



Working Papers Series
Superintendencia de Pensiones
Teatinos 317.
Santiago, Chile.

www.spensiones.cl

WORKING PAPER 36

IN AN INDIVIDUALLY FUNDED PENSION SYSTEM:
HOW CAN RISKS BE MITIGATED?

Solange Berstein
Olga Fuentes
Nicolás Torrealba

Febrero 2010



Los **Documentos de Trabajo** son una línea de publicaciones de la Superintendencia de Pensiones, que tienen por objeto divulgar trabajos de investigación económica realizados por profesionales de esta institución, encargados o contribuidos por terceros. Con ello se pretende incentivar la discusión y debate sobre temas relevantes del sistema previsional o que incidan en él, así como ampliar los enfoques sobre estos fenómenos.

Los trabajos aquí publicados tienen carácter preliminar y están disponibles para su discusión y comentarios. Los contenidos, análisis y conclusiones que puedan derivar de los documentos publicados son de exclusiva responsabilidad de su(s) autor(es) y no reflejan necesariamente la opinión de la Superintendencia de Pensiones.

Si requiere de mayor información o desea tomar contacto con quienes editan estos documentos, contacte a: documentosdetrabajo@spensiones.cl.

Si desea acceder a los títulos ya publicados y/o recibir las futuras publicaciones, por favor regístrese en nuestro sitio web: www.spensiones.cl.

The Working Papers series of the Superintendence of Pensions disseminates economic research conducted by the its staff, entrusted or contributed by third parties. The purpose of the series is to contribute to the discussion and debate of relevant issues related to the Pension System, as well as to extend the approaches on these phenomena.

These papers are preliminary research for its discussion and comments. The contents, analysis and conclusions presented in these papers are exclusively those of the author(s) and do not necessarily reflect the position of the agency.

To ask for further information or to contact the editor committee, please write to: documentosdetrabajo@spensiones.cl.

To access the papers already published or to receive by e-mail the latest list of working papers published, please register yourself at our website: www.spensiones.cl.

Superintendencia de Pensiones
Teatinos 317
Santiago 8340382, Chile.
www.spensiones.cl

In an Individually Funded Pension System: How Can Risks Be Mitigated?

Solange Berstein*, Olga Fuentes[†] and Nicolás Torrealba[‡]

February 2010[§]

Abstract

This article presents the main risks that have to be faced in an individually funded pension system and describes the regulations that enable these to be mitigated in the case of Chile. One of these main risks refers to the investment of the funds and an analysis is made of the support that a life-cycle investment strategy might provide in this respect. On evaluating these strategies, there is discussion as to which is the most suitable risk measurement for consideration.

Keywords: DC pension schemes, portfolio choice, pension risk, age-based investment strategies, risk sharing, risk based supervision

JEL codes: G23, G11, G32, J26, J32, C15

*Head of Pension Supervisor. e-mail: sberstein@spensiones.cl

[†]Head of Research Division of Pension Supervisor. e-mail: ofuentes@spensiones.cl

[‡]Analyst of Research Department of Pension Supervisor. e-mail: ntorrealba@spensiones.cl

[§]Correspondence: Huérfanos 1273, floor 8, Santiago, Chile. Telephone: (562) 753-0200. Fax: (562) 753-0201

1 Introduction

The funding of pensions is an issue that has acquired particular relevance in recent years, due to the increased longevity of the population. Whatever the system adopted by a country, there will always be risks that have to be mitigated. In the case of defined-benefit systems, the institution sponsoring the plan assumes the investment and longevity risks. Meanwhile, the workers assume the labor risk which may imply, in some cases, having no benefit at all, due to failure to meet the requirements, and in others, receiving very small benefits indeed. At the same time, there is the risk that the sponsor may find itself in a state of insolvency and be unable to fulfill its commitments. On the other hand, in a defined-contribution pension system, the investment and longevity risks are assumed by the members, during their active life at least, and additional to these are the risks associated with the labor market, among others.

In the case of Chile, the defined-contribution pillar is the main source of retirement income provided by the pension system, and contribution to it is mandatory. In this context, insofar as the risk associated with investments made to fund the pension is concerned, the actual regulation offers five types of fund that differ in their investment strategy and associated risk. In the event of the member's not choosing a type of fund, a default allocation mechanism is assigned according to his/her age. In any case, the most aggressive option is restricted to people who are at least 10 years away from reaching legal retiring age.

The modern financial theory has proposed that a suitable investment strategy for mitigating the important risks associated with obtaining a pension in an individually funded system is to allocate assets in the portfolio according to the life-cycle profile of the individual, with exposure to risky assets decreasing over time toward a portfolio composed of less volatile assets at the point of retirement. This strategy aims to minimize the risk associated with a sudden fall in the value of the pension funds at the very moment when the person "needs" or has planned to start drawing a pension. This strategy is also consistent with the fact that at the beginning of the working life, the individual's wealth is concentrated in his/her human capital, while his/her financial wealth is minimal, so it is more feasible to take a risk on financial investment in search of a greater expected return. When financial wealth accumulates and draws level with human capital in terms of importance, it becomes more relevant to offset the risks associated with the two sources of wealth, while at the end of the working life the human capital has already depreciated and the main source of wealth is the capital accumulated to fund the pension.

Although the choice of an optimum investment strategy depends on individual characteristics, such as the degree of risk aversion, human capital, expected volatility of wage and work history, family composition, other sources of wealth, etc., in practice the vast majority of the members of a pension system do not have sufficient knowledge to take a sensible decision with regard to the investment of their funds. This is true in any system, where there is abundant evidence that the scant level of financial knowledge makes it impossible for basic deci-

sions to be taken, and biases occur such as choosing on the basis of the past performance of the funds (“rear view mirror”).

This becomes even more important in a system where participation is far more widespread at all educational levels of the population because it is mandatory, as is the case in Chile. In the Social Protection Survey 2009 (EPS 2009), 80% of members state that they do not know how pensions are calculated by the Pension Fund Administrator (AFP), and half of those who do answer (about 8.4% of the total) wrongly state that they are calculated on the basis of the wages of the final years. At the same time, 94% of members state that they do not know anything about the pension options that exist and about 64%, that they do not know the type of fund in which their pension savings are held.

Consistent with the lack of financial knowledge for taking reasonable decisions about their pension funds, there is also a high degree of inertia in investment decisions. In Chile, for example, between August 2007 and November 2008, a period of increased volatility in the financial markets, shows that only about 4% of members made voluntary changes of fund, while 72% of the total remained in the system’s default option.

As far as the risk associated with the labor market is concerned, this is reflected in the density of contributions, the promptness with which these are paid and the wage level. Although participation is mandatory for those workers in the formal sector of the economy, there is a high percentage of self-employed in the population who pay contributions voluntarily and there are workers with fixed-term jobs, who have a high risk of suffering several unemployment episodes during their working life. This leads to low contribution density and/or intermittent contributions over the length of the life-cycle. The risk associated with job instability makes it even more important to define an investment strategy for pension funds that is consistent with the risks associated with the pension, with a view to mitigating these; and the planning investment horizon, measured as the years remaining to the member before retirement.

In addition to the risks that have to be contended with during the active stage, workers have to adopt important decisions on retirement, bearing in mind the pros and cons of each one of them, such as the moment to retire, and whether to do so through programmed withdrawal or a life annuity. In the case of the former option, the Pension Fund Administrator continues to manage the resources and it is the member who continues to assume the investment and longevity risk. On the plus side, he/she also retains ownership of the funds. In the case of a life annuity, it is the insurance company that assumes these risks, but the pensioner then runs the risk of early mortality, having given up the ownership of the funds.

It is for this series of reasons that it becomes important to establish clearly which are the risks to be faced and what possible measures exist to mitigate them. This article is a contribution towards providing a comprehensive description of the risks and the main mitigating measures in the case of Chile. Alternatives for advancing towards a better management of these risks are also explored. In the next chapter a description of the relevant risks is given. Chapter 3 gives a detailed description of how these are tackled by regulations in Chile

during the active stage, the transition and when the member is already retired. In the last section of this chapter there is a remark on the role of the solidarity pillar in the case of Chile, as a way of sharing risks between different generations, and as a mechanism to give the population a greater level of protection. Chapter 4 looks in more depth at the life-cycle type of investment strategy as one of the mechanisms for mitigating risks and at the most appropriate way of measuring financial risk in the case of an individually funded pension system, while Chapter 5 gives the final conclusions.

2 Relevant Risks in an Individually Funded System

2.1 Risk associated with the contributions

In a defined-contribution system, pensions depend to a very large extent on the contributions paid during the worker's active life. If a worker contributes continuously on the basis of his/her real wage, his/her possibilities of obtaining an adequate pension increase very significantly. There are many different reasons why a worker does not pay contributions during particular periods. In Berstein, Larraín and Pino (2006), an analysis is made by gender to discover what the main reasons are. On the basis of information obtained through a survey of work histories¹, for the Chilean case, it was found that, in the case of men, one of the main reasons for not contributing was the fact of their being self-employed, meaning that they were not obliged to pay contributions, and this accounted on average for some 19% of their working lives. Another important reason was informal work or inactivity, either because of unemployment or because of being outside the workforce. By contrast, in the case of women the main reason for not paying contributions is simply the last one mentioned, being outside the workforce on average for 35% of the time.²

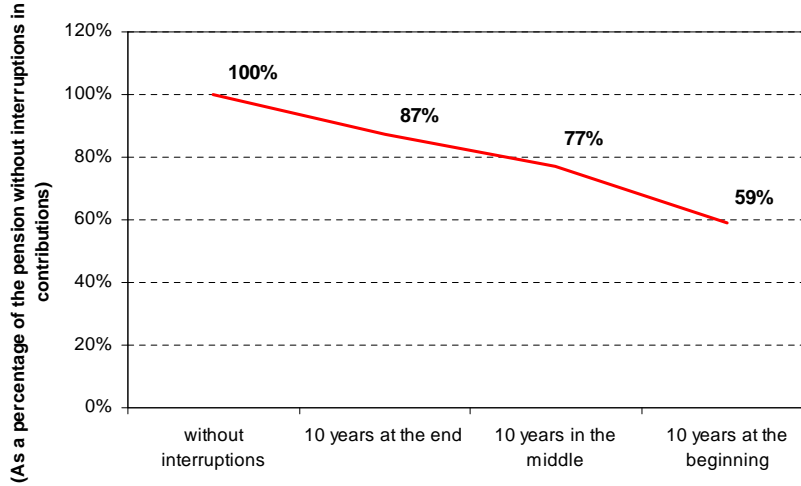
But it is not only the continuity and amount of the contributions that matter; the time at which these are made is also important. In a funded system, unlike pay-as-you-go systems, the contributions made during the early years of the working life are decisive. This is due to the impact on these savings of the compound interest generated over a long period of time. This means that the early years of the working life make a very important contribution to the funding of the pensions. In fact, the first 10 years may finance around 40% of the pension as shown in Figure 1³.

¹Social Protection Survey (EPS, 2002).

²Using information from EPS 2009, we have that men are self-employed 22.4% of the time. While women are outside the workforce 34.4% of the time. These values were computed from data on individual labor histories between 2006 and 2009.

³For this calculation, it is assumed an annual real investment return of 4% and that the person pays contributions for 40 years.

Figure 1 - Effect of contribution's interruptions over the pension value



Source: Authors' calculations

According to the previous analysis, early contributions are very important when funding a pension; however, this does not make the contributions paid during the rest of the active life less important. What is more, the age of retirement is a key element in determining the amount of the pension. Retiring later means more contributions which helps to increase the pension. But all the same, even if no contributions are paid, the very fact of putting off retirement increases the pension, because the number of years to be covered out of the funds is reduced. In fact, every year that the pension is brought backward may result in its being reduced by about 6.7%, without considering that contributions are paid in that period⁴.

