

Global

Pension Watch

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Economic Analysis

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Pension risk in pension systems: What it is and how to measure it; implications for the regulation of investments in defined-contribution systems

- **Pension risk is defined by the variability of the expected replacement rate**
It is therefore a long-term measure of risk, as it is focused on the final result, which is the pension.
- **It is a broad measure of risk, given that it synthesizes factors that can negatively affect the expected replacement rate,**
and corresponds to factors that are independent of the decisions taken by the members of the pension scheme.
- **All pension systems have associated risks,**
but the form in which these risks are dealt with and mitigated depends on each type of system.
- **Pension risk will depend on the system**
to which the pension belongs and the individual characteristics of its members.
- **For individual-capitalization systems, the challenge lies in how to measure pension risk,**
particularly how to take it into account when formulating public policies and setting up the regulatory structure of pension systems.

Pension risk in pension systems

The main objective of pension systems is to provide a secure income to individuals in circumstances when self-provision is not viable, such as old age, widowhood or invalidity. Pension systems are designed to achieve this key objective. They may differ substantially in various fundamental aspects, such as whether they are publicly or privately administered, the ownership of the savings, the definition of the benefits, requirements for accessing the benefits, etc. As well as the aim of evening out income levels during the life cycle, the different pension systems share the need to establish obligatory saving or contribution mechanisms. The creation of these systems and the obligatory nature of the contributions arise from people's tendency to value the present over the future (high discount rates), to underestimate the probability of certain risks occurring, and to opportunistic behavior.

The success of a pension system can be measured in terms of three elements: i) its coverage, or the percentage of the population who participate in the system (by contributing or receiving benefits); ii) the quality of the benefits, in other words whether they are sufficient and allow individuals to maintain their level of income relatively constant; and iii) efficiency, or at what cost the results of the system are obtained.

Regardless of the design of the system, which will determine its results, all pension systems have vulnerabilities, or situations that make it difficult or impossible to provide adequate protection for its members. The impact of these risks varies according to the characteristics of each system.

Pension risk is a useful concept for evaluating the vulnerabilities of pension systems. It measures the effect of different events that can alter the pensions paid out. This concept includes risks of different kinds and different origins, depending on the pension system, as different designs mean that not all pension systems have the same vulnerabilities, or that these vulnerabilities do not affect them in the same way.

Pension risk also has an individual dimension; in other words, members of the same system may face the same risks in different ways. Individual characteristics such as age, wealth or employment situation mean that individuals do not face the same risks, or at least they do not do so to the same extent or with an equal probability of them occurring.

There are so many design variables in pension systems that it is unlikely that there are two identical systems in the world. However, it is possible to distinguish certain fundamental differences that enable us to group together different pension systems. Among these are whether the plans are defined-benefit or defined-contribution, or whether the pension funding method is based on capitalization or pay-as-you-go. In defined-benefit plans the sponsor of the plan (the State or employers) undertakes to provide a pension of a fixed amount to all those who comply with its eligibility requirements. In defined-contribution plans the future pension is not defined; it is the result of variations in the contributions and investments made. The pay-as-you-go system consists of using all the contributions made by active members in a particular period to pay pensions during the same period. In the capitalization system the contributions made by active members of the plan finance their own pensions in the future once they reach the passive phase of life. There are intermediate solutions, such as the pay-as-you go systems with partial capitalization, where the income from a particular period is used to pay benefits during the same period, but if the amount collected is greater than the benefits to be paid, the excess accumulates as reserves; and conversely, if the amount collected from the contributions is lower than the benefits to be paid, the shortfall is paid from reserves or external contributions (such as taxes).

Definition of pension risk

Replacement rate:

The ratio between the amount of pension received and income earned during an individual's working life

Pension risk may be defined synthetically as the variability of the expected replacement rate, in other words the variability of the expected pension in relation to the income received during an individual's active working life. This is a **broad concept of risk** in the sense that it includes various factors that may impact future pensions during members' life cycles; **it is also a long-term risk as its focus is on the final result** of a series of elements and processes that take place throughout the worker's life.

The main objective of pension systems is to maintain individuals' level of consumption relatively stable in situations that prevent or limit their capacity to sustain themselves, such as old age, widowhood or invalidity. The variable often used as an objective to evaluate the benefits provided by pension systems is the replacement rate, rather than the amount of the pension. The replacement rate is the ratio between the amount of the pension and the wage received. It, therefore, responds directly to the level of compliance with the main objective of pension systems, which is to maintain consumption during the life cycle. In addition, by using the replacement rate it is possible to isolate the differences in pension amounts that do not correspond to the structure of the pension system, but rather to the labor market.

