could handle the investments more effectively. This was stressed by the President of the Republic, Michelle Bachelet, in her Message to Congress presenting the pension system reform bill:

"The management of investment in pension funds is an essential component of the success of an individual capitalization system. The results in terms of the return on investment by the funds are a key factor in the future value of pensions. On this matter, it is estimated that a difference of one percentage point in return over a contributor's active lifetime may have an impact of around 20% on the pension.

… the excessive detail and complexity of the regulation of investment in pension funds under the current Decree Law 3500 does not allow the flexibility and adaptability required by continuously changing financial markets...".

With the reform, the Law provided a basic simplified structure that covered instrument eligibility and investment limits. The more precise details of regulation were left to the government through the creation of the "investment rules" by the Pension Superintendency. A Technical Investment Council (CTI) was set up for this purpose. Its mission is to advise the government on matters relating to the investment and to recommend any changes it may deem necessary.

1.4. Investment Systems Compared

In 2005, both Mexico and Peru adopted a multi-fund system. In Mexico, the pension fund administrators (Afores) offer five types of funds called Specialized Retirement Fund Investment Companies (Siefores). However, Mexican contributors cannot freely choose which fund to invest their savings in, but are instead assigned funds in accordance with a life-cycle model. Under this model, the savings of young contributors are deposited in the fund with the greatest proportion of investment in equity instruments (SB5, which invests up to 30% in these kinds of securities); as the contributors become older they are obligatorily transferred to funds with a lower investment in equity instruments. Table 6 shows details of the Mexican Siefores investment system (types of funds). It is notable how low the maximum limit of investment in equity instruments by the most aggressive Siefores is, as well as the fact that differences between the different types of Siefores are not very significant.

Table 6
Mexico: Investment rules, maximum limits by instrument, in 2010

Security	SB1	SB2	SB3	SB4	SB5
Equity (share indices)	-	15%	20%	25%	30%
Fixed income	100%	100%	100%	100%	100%
Foreign securities	20%	20%	20%	20%	20%
Asset-backed securities	10%	15%	20%	30%	40%
Structured instruments	-	5%	10%	10%	10%
Real estate and infrastructure trusts (FIBRAS)	-	5%	5%	10%	10%

Source: Pension Superintendency

In Peru, the AFPs offer three types of different funds with a different risk-return combination. The Type 1 fund, or Capital Maintenance Fund, maintains a maximum of 10% invested in equity. People over the age of 60 are required to hold their savings in this fund, unless they express their decision in writing to keep it in the Balanced Fund. The Type 2 fund, or Balanced Fund, is the intermediate fund, which can invest up to 45% in equity. Contributors who do not choose a fund themselves when they enter the system are assigned to this fund. Finally, the Type 3 fund, or Growth Fund, was designed for contributors with a long investment horizon and may invest up to 80% in equity.

Table 7
Peru: Investment rules, maximum limits by instrument, in 2010

Security	Fund Type 1: Capital maintenance	Fund Type 2: Mixed	Fund Type 3: Growth
Equity	10%	45%	80%
Fixed income	100%	75%	70%
Trading derivatives	10%	10%	20%
Certificates of deposit / assets in deposits	40%	30%	30%

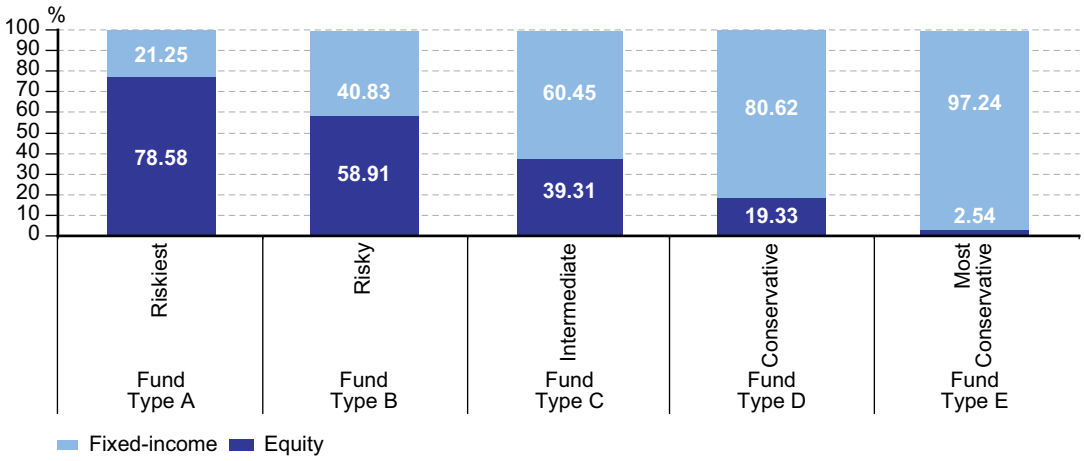
Source: Pension Superintendency

1.5. Pension Fund Investments

As of April 30, 2010, the total value of the pension funds stood at USD 121,529 million. Of this, 48.3% was invested in equity instruments and 51.5% in fixed income. The composition of the portfolio for each of the different types of funds is given in Chart 4, which shows how the funds maintain a level of equity that is close to the maximum limit allowed by the investment rules.

Chart 4

Portfolio composition as of April 2010. Fixed income and equity

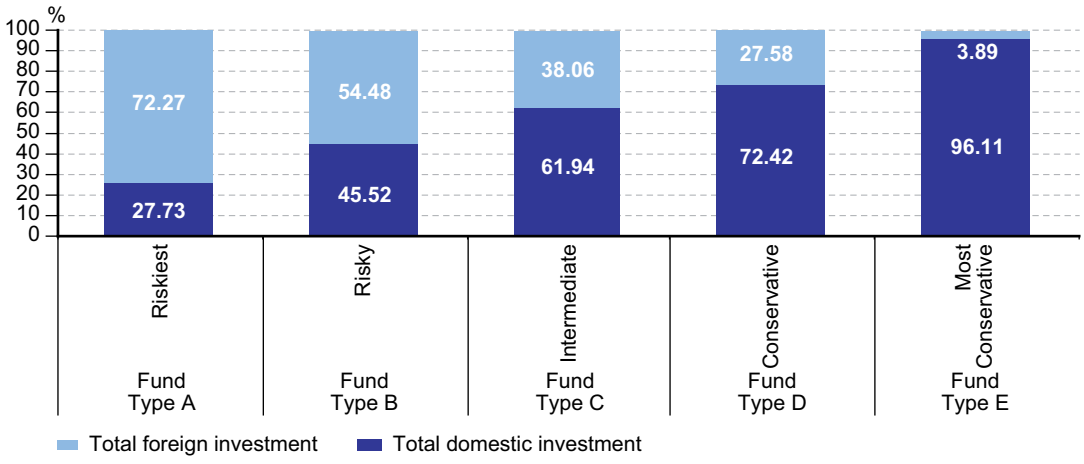


Source: Pension Superintendency

In April 2010, 53.4% of all pension fund assets were invested in Chile, and the remaining 46.6% abroad. Chart 5 shows the major differences between the different types of funds with regard to international diversification.