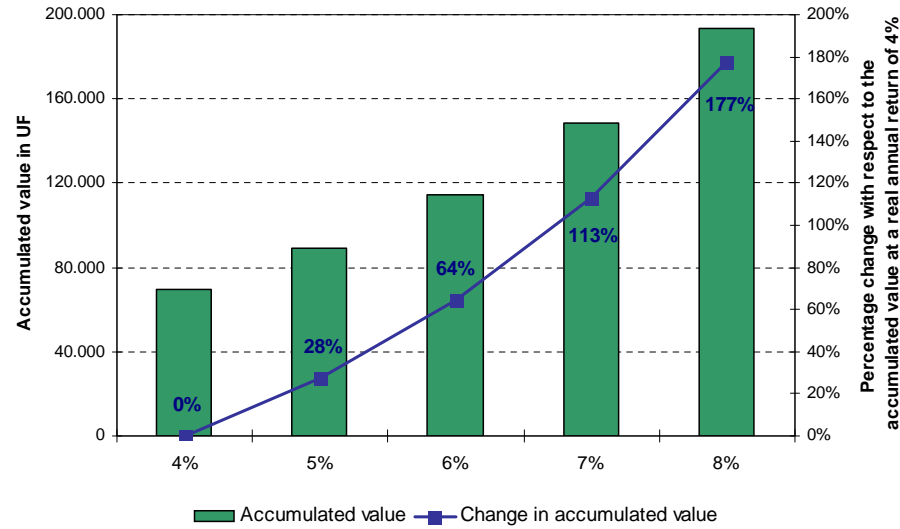
2.2 Risk associated with investments

Another decisive element in the amount of pensions provided by a funded system is the yield obtained by the investments made with pension fund resources. In this sense, it should be emphasized that one point of extra yield over a worker's life-time can represent around 30% of additional pension⁵. In Figure 2, it is possible to see that a person's balance grows increasingly with every one percent rise in the pension fund's yield, with the result that the pension of a person who receives a yield of 8% almost triple that of the person who only manages a yield of 4% (177%). A higher expected yield always has a higher associated investment risk, so it is important to consider the probability distribution associated to particular investment strategies over the course of the workers' life cycle.

⁴This computation considers a real annual investment return of 4% for a man who puts backward his retirement age from 65 to 64 years of age.

⁵Considering a 1% increase from 4% to 5% in Figure 2.

Figure 2 - The effect of the investment return on pension
(UF: inflation indexed unit of account)⁶



Source: Authors' calculations

The objective function of a pension fund administrator should therefore be the expected value of the pension and the dispersion around that expected value, in other words, a long-term objective. However, in many cases there are incentives to achieve a better return in the short run, which may result in a risk that is greater than the one considered “optimal” or, taking decisions that do not necessarily correspond to the final objective.

At the same time, in the management of third-party funds there is always a potential conflict of interests that has to be regulated. In the case of the pension funds, this is even more necessary due to the nature of these funds: on the one hand these are mandatory savings, part of a country’s social security, and on the other, most of those enrolled in the system have too little financial knowledge to be able to monitor the performance of their funds for themselves⁷. This is known as fiduciary risk.

Finally, in a funded system there is always the possibility or, in some cases, the obligation, to transform the accumulated savings into a life annuity on retirement. This involves a considerable re-investment risk, due to the changes that occur in interest rates. A larger or smaller pension may be obtained with the same balance in the individual account, depending on the level of interest rates at the moment when the person purchases the life annuity.

⁶ At December 31st, 2009, 1 UF is equivalent to 20,942.88 chilean pesos, or US\$ 41.

⁷ There is vast empirical evidence of the low level of financial and pension knowledge among members. For the case of the United States, see Lusardi and Mitchell (2006, 2008). Additional evidence regarding members’ behavior is to be found in Tapia and Yermo (2007) and, Barr and Diamond (2008).

In Chapter 4, a methodology is proposed for appropriately measuring pension risk, taking into account all the relevant risks and factors that affect a member's pension; with the aim of evaluating how different investment strategies affect the expected value of the pension and the volatility around that expected value.

2.3 Risk associated with operations

In every industry there are always operating risks which have to be taken on board. In the case of the pension system, these are once again of special importance, not because the risks are greater than in other industries, but because members are less alert and less well-prepared to detect possible operating problems that might have produced direct consequences on their accumulated funds and therefore on their future pensions. In general there is lack of knowledge about the pension system and even about what is going on in the worker's own individual account. Using information from the EPS 2009, a 57% of members state that they do not know the accumulated amount on their individual account.

Operating risks may be found in the different processes, from the moment when the contribution is paid in until the benefits are paid out. The first process in which it is necessary to detect and mitigate risks refers to the payment of contributions by employers. This must be done promptly and, if an employer fails to make the payment, this must be detected by the worker or the fund administrator, in order to start the collection process. There is therefore the risk of this payment not being made and not detected in time. Once the contribution has been paid in by the employer, it must be credited in the worker's individual account, a process that is not without risk either. Then the resources are invested in accordance with the member's choice, and the worker has the possibility of switching his/her funds between different investment alternatives or even between different administrators. These processes must also be carried out in an environment of controlled risk.

The investment process carried out by the administrator with the resources in its care also implies operating risks of various kinds related with trades, current account management, custody and accounting, among others.

The risks listed so far are related with a worker's active stage, in other words, while he/she is accumulating savings for retirement; however, on retirement there are also operating risks to be faced that need monitoring. These have to do with the mechanism by which a particular pension option is chosen and the resources transferred to the institution providing the benefit. At the same time, the institutions paying the benefits carry out processes by which these payments are actually made, and these include operating risks that may result in the benefit not being paid at the correct time.

Operating risks are therefore present in the whole chain of processes involved in producing a pension. All these risks must be adequately identified and monitored by the administrator, while the regulator must also take them into account when designing regulations and supervising the pension system.

2.4 Risks associated with the Solvency of the Institutions

In the case of the Pension Fund Administrators that provide the service of managing the funds during a worker's active life, the fund is separate from the administrator's net worth and therefore the possible bankruptcy of the administrator does not endanger the pension funds. However, an administrator that finds itself in a complicated financial position may generate concern with regard to the risks faced in all the processes that this institution carries out.

Unlike the administrators of funds during the accumulation stage, when the worker retires, he/she has the possibility of purchasing a life annuity in an insurance company. In this case there really is a direct solvency risk that would affect the payment of benefits, because in the case of the bankruptcy of an insurance company, the pensions would form part of the commitments to be paid out in the liquidation process, with the possibility of there being insufficient resources to pay all such commitments. In this case, there might possibly be state guarantees involved that could take on all or part of the pension payouts that are owed.

At the same time, in many cases the Government plays an active part in providing pensions in the majority of the world's economies, and this is true even where there is an individually funded system, since this is often part of a scheme in which there is more than one pillar, and where one pillar may have government funding. Therefore, the possible risk of Government insolvency can also be included among solvency risks, whether concerning the direct provision of benefits or as guarantor in the case of insolvency of the private actors.

2.5 Risk associated with decision-making

In an individually funded system, individuals often have the possibility of making choices. The result of these decisions depends to a large extent on the ability of these individuals to take informed decisions with awareness of the consequences. One of the main decisions is related with the amount to be paid in contributions. In general, contribution to at least one of the pillars that fund pensions is mandatory. In the case of a contributory pillar of mandatory individual funding, the amount contributed may also be insufficient for the expectations of those retiring. That is why there are also voluntary savings instruments in existence, to supplement the pension. However, the decision to use these savings vehicles, and how much to deposit, is an individual decision. In general there is short-sightedness in individual decisions; in fact this is the justification for making contribution mandatory, as we come up against the risk of savings being insufficient to fulfill expectations. In the case of a funded system this is especially important, because the savings made at the beginning of the working life are relatively more important in funding the future pension, as was shown in the previous section.

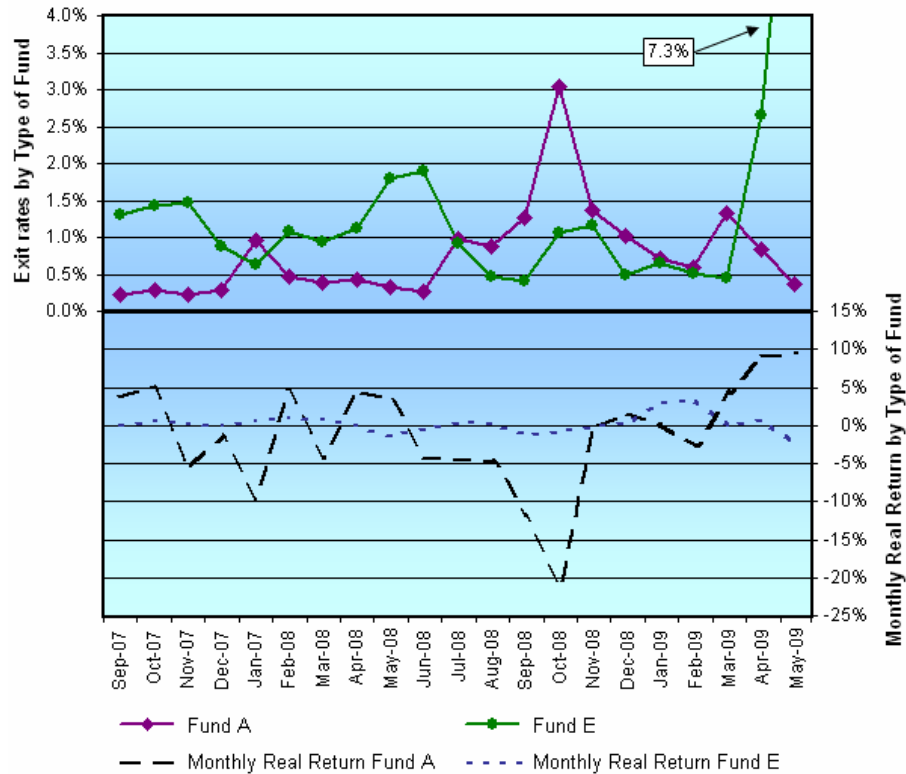
Moreover, if the decision is made to save over and above the mandatory part, or even with regard to the mandatory savings, people must decide who will administer those savings. This is also an important decision, which must

be based on the attributes offered by the various administrators. One of these is the management of investments, for which one can evaluate historic yield, the relative risk of the portfolios and investment policies. The other important attribute is cost, for which one needs to compare the price charged by each administrator. Finally, one should consider the service provided by the different suppliers. All these characteristics must be evaluated. A poor decision in this area can result in lower yield, higher risk, higher costs or a lower quality of service than expected.

Despite the above, the decision variable that implies most risk has to do with the investment alternative. When deciding between different administrators, it is possible that if each of them has a similar investment policy, the impact of choosing one or the other may be relatively low. However, even when the same administrator is concerned, but offering different investment alternatives, the impact of decision-making may be considerably greater. For example, deciding to enter a fund with 80% in equities or one that invests exclusively in fixed income is a decision of high impact on expected returns and risk. What is more, it is possible that a person is changing constantly from one fund to another, depending on the performance of the markets. This may produce a positive result in terms of accumulated savings if sensible decisions are taken; however, it is also likely that these decisions will not be the most appropriate and will have a negative effect on the funds. If we bear in mind that it is very difficult to predict market developments and that there is generally a considerable lack of financial information among savers, decisions of this type represent a very important risk.

