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Communicating Pension Risk to DC Plan Members

THE CHILEAN CASE OF A PENSION RISK SIMULATOR

Pablo Antolin, Olga Fuentes

JEL Classification: D14, D18, G23, G28, I28, J26, O16, O19

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Abstract/Résumé

COMMUNICATING PENSION RISK TO DC PLAN MEMBERS: THE CHILEAN CASE OF A PENSION RISK SIMULATOR

Abstract: The purpose of this paper is to discuss a few issues related to how best to communicate uncertainty about projections of future pension benefits to members of DC plans, and especially to present a pension risk simulator developed by the Chilean regulator (Superintendencia de Pensiones, SP) that addresses directly how to convey that uncertainty and aims at eliciting a pro-active response from individuals in terms of contributing more and for longer.

JEL codes: D14, D18, G23, G28, I28, J26, O16, O19

Keywords: Pensions, pension benefits, projections, defined contribution pension plans, financial education, communication, uncertainty, pension risk simulator.

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COMMUNIQUER LE RISQUE DE RETRAITE AUX ADHÉRENTS DES PLANS À COTISATIONS DÉFINIES : LE CAS CHILIEN D'UN SIMULATEUR DE RISQUE DE RETRAITE

Resumé : L'objectif de ce document est de discuter de quelques questions liées à la manière de communiquer l'incertitude autour des projections des futures prestations de retraite aux adhérents des plans de retraite à cotisations définies. En particulier, le but est de présenter un simulateur de risque de retraite développé par le régulateur chilien (Superintendencia de Pensiones, SP) qui aborde directement la manière de transmettre cette incertitude et vise à susciter une réponse proactive de la part des individus pour qu'ils cotisent d'avantage et pendant plus longtemps.

Codes JEL : D14, D18, G23, G28, I28, J26, O16, O19

Mots clés : Pensions, projections, plans de retraite a cotisations définies, alphabétisation financière, éducation financière, communication, incertitude, simulator de risque sur la pension.

COMMUNICATING PENSION RISK TO DC PLAN MEMBERS: THE CHILEAN CASE OF A PENSION RISK SIMULATOR

By Pablo Antolin and Olga Fuentes*

1. Introduction

Defined contribution (DC) pension plans play a key role in providing retirement income in many countries and their importance as a source of future retirement income is growing rapidly. As a result, DC pension plans will be a determining factor of old-age adequacy for future retirees. Future pensions from DC pension plans will depend on choices members and regulators will make about how much to contribute, how to invest, when to begin withdrawing a pension and how pension benefits should be withdrawn. All of these choices depend in an important way on changes over time in a number of factors that are uncertain. Therefore, in order to make these decisions, members must understand the nature of their pension plans and the risks they face.

Pension benefits from DC pension plans are inherently uncertain. Future pension benefits from these plans depend on a number of factors such as returns on investment, discount rates, inflation, wages and employment, as well as life expectancy, which are uncertain. The difficulty in making decisions is that the changes in these factors are unknown at the time the decisions are made. Regulators can help members manage this task by communicating those choices and their implication on regular basis, as well as projections showing their likely future pension.

Pension statements and pension risk simulators can help in conveying pension information and the uncertainty about future pension benefits from DC pension plans. Pension statements can provide basic accounting information such as a member's current balance and current asset allocation, along with general information about the pension plan. Pension statements can also provide projections about future benefits, although those projected pension benefits are never certain. Questions regarding the returns on investments, whether the person will lose their job or how long the person will live are among the factors that generate uncertainty.

Pension risk simulators can be used to help the employee understand the nature of this uncertainty about projected future pension benefits. To convey this uncertainty members need projections they can readily comprehend. There are two main approaches to provide projected future pension benefits: deterministic versus stochastic projections. The main difference between them is that deterministic projections yield estimates of the most likely pension benefit, which despite being more likely, may have a probability of occurring that is less than X%; while stochastic projections provide a whole range of possible outcomes for future pensions, each with their own associated probability. Consequently, a particular advantage of stochastic modelling is that it allows for the uncertainty regarding projections of future benefits from DC pension plans to be quantified. The drawback of stochastic models is that they may be complex, which means that some appropriate form of communication will be needed to convey the relevant information to members in a way that is easy for them to understand and that enables them to use the information effectively when making decisions about their defined contribution savings.

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The purpose of this report is to discuss a few issues related to how best to communicate uncertainty about projections of future pension benefits to members of DC plans, and especially to present a country case of the development of a pension risk simulator. The pension risk simulator project was carried out by the Chilean regulator (Superintendencia de Pensiones, SP) and assesses how best to communicate projections of future pension benefits to members of DC pension plans, and in particular, how to convey the uncertainty underlying these projections. The ultimate goal of such exercise was the design of a web tool that would allow people to assess their choices and hopefully make them to take active actions to increase their chances of achieving their target retirement income by, for example, contributing more or contributing for longer by retiring later. The pension simulator was launched on September 2012. It is available at www.spensiones.cl.

It is important to bear in mind that the financial literacy of members tends generally to be low, which makes the goal of effective communication much harder to achieve.[1] In this context, the discussions and analysis in this report focus on alternative ways to effectively convey projections and uncertainty about future retirement income from DC pension plans, taking into account the current level of financial literacy. Nevertheless, there is a need to improve financial literacy.

Finally, providing pension benefit projections may lead to issues of fiduciary responsibility. When regulators provide projections of pension benefits, especially when such projections use more sophisticate and "precise" models, and despite of including probabilities, may create expectations in pension members that the regulator stands behind such projections. Pension members may believe that such projections are closer to a promise and they may take them for granted. This will defeat the purpose of providing pension benefit projections (*i.e.*, provide an assessment of uncertainty, convey this uncertainty, and push members to be pro-active). Moreover, this potential fiduciary responsibility may create implicit liabilities. Regulators could address this problem by clearly stating that those projections are to guide and encourage pension members to make active decisions about saving for retirement, and that they are far from a promise.

Section II introduces the type of pension information that can be provided, for example through pension statements and/or pension risk simulators. Section III discusses several issues related to the way uncertainty about future pension benefits can be conveyed. Section IV is the core of this report and presents the pension risk simulator developed by the Chilean Superintendence of Pensions (SP).

II. Pension Information, Pension Statement and Pension Simulators

In order to make effective decisions about how best to save for retirement, individuals need information on fundamental issues as to how their pensions plans work, what benefits they can expect from various sources, the risks they face and what specific actions the members need to take. Furthermore, individuals need on-going updates on the status of their pension savings in order to see whether they are on target to meet their retirement savings goals. In defined contribution plans such information would include current account balances, how assets are allocated, fees and investment gains and losses.

The type of pension information that members may need to take active decisions can be divided into two categories. The first category covers current basic accounting information, while the second category covers forward looking information. The forward looking information can refer to the impact on pension benefits of various choice variables; and/or the impact of uncertainty (risks) about several pension parameters, such as returns on investment, employment, or life expectancy.

[1] OECD (2008), and Lusardi and Mitchell (2007).