Chart 5

Portfolio composition as of April 2010. Domestic and foreign investment

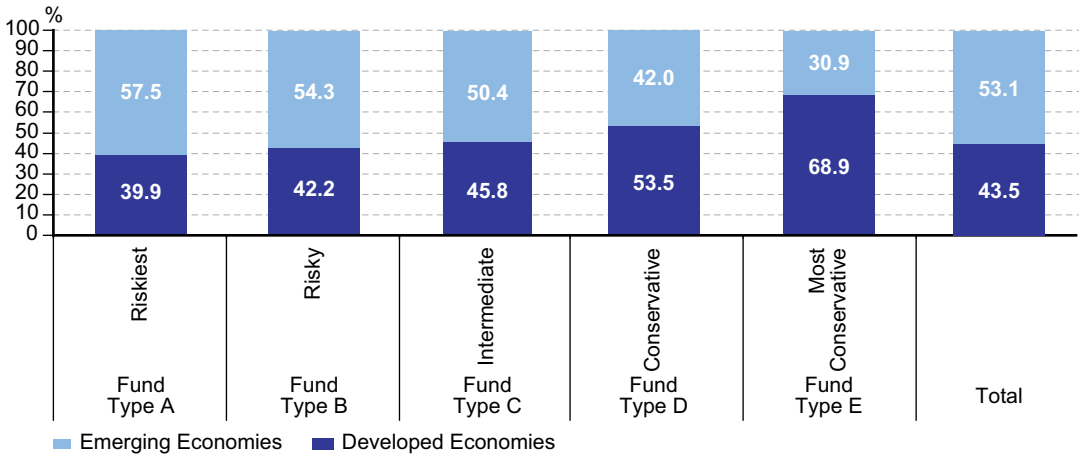


Source: Pension Superintendency

The riskiest Fund A has the greatest proportion of investment abroad. This proportion falls off gradually to the most conservative Fund E, which has the highest proportion of investment in Chile. It should be noted that the riskiest funds also have a more aggressive investment profile abroad, as can be seen in Chart 6. The greater the risk in the type of fund, the greater the proportion of foreign investment in emerging economies. Thus, the riskiest funds not only have a greater proportion invested in equity and abroad, but their portfolio also has a more aggressive risk profile. This is not explicit under the investment rules, but rather responds to the wish of the AFPs to comply with their mandate and offer contributors types of funds with clear progressive differences in the risk-return combination.

Chart 6

Portfolio composition as of April 2010. Investment abroad by geographical area

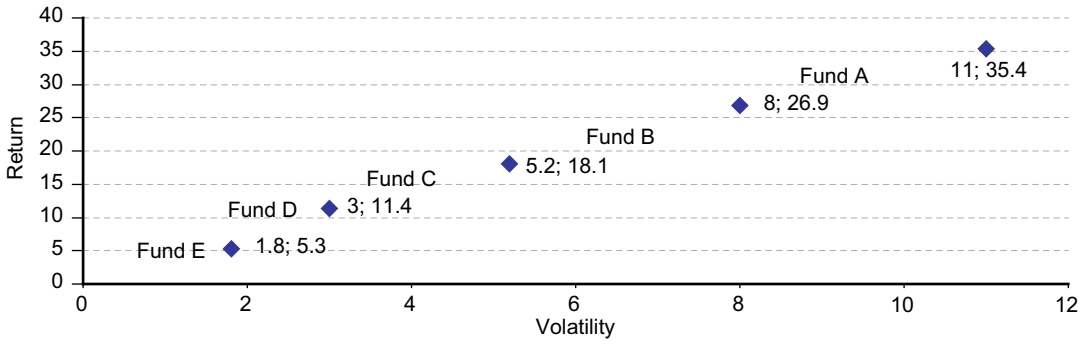


Source: Pension Superintendency

It is interesting to see how the funds are categorized as expected in the chart showing the risk-return combinations. The risk is a result of volatility, which is measured as the standard deviation of real daily returns. In fact, fund performance confirms the premise on which the multi-fund system was established: the greater the investment in equity the greater the return, but also, the greater the risk.

Chart 7

Returns and volatility of returns by type of pension fund, annual percentage, May 2009 to April 2010



Source: Pension Superintendency

Diversification is a key aspect in pension fund administration, as it limits portfolio risk considerably. Pension funds in Chile have investments in more than 48,000 different financial instruments handled by 500+ issuers from some 60 countries. With this fragmentation, the funds are not particularly exposed to the risk of one issuer, one economic sector or one market, as the risk is diluted and offset by other issuers, economic sectors and markets. In short, Chilean pension funds eliminate diversifiable risk by spreading their investments, and they are only exposed to systematic risk, which corresponds to the risk for the entire financial market.

Table 8 shows this diversification broken down into five major categories of financial instruments: domestic equity, private domestic fixed income, public domestic fixed income, foreign equity and foreign fixed income. It shows a healthy diversification of the portfolios of the different funds. Although the most conservative Fund E is, by its nature, focused on the domestic market, it has fixed-income instruments from more than 100 different issuers (those available) from different sectors in the Chilean economy and with a variety of maturities.

Table 8

Aggregate portfolio of pension funds by type of fund and type of security, as of 30 April 2010

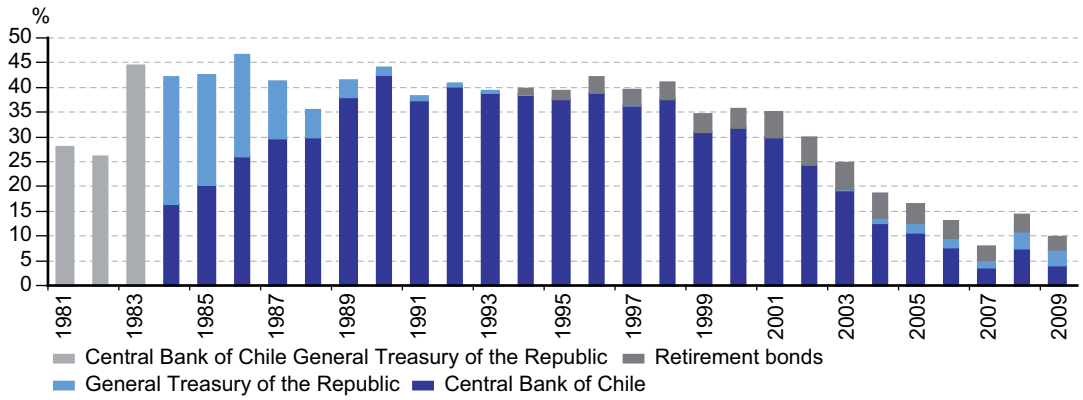
	Fund Type A	Fund Type B	Fund Type C	Fund Type D	Fund Type E	Total
	Riskiest	Risky	Intermediate	Conservative	Most Conservative	
Domestic equity	17.3%	18.7%	17.3%	9.2%	0.2%	16.0%
Domestic private-sector fixed-income	7.8%	19.2%	32.8%	49.3%	74.5%	27.8%
Domestic public-sector fixed-income	2.6%	7.4%	11.8%	14.0%	21.2%	9.5%
Foreign Equity	61.3%	40.2%	22.0%	10.1%	2.3%	32.3%
Foreign Fixed Income	10.9%	14.2%	15.9%	17.4%	1.6%	14.2%
Total assets (USD million)	26,711	25,321	50,767	14,857	3,872	121,529

Source: Pension Superintendency

There is a notably low investment in Chilean government instruments: as of April 2010 it only amounted to 9.5% of total funds. Even in the most conservative Fund E this percentage is only 21.2%. Meanwhile, in Mexico, the percentage of investment in Mexican government fixed income was 64.68% of the total of pension funds. As of December 2009, investment in domestic government instruments amounted to 42% in Colombia and 20% in Peru, in both cases as a percentage of total funds. In the case of Peru and Colombia, the high exposure to government debt may be the result of the relatively new private pension systems there (introduced in 1994 in Colombia and in 1993 in Peru). The extremely high exposure to this form of debt by pension funds in Mexico is a cause for concern and is not justified solely by their relatively short life (since 1997). Chart 8 shows how in Chile the proportion of funds invested in government debt at no time reached 50%.