Figure 3 shows exit rates per type of fund and real yield for the A and E-Type Funds between September 2007 and May 2009, a period of increased volatility in the financial markets. Here it can be seen spikes in the exit rates with a larger number of people changing funds, behavior apparently influenced by short-term financial results. In the month of May 2009, in particular, when the Fund E achieved a negative real yield and Fund A showed an important recovery, approximately 13,500 members left Fund E, corresponding to an exit rate of 7.3% measured as the ratio between the number of people who changed fund and the total people in the original fund in the previous month.

Figure 3 - Exit rates by type of fund
People that made voluntary fund changes



Source: Authors' calculations

2.6 Risk associated with Life Expectancy

A risk that is present in all pension systems, regardless of their nature: public or private, defined-contribution or defined-benefit, is that of life expectancy. In the case of a defined-contribution system of individual funding, this risk is shared between the member and, possibly, the provider of a life annuity during the retirement stage. In some cases, it may be that part of this risk is taken on by the Government through subsidies and guarantees. In any case, it is the member who assumes part of the longevity risk, since his/her savings, in principle, do not depend on the population's life expectancy at every point in time. The contribution rate is generally fixed, as is the legal age at which an individual can retire. If there is a large increase in the population's longevity during a worker's active life, it is probable that when he/she retires, the accumulated savings will result in a lower pension than the person expected in terms of the life expectancy at the point when he/she began paying contributions.

It is possible for a worker to put off retiring age in order to achieve a higher

pension; however, in that case the longevity risk occurs in the form of modifying the retiring age. Whether through a lower pension or a higher retiring age, the life expectancy risk is still present. Nonetheless, once retirement has taken place, there are generally alternatives available in terms of retirement products that do not have this risk for the member, as is the case of the life annuity. In this case, it is the insurance company, or pension provider using this method, that assumes the longevity risk. There is still, of course, the institution's solvency risk, which may result in non-payment of the pension or concurrence of state guarantees.

At an individual level, when talking of life expectancy, longevity risk has its counterpart in mortality risk, in other words, the probability of not surviving for very long after retirement. In this case, an individual with an uncertain state of health may be expecting a fairly short life and perceive that the purchase of a product to insure against the risk of living too long is not particularly attractive, given his/her situation.

3 Elements that Mitigate these Risks in the Case of Chile

3.1 Obligation to Contribute and Incentives to Save

In general, contributing towards the funding of a country's social security is mandatory. This is due to the need for solidarity mechanisms and to a generalized short-sightedness among the population that prevents people from realizing the need to save for the workforce's retirement stage, whether for reasons of old age or disability. This is why wage-earners are obliged, in the case of Chile, to contribute to the individually funded system, in order to finance future pensions. However, despite this mandatory saving, according to studies developed on the basis of a survey first carried out in 2002⁸ and social security histories with administrative contribution data, it was concluded that a considerable percentage of the population was not contributing the amount needed to fund a sufficient pension for a respectable old age (Berstein et al. (2006)). Specifically, greater vulnerability was discovered in those groups that were self-employed during a significant percentage of their active life.

This is why the 2008 pension reform obliges workers with these characteristics to pay contributions when they are carrying out work independently. This obligation will take effect gradually over time, starting with three years of pension education and then incorporating a gradually increasing contribution, to be deducted by default from the worker's tax rebate unless he/she specifically says otherwise. In this way, mandatory contribution would begin for these workers 6 years after the date of the reform, the contribution being deducted from the corresponding tax rebate.

Another of these vulnerable groups consists of young people who, in Chile's case, have a high degree of informality. This means that important gaps occur while these workers are young and these are difficult to make up by means of future contributions. This is why the reform includes a subsidy on hiring young people and a subsidy on their own contribution. This makes the hiring of young people, with their corresponding contract and contribution payments, less onerous for companies. Meanwhile, the subsidy on contribution is made up as an over-contribution of 50% more than the amount contributed by any low income worker between 18 and 35 years old, for the first 24 contributions. This input has a significant effect on the future pensions of these workers⁹.

In Chile, women have very low participation in the labor market. This has direct repercussions on the future pensions of this group of the population. If one adds to this: lower wages, the fact that gaps generally occur at early ages, that women have greater life expectancy and, in Chile at least, they retire at a legal age that is 5 years earlier than that of men, all this implies that women's pensions end up being far lower than those of men (Berstein and Tokman (2005)). In order to deal with this problem, the pension reform included

⁸Social Protection Survey (EPS, 2002).

⁹Superintendencia de Pensiones (2009c). Chile 2008: A Second-Generation Pension Reform.

the figure of voluntary contributor. This allows people who is outside the work-force, and therefore receives no wages, to pay contributions into the pension system and not only save for old age but also have the coverage of the disability and survivorship insurance.

This same voluntary type of contribution is often necessary for those who are working and wish to deposit more than the mandatory amount. What is more, it is important to encourage this type of savings with regard to workers in general, due to the increase in the population's longevity, periods of unemployment or inactivity that need to be offset, under-contribution at particular points, or any other reason that implies insufficient saving. In the case of Chile, voluntary saving has been encouraged through tax exemptions, but this is only attractive for the population that actually pays taxes. In Chile this includes about 15% of workers¹⁰. This is why a subsidy on voluntary saving came into effect in 2008, amounting to 15% of the amount saved, with a cap of US\$437 per year as of December 2009. The possibility of signing collective voluntary saving contracts, to which the employer can contribute, was also introduced. In these cases, the employer can establish a period of accrual for his/her contribution in order to encourage the worker to remain in the firm and so also increase the firm's incentives to teach and train its workers.

Finally, there are not only mandatory contributions and voluntary saving incentives, but also certain restrictions with regard to the timing and manner in which the saved funds can be withdrawn. In Chile the legal retiring age is 60 for women and 65 for men. There is the possibility of taking early retirement and starting to use the funds. However, the requirements for exercising this option were significantly, though gradually, increased in the year 2004¹¹. Given the increase in the population's longevity and the low level of pensions in general, it became necessary to increase these requirements. People were often using the pension as a second income and, when they really retired from the labor market, their income dropped drastically, meaning that their standard of living did likewise.

3.2 Investment Regulation

Investment risk is one of the main risks in an individually funded system, where this risk is absorbed mainly by the members through fluctuations in their future pension. This risk is made up not only of market risk, which is reflected in the price of the instruments in which the pension funds are invested, but also in the fiduciary risk that occurs when the management of the resources is entrusted to a third party that may have incentives other than those of the members.

¹⁰Estimated value using information from Socioeconomic Characterization Survey 2006 (CASEN, 2006).

¹¹Currently the requirement is to be able to finance a replacement rate of 67% and 150% of the minimum pension. When fully implemented, as from August 19 of 2010, the individual has to be able to finance a replacement rate of 70% and 150% of the minimum pension. Beginning July 1 of 2012 the requirement in terms of the minimum pension is replaced by 80% of the value of the maximum pension with solidarity contribution (*Pensión Máxima con Aporte Solidario, PMAS*)

In the case of Chile, these risks are mitigated via a series of mechanisms that range from the setting of investment limits to mechanisms of information for members.

3.2.1 Investment Limits

The Pension System includes a variety of limits for investment in the pension funds. Structural quantitative limits are fixed in the law (Decreto Ley N. 3.500 (1980)) and more specific limits are defined in secondary regulations (Pension Fund Investment Regime (2008)).

The structural limits defined in the Law refer to a maximum limit for government instruments, foreign investment as a whole and by type of fund, investment in foreign currency without exchange hedging and investment in instruments with higher relative risk, in addition to a maximum limit on equities per type of fund, which is the origin of a multi-fund scheme¹². In addition, limits are also defined in the Law with regard to issuers, in order to avoid concentration of ownership and participation in control on the part of the Pension Funds.

The Investment Regulations, meanwhile, regulate specific matters of Pension Fund investments which by their nature call for greater flexibility and detail. So investment limits are set with the aim of encouraging an adequate diversification of the Funds. This investment regime is a norm issued by the Pension Supervisor and submitted for the consideration of the Technical Investment Council (CTI). This Council is a permanent one and its aim is to make reports, proposals and pronouncements with regard to the investments of the Pension Funds, in order to achieve an adequate yield for the Funds. In this way, the CTI represents a highly specialized counterpart, which helps to improve the design of the regulations concerned with the investment of the Pension Funds¹³.

This investment regime may include rules for regulating the investment of the Pension Funds based on a measurement of the risks of the investment portfolios in each one of them. In this way, it is possible to establish a regulation criterion, using risk measurements in a way explicitly stated in the Law. It is worth underlining that market risk measurement is a common and necessary practice for portfolio managers. Although in the case of the Pension Funds, the regulations have not so far included the demands of such measurements, most Administrators have implemented relative market risk indicators that allow them to carry out their portfolio management comparing themselves with their competitors. Nevertheless, when defining absolute risk and limits on the basis of a risk measurement and its compulsory publication, the clear definition of the methodology and metrics is decisive for the system to work well. The next chapter discusses the difficulties of defining a risk measure for pension funds.

The aim of the Pension Supervisor is to obtain a methodology for measuring

¹²The multi-fund scheme is described in section 3.2.2 of this chapter.

¹³The CTI is a council currently made up of five experts in financial and investment matters (plus five replacements). The appointment of its members corresponds to the President of the Republic, the Council of the Central Bank of Chile, the AFPs and the Deans of the Economics and Administration Faculties of accredited universities.

the market risk of the Pension Fund portfolios, including the relevant characteristics that define the nature of these funds: mandatory savings, an investment horizon determined by the age of the members, etc., in order later to be able to use this methodology in the design of rules for regulating the investment of the Pension Funds.

3.2.2 Multi-fund Scheme

Both mandatory and voluntary savings have been managed since August 2002 under the multi-fund scheme. This consists of five types of fund, differentiated by the proportion of their portfolio invested in equity securities. The assumption behind this differentiation in the investment portfolios is that the greater the proportions of equities, the higher the expected return and risk.

The main aim of setting up this scheme in the pension system is to increase the expected value of the pensions to be obtained by members. The possibility of investing in a portfolio of financial assets whose risk is matched with the member's investment horizon makes it possible to increase the expected value of the person's pension. This increases the efficiency with which the pension system achieves its basic goal: to provide its members with an income that makes it possible to replace, adequately, the one they were receiving during their active life.

Moreover, the creation of a multi-fund system allows members to achieve a portfolio distribution that is more in tune with their preferences and needs, in terms of risk and yield. Different members may have different preferences with regard to the composition of the portfolio of their pension funds, which are reflected in varying degrees of risk aversion. The creation of this system allows members to exercise their preferences, producing an increase in their well-being. For example, younger members may prefer a fund with a higher expected level of risk and return, in order to increase the expected value of their pensions, while older members, or those already retired, may prefer a fund with minimal risk, to reduce the fluctuations in the value of their pension to a minimum.

In the multi-fund system, the choice of fund type is free for members of the pension system. However, there are certain access restrictions. In the individual funding account of mandatory contributions, male members over 55 years old and female members over 50 may opt for any of the four funds with less exposure to equities (B, C, D and E); on the other hand, members receiving a pension may choose one of the three funds with less exposure to equities (C, D and E). These restrictions seek to avoid members who are close to retiring age, or already retired; taking high risks that may have a negative and possibly irreversible effect on the level of their retirement pensions.

In addition, where members of the pension system do not select a fund type when enrolling in the system, they will be allocated by default according to their age. The rule for allocating members to one of the five funds consists of separating them into three age-brackets, with the younger members being placed in a fund with more equities and older members in funds with a higher proportion of fixed income. This rule is applied to both active members and

pensioners. In addition, a gradual allocation of members to the Pension Funds that correspond to them has been established, with 20% of their balances being transferred at the point when they change age-bracket and then 20% per year over a period of four years, until the transfer of all their resources is complete.