Basic accounting information

Accounting information is the most basic and crucial information that should be communicated to members of DC plans. This type of information is generally provided with the help of the pension statement. Moreover, it is generally required to meet regulatory disclosure guidelines.[2] Accounting information is a statement of facts. It is mainly used for required disclosures and generally includes such items as the name of the pension plan and contact details, the member's current account balance, current asset allocation, development in the account since the last statement date, including contributions, investment performance and fees. Basic disclosure is necessary to keep a pension system accountable and transparent, and also to give members the ability to verify items such as pensionable salary and contribution levels. Disclosure of accounting information also helps educate members about their pension and can help increase employee appreciation of their benefits. In this context, a basic list of accounting information in a pension statement could include current balance, current investment allocation, contributions, accruals, and fees charged.

Ideally, the accounting information provided in the annual pension statement should be comprehensive, covering all pension accruals from all sources for individuals. However, this degree of comprehensiveness rarely happens in practice for a number of reasons such as the complexity of calculating accurate accruals (witness the OECD project on how to improve the comparability of reported returns on portfolios across countries). Whether providing such comprehensive pension statements is a realistic goal depends on the pension markets in various countries and to what extent pensions are similar or coordinated across providers.

Forward-looking information

Pension statements can also be designed to be forward-looking. They can provide information that helps members plan for retirement by giving them a more concrete idea of what to expect from the plan over the long-term.

The pension statement can be a powerful instrument in assisting members to make important decisions about their pensions, rather than solely as a means of disclosing facts. It can, for example, show the impact on pension benefits of various choices individuals and regulators can make, such as retiring late, increasing contributions, choosing an annuity as opposed to a lump sum, or deciding to purchase a particular level of death and disability coverage. The OECD "Roadmap for the Good Design of DC pension plans" stresses the importance of *contributing and contributing for long periods*, as well as the beneficial impact of postponing retirement to increase the adequacy of retirement income.[3]

Pension statements that include information on the impact of different choice variables can be found in some countries such as Chile and Sweden that provide information on the impact on pension benefits of postponing retirement, and Mexico that provides information on the impact on pension benefits of increasing voluntary contributions.

There is debate as to the inclusion of pension projections in the pension statement outweighs the potential confusion or misunderstanding such projections may cause for members. Some argue that at younger ages, pension projections are so uncertain that they may do more harm than good. For older-aged members, projections become less uncertain and more useful, but there may not be enough time to make up for any projected shortfall in pension savings. Furthermore, regulators and stakeholders are asking how

2 . See Antolin and Harrison (2012)

3 . See as well Chapter 6 at the OECD Pension Outlook (2012).

literacy on pension and financial matters may be raised sufficiently so that pension projections become a truly useful tool for members.

Additionally, forward looking information about pension benefits are subjected to a great deal of uncertainty. Pension benefits depend on certain risky variables such as future values of returns on investment, employment prospects and life expectancy that are unknown. Financial market, labour market and demographic risks make pension benefit projections inherently uncertain. Pension statements could be used to present projections of future pension benefits and the uncertainty surrounding those projections. However, this approach may be trading off completeness for additional complexity.

In practice, the majority of pension projections are deterministic as they typically show pension outcomes without a probability range. These deterministic projections have the advantage of clarity and simplicity. However, they fail to provide a measure of or quantify uncertainty, let alone recommendations on how to respond to the implications of uncertainty. In some cases, these projections show pension outcomes under one or two scenarios, often with a caveat that the results are uncertain and not guaranteed. Sometimes uncertainty is dealt with by providing pension outcomes for different scenarios (e.g. different rates of returns on investment, different wage growth paths).

Therefore, the main drawback of deterministic projections is that they lack probability distributions that permit assessing uncertainty more accurately. The best approach to convey uncertainty may be to provide projections of future pension benefits including a range of probabilities for different pension outcomes (as discussed in Antolin and Payet, 2011). However, these types of projections are more complex to prepare and can be difficult for members to interpret. However, if designed appropriately, projections on future pension benefits including a range of probabilities for different outcomes could convey the most valuable information on uncertainty and risks.

The best tool to provide this information on uncertainty about future pension benefits may be a pension risk simulator. On-line pension projection tools enable individuals to input assumptions for future values of several key parameters (e.g. contributions, retirement age, returns on investment) to obtain projected retirement income. However, they require a high level of knowledge about assumptions, but have the advantage that the individuals who choose to use them are more likely to understand the results. Additionally, on one hand obtaining a wide variety of results could add another layer of confusion that, on the other hand, would serve to further underline the message that projection results should not be considered as definite or relied on exclusively. The pension risk simulator introduced in section IV addresses several of these issues.

A pension risk simulator has three main objectives. After establishing or setting the retirement income that one may have as a goal, a pension risk simulator aims at (1) informing members of the risk of falling to reach the target retirement income set as an objective; (2) indicating members how by changing choice variables (e.g. contributions rates, the length of the contribution period by for example retiring later and contributing one more year) the chance of reaching the target retirement income increases; and (3) telling members about the impact that portfolio choice can have on the risk of reaching the target retirement income.

III. Communicating Uncertainty about Pension Benefits

Pension statements using deterministic projections of future retirement income can be easy to understand but are less accurate in communicating uncertainty. They can convey uncertainty by using caveats or warnings, or presenting results under different scenarios, but they cannot provide any quantification or approximation of the uncertainty about projection because they lack probability ranges for possible pension outcomes. For example, a pension statement based on a deterministic approach could say: "*If you continue to make the same monthly contributions that you are making now for the next X years, and*

economic conditions vary in a typical fashion, you should expect a monthly income at retirement of ***36% of your final salary****."* Uncertainty could be conveyed using only a warning: "*However, this amount is not guaranteed*" and adding the implications of a worse case scenario: "*If you suffer more unemployment and enjoy lower returns on investment, you should expect a monthly income at retirement of only 20% of your final salary."* The main drawback with this approach is that it is not possible to quantify or approximate this uncertainty.

Pension statements using a stochastic approach can easily quantify and approximate uncertainty, but at the cost of some added complexity. A pension statement communicating the same uncertainty as previously with the help of stochastic modelling could be as follows: "*If you continue to make the same monthly contributions that you are making now for the next X years, and economic conditions vary in a typical fashion, your should expect a monthly income at retirement of* ***at least 36% of your final salary in 5 out of 10 times***."

Alternatively, pension statements could combine both the deterministic and the stochastic approaches. The deterministic model uses a more straightforward approach to communicate projections, while the stochastic model is a better tool to quantify risks. Hence, pension statements could communicate uncertainty using the deterministic approach in their presentation but backed by the quantification provided by a stochastic model. For example, the pension statement could say "*If you continue to make the same monthly contributions that you are making now for the next X years, and economic conditions vary in a typical fashion, you should expect a monthly income at retirement of 36% of your final salary. However, the uncertainty about this number is quite large."* Where the qualification "*the uncertainty is quite large*" is supported by stochastic modelling and its probability range. Nevertheless, in what follows the report focuses on proposals to convey uncertainty using a stochastic approach with a full range of probability distributions to convey uncertainty.

The discussion herein focuses on the form to communicate or convey uncertainty about pension benefits in a way that it is understandable for the typical plan member. The main tool to do this is a pension risk simulator. The issues to be considered include, for example, the language in which the information is communicated, the amount and purpose of the information, the techniques used to convey the message, and the visual form of the message.