Chart 8

Investment by pension funds in the public sector (% of total pension funds)



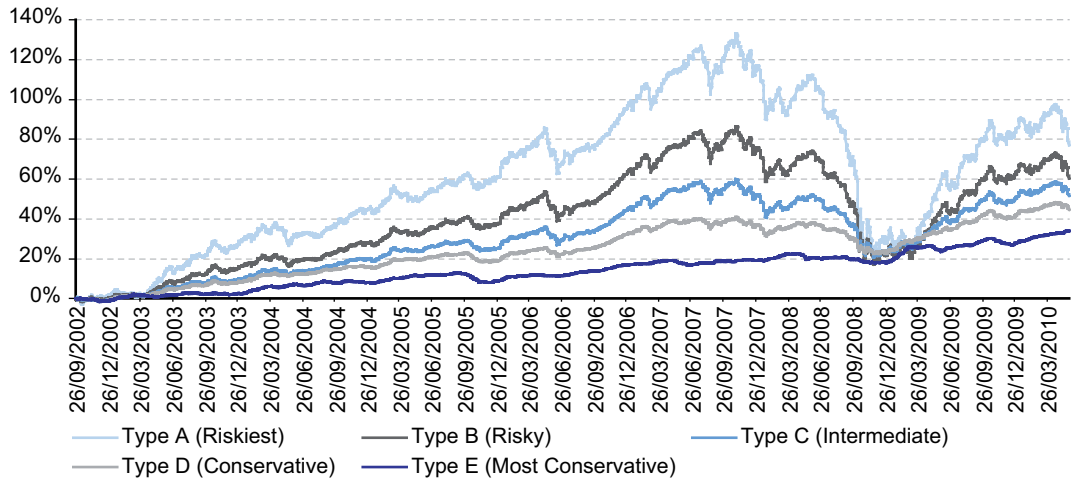
Source: Pension Superintendency

2. The short-term impact of the crisis

During economic and financial crises, the value of pension funds falls, affecting the pension savings of the workers who are part of the system. Pension funds are invested in financial assets, which in crisis situations typically experience extreme variations in price. As a result, the accumulated balance of pension funds may experience a severe decline. Chart 9 shows the real average return of the system for the five types of pension funds in Chile. It shows the impact of the subprime crisis on the real return of the funds, particularly those with a higher proportion of equity. It also shows that the most aggressive funds have recovered more strongly; however, the size of the fall was so great that they have still not recovered to their pre-crisis levels. On the other hand, the conservative Fund D and the most conservative Fund E experienced limited falls and quickly recovered their losses.

Chart 9

Real return of pension funds



Source: AFP Provida

On October 31, 2007, pension funds reached their highest pre-crisis level; they reached their low on November 23, 2008. Table 9 shows the losses suffered by each of the funds in the subprime crisis. It can be seen that the return on all the funds was negative, but the size of the losses was considerably different: while the riskiest Fund A lost 48.46% of its value, the most conservative Fund E only fell back 6.88% in real terms.

Table 9

Real returns in the subprime crisis (between 31/10/2007 and 23/11/2008)

Fund Type A	Fund Type B	Fund Type C	Fund Type D	Fund Type E
Riskiest	Risky	Intermediate	Conservative	Most Conservative
-48.46%	-37.19%	-24.35%	-13.06%	-6.88%

Source: Pension Superintendency

It should be remembered that price rises and falls are normal in the financial markets and reflect changes in the economic situation or in the expectations of the economic agents. Historical experience shows that financial crises or severe falls in the prices of financial instruments occur every so often and affect stock prices above all. Between 1926 and 2009 there have been 14 economic and financial crises of major size and global scope. The average duration of the falls in returns on the financial markets was 22 months, with average losses of 40.3% in share prices.

Table 10

Main global economic and financial crises since 1929

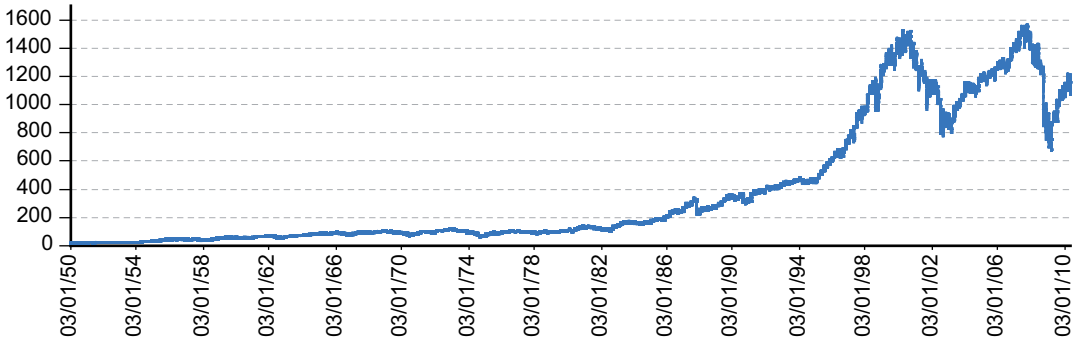
Crisis	Duration (months)	Returns	Returns after 1 year
Great Depression (1929-1932)	34	-86%	124%
World War II (1937-1942)	61	-60%	59%
Post-World War II (1946-1949)	37	-30%	42%
Oil crisis (1973-1974)	21	-48%	38%
Debt crisis (1980-1982)	21	-27%	58%
Stock market crash (1987)	4	-34%	23%
Dotcom bubble (2000-2002)	31	-49%	34%
Subprime crisis (2007-2009)	17	-57%	69%

Source: AFP Provida

The last financial crisis started in the U.S. and quickly extended to the rest of the world's financial markets. During this so-called "subprime crisis", the U.S. Standard & Poor's stock market index fell 56.8% (see Chart 10) over a period of 17 months. Despite these overwhelming figures, Table 10 shows that the size of the fall and its duration are within the historical average.

Chart 10

Standard & Poor's (1950-2010)



Source: Bloomberg

Even with the major losses recorded in 2008, the funds show positive performance when considering longer periods of time. As can be seen in Table 11, as of April 2010, all the funds had achieved positive and significant real annual average returns since the launch of multi-funds in 2002. The gradual evolution of the return registered according to the risk profile of each type of fund can be seen for the longer period and is recovered in the relatively short period that excludes the crisis (the last 12 months), while in the medium run the steady returns are inverted due to the weight of the crisis in the period and its size. This trend confirms the importance of limiting the investment in equity instruments in periods close to retirement age. In fact, two years after the crisis the most aggressive funds have still not recovered to their pre-crisis levels.