Table 4 gives a summary of the criteria for access restrictions and default allocation.

Figure 4 - Default by age and restrictions for choosing riskier funds

Men		35 or less	36 to 55	56 and older	Retirees
Women		35 or less	33 to 50	51 and older	Retirees
Investment Options	A Fund	O	O	X	X
	B Fund	O Default	O	O	X
	C Fund	O	O Default	O	O
	D Fund	O	O	O Default	O Default
	E Fund	O	O	O	O
X		Not available			
O		Allowed to choose			
O Default		Assigned automatically			

Source: Pension Supervisor

The allocation of funds by default seeks to establish an investment path that is consistent with the life-cycle over the length of the member's active period. In this way, during the early years he/she is allocated a fund which has a higher proportion of its assets invested in equities. Then, as time goes by, the exposure to equities is gradually reduced as the member accumulates a larger quantity of resources in his/her individual funding account.

3.3 Explicit Responsibility of the Administrator

The AFPs have a series of obligations and responsibilities which help to mitigate the risks of the Pension System. In general terms, these refer mainly to the corporate governance of the AFPs and the management of the Pension Funds. In particular, there is the inclusion of explicit AFP responsibility in the Law, associated with greater responsibility on their part in various areas. In this sense, the requirements in terms of obligatory reserve (*encaje*) and relative minimum yield are also important. These are described further on.

These responsibilities became more evident through Law 20,255 (2008) which stipulates, in general terms, that the Administrators shall be answerable for damages caused to members in their individual funding accounts as a result of their failure to fulfill their obligations promptly, as also the instructions given them by the member in the exercise of his/her rights as established in this law. Law 20,255 includes changes that make the AFPs explicitly answerable in various matters. In that same law, with regard to the outsourcing of services related with the AFPs' corporate purpose, the responsibility remains with the Administrator. This is when the outsourced services have to do with the administration of individual accounts; the portfolio management of the resources that make up the Pension Fund; services of information and consultations referring to the functioning of the Pension System; reception of pension applications and

their dispatch to the Administrator for the corresponding formalities; and the reception and transmission of information.

Law 20,255 also delegates greater responsibility to the AFPs in relation to the management of the Pension Funds. In this way, the Administrators must have investment policies for each of the Types of Pension Fund that they manage, and for conflicts of interest: these to be prepared by the Board of Directors. A copy of the investment policy and the policy for solving conflicts of interest must be sent to the Pension Supervisor and must also be published on its website, so that it is available to members.

The Pension Supervisor shall establish the minimum elements to be included in the investment policies. In any case, the Law states that the policy for solving conflicts of interest must refer to the following matters as a minimum:

1. Procedures and internal control rules that ensure an appropriate handling and solution of conflicts of interest that may affect the directors, managers, administrators and principal executives of the Administrator;
2. Confidentiality and handling of inside information, and
3. Requirements and procedures for choosing candidates for board members in the companies in which the Pension Fund resources are invested.

In addition, an Investment and Solution of Conflicts of Interest Committee must be set up within their Boards of Directors. This Committee will have the following functions and attributions:

1. To supervise compliance with the investment policies, which must be compatible with the terms of the policies for solving conflicts of interest, and supervise compliance with the Pension Funds' investment limits.
2. To review the aims, policies and procedures for managing the risk of the Pension Funds' investments.
3. To examine the information relating to the Pension Funds' operations with derivative instruments and foreign securities.
4. To prepare the policy for solving conflicts of interest and propose it to the Administrator's Board for its approval.
5. Supervise adequate compliance with the policy referred to in the previous point.
6. Produce an annual report for the Board on the matters referred to above.
7. Other functions entrusted to it on these matters by the Administrator's Board.

This Investment and Solution of Conflicts of Interest Committee shall be made up of three of the Administrator's directors, two of whom must be autonomous. The autonomy of two members of the Administrators' Board refers

to the fact that they do not represent the interests of the controller, meaning that they can take better care of the member's interests in situations where conflicts of interest might arise.

3.4 Minimum Yield and Obligatory Reserve

In Chile there is a mechanism of minimum yield in relative terms, related to the average yield of the system over a period of 36 months. This mechanism considers that if in this period an administrator has a yield below the average of the system minus fifty percent or 4 percentage points, in the case of funds A and B, or 2 percentage points in the case of funds C, D and E, the administrator must put in its own funds to offset the difference between its own yield and the system average. The administrator must take these funds from the Obligatory Reserve, which is a reserve fund that AFPs must have in place at all times and, if the funds are insufficient, it must put in additional funds of its own. In the event of using resources from the Obligatory Reserve, these must be replaced. In any case, if the administrator does not have enough resources, the Government will do so and will proceed to liquidate the company.

The Obligatory Reserve mentioned above is equivalent to one percent of the total value under management and the resources form part of the administrator's net worth. These resources have to be invested in the same instruments as those in which the pension funds are invested. In this way, the availability of resources is safeguarded in the event of a yield lower than the minimum yield, and at the same time, the Administrator has investments in the same instruments as those in which the funds are invested. Therefore the Administrator has incentives to invest in the best possible way. The Obligatory Reserve in Chile is a high percentage of the Pension Fund Administrators' net worth, representing on average some 56% of the total¹⁴.

3.5 Supervision of the Administrators with a Risk-Based Approach

Risk Based Supervision (RBS) has its origins in banking and in the insurance industry. One of its main aims is to ensure that the institutions adopt robust procedures to manage risk and maintain appropriate levels of capital.

The supervision of the pension system faces challenges that are similar in many ways to those faced by the supervision of banking and the insurance industry. It needs to develop towards an approach that places emphasis on solid risk management on the part of the institutions being supervised, to strengthen financial stability and ensure more efficient and reliable results. It is essential to ensure that all authorized institutions meet minimum standards of risk management.

Three components can be identified in the architecture of RBS:

¹⁴Information based on AFPs' financial information at June 2009.

1. **The supervised institutions:** RBS must ensure solid risk management at the level of the institution being supervised. In this context, what counts is the institution's ability to identify, measure and manage all the relevant risks, which should also be reflected in the existence of solid internal management architecture, including at the same time a suitable risk-management strategy, evidence of the Board's involvement, the existence of risk-management functions in the hands of competent, independent and responsible professionals, and adequate internal controls.
2. **The supervisory institution:** Here there are elements ranging from the supervisor's powers to issue rules (including rules focusing on the architecture of risk management and procedures for risk management in the supervised institutions), to the existence of a risk-scoring model to guide supervision strategy and procedures. In addition, there is the need for the supervisor to have an organizational structure that is consistent with the requirements of the previous elements, establishing areas focused on relations with the supervised institutions and other technical units that are more specialized in quantifying and analyzing the different types of risk.
3. **Other participants in the market:** Included here are those participants in the market that have the ability to influence the decisions and actions of the pension funds (e.g. members, auditors, actuaries, risk-rating firms and market analysts). Under the RBS scheme it is expected that these market participants will be able to contribute to market discipline and the adoption of solid risk-management practices on the part of the institutions, which may depend in turn on the rules issued by the supervisor. For example, the role of the auditor may be improved by expanding the horizon of audits to include an analysis of the effectiveness of the risk-management systems and internal controls, imposing the obligation to notify the supervisor in the event of finding potential threats. The influence of members, risk-rating firms and other market participants may be strengthened, thanks to the good handling of accountancy, auditing and the rules governing information activities issued by the supervisor.

RBS considers supervision as a continuous process of follow-up and learning. This process involves the supervisory body's defining a supervision strategy, in addition to obtaining agreements with the supervised institutions in relation to weaknesses that have to be overcome and, finally, following up the fulfillment of the agreements reached.

The Pension Supervisor began the process of studying and analyzing this supervision approach at the beginning of 2005, reaching the conclusion that it did not fully comply with the guiding principles of RBS. In the year 2006, the Pension Supervisor defined the need to adopt these guiding principles as one of its institutional projects. It was considered necessary to advance towards a supervision that was a) more effective, bearing in mind all the relevant risk factors from a preventive perspective; b) more efficient, identifying the key risk factors

and then assigning supervisory efforts in proportion to the global risk of each body and c) more in line with best practices, following the global trend, which is becoming more and more important in an increasingly globalized financial market.

Undoubtedly, what is required is the formulation of an integral, preventive supervision process. This means incorporating a review of all the relevant risks in each activity, in addition to being able to predict situations of weakness. To achieve this last, the evidence shows that the most relevant variable is the quality with which the supervised institution handles risk management and the internal controls associated with its main operating processes.

3.6 Information or understanding

3.6.1 Information in the active stage

Workers enrolled in the pension system have to take decisions during the whole of their active life, and each of these decisions may have a significant impact on the final pension. This is why the information provided by the Administrators is so strictly regulated. In the first place, there is the obligation to provide certain information by defined means and with a given regularity, for example, by letters, the web page or printed means of communication with nationwide circulation. By means of four-monthly letters, called the “four-monthly statement”, members receive information about the state of their contributions, the commissions charged and the yield obtained. In this way, members can check that their employers are complying with their legal obligation to contribute monthly in their respective Administrators. This information is also available on the web page of each AFP. This information is vitally important, but unfortunately very few members actually consult it and even when they do read the information, in many cases it is not understood. Even greater efforts need to be made to awaken more interest in this information and, at the same time, to simplify it so that it is understood by the majority of workers.

For those workers with more preparation in financial matters, information is also available about the investment portfolio of each of the Funds being managed, both on the Pension Supervisor’s website and on that of each of the Administrators. This information is as detailed as possible, for consultation by members. This contributes to the transparency of the system, even though in many cases the workers do not have the ability to analyze it. Even though the information given has all the details of each instrument in which the Funds are invested, according to Law 20,255, this information has a time-lag of 4 months. Nevertheless, the information added at the system level per instrument class is available with a time-lag of only one month. The aim of this measure, which was incorporated in the recent pension reform, was to safeguard transparency on the one hand, but without this meaning the disclosure of each Administrator’s strategic information, which would discourage the dedication of resources to seeking the best investment strategies. The time-lag in providing this information mitigates to some extent the traditional herding effect, which leads all

Administrators to adopt similar investment strategies and where in fact some of them simply follow others.

Given that the portfolio information is very complex, the existence of investment alternatives for members makes it necessary to communicate the characteristics of these alternatives in as simple a way as possible, to facilitate members' decision-making. This is why every communication about the Pension Funds since the year 2008 has carried the name of the Fund, these names having been given to the Funds by the Pension Supervisor in accordance with their characteristics. In the case of Chile, there are five investment alternatives offered by each of the administrators: A – most risky, B – risky, C – intermediate, D – conservative, E – most conservative. These names must be used by the administrators, even in their advertising.

With regard to advertisement campaigns, there are also certain restrictions on how the Administrators can use the information. For example, it is the Pension Supervisor that officially issues the figures of historic yield, publishing the yield of the previous month, that of the previous 12 months, the yield since the creation of the multi-funds, i.e. 2002, and since the creation of the system, i.e. 1981. Publicity may only be based on these yields and if information is given on the position in the ranking, the period and fund concerned must be specifically stated. Otherwise, all the administrators could theoretically claim to be the ones with best yield, depending on the period and fund concerned, and this would produce great confusion among the population.