The design of how to convey uncertainty on pension benefits depends on the language in which the information is communicated. The form in which the information is communicated, that is the language used, needs to make use of simple and straightforward concepts, and to reduce technical jargon to a minimum.[4]In this context, some people may find it clearer to use *absolute numbers* (e.g. your pension may be EUR 1 200 a month) instead of *relative numbers or ratios* (e.g. your pension may be 36% of your last salary). However, absolute numbers for future pension benefits may be more uncertain than relative numbers, in particular when reduced to single units (e.g. EUR 1 234) instead of rounded numbers (e.g. around EUR 1 200). Even more problematic when using absolute numbers is the need to provide real values instead of nominal. In addition, should real values be evaluated at the time of submitting pension statements or at the time of retirement? Compounding the assessment, terms like *probability* or *likelihood* (*e.g.*, your pension benefits may be Eur 1 200 with a probability or likelihood of …), or technical concepts as the *average*, *median*, *percentiles* (e.g., your pension benefits may be on *average*, your *median* pension benefits may be EUR 1 200 with a likelihood of …) may be confusing for many people. Is it better to write "your pension benefits may be EUR 1 200 with a likelihood or probability of 50%" or "your pension benefits may be EUR 1 200 five times out of ten"? Therefore, there is a need to discuss the appropriate the language used to communicate future pension benefit projections and the uncertainty surrounding them in a simple and straightforward manner.

[4] For example, people may find easier to understand "pension benefits relative to your final salary" than "replacement rate".

The design of how to convey uncertainty on pension benefits also depends on the amount of information to provide and on its purpose. Simulators may only provide the projected future pension benefits and their uncertainty: "your pension benefits at retirement would be equal to 36% of your final salary 5 times out of 10". They could also include a statement on the chances of a shortfall: "*it is possible that in 2 out of 10 times your pension benefits would be less than …*" Finally, simulators could also provide recommendations: "*by increasing your monthly contribution by 5 percentage points you could reduce the likelihood of a shortfall by 20 percentage points or you could get a pension benefits at least 36% of your final salary 9 times out of 10*".

Conveying uncertainty of pension benefits should be specific to the individual and should not include anymore than the most basic, underlying assumptions about the modelling. Conveying uncertainty of pension benefits need to take into account individuals' past employment, contribution and accumulation history as well as their specific personal characteristics (e.g. age, gender, labour market history, wage profile, educational level, etc.).

The techniques used to convey the message are also important. Communicating measures of uncertainty and risk on pension benefit statements can be achieved using a variety of representations, from language or text to tables to graphics or figures to icons and animations. The question is whether the use of only language or graphs and tables, or icons and animations as well would enhance and clarify the message. Regarding graphs, there are several options to consider. One could use standard histograms to reflect the frequency of each amount of pension benefits occurring; a kind of fan chart whereby the replacement rate or pension benefits that one could receive increase and decrease according to different probabilities, or pie charts reflecting the frequency or probability of different replacement rates occurring.

Additionally, the visual form the message takes can also help with communication. For example, several studies suggest that the use of visual graphics such as "smiley faces" and animated icons to convey success, higher likelihood or positive behaviour – recommendations – may be quite useful to focus people's minds.[5]

IV. A Pension Risk Simulator

This section briefly presents the experience in developing a pension risk simulator by the Chilean Superintendence of Pension (SP). One of the permanent concerns for the SP is that affiliates have all the necessary information in order to take decisions that promote their wellbeing during retirement. Since 2005 the SP sends personalized pension projection (PPP) to affiliates. These statements contain information that shows the effect of expected pension from: maintaining regular contributions (for affiliates with 10 or more years to retirement) or from postponing retirement (for affiliates who have less than 10 years to reach the legal retirement age).

Seeking to improve these measures, the SP, in a joint initiative with the OECD has developed a web-based pension simulator with information regarding not only expected pension but also pension risk. What follows briefly describes the history of this simulator development, including its relation to the PPP. It first describes the PPP and the model developed by the Superintendence of Pensions in order to measure pension risk. Secondly, it details this project's stages and thirdly, describes the simulator including its inputs and results. Finally, it discusses future developments.

[5] See David Spiegelhalter for applications to health: Risk and Regulation, Winter 2009, pp. 8-9; his web page on communicating risks http://www.statslab.cam.ac.uk/Dept/People/Spiegelhalter/davids.html; and the project on understanding uncertainty http://understandinguncertainty.org/

From the Personalized Pension Projection to the Pension Risk Simulator

The Personalized Pension Projection (PPP)

Since 2005 the SP included new information in the pension statements that are received by affiliates every four months. This information is personalized and is sent in a yearly basis. This annex is called the Personalized Pension Projection (PPP) and it contains a forecast of the affiliates' pension under various assumptions.

This forecast is targeted to people with 30 or more years of age. For women (men) between 30 and 50 (30 and 55) years, the PPP shows the expected pension if contributions continue to be made every month assuming a wage equal to the average salary in the last three years. The PPP also shows the expected pension if no more contributions are made. In this way, affiliates are able to see the positive effect of continuing with their contributions.

For women (men) between 51 and 58 (56 and 63) years, the PPP shows the expected pension if affiliates continue to contribute half of the time until the legal retirement age (60 years for women and 65 for men). Also, affiliates are showed their expected pension if they postpone their retirement for 3 years. In this case, affiliates are able to see the positive effect on their pensions of postponing retirement.

The focus groups research undertaken so far suggests that members of the pension system appreciate the information provided in the PPP. Moreover, the available evidence (see Fajnzylber et al, 2009) shows that the PPP has increased the probability of making voluntary contributions in 1.4% for individuals in the 40-50 age group. The effect has been smaller for younger affiliates. In a recent study Miranda (2012) finds evidence of a positive effect of the PPP on postponing retirement. Specifically, results show that, on average, affiliates that received the PPP more than once postponed retirement. This effect was higher for affiliates with higher income and pension savings funds levels.

Given the favorable experience with the PPP, the SP in this joint project with the OECD decides to go further and develop a pension simulator able not only to provide information on expected pensions but also on pension risk.

The Relevance of Informing (Pension) Risk[6]

The Chilean pension system corresponds to a defined contributions (DC) type. Its main pillar is a contributory one, where all workers in the formal sector are obliged to contribute 10% of their taxable income in their individual accounts.

Throughout their lives, workers can make an important number of choices, all of which can have a significant impact not only on their expected pension and replacement rate at retirement, but also on the uncertainty associated to this expected outcomes. For instance, individuals can choose the type of fund in which their individual accounts are invested. These funds range from the riskier one[7], fund A (with a limit of 80% that can be invested in equity) to the less risky fund, E (which is limited to 5% of investment in equity). The fund or mix of funds that affiliates choose affects not only the expected return of their accounts, but also their risk.

Individual may have a low level of comprehension of the risk involved in saving for retirement. In this context, a pension risk simulator aims at helping them to understand the risk. For example, if

[6] This Section is partially based on Berstein et al (2010) and Berstein et al (2012).