Table 11

Real return of pension funds, as of April 2010

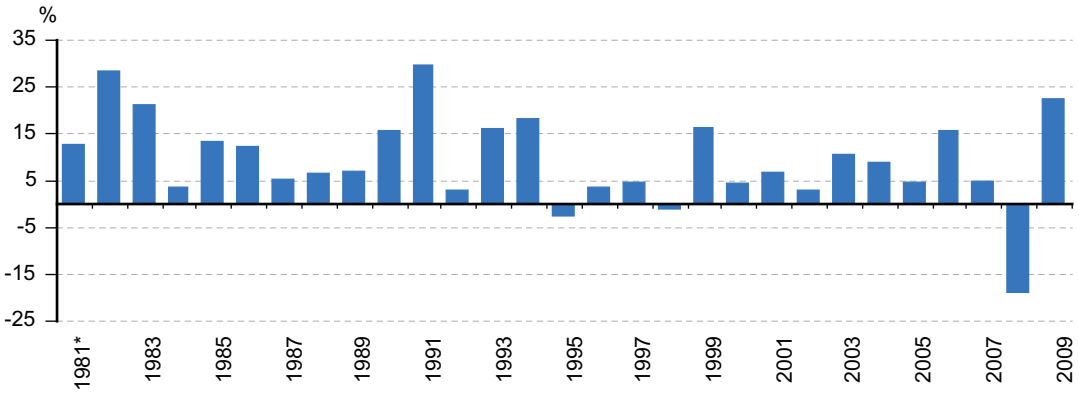
	Fund Type A	Fund Type B	Fund Type C	Fund Type D	Fund Type E
	Riskiest	Risky	Intermediate	Conservative	Most Conservative
Last 12 months (May 2009 - Apr 2010)	35.42%	26.91%	18.08%	11.44%	5.34%
Annual average in last 36 months (May 2007-Apr 2010)	-3.03%	-0.91%	0.68%	2.11%	3.69%
Annual average since launch of multi-funds (Sep 2002-Apr 2010)	9.14%	7.33%	6.18%	5.28%	3.83%
Annual average since launch of the system (Jun 1981-Apr 2010)	-	-	9.29%	-	-

Source: Pension Superintendency

The intermediate Type C fund accumulates the most extensive history, as it has been operating since the system was launched in 1981. Chart 11 shows the average real annual return registered over this period. It can also be seen that, apart from the major fall of 18.94% in 2008, it only had a real annual negative return on two occasions, and of a much lesser size: -2.52% and -1.14% in 1995 and 1998, respectively.

Chart 11

Real annual return of the intermediate Type C fund (1981 to 2009)

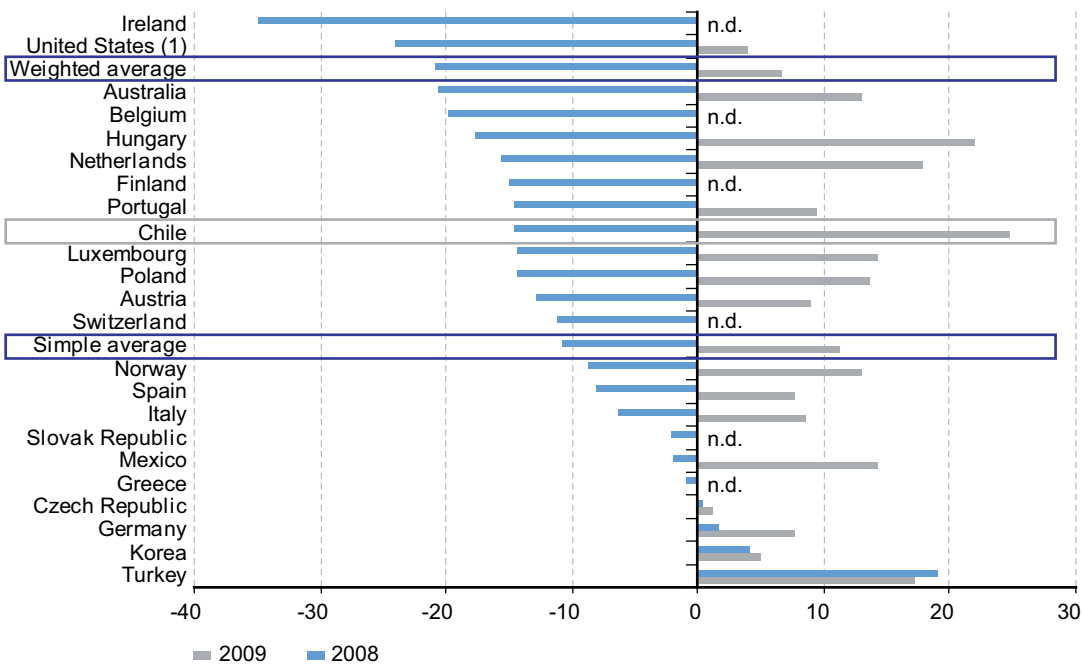


*From July 1981 to December 1981.
Source: Pension Superintendency

As can be seen in Chart 12, the Chilean pension funds were those that recovered best among OECD member states.

Chart 12

Nominal rate of return of the pension funds in selected OECD countries, 2008-2009

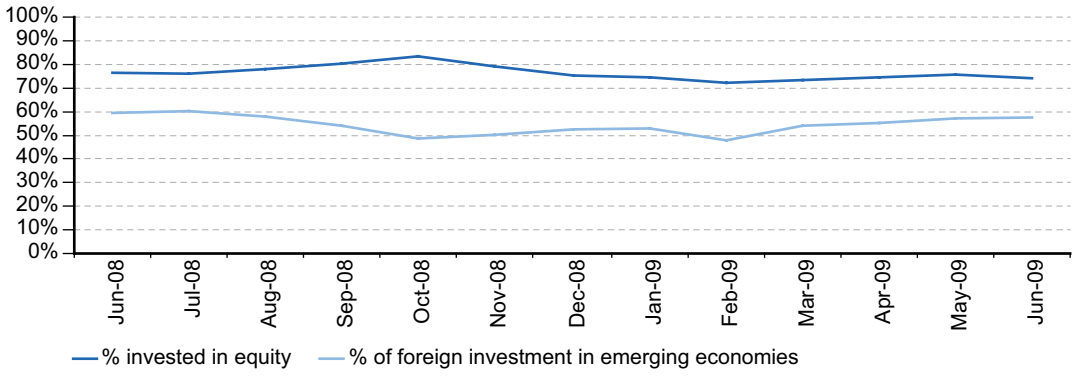


1: Estimates include individual pension funds. Figures for 2009 include the period between January and June
Source: OECD Pension Markets in Focus, July 2010

The reason for this relatively swift recovery of the Chilean pension funds is that the AFPs remained closely linked to the investment profiles of their funds. As a result, they did not significantly reduce their exposure to assets of greater risk when the crisis broke out. Chart 13 shows the proportion of Type A pension funds invested in equity assets, and the proportion of investment abroad in emerging economies during the period before and after the crisis. These ratios remained relatively constant, so there was no change in the risk profile of pension fund investments. We should bear in mind that the information in Chart 13 does not consider the price effect on the ratios: in other words, in the context of a sharp fall in the value of equity assets, the proportion of the fund invested in these instruments would tend to fall, as the pension funds are valued at market prices. Thus, as markets began to recover, the funds did so in the same conditions in which the losses occurred.

Chart 13

Investments of riskiest Type A fund



Source: Pension Superintendency

3. Long-term multi-fund returns

Although in historical terms pension funds have obtained a positive accumulated return, it is not possible to guarantee the future performance of investments based on past returns.

A simulation exercise has been carried out to evaluate the different possible scenarios for the price behavior of the different types of assets in which funds are invested. To simplify the analysis, the assets are grouped together into two major categories: fixed-income and equity instruments. Using Monte Carlo simulations, the performance of these two types of instruments are projected for a period of 1 to 50 years. Specifically, an algorithm is used to resolve the equation of their performance based on a repeated random sample of values for the prices of assets.

4. Model for the long-term dynamics of financial asset prices

The prices of the fixed-income and equity instruments are modeled as random variables using a multiplicative model with the following general characteristics:[3]

$$P_T = P_0 e^{gT}$$

The model indicates that the price of a financial asset at a time t = T is equal to the price of the asset at the time t = 0 increased exponentially at a rate "g" over a period T. The unit of time measurement is years. Thus, the performance of the asset price is determined by rate "g".