In addition, in order to enable members to take proper decisions, the Administrators have been mandated since 2005 to send them a pension forecast. This is for the case of those members over the age of 35, who are shown what their pension would be at retirement if they contribute constantly up to retiring age, versus the situation if they do not. In this way, on the one hand there is a reflection of the importance of contributing and, on the other, a person may become aware that even if they do contribute constantly, they will have a pension lower than they want and this information is useful for taking measures at an early stage to correct this situation. For those already close to retirement - less than ten years away - instead of showing them what will happen if they contribute or not, they are shown the impact that postponing retiring age will have on their pensions. This also helps in the taking of informed decisions. Fajznylber, Plaza and Reyes (2009) analyze the impact of providing pension forecast information on savings decisions. The authors find that the information given regarding the difference between pension forecasts of contributing constantly up to retirement versus do not contribute, caused an increase in the probability of making voluntary contributions for old age, of approximately 1.4 percentage points, for individuals in the 40-50 age bracket group.

3.6.2 Information in the transition stage

After many years of contribution, members have to decide in which way they want to receive the payment of the benefits to which they are entitled. This stage is very important for members, because the payments they will receive for

the next 20 or 30 years depend on this decision or, in the event of their death, how much their beneficiaries will receive or how much will go into their estate. To reduce the risk of taking an inadvisable decision, information is essential. This information has to be clear and complete. For this purpose, the law in Chile was amended in 2004 to incorporate an electronic quotation system for pension offers. Through this electronic system, life insurance companies and pension fund managers offer a pension to pensioners. The person can choose from among these offers or even receive an external offer and compare it with the ones in the system, though this external offer has to be better than those in the system in order to be accepted. The same law defined a ceiling for the fee that can be charged by brokers and only allows them to charge this fee if the person chooses a life annuity.

Nevertheless, the information is very complex and is therefore difficult to understand, even though this electronic system exists and all the information is transparent. For this reason there is a role for brokers to help people understand their alternatives. However, as mentioned before, these brokers are allowed to charge a fee from the fund only if the pensioner chooses a life annuity, and this generates a conflict of interest. The 2008 Pension Reform replaced these brokers with pension assistants, who have to be certificated by the Pension Supervisor and the Insurance Supervisor. These pension assistants can charge a fee that is paid out from the fund not only in the case where a life annuity is chosen but also if the pensioner decides to go with programmed withdrawal. This solves the previous conflict of interest by allowing the charge in both cases.

Another of the risks present at this stage, as in any other, is the operational risk. Pension Fund managers, insurance companies and the provider of the electronic quotation system are closely supervised by the pensions and insurance supervisors. This risk could involve the amount paid being incorrect or someone being allowed to retire who should not been able to retire because of failure to meet the requirements or a delay in the first payment, among others. The consequences of any mistake during the retirement process are very visible, unlike the accumulation phase, and this makes it easier to control and supervise.

Finally, in a defined contribution scheme where there is an annuitization alternative at the time of retirement, there is an important risk to consider, which is the interest rate or annuitization risk. This is because the amount of funds accumulated during a lifetime may be used at this stage to finance a life annuity, and the price of this annuity will depend on the level of the interest rate at that time. The higher the interest rate the higher the pension that a certain amount can buy.

3.7 Alternatives at retirement

Once retired, the risks faced by the individual are different, depending on the retirement product. If a life annuity is chosen, the risks are shared with the insurance company. It is the company that bears the longevity and investment risk, while the individual faces the opposite side of the longevity risk: early decease being the downside as far as he/she is concerned. In the case of pro-

grammed withdrawal, it is the pensioner who bears the longevity and investment risk, because the longer he/she lives, the lower the pension he/she will receive in those last years.

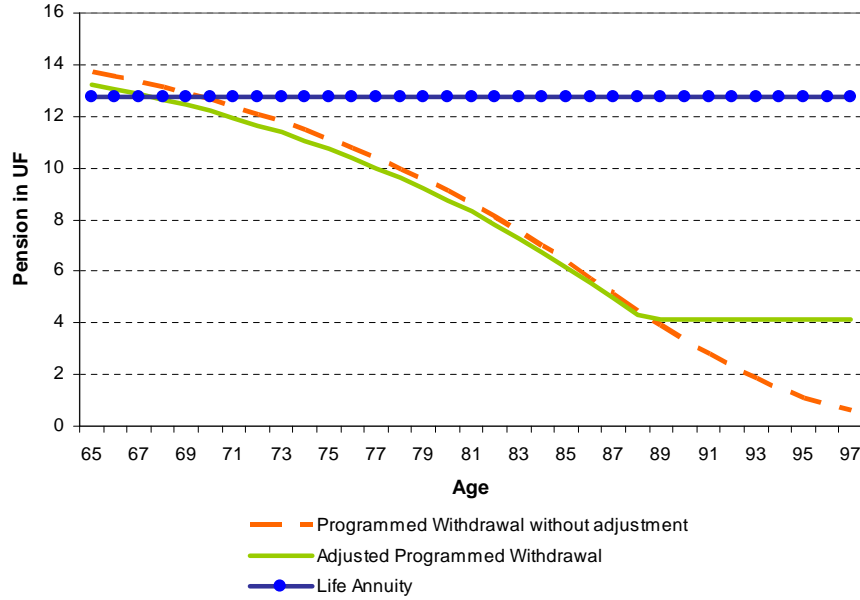
There are alternatives that combine these two products, a deferred life annuity with a temporary programmed withdrawal or splitting the fund and using part of it to buy an annuity and part a programmed withdrawal. Figure 5 shows the projected pension for a representative individual under a programmed withdrawal arrangement and a life annuity. By design, the programmed withdrawal decreases over time, given that life expectancy rises as the person gets older.

Within the life annuity product there are also alternatives: there can be arranged guaranteed periods or a variable life annuity can be designed which may keep some market risk in the product.

In the case of programmed withdrawal, given the longevity risk, an amendment to the law was introduced in 2008, meaning that there is a reserve for old age included in the formula of the programmed withdrawal, so that the probability of a pension falling below a certain threshold is reduced. Figure 5 shows the impact of this reserve.

Another variable that allows future pensioners to manage risk is the date on which they decide to purchase an annuity. Given the existence of the programmed withdrawal, it is possible to retire and receive a pension without necessarily annuitizing at that same moment. If interest rates are low or market performance is poor, it may be advisable to wait for a better time for purchasing an annuity. However, waiting will always imply risk, given that conditions may be better or worse in the future. The same is true about the timing of retirement, which can also be freely decided after the legal retirement age or after meeting the legal requirements in terms of replacement rate and the level of the pension.

Figure 5 – Comparison between programmed withdrawal and life annuity
(UF: inflation indexed unit of account)¹⁵



Source: Authors' calculations

3.8 Role of the Solidarity Pillar

The aim of the Solidarity Pillar is to reduce poverty, whether in old age or in the event of disability to work, and to provide a co-insurance against numerous risks. This pillar is funded out of the nation's general taxation and offers the possibility of paying benefits to people who reach old age or become disabled to work with little or no participation in the Pension System. In the case of old-age pensions there is the Basic Solidarity Old-Age Pension (*PBS*¹⁶) and the Old-Age Solidarity Pension Top Up (*APS*¹⁷).

The *PBS* is a benefit funded by the government which is available for people who have no pension right in any pension regime, either as originators or as beneficiaries of a survivorship pension, and who meet a series of requirements, such as being at least 65 years old and belonging to a family group from among the poorest percentage of the population. The implementation of this benefit has been gradual, starting with 40% of the population in July 2008. As from 1st July 2011, this percentage will correspond to 60%. In the same way, the value of the *PBS* increased from \$60,000 in July 2008 to \$75,000 since July 2009, from

¹⁵ At December 31st, 2009, 1 UF is equivalent to 20,942.88 chilean pesos, or US\$ 41.

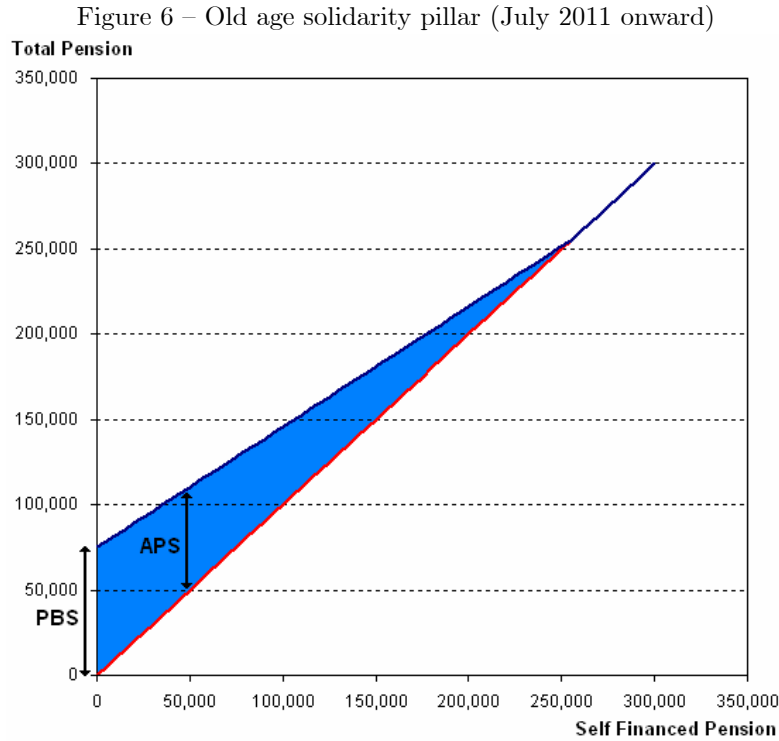
¹⁶ In Spanish, *Pilar Básico Solidario*.

¹⁷ In Spanish, *Aporte Previsional Solidario*.

then on the value will be adjusted annually by inflation.

The *APS* is the benefit funded by the government which is open to those who have a pension that is greater than zero and less than, or equal to, the Maximum Pension with Solidarity Top Up (*PMAS*¹⁸) and who also meet the same requirements as for *PBS*. This is also implemented gradually starting with a value of \$70,000 for the *PMAS* and when fully functional, as from 1st July 2011, will be \$255,000.

Figure 6 shows the relation between the self-funded pension and the total pension for those people entitled to the Solidarity Pillar. The values used correspond to the structure of the system when fully-functional. In this figure it is possible to appreciate the effect of the Solidarity Pillar in mitigating market risk on pensions. This is due to the fact that the pension obtained under the Solidarity Pillar has a minimum, given by the *PBS*. Another important point is that this system does not reduce substantially incentives to save. This is because the total pension increases as the self-funded pension gets larger, until it reaches the value of the *PMAS*, i.e. \$255,000.



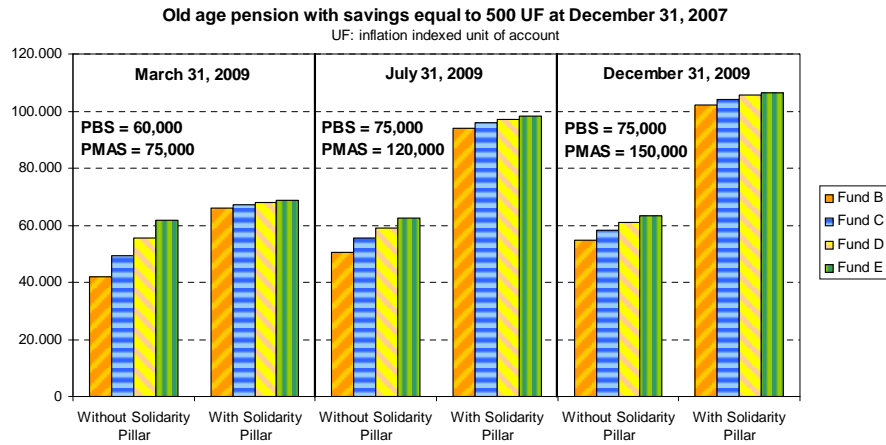
Source: Studies Division, Pension Supervisor

In order to be able to evaluate the mitigating effect of the Solidarity Pillar, an exercise was carried out to calculate the pension that would be received by

¹⁸In Spanish, *Pensión Máxima de Aporte Solidario*.

a married man with a wife three years younger, who has a balance of 500 UF on 31st December 2007. Figure 7 shows the amount of the pension in current chilean pesos, for a person that has contributed during their life span in different types of fund. It shows the case “Without Solidarity Pillar”, which corresponds to the self-funded pension, and the case “With Solidarity Pillar”, which has different *PBS* and *PMAS* values, depending on the date presented. It is easy to see how the Solidarity Pillar smoothes the pension value among the different strategies. This effect becomes slightly less as the difference between the *PBS* and the *PMAS* increases.