[7] Once a certain age is reached the riskier funds are not eligible for affiliates.

individuals focus only on expected returns, they may be tempted to select the riskier funds, which could raise the expected value of their pension funds and pension payments, but at the cost of increasing the riskiness of these variables. This is, while the expected pension payment could be increased, the probability of obtaining low pension values could also be higher.

The current evidence shows that affiliates have a low degree of understanding of variables distinct to returns, e.g. fees and commissions. Given this, it is likely that risk-related information may not be correctly understood nor incorporated into the affiliates' decision making process. The pension system includes safeguards against this possibility. If individuals do not explicitly choose a type of fund, they are assigned one, according to their age[8]. Nevertheless, there is a clear need to advance in developing risk-related measures and to give this information to affiliates, in the most user-friendly manner, in order for them to incorporate this input and apply it to make decisions concerning their pension savings.

The Need to Develop a Pension Risk Model and Simulator

In light of the importance of providing better risk-related information to affiliates, it becomes necessary to develop adequate tools to generate such information. Traditional measures of risk, such as standard deviation of returns, or value-at-risk, seem inadequate for long-horizon investors and may lead individuals to wrong choices, which is the case for members of a pension system.

This led to the development of a more adequate methodology, which is better suited to quantify long-term risk or pension risk, and since it's relevant for individuals to receive this type of information, the design and implementation of a user-friendly simulator became necessary.

The Superintendence of Pensions built a pension risk model that feeds on a representative affiliates' characteristics: age, gender, level and density of contributions, age of retirement, investment strategy, and beneficiaries' number and characteristics. With information regarding current balances in mandatory and voluntary pension savings, the model constructs a consolidated balance. This sum grows monthly during all the affiliate´s active life, this is, from actual age through age of retirement. There are two sources of growth: one is the monthly contribution made by users, which comes from their mandatory and voluntary savings and is affected by their density of contributions. The second one is the return earned by their existent pension savings. The model assumes that these returns vary by type of fund and evolves stochastically over time.[9]

The risk is introduced by projecting a probability density function for the final pension, based on 2 000 series of simulated monthly real returns by each multi-fund and the annuity discount rate. The length of each trajectory of monthly real returns depends on the investment horizon of the affiliate, i.e. the number of years remaining to retirement. As a result, 2 000 possible values are simulated for the final balance in the affiliate's pension account. This account is then transformed into a life annuity, where the implicit rate of return offered is also simulated. With the different scenarios for pension payments, a probability density function for pensions is constructed. This output allows the estimation of multiple

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8 Specifically, women (men) are assigned to fund B until age 35, then to fund C until age 50 (55), and afterwards, they are assigned to fund D.

9 To be precise, the model contains eight asset classes: fixed income (local government and corporate), foreign fixed income for developed and emerging economies, domestic variable income, foreign variable income for developed and emerging economies and bank deposits. The weight of each class for the different types of funds is obtained from actual portfolio data of the pension funds. The rate of return for these assets is assumed to evolve according to a random walk, where the possibility of the occurrence of crisis is considered by means of a jump diffusion process.

pension risk measures, such as confidence intervals and probability of reaching a specific pension, among others.[10]

Stages of the Project

This Section describes the different stages that have been carried out in order to develop this project, from the initial pre-focus groups, aimed at assessing the degree of understanding that potential users showed about pensions and risk, and ending with the efforts made to connect the pension risk model with the web interface.

Pre-Focus Groups

During the first half of January 2011, a series of group interviews of plan members were held with one of the consultant firms, Feedback, that participated in this project.[11] The objective of these meetings was to gain insight on the degree of understanding that potential users had about: the pension system (e.g. different types of funds, types of pension, etc.), the general notion of risk and uncertainty, and pension risk. Additionally, participants were asked what kind of inputs and outputs should be present in a pension risk simulator.

For this stage there were a total of three group interviews held, with an average of seven participants per session. The groups were divided according to educational level. These were: complete technical secondary, complete secondary and complete university levels.

The results from this stage were used to develop user-friendly language that was to be employed in the web tool, especially for the explanation of the different inputs and results. Moreover, since participants were showed several options for informing about pension risk, their views were useful in order to design graphics that informed about these concepts in the most comprehensive way possible.

Simulator Design

A second consultant firm was hired in order to design the interface of the web tool for simulating pension risk. During this stage all relevant aspects for the web tool were defined. The two main sources of information used in order to develop this process were specifications made by the Superintendence of Pensions and the results of the preliminary interviews described in the previous Section.

During the months of January, February and March of 2011, several meetings between the SP and the consultant were held in order to define the variables that were to be included in the web tool, i.e. all relevant inputs, options and outputs; the logical process through which users should proceed in order to use the simulator; the visual design; plus all the programming work necessary to implement the web tool.

The result of this work was a model of the final web tool. This model contained all the elements of the web tool but lacked an engine to perform actual estimations of pension risk. The engine was fully developed by the Studies Division with the support of the IT department at the Superintendence of Pensions. This process took over a year, which required a large numbers of resources and human capital

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[10] Initially the methodology considered 10 000 simulations, but this compromised the time the model lasted in getting its results. Reducing the number of simulations to 2 000 did not change significantly the properties of the density function, from which the different outcomes are obtained.

[11] Two consulting firms were hired to participate in the project. One of them was in charge of performing the pre-focus and usability tests (Feedback). The other one (AyerViernes) was in charge of the design of the web tool.

developing first an adequate methodology flexible enough to be able to get the simulated results in the shortest time possible and programming skills to connect the engine with the web tool. The pension simulator was launched in September 2012. It is publicly available at www.spensiones.cl

Usability Tests

Once the model for the web tool was complete, several usability tests were made to assess if the design, variables, texts and elements of the model were adequate.

A total of twelve individual tests were made, with users that were classified according to their educational level. The mix of educational achievements was similar to the one used in the pre-focus group interviews.

The tests were extremely useful in order to detect difficulties in the general use of the web tool. One of the main points that emerged was that users preferred to obtain a log in password on line, at the time of first access, rather than through standard mail, which was the main option that the SP had considered.

Different design problems were identified, which affected distinct types of users. In the case of older users, they showed more difficulty when browsing the tool, finding help and the definitions for variables. In the case of younger users, they typically showed a lower degree of understanding of the pension system, and had difficulties filling the information related to projections of future income, density of contribution and future voluntary savings.

Main Results

Once the pre-focus groups and usability tests were finished, there was a relevant amount of feedback that was used to modify and improve the design of the web tool.

One of the main difficulties that users found was that obtaining a password to access the simulator proved cumbersome. Initially, this password was to be sent to affiliates with their pension statements, attached to the personalized pension projection. However, users preferred to obtain their password on-line at the time of their first use of the simulator.

The help icons were hard to find for some users. However, once these icons were identified, their presence was considered useful, since most of the information they gave was easy to understand. Moreover, users stated that they preferred to have on-the-fly help, rather than having to navigate to a different web page to obtain the assistance they needed. In order to make sure that these icons were identifiable, a message box was included in the simulator. This pop up box appears upon entering the simulator and show users the format of the help icons, inviting them to use this if necessary.

Regarding the outputs that users preferred to obtain from the simulator, it is interesting to note that most of the interviewees preferred to be informed of their expected pension in monetary terms, rather than as a replacement rate.