A commonly used hypothesis for possible changes in "g" is that it behaves as a random variable (rv) with a normal probability distribution and constant mean and variance. The fact that "g" adopts this functional form makes the above calculations easier, as it is possible to linearize the equation, and the prices will be random variables with a log-normal distribution:

$$Ln(P_T) = Ln(P_0) + gT$$

$$Ln \frac{(P_T)}{(P_0)} = gT$$

$$g = \frac{1}{T} Ln \frac{(P_T)}{(P_0)}$$

The log-normal distribution of the variables provides three desirable properties to the price behavior of financial instruments:

1. They are always positive.
2. For any moment t=n prices are not known values, as they depend on the random variable "g". However, when the "g" variance is zero, the equation takes the form of a deterministic model applicable to the price of a fixed-income asset, in which the interest rate is determined a priori for a given period.
3. Price changes are continuous for short periods of time.

Rate "g" is an annualized rate of return over a time horizon that ranges from zero to T. In this context, "gT" may be interpreted as an accumulated growth rate which also has a normal distribution. Luenberger (1998) and Hull (2008) show that the variable "gT" follows a stochastic pattern described by a Geometric Brownian Motion (GBM) or the "dzt" Wiener process.[4]

Therefore, under the GBM hypothesis for "gT", prices would behave as follows:

$$P_T = P_0 e^{vT+\sigma dz}$$

Where the random variable "gT" has a normal distribution with constant mean and variance:

$$gT \sim N(vT, \sigma^2 T)$$

The change over time in the asset price is as follows:

$$Ln\left(\frac{P_T}{P_0}\right) = vt + \sigma dz_t$$

$$dLn\,(P_t) = vt + \sigma dz_t$$

3: An alternative way of modeling asset prices would be additive. However, a specification of this type would not lead to a log-normal distribution for asset prices which, as mentioned below, enables us to capture some relevant characteristics. For more details of these alternative specifications and their limitations, see Luenberger (1998).

4: Under the GBM hypothesis, a random variable "x" exhibits a variation over time given by a stochastic differential equation of the type: $dx_t = vdt + \sigma dz_t$

where

$dz_t = \varepsilon_t \sqrt{dt}$

With $\varepsilon_{tz} \sim N(0,1)$

Its analytical solution is given by: $x_t = vt + \sigma z$

This can be expressed equivalently in terms of P(t) as follows:

$$\frac{dP_t}{P_t} = \mu dt + \sigma dz_t$$

where:

$$\mu = v + \frac{1}{2}\sigma^2$$

Following Luenberger (1998), the above stochastic process for the price of a financial asset may, in turn, be extended to the case of the value of a portfolio with n assets, in such a way that the price of the i-th asset where i=1, 2, 3,…n is given by a behavioral equation as follows:

$$\frac{dP_i}{P_i} = \mu_i dt + \sigma dz_t$$

with covariance:

$$Cov(dz_i, dz_j) = \sigma_{ij} dt$$

Based on the above, the change in price for each asset i at an instant of time t has a log-normal probability distribution with an expected value and variance given by the following:

$$E\left[ln\left(\frac{dP_i(t)}{(P_i(0)}\right)\right] vt = (\mu_i \frac{1}{2} \quad \sigma^2)t$$

$$Var\left[ln\left(\frac{dP_i(t)}{(P_i(0)}\right)\right] = \sigma_i^2 t$$

A portfolio with "n" assets is built by assigning a weight w(i) to each asset i=1, 2, 3,…n, where the sum of all the weights w(i) is equal to 1. As a result, the instantaneous rate of change of the value of a portfolio V is given by the equation:

$$\frac{dV}{V} = \sum_{i=1}^{n} w_i \frac{dP_i}{P_i} = \sum_{i=1}^{n} w_i \mu_i dt + w_i \sigma dz_t$$

Where the variance in the stochastic term dz(t) is given by the term:

$$E\left(\sum_{i=1}^{n} w_i dz_t\right)^2 = E\left(\sum_{i=1}^{n} w_i dz_i\right) E\left(\sum_{j=1}^{n} w_i dz_j\right) = \sum^{n}_{i,j=1} w_i w_j \sigma_{ij} dt$$

Therefore, for a portfolio V(t) with a log-normal distribution, the expected value of its return and its variance is given by:

$$E\left[Ln\left(\frac{dV}{V}\right)\right] = vt = \sum_{i=1}^{n} w_i \mu_i t - \frac{1}{2} \sum_{i,j=1}^{n} \sigma^2(t) =$$

$$\sigma^2(t) = \sum_{i,j=1}^{n} w_i w_j \sigma_{ij} t$$

Where "v" is the annualized rate of growth in the portfolio's value, determined by the allocation of assets to the portfolio, in other words, by w(i).

$$v = \frac{1}{t} E\left[Ln\left(\frac{dV}{V}\right)\right]$$

The model described so far can represent the individual performance of some fixed-income instruments. To better capture the performance of investment in fixed income by pension funds, we constructed an index or weighted average of the interest rates of these types of instruments with different maturity periods.

The construction of an interest rate index also requires simulation of the behavior of the interest rate curve over time. In order to do this, a working hypothesis was used in which the prices of fixed-income assets with differing terms are proportional to the prices of short-term instruments, and all the volatility in the prices comes from the volatility of the short-term instruments.[5]

5: This assumption allows simulations to be made, though it does not take into account that the volatility of the long-term index-linked fixed-income assets tends to be lower, while short-term fixed-income assets tend to have a higher volatility (Walter, 2009). The model used does not consider this observation, so there is a bias towards higher volatility in the fixed-income assets to be considered.

The Ornstein-Uhlenbeck behavioral equation for short-term r(t) rates cited by Vasicek (1977) meets the assumptions set out in the above paragraph. The specification of this formula is:

$$dr = \alpha\,(\gamma - r)\,dt + \sigma dz \text{ con } \alpha > 0$$

This equation differs from the Wiener process used in modeling equity prices because it defines stationary behavior for the random variable. Thus, in this equation the term "$\alpha(\gamma-r)$" makes the process tend towards its mean long-term value: "γ". The value "α" is known as the velocity of regression to the mean.

Vasicek (1977) demonstrates that it is possible to construct an interest-rate curve for different terms based on the Ornstein-Uhlenbeck equation by calculating prices for zero-coupon bonds using equations which are only dependent on the "α" and "γ" parameters.

Vasicek assumes that the performance of any bond at a time t and with maturity of T is given by an internal rate of return in t, which is an inverse function of its price.

$$R(t,T) = -\frac{1}{T} Ln\,(P(t,t+T)) \text{ con } T > 0$$

Based on the above, the short-term interest rate is defined as an instantaneous rate when t tends to zero.

$$r(t) = R(t,0) = lim_{T\to 0}\, R(t,T)$$

Vasicek demonstrated that the price of a bond with maturity T is given by a specific functional form:

$$P(t,\,T,\,r) = exp\left[\frac{1}{\alpha}\,(1 - e^{-\alpha(T-t)})\,(R(\infty) - r) - (T-t)\,R(\infty) - \frac{\sigma^2}{4\alpha^3}\,(1 - e^{-\alpha(T-t)})^2\right] \text{con } t \le T$$

Where R (∞) corresponds to the return at maturity of a bond with a very long term (when T tends to infinity):

$$R(\infty) = \gamma + \frac{\sigma}{\alpha} - \frac{1}{2}\,\sigma^2 \Big/ \alpha^2$$

Vasicek then demonstrated that the interest rate structure for different terms can be calculated using the following equation:

$$R(t,T) = R(\infty) + (r(t) - R(\infty))\,\frac{1}{\infty T}\,(1 - e^{-\alpha T}) + \frac{\sigma^2}{4\alpha^3 T}\,(1 - e^{-\alpha T})^2 \text{ con } T \ge 0$$