Figure 7 – The mitigating effect of the solidarity pillar



Source: Authors' calculations

4 Life cycle investment strategies

In the previous chapters, an extensive analysis has been made of the relevant risks in a defined-contribution pension system; and the various mechanisms existing in the Chilean case to mitigate these risks. One of the mechanisms, widely analyzed in financial theory, refers to the definition of investment strategies that are consistent with the individual's life-cycle. In the case of Chile, this element is present through the default strategy defined in the law for those who do not actively select a fund. The aim of this chapter is to evaluate the impact of implementing different investment strategies on expected pensions and pension risk, comparing static strategies with those defined according to the member's age, in order to evaluate the effect on the pension risk of adopting life-cycle investment strategies.

4.1 Investment strategies based on age

4.1.1 Current regulation in Chile

Current regulation, based on the multi-fund system, offers 5 types of fund with different investment strategies and associated risk: fund A being the riskiest with a 80% maximum investment limit in variable income, and fund E being the most conservative, with a 5% maximum limit in variable income.

The member voluntarily chooses the fund which best suits his/her needs, investment horizon and risk/return preferences. Access restrictions according to age exist for members in the active stage and pensioners, which were listed in section 3.2.2.

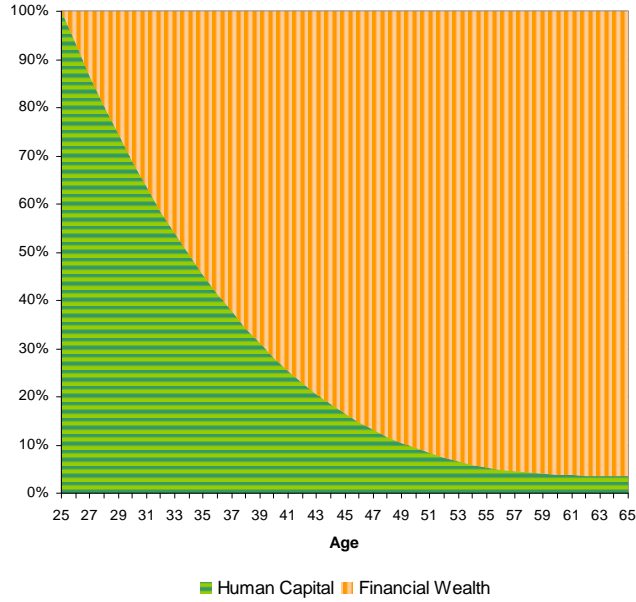
For those members who do not opt voluntarily for a type of fund, a default path is assigned to them that is consistent with the individual's life-cycle, where the exposure in variable income decreases with age in order to protect the member from the greater risk associated with equities when he/she is close to retirement. As was analyzed in section 3.2.2, this allocation of funds by default turns out to be an important mechanism in mitigating risks, consistent with the recommendations given by international bodies and specialized journals. The theoretical grounds supporting such recommendations are analyzed in the next section.

4.1.2 Conceptual framework

It can be argued conceptually that an individual's total wealth is made up of his/her financial wealth and human capital, the latter element being measured as the present value of his/her future income from work. When the individual is young, his/her wealth consists almost entirely of human capital, whereas when he/she is close to retirement, his/her financial wealth is the main source of his/her total wealth. An individual's pension therefore comes from these two sources of wealth, in other words, what he/she manages to accumulate in his/her individual account, and the present value of future contributions. This latter bears a close relation with his/her human capital and future prospects of labor

income. Figure 8 represents the way the composition of an individual's total wealth changes over time.

Figure 8 – Total wealth composition



Source: Authors' calculations

Viceira (2007) argues that the change in the relative importance of these two sources of wealth over the course of an individual's life justifies the adoption of investment strategies in which the portfolio is gradually adjusted according to the worker's age (age-based strategies). At the beginning of the working life, it would be more appropriate to take risks in financial investment in search of higher returns. In this case, the human capital would act as an insurance mechanism since, assuming relatively constant labor income, this component may approximate to an implicit investment in bonds. When approaching retiring age, the aim changes to one of safeguarding financial wealth by investing in safer instruments.

In this context, an investment strategy consistent with the member's life-cycle would be one providing a higher weighting of risky assets at the beginning of the working life, with gradual changes in the composition towards safer assets as the individual gets older and approaches retiring age.

The design of investment strategies of this type also means taking the heterogeneity of the members into account. For example, it would be more plausible to assume that labor income is uncertain and might therefore not be similar to an implicit holding in bonds. The level of uncertainty in labor income will depend on the degree of correlation between wages and the economic cycle, the type of contract the worker has (open-ended or fixed-term) and his/her level

of education, among other factors. On this line, Gomez, Kotlikoff and Viceira (2008) argue that for plausible values of wage volatility, it is still advisable to have an investment policy with decreasing amounts of variable income according to age, but to select a more conservative portfolio for those individuals with more unstable jobs¹⁹.

If, on the other hand, the member qualifies to receive benefits from the solidarity pillar, subsidies and/or guarantees to make up his/her pension, a more aggressive investment strategy would be better, because the obtaining of such benefits would mitigate the risks associated with a portfolio more slanted towards equities. Another relevant factor is the degree of risk-tolerance, meaning that a well-defined set of strategies should include aggressive, intermediate and conservative options, to satisfy the various risk/return preferences of individuals.

Internationally, this type of investment strategies are widely-known and in demand in the mutual fund market. The composition of the different investment portfolios differs in the weighting given to the different assets depending on the target investment horizon, calculated as the number of years still to go before retirement; and also including investment strategies for the passive stage. In general, mutual funds products are oriented to a relatively aggressive profile, with a percentage invested in variable income that is close to 90% at 40 years from retiring age, and falls to approximately 40-45% at retiring age²⁰.

In order to measure how different investment strategies affect risk in a defined-contribution pension system, it is necessary to have an adequate measurement of risk that includes all the relevant factors that may affect an individual's pension. The following section concentrates on this last point.

4.2 Short-term volatility versus pension risk

Having a reliable measurement of pension risk available is no easy task. For example, the short-term volatility of the pension funds' return is not necessarily a good indicator of the pension risk in the case of a member who is at the beginning of his/her active stage and is still 30 years off retirement. In the light of this, it is necessary to concentrate on the considerations needed to have a pension-risk definition that makes sense.

The financial literature has analyzed and suggested various quantitative tools for measuring risk, but these generally present serious limitations when it comes

¹⁹Two additional factors could be mentioned in favor of life-cycle strategies, even under the assumption of wage uncertainty. On the one hand, in the presence of negative shocks on wages, the worker might qualify to receive benefits from unemployment insurance, smoothing the effect of the job loss on his/her level of income. On the other hand, the worker may adjust the number of hours worked in response to cyclical fluctuations or shocks in the labor market and thereby stabilize his/her work income.

²⁰In Chile, there are some insurance companies that offer mutual funds oriented to voluntary pension contributions (*Aporte Previsional Voluntario, APV*) which include the concept of life-cycle strategy, where the investment strategy depends on the target investment horizon. When the horizon is less than five years, most of the fund is invested in fixed income (similar to fund E) and when the horizon is greater, 40 years for example, there is a predominance of equities (similar to fund A).

to evaluating their use in measuring the risk of the pension system. The application of VaR models, for example, might be an attractive alternative. It is an instrument in widespread use in the financial sector as a measure of market risk and is easy to interpret. However, it has one important limitation: it has a short-term approach which is not appropriate for measuring long-term investment strategies such as is the case of the pension funds.

A specific case that brought these limitations to light during the financial crisis was the VaR model implemented by the National Commission of the Retirement Savings System in Mexico (CONSAR), as a way of measuring the market risk of the pension funds. Since it did not envisage the possible occurrence of extreme episodes, it had to be suspended during a period of growing volatility in the financial market²¹.

We can certainly identify various limiting factors in models such as VaR, which are widely used to measure market risk. First, the investment horizon is relevant. Risk measurements that consider a time-horizon of a day, a month or a year are not suitable for measuring pension risk. The investment horizon associated with pension fund investments from the time when the member starts to pay contributions is significantly longer, 40 or 45 years. Secondly, the properties of the time-series have to be considered, since basing scenarios on historic information corresponding to a short, relatively stable period increases the likelihood of the VaR exceeding the predetermined limits if a future scenario of greater financial volatility occurs – as in the case of Mexico – adding an additional source of instability to the market.²² Finally, it is essential to choose an appropriate variable on which to measure pension risk, one that includes all relevant sources of risk faced by members of the pension system: contribution density risk or the risk of becoming unemployed; the funds' investment risk; and the risk of annuitization or re-investment, when the final balance of the member's individual account is transformed on retirement into the value of the pension.

Bearing in mind the long-term nature of the pension funds and the aforementioned risks associated with the pension, pension risk must be measured and evaluated from the point of view of the contributor's life-cycle. Consistent with this latter, the target variable that best represents the member's position on retirement is the replacement rate, measured as the ratio between the value of the pension at the moment of retirement and a relevant measurement of wage. Specifically, we can identify four relevant factors that will affect its expected value and volatility: (1) the accumulated return of the funds' investments (accumulated balance in the individual funding account at the moment of retirement), (2) the accumulated volatility of the chosen investment strategy;

²¹Specifically, the volatility to which members of the Mexican pension system are exposed is controlled by legal limits imposed on the VaR, which has to be calculated daily by the pension fund administrators (Afores). Failure to comply with these limits implies compensation to the members for the losses that occur. The VaR is calculated on the basis of a simulation method with information about the historic returns of financial assets, including 1,000 days of data. Prior to June 2009, the time-window for calculating the VaR corresponded to 500 days of information on returns. Further information on <http://www.consar.gob.mx/>.

²²See Bernstein and Chumacero (2008).

(3) the volatility associated with contributions (failure to contribute consistently throughout the life cycle), and (4) the cost associated with one unit of pension, or necessary capital (annuitization or re-investment risk.).

What we are definitely interested in analyzing is the probability density function of the replacement rate, and how this distribution changes on the basis of different investment strategies during the member's life cycle. Conceptually, the appropriate measurement of risk is given by the marginal effect on the expected replacement rate of carrying out a particular investment strategy, the scatter around that expected value and the shape of its density function.

In the next section we shall analyze the database and methodology used to estimate the probability density function of the replacement rate. That methodology provides us with the appropriate tool for correctly evaluating the impact on expected pensions and volatility of following different investment strategies, and particularly life-cycle strategies.

4.3 Impact on expected pensions of different investment strategies

In order to be able to measure the pension risk associated with different investment strategies, a simulation exercise has been carried out. This exercise includes the characteristics of the Chilean pension system as well as the characteristics of the Chilean labor market. In this way information is obtained about the replacement rates associated with different investment strategies, and analyze the probability density function of these replacement rates to have an assessment of pension risk.