One of the main challenges that emerged, and that will certainly difficult to deal with, is the low degree of understanding related risk concepts. While potential users show no problem in understanding the expected value concept, the idea of uncertainty is harder to grasp. Firstly, the concept of risk tends to be associated with negative outcomes, thus ignoring the right tail of the distributions. Moreover, participants tended to adopt a static posture towards risk: They were aware that they were subject to risk (e.g. low returns, losing their job, etc.) but most of the time they assumed that there was nothing for them to do if they wished to reduce that risk. For instance, they weren’t conscious that by changing the type of funds in

which their pension savings are invested, they could manage, to a certain degree, the risk associated to the returns that they could obtain.

There are also difficulties understanding information related to pension risk. For instance, when participants were showed an expected pension, plus a confidence interval associated to the expected value, they failed to understand what this interval meant. When they received and explanation such as: "*this range represents the interval in which your future pension will be in 9 out of 10 cases*", they interpreted that the word "cases" made reference to the future pension of different individuals and they lost interest in the exercise, since it was no longer personalized. On the other hand, if the explanation was: "*this range represents the interval in which your future pension will be in 9 out of 10 of the scenarios considered*", some individuals complained, because they thought that the exercise lacked rigor, since 10 scenarios were far too few in order to obtain credible results[12].

All this results were taken in count in order to design the help sections of the simulator, as well as the type of results that users will get and their explanation. However, improving the degree of understanding about the pension system and the notion of risk remains an important and difficult challenge.

Connecting the Risk Model with the Web Tool

The pension risk model based on stochastic simulations was developed using STATA®. Using *Montecarlo* techniques the methodology simulates the evolution of pension funds' returns, as well as that of annuity rates. Assuming different investment strategies, the model is able to simulate the evolution of the individual's capitalization account and obtain simulated pensions and replacement rates values, which can be used to measure expected pension and dispersion measures such as standard deviation and confidence interval for the expected pension and replacement rate. A thorough simulation exercise has being developed, taking into consideration all relevant risks faced by an affiliate to the pension system. Specifically, in the pension simulator three relevant factors that will affect the expected pension and volatility are incorporated: (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; and (3) the cost associated with one unit of pension, or necessary capital (annuitization or re-investment risk). Also, proper care has been taken in the assumptions of the model, since these are relevant in determining the main outcomes. Given this, robust scenario analysis has been performed with respect to the evolution of pension fund returns.

The Pension Simulator

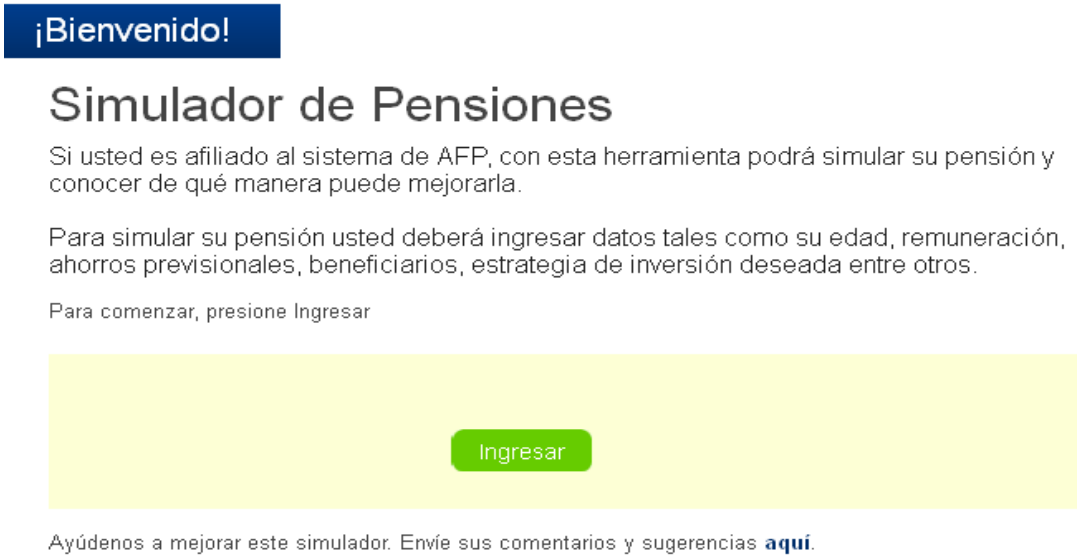
This Section describes the relevant inputs used by the simulator, as well as the results showed to users. In light of the low level of knowledge of the pension system that was detected during the pre-focus groups and usability tests; all relevant variables in the simulator include help icons, which explain the relevant concepts in simple terms.

Initial Page

Upon entering the simulator, users are invited to forecast their future pension. Users are also encouraged to learn about the risks attached to that pension and what actions they can take in order to manage those risks (see **Figure 1**).

[12] As previously detailed, the pension risk model uses 10 000 scenarios, but telling users that the pension will be in a given interval for 9 000 out of 10 000 scenarios seemed more cumbersome.

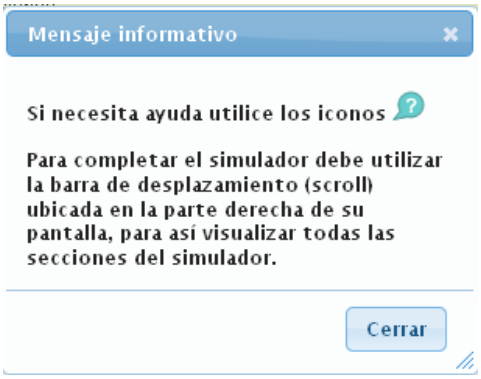
Figure 1: Simulator – Initial Greeting



Main Elements

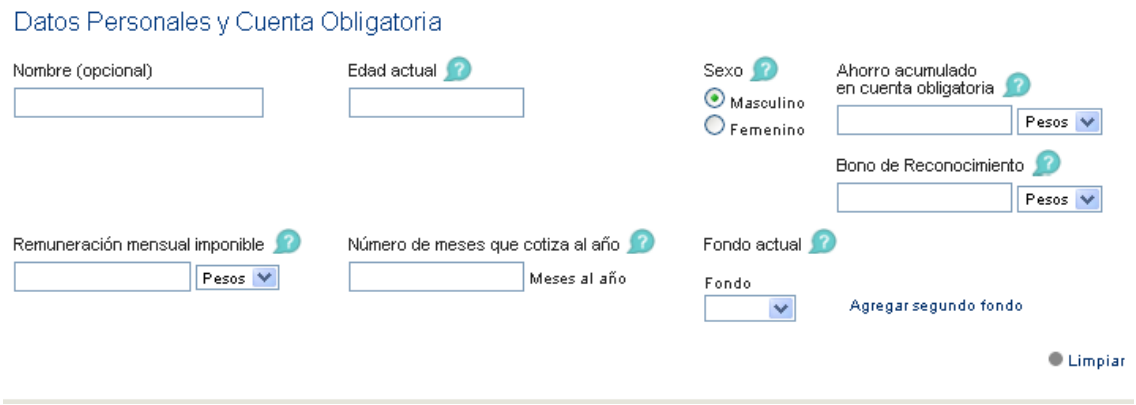
Once users access the simulator, they are showed a message that invites them to fill all the relevant sections, for which they need to navigate using the scroll bar, and also make use of the help icons that are placed at most of the sections initial titles and also key variables (see **Figure 2**).