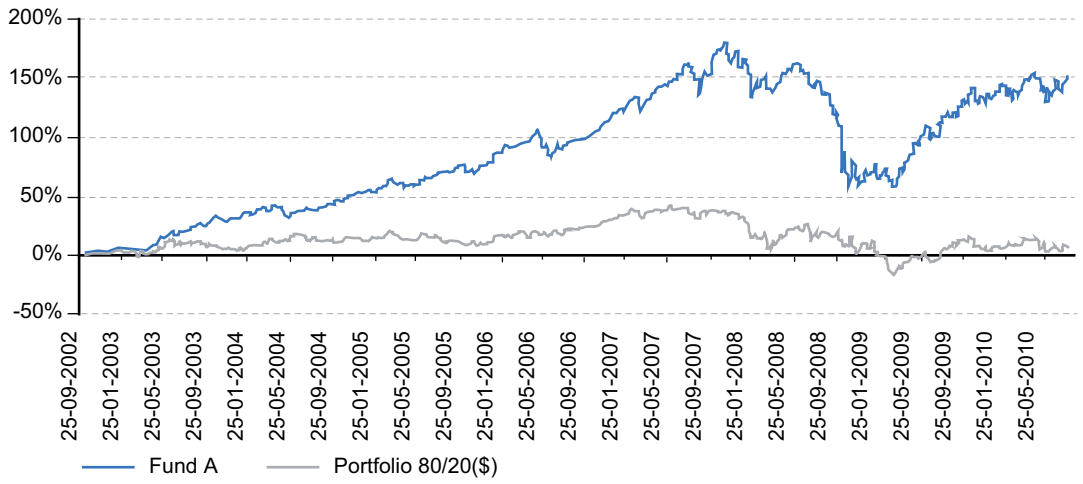
5. Results of the simulations

A total of 250 simulation exercises were carried out projecting various random movements in the price of financial assets (separately: fixed income and equity, domestic and foreign); these random movements in turn generate returns and volatilities associated with these instruments. The implications on the different kinds of funds were then analyzed according to their composition. This was done by building portfolios composed of different instruments that were weighted according to the composition that the funds must have according to the investment rules.

This simulation is a significant exercise of simplification, as investment management enables movements that are significantly different from those given simply by complying with the legal investment rules referring to the maximum investment limits by type of instrument. In fact, as shown by Chart 14, the return of the Type A fund has been far higher than the return which a portfolio made up of 80% equity and 20% fixed income would register, using the MSCI World and BarCap Aggregate indices to simulate the returns of these assets.

Chart 14

Type A fund return vs. 80/20 portfolio



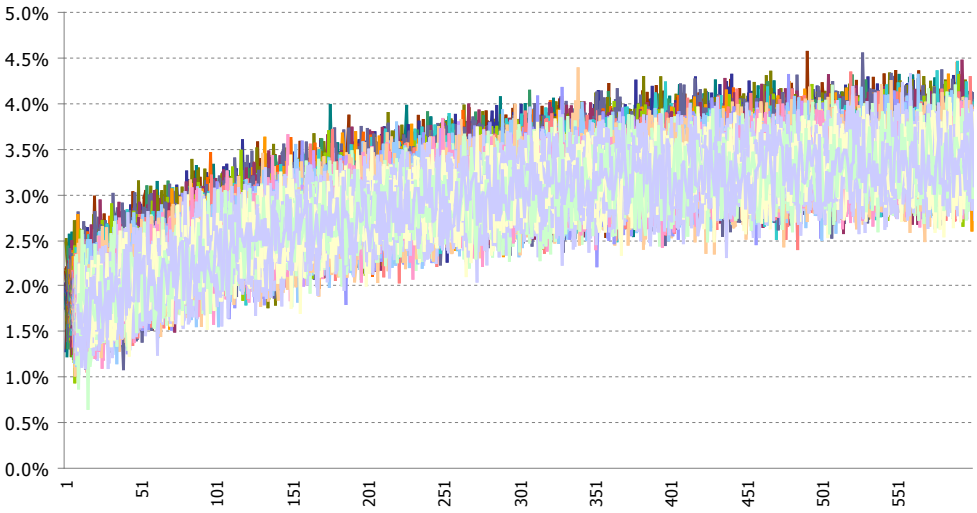
Source: AFP Provida, BBVA Group

5.1. Domestic fixed income and foreign fixed income

The Vasicek technique is used to project the movements for domestic and international fixed-income asset prices. Domestic fixed-income uses the short-term rate associated with Central Bank of Chile discountable promissory notes (PDBC). International fixed-income uses the rate associated with U.S. short-term government debt (U.S. Treasury Bill). These rates are used to separately construct an interest rate curve for the different time horizons. Charts 15 and 16 show the respective results of the simulations for domestic and foreign fixed-income. They show a stable and similar behavior between both instruments, although movements in foreign fixed-income show a steeper slope and reach lower levels than Chilean fixed-income.

Chart 15

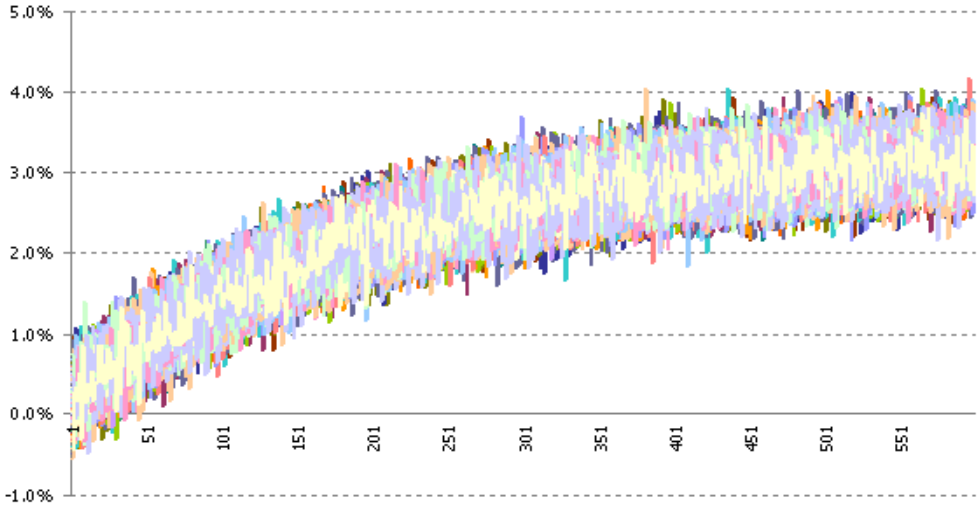
Simulation of domestic fixed income (250 paths in a 600-month horizon (50 years))



Source: Bloomberg and BBVA Research

Chart 16

Simulation of domestic fixed income (250 paths in a 600-month horizon (50 years))