4.3.1 Methodology

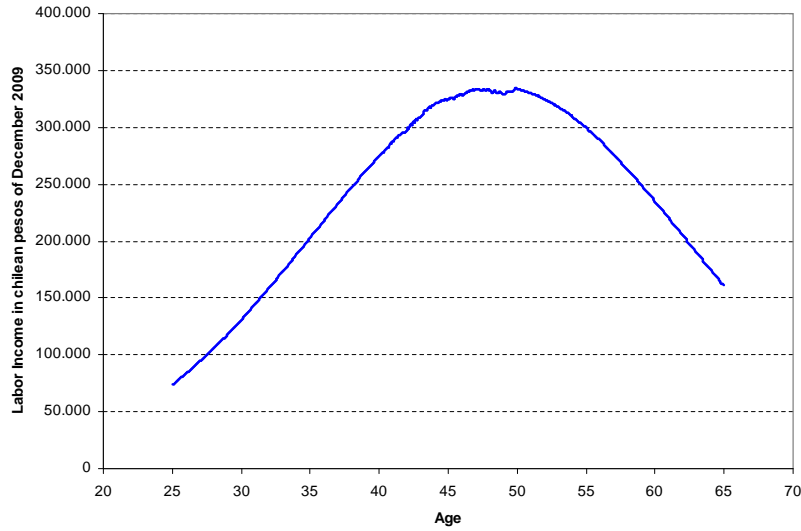
As mentioned in the earlier chapters, a major part of the value of the pension is given by the contributions that members pay into the system. To obtain the characteristics of the labor market which influence the pension, information from the *Historias Previsonales de Afiliados* Database (HPA) and EPS 2009 is used. This database contains administrative information provided by the Pension Fund Administrators for a representative sample of members and survey information on members characteristics comprising a panel for the period July 1981 and December 2009. With this information, profiles are constructed of income and probability of contributing in the pension system. These profiles constitute important input for the simulation.

The information on income to be found in the database is only present for those periods in which individuals are observed, so it is necessary to estimate the income for those periods that are not included, to have a complete life-cycle and estimate pensions. In order to construct these complete profiles of income and contribution probability for individuals' whole active working period, a model of panel data is estimated with random effects for a specific cohort of members (those born between 1960 and 1964 with ages between 17 and 21 at the beginning of the DC pension system in 1981) and a forecast is made of

income and contribution probability for the individual's entire period of active working life.

On multiplying the estimated income at each age by the probability of contributing at that same age, a profile of expected contribution is obtained, for periods which are not observed. This information captures the components of the labor market that influence the accumulation of balance in the members' individual funding accounts, which makes it possible to produce a more realistic forecast of the balance at the point of retirement. Figure 9 shows the life-cycle profile of labor income for the case of men, which is the one used in this exercise.

Figure 9 – Life-cycle profile of labor income for men



Source: Authors' calculations based on data from HPA 2009 and EPS 2009

On the other hand, in order to characterize the multi-fund scheme in the pension system, a mapping exercise is made of the five types of fund on the basis of five asset categories, in order to obtain a longer series of returns, unrestricted by the period that the multi-funds have been in existence²³. Table 10 shows the indexes used for each asset category, information available since June 1996. With monthly information on the multi-funds since the year 2002, a mapping is made on the basis of these asset classes. Table 11 shows the weights per asset class that were used and the correlation between the real and mapped series of returns.

²³In order to determine the weights for each asset category, each fund is characterized fixing its composition in base of a yearly average, using information at december of each year, between 2002 and 2008, both inclusive.

Table 10 – Index by asset type

Asset Category	Index
Domestic equity	IPSA (Selective Asset Price Index)
Foreign equity	Morgan Stanley Capital Investment - Emerging Markets
Domestic fixed income	LVA Index - Government Sector
Foreign fixed income	US. Treasury Notes
Financial intermediation	LVA Index - Financial Intermediation Sector

Source: Authors' calculations

Table 11 – Mapping of multifunds

Asset Category	Fund A	Fund B	Fund C	Fund D	Fund E
Domestic equity	24%	22%	18%	12%	0%
Foreign equity	52%	34%	21%	10%	0%
Domestic fixed income	9%	24%	39%	52%	77%
Foreign fixed income	1%	1%	2%	3%	4%
Financial intermediation	13%	19%	19%	23%	19%
	100%	100%	100%	100%	100%
Correlation between effective and mapped returns	86%	86%	87%	85%	82%

Source: Authors' calculations

The parameters needed for the simulation process are estimated, using monthly information from June 1996 until June 2009. Table 12 shows the return and standard deviation for each Type of Fund.

Table 12 – Annual mean return and standard deviation by type of fund

	Mean (1)	S.D. (2)
Fund A	7,7%	22,0%
Fund B	5,6%	15,7%
Fund C	4,7%	10,6%
Fund D	4,2%	6,0%
Fund E	3,5%	4,1%

(1) Information for 1996 and 2009 is annualized.

(2) Consider years 1997 to 2008.

Source: Authors' calculations

In order to simulate series of monthly returns per Type of Fund, asset categories are modeled assuming mean reversion with correlated shocks using the Cholesky's de-composition methodology. Once the simulated series by asset category have been obtained, the mapping described in Table 11 is used to obtain the simulated series of monthly returns per Type of Fund.

Subsequently, the simulation exercise combines the information on the contribution profile and the series of returns per Type of Fund, with different investment strategies based on the multi-fund system. In this way, it is possible to accumulate the individual's balance in his/her individual funding account right up to retiring age. In this exercise, it is assumed that the individual starts paying contributions at 25 years of age and retires at the legal retiring age, in other words, 65 years.

Finally, with the information on the balance, a life annuity pension is obtained. This calculation includes the formulae and parameters applied in the Chilean system. The process includes annuitization risk through a simulation of the discount rate used to calculate the pension. Finally the replacement rate associated with the pension is calculated; using the average expected income for the last three years prior to retirement.

10,000 simulations are made for different fund investment strategies. In this way, a probability density function of the replacement rate is obtained for each strategy, and the pension risk can be measured, for instance, as the probability of having a replacement rate lower than a specified level.

4.3.2 Results of the Simulation

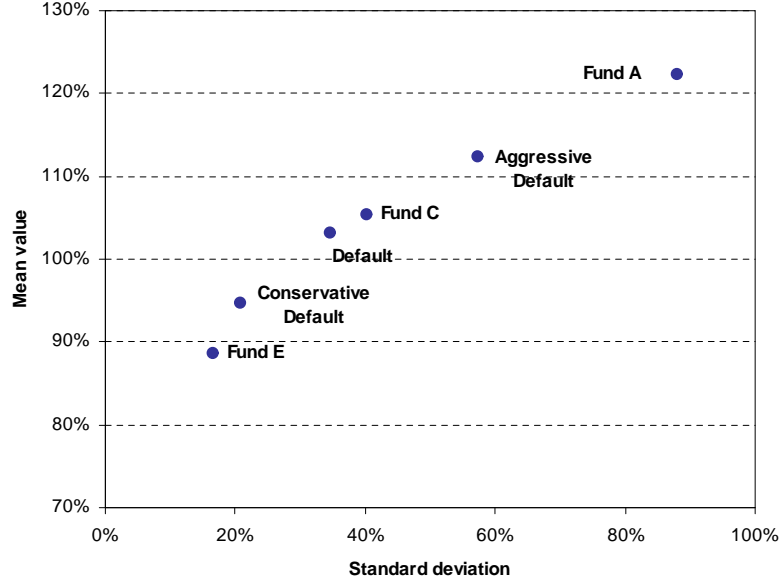
Table 13 describes the investment strategies analyzed in this exercise. The strategy *default allocation* is the default option described in detail in section 3.2.2. The static strategy that invests the individual account savings in Fund A is restricted in accordance with the Law for the last 10 years prior to retirement. In this case a transition is made towards the Fund B. The other static strategies involve investing the individual account savings in Fund C or Fund E throughout the whole period.

Table 13 – Description of investment strategies

Trajectory	Description
Fund A restricted to Fund B	Remain in Fund A until age 55 then gradually transfer the savings to Fund B .
Aggressive Default	Same structure as Default but transit between Funds A , B and C .
Fund C	Remain in Fund C during the whole period.
Default Allocation	Defined by Law, affiliates transit between Funds B , C and D .
Conservative Default	Same structure as Default but transit between Funds C , D and E .
Fund E	Remain in Fund E during the whole period.

Figure 14 shows the results of the analyzed investment strategies in terms of the average value and standard deviation of the replacement rate. It is interesting to emphasize that there are no dominant strategies in terms of risk/return, but rather a frontier where more conservative strategies provide a lower replacement rate, but with less volatility, and the more aggressive strategies provide higher replacement rates, but associated with much higher volatility. These results reinforce the idea that the multi-fund system allows members to follow investment strategies that match their own levels of risk aversion. Moreover, it can be seen that the strategy *default allocation*, which is where most members who have not voluntarily chosen a fund are located, is situated in an intermediate area with an expected replacement rate of 103% and a standard deviation of 35%; this definitely being a less risky strategy than investing in the static-strategy C.

Figure 14 – Mean value and standard deviation of replacement rate by investment's trajectory



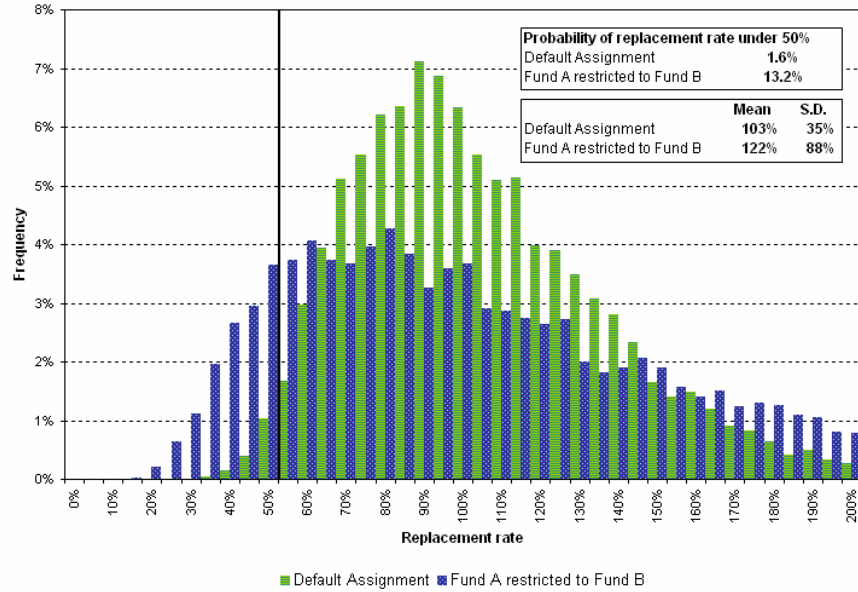
Source: Authors' calculations based on simulation results

Figure 15 shows the results of the simulation for strategies A and *default allocation*. It can be seen how the more aggressive strategy has a greater volatility in terms of replacement rates. This means that, when confronting an adverse financial scenario, the probability of achieving low replacement rates is greater. In fact, the probability of obtaining a replacement rate of under 50% is 13.2% for strategy A; while in the case of the *default allocation* strategy, the probability is only 1.6%.

Figure 16 compares different static strategies (A, C and E). In this case too, it is obvious that the more aggressive strategies have a considerable cost in terms of volatility, in order to obtain higher replacement rates. Here, the likelihood of obtaining a replacement rate of less than 50% is 13.2%, 3.0% and 0.1% for strategies A, C and E, respectively.