Figure 2: Simulator – Informative Message



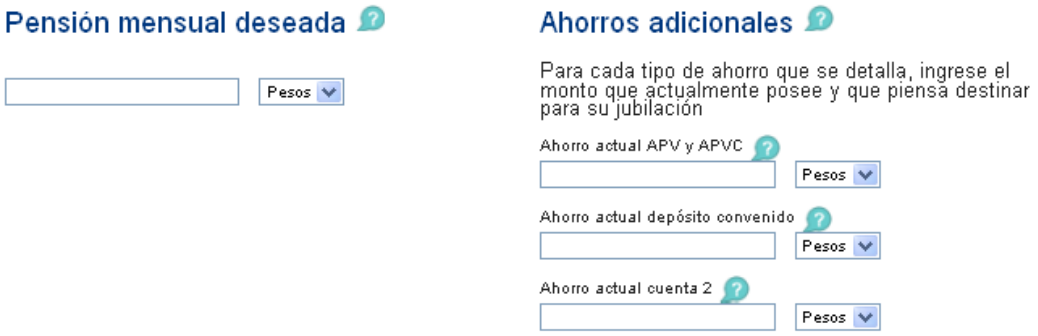
In order to employ the simulator, users must enter a series of inputs. Firstly, personal data must be given (see **Figure 3**). In this section users are required to enter their current age; gender; current balance in the mandatory personal pension account; monthly net income; average density of contributions; and current type of fund.

Figure 3: Simulator Inputs – Personal Data



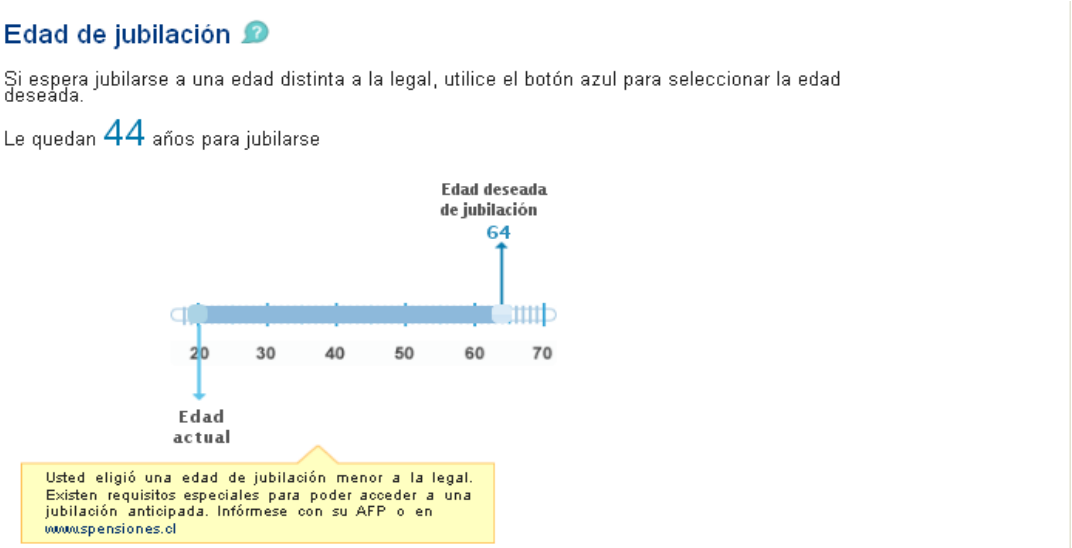
Next, users are asked about their desired monthly pension upon retirement, as well as the current balance on any other type of voluntary pension-saving vehicles (see **Figure 4**). Currently these vehicles are: voluntary savings, which can be made individually or collectively and are entitled to tax benefits; agreed deposits; and special deposits (called "Cuenta 2").

Figure 4: Simulator Inputs – Desired Pension and Additional Pension Savings



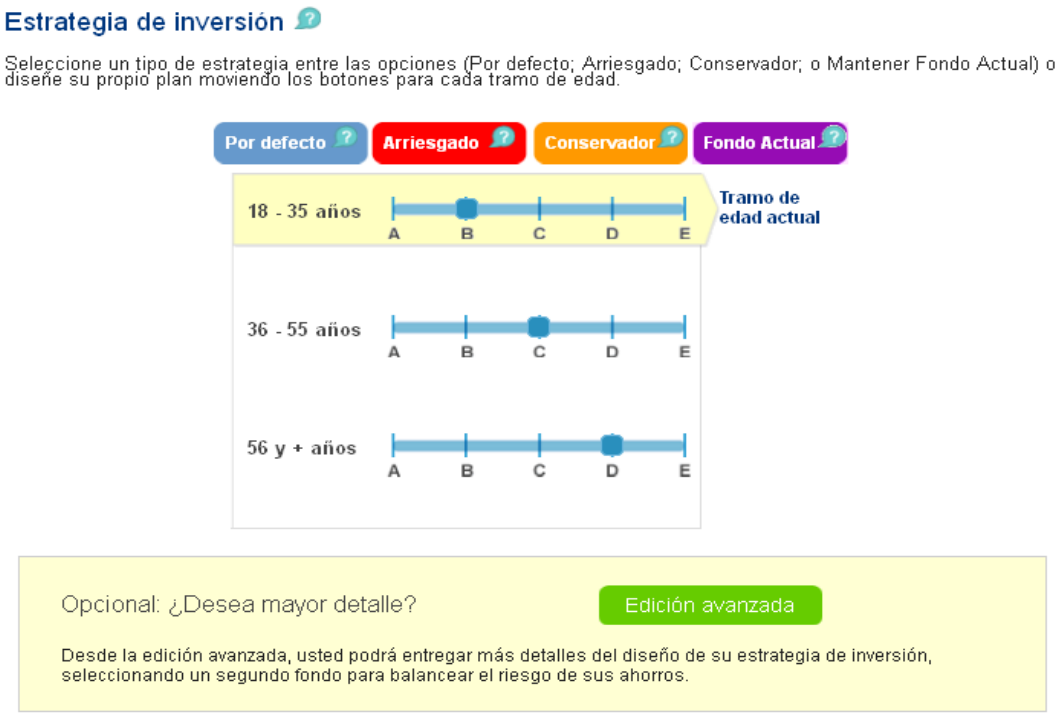
Afterward, users are asked about their preferences regarding age of retirement (see **Figure 5**). Under current Chilean legislation the legal age of retirement is 65 years for males and 60 for females. If the user selects an earlier age the Simulator gives a warning regarding the existence of special requisites that must be fulfilled in order to be eligible for early retirement.