Source: Bloomberg and BBVA Research

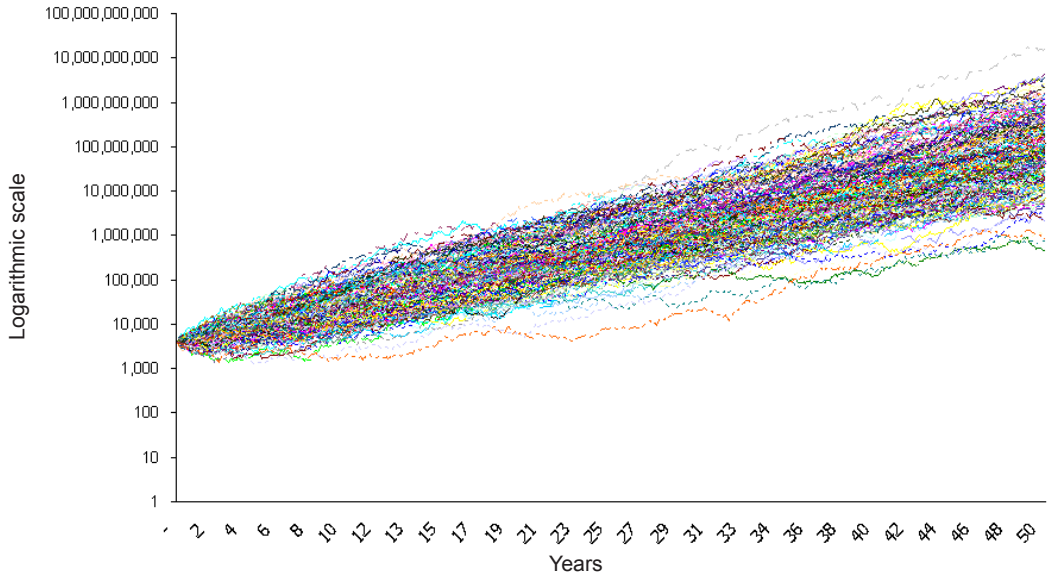
The model used does not take into account the evidence indicating that the volatility of the long-term index-linked bonds tends to be lower as the investment horizon is extended, while the volatility of short-term fixed-income tends to increase with the investment term (Walter, 2009). Thus, the extrapolation of volatility from short-term fixed income to instruments of higher terms imposes a greater volatility to the latter assets than what is actually observed.

5.2. Domestic and foreign equity

The model used to project random movements in equity asset prices described in section 4 is multiplicative, so that the results for the range of possible returns describe an accelerated growth associated with a rising trend typical of the performance of equity assets. Chart 17 shows the 250 simulated movements for the value of the Chilean IPSA stock market index, while Chart 18 illustrates the 250 random movements for the value of the international equity index (MXWO). This is a free-float index of weighted shares that includes different securities markets in developed economies. The result of the simulations for the two types of equity shows, as is to be expected, an upward trend, though growth is more limited in the foreign equity index as compared to the performance of the Chilean stock market index. Intuition backs this result, given that the changes in the deeper and more developed capital markets would be more stable than in shallower markets, where there is still much room to grow by incorporating sectors and companies with high marginal returns.

Chart 17

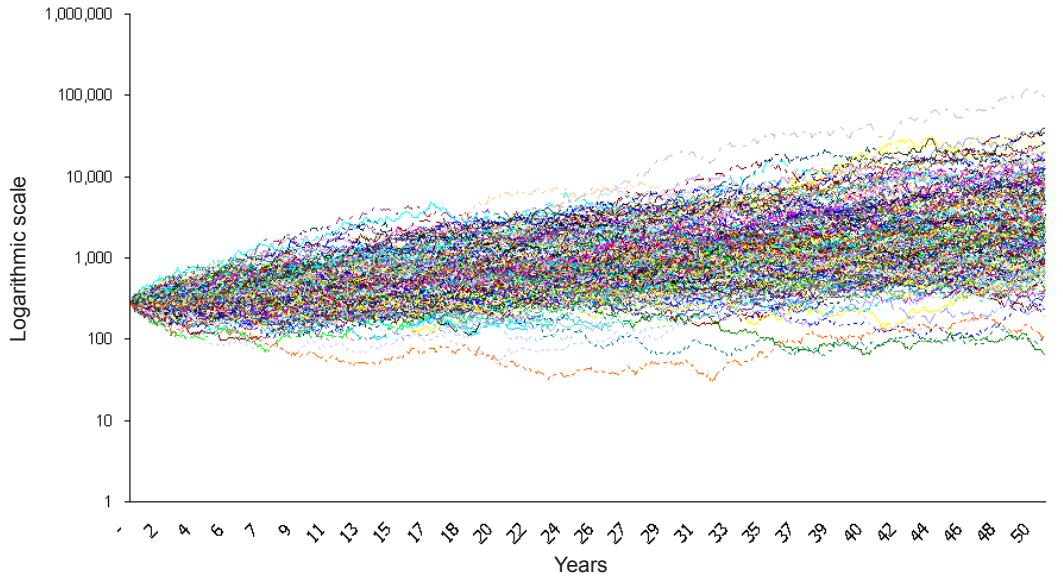
Simulation of domestic equity (Based on 250 scenarios for 1 - 50 years horizons)



Source: Bloomberg and BBVA Research

Chart 18

Simulation of foreign equity (Based on 250 scenarios for 1 - 50 years horizons)



Source: Bloomberg and BBVA Research

The charts clearly show the extent of the dispersion of trends for national and foreign equity. It can also be seen how the dispersion increases with the time horizon.

5.3. Implication for multi-funds

Once the random movements are projected for the different assets, based on historical movements in prices of representative securities in each of the four kinds of investments –fixed income and equity, domestic and foreign– the portfolios with the different types of assets are built, in the proportions corresponding to each type of fund. In this way, the riskiest Type A fund is constructed as a weighted average of the variation and return for each asset, in the proportion in which the security is represented in this type of fund. This procedure is carried out for each of the five types of fund, according to the weightings shown in Table 12 corresponding to the average for these proportions for the 12 month period between August 2009 and July 2010. In this way, the proportion of each type of instrument, in this case Fund A (riskiest) will be 18.2% of domestic equity, 11.2% of domestic fixed-income, 60.6% of foreign equity and 10% of foreign fixed-income.

Table 11

Composition of the pension fund portfolio. Average, August 2009 to July 2010

	Fund Type A	Fund Type B	Fund Type C	Fund Type D	Fund Type E
% of total fund	Riskiest	Risky	Intermediate	Conservative	Most Conservative
Domestic equity	18.2%	19.3%	17.6%	9.4%	0.1%
Foreign Equity	60.6%	39.9%	21.7%	9.8%	1.5%
Domestic fixed income	11.2%	28.4%	47.1%	65.3%	94.8%
Foreign Fixed Income	10.0%	12.5%	13.6%	15.5%	3.6%

Source: Pension Superintendency

In addition, the portfolios of the five types of funds were built exclusively with domestic assets in order to explore the differences found in expected returns when incorporating investment abroad. In this case the weightings indicated in Table 13 for the fixed-income and equity assets correspond to the maximum limits currently established by the investment rules for equity in each of the five types of funds.

Table 12
Composition of portfolios with domestic investment only

	Fund Type A	Fund Type B	Fund Type C	Fund Type D	Fund Type E
	Riskiest	Risky	Intermediate	Conservative	Most Conservative
Domestic equity	80%	60%	40%	20%	5%
Domestic fixed income	20%	40%	60%	80%	95%

Source: Pension Superintendency

The results for the five types of funds according to the asset composition described above are presented in Table 14. The return is markedly higher in more aggressive funds, and decreases according to the proportion of investment in equity assets. This is the average result of the simulation exercises and is in line with economic theory, as there is a risk premium associated with the equity instruments more visible in the aggressive funds. If the expected return in equity were not greater on average, its demand would fall, leading to a fall in prices, and this would end up raising the return and re-establishing the risk premium.

The low volatility associated with the funds with greater presence of shares is a surprising result, although it increases as the proportion of shares is lower. There is a theory called time diversification which assumes a reduction of the volatility of long-term equity returns. This implies a practically certain recovery of possible falls in prices in a highly diversified share portfolio. This theory has been widely questioned. Walker (2009) argues that diversification over time is a fallacy; in other words, the risk of investing in shares does not reduce over time. Valdés (2010) goes further to state that the risk of investment in shares increases with the investment period because time increases a) the prediction error, which is strengthened due to its continuance; and b) the estimation error, as over longer periods of time the number of data that are independent of each other for use in predictions is reduced.