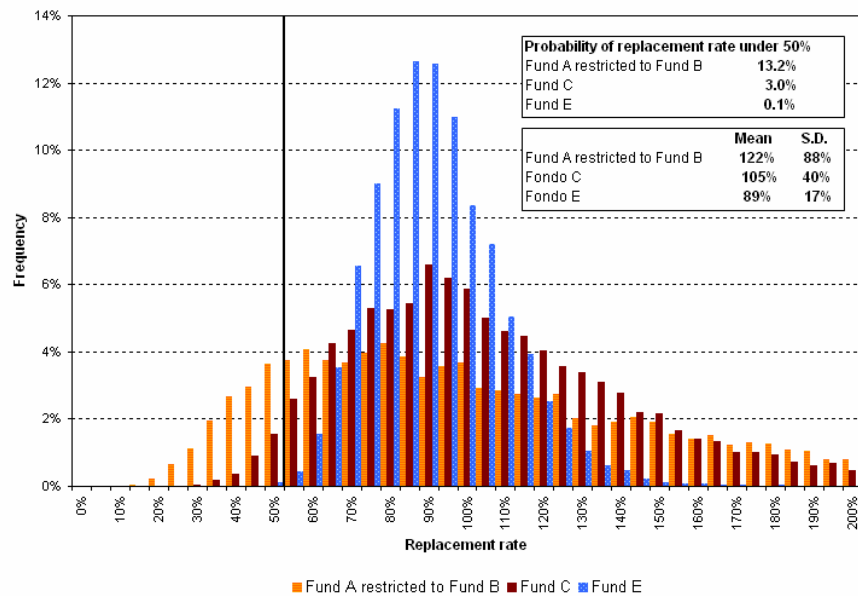
Finally, Figure 17 compares the *default allocation* strategy with two alternative strategies based on it: an aggressive strategy which travels through Fund A, B and C over the course of the life cycle, and a conservative strategy, which does the same, but traveling through fund types C, D and E. On comparing these results with those in Figure 15, it can be seen that the life-cycle strategies have an advantage in terms of obtaining reasonable replacement rates, but with much lower levels of volatility than the static strategies.

Figure 15 – Default allocation and fund A



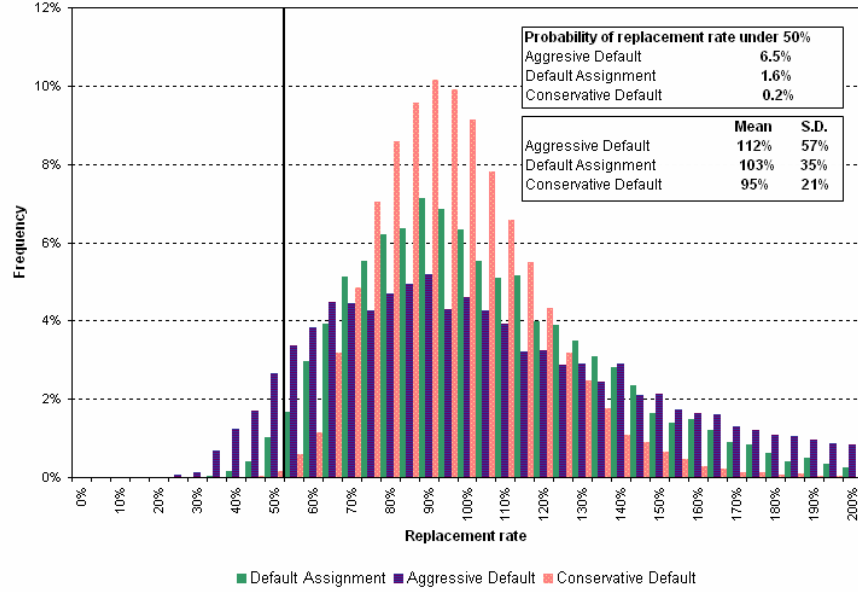
Source: Authors' calculations based on simulation results

Figure 16 – Funds A, C and E



Source: Authors' calculations based on simulation results

Figure 17 – Default allocation and its versions



Source: Authors' calculations based on simulation results

Table 18 presents a summary of the probabilities of obtaining replacement rates below certain levels, for all the investment strategies analyzed in this exercise. On analyzing the left tail of the probability density function of the replacement rate as a measurement of pension risk, it can be seen that the more aggressive investment strategies present a greater risk of obtaining lower replacement rates. In this case, this fact is observable up to replacement rate levels of about 70%. Above that level, the results begin to revert, with an increase in the probability of this occurring in more conservative investment strategies. This last point is relevant because it would appear to indicate that extremely conservative strategies, such as the static strategy in Fund E, would give a lower probability of obtaining a particular replacement rate for high values of this variable, even when compared with the most aggressive strategy (column 8 of Table 18), simply because it has an expected yield that is considerably lower when compared with relatively more aggressive strategies.

Table 18 – Probability to obtain a replacement rate under a certain value

	Replacement Rate								Probability
	< 10%	< 20%	< 30%	< 40%	< 50%	< 60%	< 70%	< 80%	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	
Fund A restricted to Fund B	0.0%	0.2%	2.0%	6.6%	13.2%	21.0%	28.4%	36.6%	
Aggressive Default	0.0%	0.0%	0.2%	2.1%	6.5%	17.3%	22.6%	31.5%	
Fund C	0.0%	0.0%	0.0%	0.6%	3.0%	8.8%	17.8%	28.3%	
Default Allocation	0.0%	0.0%	0.0%	0.2%	1.6%	6.3%	15.3%	27.0%	
Conservative Default	0.0%	0.0%	0.0%	0.0%	0.2%	1.5%	9.9%	25.6%	
Fund E	0.0%	0.0%	0.0%	0.0%	0.1%	2.1%	12.2%	32.4%	

Source: Authors' calculations based on simulation results

As a result, it can be said that investment strategies that follow a life-cycle path present better results in terms of pension risk. This is consistent with the theory which puts forward the necessity of reducing the volatility to which members' financial resources are exposed as retiring age approaches and in this way mitigating the risk of a potential loss that would be impossible to reverse later.

5 Conclusions and Challenges

This article describes the main risks faced in a defined-contribution pension system. These risks are always going to exist, whatever the system in a particular country may be, and what is important is to identify them properly, so that the design can allow for appropriate risk management to mitigate them or avoid them if possible. Many of the risks faced will persist, even where appropriate design measures are adopted or mitigation attempts made, which is why a sharing of risks between the various agents of society is also a necessary condition for the success of a pension system.

What is more, it is also crucial to make efforts, not only in the regulation of a pension system, but also in on-going supervision, given the importance of this service for the population. Where a mandatory system is in place, which is part of a country's social security and which constitutes the main source of income for the elderly population, it is not just important, but critical.

In Chile, the design copes with the various risks being faced by means of mechanisms that encourage contribution on the one hand but also make the obligation to contribute effective through the collection process. In the same way, these resources are invested throughout the worker's active life in a diversified and strictly regulated manner, including alternative investment strategies depending on the characteristics of the participants. In this respect, a life-cycle investment strategy is also established for those who do not choose a fund, this being in line with international recommendations. Then, when retirement arrives, there are various alternatives that make it possible to share the risks between the pensioners and insurance companies, depending on the particular position of the person concerned. Finally, the government also has a fundamental role through the solidarity pillar, which is a mechanism of sharing risks within one generation, and between generations that face different economic conditions.

The pension reform has meant a great contribution towards a more appropriate management of the risks and it will be vitally important to evaluate its impact in the future. Together with the reform of the pension system, there has been a change in the institutional structure of the supervisory body, which now has a wider spectrum of supervision and also includes risk as a fundamental focus in its inspections. In order to have more appropriate management of one of the main risks in an individually funded system, i.e. investment risk, progress is being made on appropriate measurements of risk. These measurements must make the final pension their objective, which may be very different from the short-term volatility.

References

- BARR, N. and DIAMOND, P. (2008). «Reforming pensions: Principles, analytical errors and policy directions». *International Social Security Review*.
- BERSTEIN, S. and CHUMACERO, R. (2008). «VaR Limits for Pension Funds: An Evaluation». *Documento de Trabajo N.26, Superintendencia de Pensiones, Santiago*.
- BERSTEIN, S.; LARRAÍN, G. and PINO, F. (2006). «Chilean Pension Reform: Coverage Facts and Policy Alternatives». *Economía*, **Volumen 6(N.2)**, pp. Pág. 227–279.
- BERSTEIN, S. and TOKMAN, A. (2005). «Brechas de ingreso entre géneros: Perpetuadas o exacerbadas en la vejes?». *Documento de Trabajo N.8, Superintendencia de Pensiones, Santiago*.
- BLAKE, D.; CAIRNS, A. and DOWD, K. (2001). «Pensionmetrics: stochastic pension plan design and value-at-risk during the accumulation phase». *Insurance: Mathematics and Economics*, **Volume 29**, pp. PP 187–215.
- BLAKE, D.; CAIRNS, A. and DOWD, K. (2003). «Pensionmetrics 2: stochastic pension plan design during the distribution phase». *Insurance: Mathematics and Economics*, **Volume 33**, pp. PP 29–47.
- COMISIÓN NACIONAL DEL SISTEMA DE AHORRO PARA EL RETIRO EN MÉXICO (CONSAR). <<http://www.consar.gob.mx>>.
- DECRETO LEY N. 3.500 (1980). «Régimen de Previsión Social Derivado de la Capitalización Individual». Published November 13th of 1980. Available at <<http://www.spensiones.cl>>.
- FAJZNYLBER, E.; PLAZA, G. and REYES, G. (2009). «Better-informed Workers and Retirement Savings Decisions: Impact Evaluation of a Personalized Pension Projection in Chile». *Documento de Trabajo N.31, Superintendencia de Pensiones, Santiago*.
- GOMEZ, F.; KOTLIKOFF, L. and VICEIRA, L. (2008). «Optimal Life-Cycle Investing with Flexible Labor Supply: A Welfare Analysis of Life-Cycle Funds». *American Economic Review*, **Volumen 98(Issue 2)**, pp. PP 297–303.
- LEY N. 20.255 (2008). «Establece Reforma Previsional». Published March 17th of 2008. Available at <<http://www.spensiones.cl>>.
- MINISTERIO DE PLANIFICACIÓN, CHILE (2006). «Encuesta de Caracterización Socioeconómica Nacional (CASEN)». Available at <<http://www.mideplan.cl/casen/index.html>>.
- SUBSECRETARÍA DE PREVISIÓN SOCIAL, CHILE (2009). «Encuesta de Protección Social (EPS)». Available at <<http://www.proteccionsocial.cl>>.

- SUPERINTENDENCIA DE PENSIONES (2008). «Régimen de Inversión de los Fondos de Pensiones». Published September 9th of 2008. Available at <<http://www.spensiones.cl>>.
- SUPERINTENDENCIA DE PENSIONES (2009a). «Base de Datos de Afiliados, Cotizantes, Pensionados y Fallecidos (BDA)».
- SUPERINTENDENCIA DE PENSIONES (2009b). «Base de Datos de Historias Previsionales de Afiliados».
- SUPERINTENDENCIA DE PENSIONES (2009c). «Chile 2008: A Second-Generation Pension Reform». First edition, October 2009.
- TAPIA, W. and YERMO, J. (2007). «Implications of Behavioural Economics for Mandatory Individual Account Pension Systems». *OECD Working Papers on Insurance and Private Pensions, N.11*. OECD Publishing.
- VICEIRA, L. (2007). «Life-Cycle Funds». *Harvard Business School, National Bureau of Economic Research (NBER) and Centre for Economic Policy Research (CEPR)*. Available at SSRN: <<http://ssrn.com/abstract=988362>>.