Figure 5: Simulator Inputs – Desired Age of Retirement



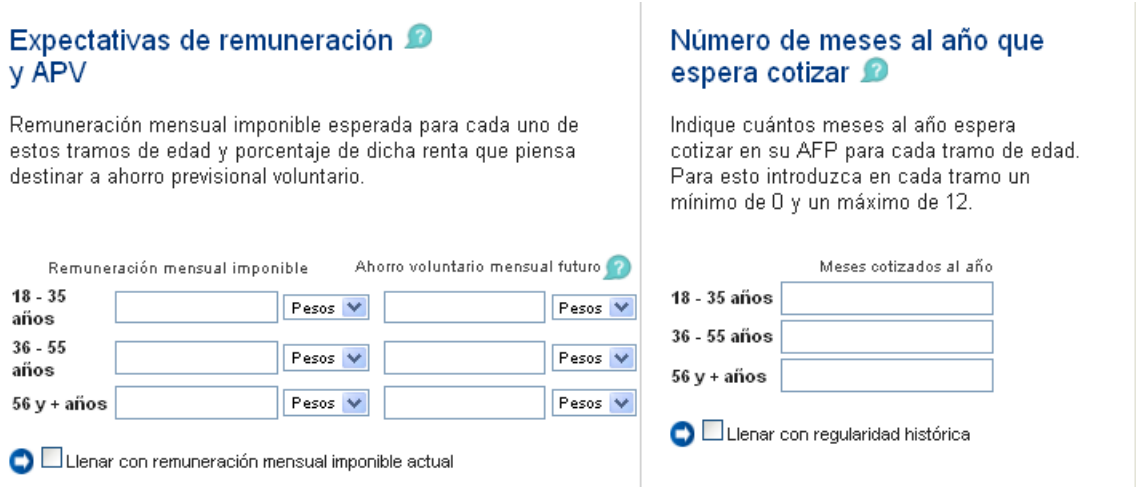
The next step is the definition of an investment strategy in order to specify the types of funds in which the user plans to keep his savings until retirement (see **Figure 6**). The Chilean pension system has 5 types of funds which vary according to the percentage of the fund that can be invested in stocks and in foreign securities. Fund A is the riskier one, with an 80% limit to invest in stocks. Fund B follows, with a 60% limit; Fund C has a 40% ceiling; while funds D and E have limits of 20% and 5%, respectively. The simulator allows users to design their own investment strategy and they can also select a predefined strategy.

Figure 6: Simulator Inputs – Investment Strategy



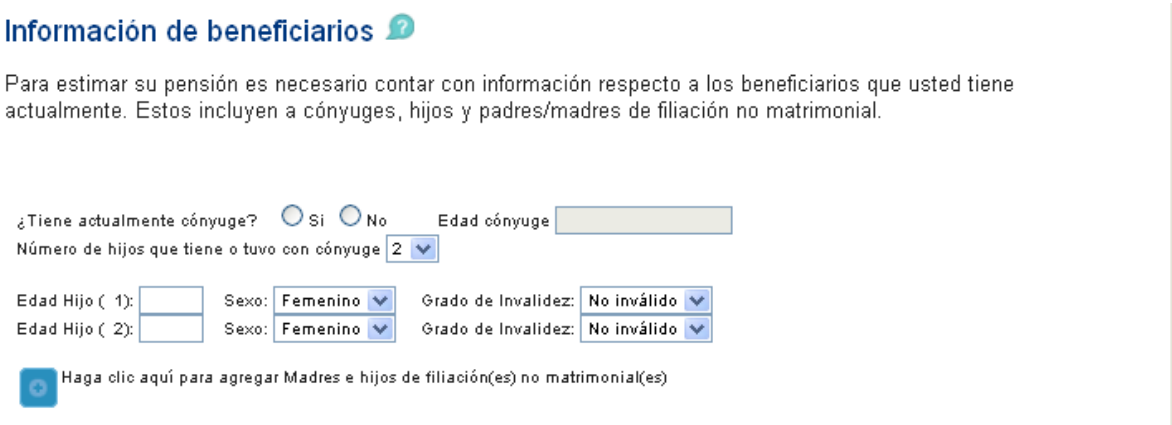
At this point, the simulator asks users to estimate their future wages, density of contributions and voluntary savings. Since the usability tests showed that this can prove a difficult exercise, especially for young individuals, the simulator includes the option to keep historic wages and contributions.(see **Figure 7)**.

Figure 7: Simulator Inputs – Future Wages, Voluntary Savings and Contributions



The last input required is information regarding expected beneficiaries at the age of retirement. This is necessary because the pension to be received by the jubilee depends on the existence and age of spouse, children entitled to pensions, and any other individual with legal rights to receive a survivor pension (this include, for instance, children older than 24 with some degree of disability). The simulator allows for an important degree of flexibility in terms of the number and type of beneficiaries that are considered (see **Figure 8**).

Figure 8: Simulator Inputs – Expected Beneficiaries



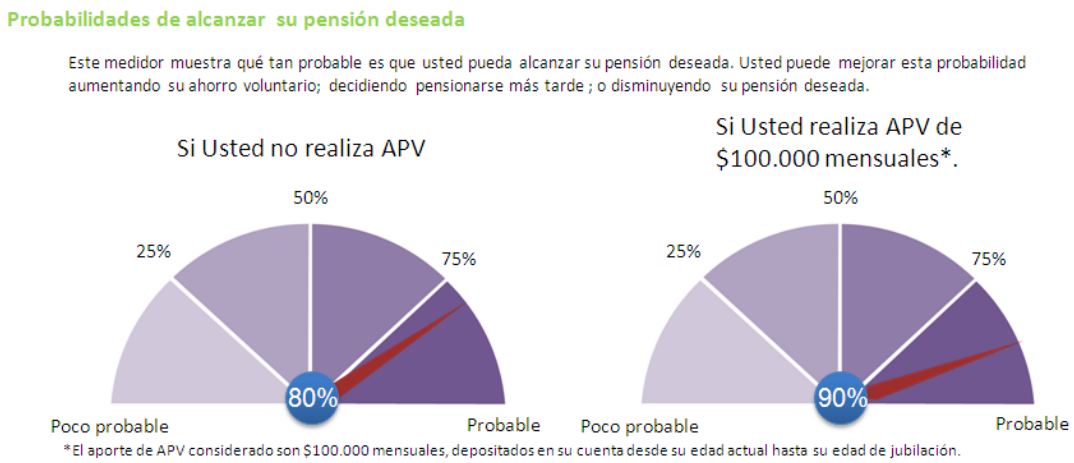
Output

Once the model estimates the probability density function for pension payment, a series of results could be given to users, such as: expected or median pension, confidence interval for pension payment, pension payment value at some specified percentile, etc.

During the testing stages of the simulator several options of outputs were evaluated. Among these, participants were showed a velocimeter that displayed the probability of reaching the desired pension with and without voluntary savings. Other types of outputs considered were columns where the length of the column showed a confidence interval for the expected pension; pie charts, that showed the percentage of scenarios where the replacement rate would be above or below some specified level; and groups of 10 faces, where the kind of face (happy, sad, surprised) was associated to the number of scenarios were the replacement rate would be above or below some specific level, or even below a pessimistic level. These outputs were discarded since participants didn't seem to understand the probability concepts that they were receiving.