Table 13
Results of the simulations

	Fund Type A	Fund Type B	Fund Type C	Fund Type D	Fund Type E
	Riskiest	Risky	Intermediate	Conservative	Most Conservative
Return only with domestic investment	14.2%	11.2%	7.9%	4.3%	1.4%
Volatility only with domestic investment	0.9%	0.7%	0.4%	0.2%	0.1%
Return with domestic and foreign investment	9.4%	7.8%	5.6%	3.2%	0.6%
Volatility with domestic and foreign investment	0.6%	0.5%	0.4%	0.2%	0.0%

Source: Pension Superintendency

As investment abroad corresponds to developed economies in the simulation, while domestic investment corresponds to the developing Chilean economy, the returns of the less diversified portfolios are higher.

Even so, the considerable equity risk premium justifies the acceptance of additional risk. It is also important to consider that linking greater volatility exclusively with equity is a simplification that is becoming obsolete. In fact, there are various fixed-income instruments with high risk levels, such as high-yield bonds and currency investment. In addition, an asset may be stable in the short term, but risky in the long term and vice-versa; as claimed by Walter (2009) “despite greater volatility, shares have a lower long-term risk than short-term fixed-income.”

Given that the objective of funds is to finance pensions, i.e., the investment horizon is long, it would be advisable to reconsider the measurement of investment risk as a short-term volatility measure, as well as the appropriateness of limiting risk by limiting equity investment, as, although, this is one aspect to consider, it is far from being the only one.

6. Conclusions

When the individual capitalization system in Chile was introduced, only one type of fund to invest savings for pensions was available. This model was unable to recognize that the best risk-return combination for savers could vary considerably according to personal characteristics such as risk aversion, age, level of wealth, etc.

Following the Asian crisis in 1997, the real annual average return of the system was -1.14% in 2008. This led to the creation of a new fund with less investment in equity instruments, conceived as a safe haven for affiliates who were closer to retirement age and those already receiving pensions. In 2002, three new types of funds were introduced: two more aggressive funds and one conservative fund. Currently there are five types of funds: A (riskiest), B (risky), C (intermediate), D (conservative) and E (most conservative). The difference between these funds is basically the maximum and minimum limits of investment in equity instruments.

The riskiest fund in Chile can invest up to 80% in equity instruments. It is also the fund that invests most abroad and that has the largest proportion of investment abroad in emerging economies.

The adoption of the multi-fund scheme is based on the premise that investment in equity has a greater expected return, but also higher risk compared with fixed-income investment. Therefore, the creation of a multi-fund scheme should make the system more efficient by increasing the expected value of pensions, while, at the same time, reducing exposure to market risk for older contributors (with a shorter investment horizon).

Affiliates can freely choose the fund in which to keep their savings and make transfers between them. The exception is affiliates who are already pensioners, who may not keep their savings in Funds A and B, and affiliates who are 10 or fewer years from retirement age, who may not choose Fund A. The system also has a default option for those affiliates who do not choose the type of fund themselves. They are assigned a fund according to their age, so that men and women under 35 years of age have their mandatory savings in Type B fund (risky), and then their assets are transferred at a rate of 20% per year to fund C (intermediate). When women reach the age of 50 and men 55, their balances are once more transferred (at a rate of 20%) to fund D (conservative).

During the 2008 crisis, all the funds registered losses, although their extent varied considerably: while fund A lost 48.46% of its value in real terms, the most conservative fund E only lost 6.88%. Even with these hefty losses, the pension funds have accumulated a positive rate of return since the launch of the multi-fund system: 9.14% as an annual average in real terms in the case of the riskiest fund. This amount falls gradually as the risk of the type of fund is reduced: to 3.83% for the most conservative fund E. However, at nearly two years from the crisis, the riskiest funds have still not recovered to the pre-crisis levels, thus confirming the importance of limiting equity exposure when the investment horizon is short.

The results of the simulation model used show positive returns for all the funds over a 50-year horizon, and a greater expected return for funds with a higher proportion invested in equity. This result confirms the idea that assets with negative qualities (such as greater risk) must have another attribute to offset them, in this case a risk premium, so that on average a portfolio biased towards equity will have a higher return than one biased towards fixed income. Indeed, if the expected return from equity were not greater on average, its demand would drop, leading to a fall in prices, and this would end up raising the return and re-establishing the risk premium.

The recommendation to take greater risk when longer investment periods are available is based on the greater expected return due to risk premium. This does not mean that the risk is reduced over time; in fact, if there were no risk there would be no premium. The recommendation is associated with the fact that over lengthy periods of time exit opportunities should arise, leading to high returns. These opportunities are reduced when the period of time is short, as the price volatility of shares is high within each period of time. Taking this greater risk would be justified by the considerable equity risk premium.

In addition, it is also important to consider that linking greater volatility exclusively with equity is a simplification that is becoming obsolete. There are high-risk fixed-income instruments and assets with different risk levels for different terms. Fund investment should have a long-term profile, which means that measuring investment risk as a measure of short-term volatility should be reconsidered, as should the appropriateness of limiting risk by limiting equity investment, as, although it is one aspect to consider, it is far from being the only one.

The individual capitalization pension system has been particularly successful in terms of investment administration and performance. The multi-fund scheme increases the system's efficiency and the expected rate of return during the accumulation period. It also limits the exposure to risk when close to retirement age. The multi-fund scheme has demonstrated that it provides a better response to the diverse needs of affiliates as a whole.

But there is more to be done in aspects such as proper measurement of risk from the point of view of the impact of certain investments on future pensions; in other words, the concept of short-term volatility risk should be shifted, as the relevant horizon is long-term.

7. Bibliographical References

Favre, Michelle; Melguizo, Angel; Muñoz, Angel; Vial, Joaquín (2006). *"A 25 Años de la Reforma del Sistema Provisional Chileno. Evaluación y propuestas de ajuste"* BBVA Provida S.A.

Bernstein, Solange; Castañeda, Pablo; Fajnzylber, Eduardo; Reyes, Gonzalo (2009). *"Chile 2008: Una Reforma Provisional de Segunda Generación"*, Superintendencia de Pensiones, Chile.

Bjeletic, Jasmina; Herrera, Carlos; Tuesta, David; Alonso, Javier (2010). *"Simulación de Rentabilidades en la Industriade Pensiones Privadas en el Perú"*, BBVA Research.

Circular 1.216, Superintendencia de Pensiones, Chile.

Decreto Ley N° 3.500, República de Chile.

OECD (2010). *"Pension Markets in Focus: July 2010, Issue 7"*, OECD 2010.

Proyecto de Ley N° 20.255, República de Chile.

Valdés, Salvador (2010). *"Acciones, Plazo de Inversión y Multifondos"*,Estudios Públicos N° 117, CEP Chile.

Vasicek, Oldrich (1977), *"An Equilibrium Characterization of the Term Structure"* Journal of Financial Economics 5, 177-188. North-Holland Publishing Co.

Walker, Eduardo (2009). *"Riesgo y Pensiones"*, Presentaciones del Seminario Internacional "Inversiones y Pensiones en los Sistemas de Capitalización", FIAP (Federación Internacional de Administradoras de Fondos de Pensiones).

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Contact details

BBVA Research
Paseo Castellana, 81 - 7th floor
28046 Madrid (Spain)
Tel.: +34 91 374 60 00 and +34 91 537 70 00
Fax: +34 91 374 30 25
bbvaresearch@grupobbva.com
www.bbvaresearch.com