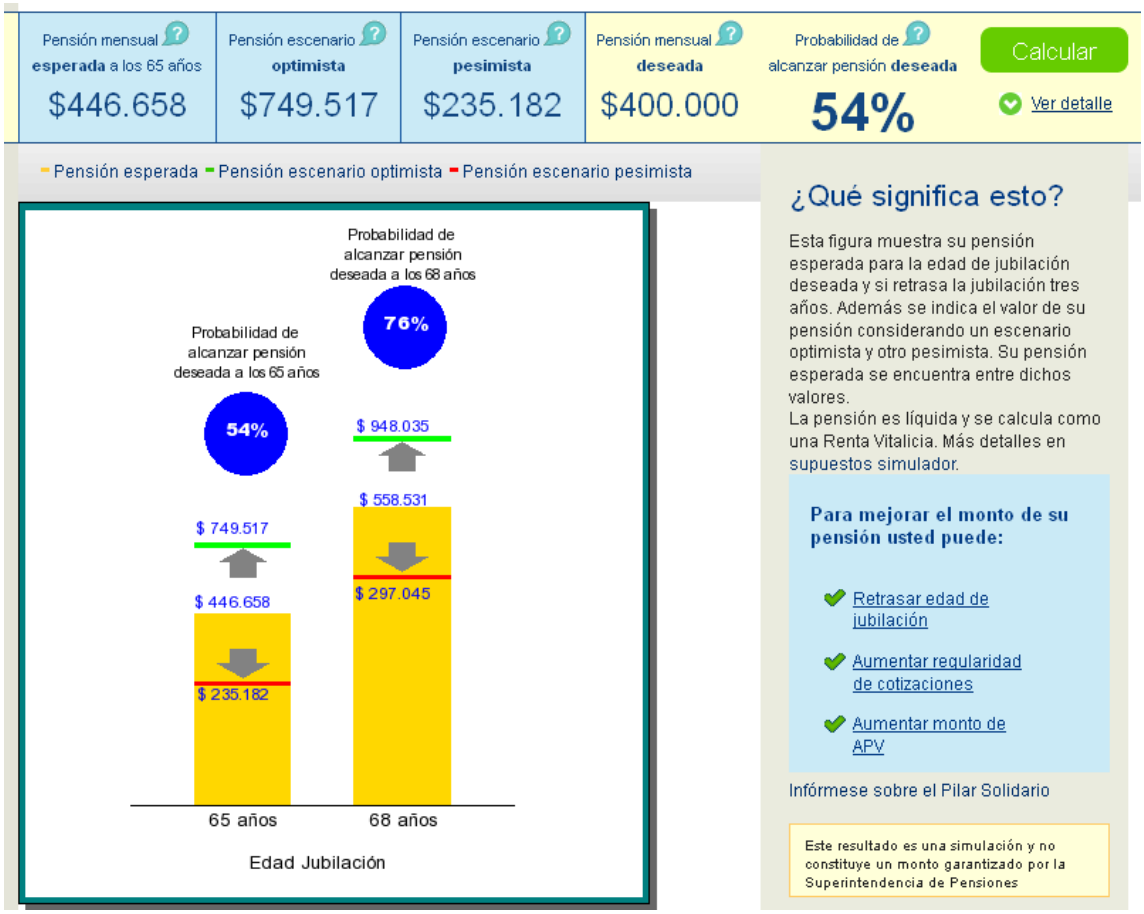
In particular, when asked what they understood after seeing the velocimeter (see **Figure 9**), participants claimed that by making voluntary savings their pension would be increased by 90%, whereas the correct interpretation was that voluntary savings increased the probability of reaching their desired pension from 80% to 90%. It's curious that participants failed to obtain correct conclusions from this figures since each output was accompanied by an explanation of the information that was being displayed.

Figure 9: Example of Simulator Output



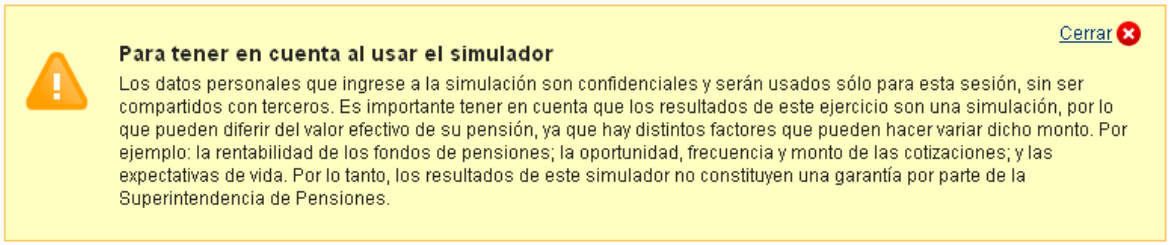
Based on the results from the pre-focus groups and usability tests, the output given by the simulator consists of (see **Figure 10**): expected pension at the age of retirement, pension payment for the 5th percentile (called "pessimistic scenario pension"), pension payment for the 95th percentile (called "optimistic scenario pension"), and the probability of having a pension payment that is equal or greater than the desired pension specified by the user. Each of these results is accompanied by an explanation of its meaning. Also, users are showed the same set of results that would be obtained if they postpone the retirement age by three years (this information is similar to the results showed to a group of affiliates that currently receive the personalized pension projection). Moreover, users are invited to experiment how changes in key variables, such as: age of retirement, density of future contributions, and level of voluntary savings, can improve their expected pensions and help them to have a higher probability of reaching their desired pension.

Figure 10: Simulator Outputs



The regulator needed to address potential problems of fiduciary responsibility. Providing sophisticated and more "precise" projections of pension benefits, despite of using probabilities to convey uncertainty, may create expectations in pension members that the regulator stands behind such projections. Pension members may believe that such projections are closer to a promise and take them for granted. To address this fiduciary responsibility the web tool clearly states that those projections are to guide, to encourage pension members to make active decisions about saving for retirement, and that they are far from a promise (**see Figure 11**).

Figure 11: Simulator Disclaimer



The pension simulator was launched on September 5th 2012. This web tool is available at the SP web page at www.spensiones.cl. Its publication generated a lot of interest among users, receiving in the first week more than 14 000 visits. Up to October 11th 2012 the number of visits has reached more than 20 000.

Finally, in order to standardize the different pension projections that affiliates currently receive, the Superintendence adjusted the personalized pension projection methodology, changing the returns that are used to the average returns included in the simulator. Moreover, the pension has been changed from a programmed withdrawal to an annuity. Pension Fund Managers will be required to use, by default, the average returns used in the Superintendence's simulator, while also allowing Managers to give users the option of modifying these returns.

Future Developments

Currently, the Superintendence is working on a second version of the pension risk simulator. The new version will include administrative records on the users' current age, density of contributions, mandatory and voluntary accounts' balance, type of fund and remuneration. This will simplify the input entry process for users. Moreover, the new version of the simulator will include features such as: considering the specific tax treatment that different voluntary savings may have; allow users to simulate the impact of withdrawing free-disposal surpluses from their accounts; and allow users to save their exercise and send the results via email. If the user desires, he will receive an invitation 6 months after the simulator was used in order to update the information and obtain a new set of results. A second round of usability tests is being programmed in order to guide the changes that will be implemented in this second version of the simulator.

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