All pension systems involve risks, but the form in which these risks are dealt with and mitigated depends on the type of system. For example, in pay-as-you-go systems, the investment risk falls on the sponsor of the retirement plan, which in general is the State, but may also be a company; while in an individual-capitalization plan this risk falls on the workers. However, it should be taken into account that, as the recent crisis showed clearly, workers who are members of defined-benefit plans are exposed to investment risk indirectly, through the effect that this risk may have on the financial capacity of the plan's sponsor to pay out the benefits that have been committed.

In an individual-capitalization system the pensions are determined by the amount of savings made during the member's active life; in defined-benefit systems, they depend on the solvency of the plan sponsor, as well as general requirements that are established to access the benefits, such as a minimum number of years of contributions. As a result of this, the decisions taken during a worker's active life will affect the pension received in the future. Among the most important decision variables are the age of entry into the labor market, the length of time the worker remains in the labor market, whether the worker makes contributions or not (in the case of independent workers) and the age at retirement.

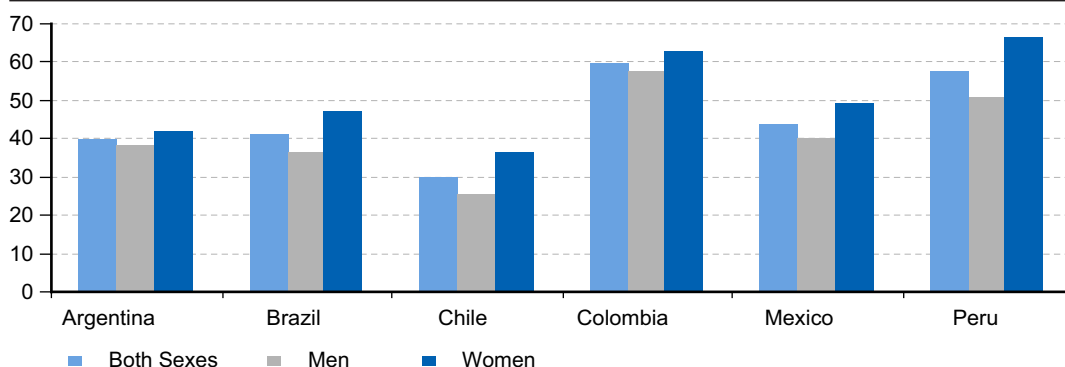
However, **there are a number of situations that lie outside the control of individuals (they are not decisions) and that determine the amount of pension savings they can accumulate or their eligibility for access to benefits.** These situations can be seen as different states of nature, when the same decision can lead to different results, and this defines the existence of a risk.

A clear example of risk is unemployment, as while individuals are involuntarily unemployed they are not making contributions, so their contribution density falls. Thus if there are frequent and/or prolonged periods of unemployment this will have a negative impact on the amount of the expected replacement rate, either because of the lower volume of accumulated savings in a defined-contribution and capitalization system or because the requirements in a pay-as-you-go system are not complied with. The lower contribution density resulting from unemployment will, as has been pointed out above, reduce the possibility of achieving an adequate replacement rate. This occurs regardless of the decisions taken by the individual affected by this situation; in other words, it is an involuntary situation, which determines it is a risk. In short, unemployment is one of the sources of pension risk faced by individuals during their active lives, in both defined-contribution and defined-benefit systems.

In addition, during their active lives members of some company-sponsored defined-benefit systems are exposed to the risk of changing jobs, which could mean not complying with requirements even when the contribution density is high. Another labor-market risk that is part of defined-benefit pension systems is a fall in wages or unemployment during the years immediately preceding retirement, which typically are those used to define the pension the worker will receive.

Chart 1

Workers Engaged in Low Productivity Sectors (Total Informal Sector) 2008-2009



Source: CEPAL

One factor that affects the contribution density and that is particularly relevant in developing countries is informality, which in general is associated with very low-productivity jobs. Workers in the informal sector do not make contributions to the Social Security system, so that despite being employees their contribution density is low or nil. This limits their chance of getting decent pensions, whether in a defined-contribution or defined-benefit system. The accompanying chart shows the importance of the informal sector as a proportion of total employment for a group of countries in Latin America in 2009. The most serious cases are Colombia and Peru, where more than 50% of workers are employed in the informal sector. The chart reveals that this situation is particularly serious in the case of women, as in all cases their participation in the informal sector is higher than that of men.

During the active life or accumulation period, another source of pension risk apart from factors associated with the labor market (e.g. unemployment) is market or investment risk. As explained above, this will impact the expected pension of individuals in a more or less direct way depending on the type of system they are part of. In a defined-contribution system members' savings are invested in the financial markets. This means that the variability of returns may significantly affect total savings at the end of their active life, and thus pensions. In a defined-benefit system the variability of returns on the financial markets may affect the plan sponsor's solvency or capacity to pay, which will affect the possibility of complying with the agreed benefit.

It is not only during the active life of members that there are factors affecting pension risk; all the different phases of life include sources of uncertainty. At the time of retirement, there is an interest-rate risk also known as reinvestment in defined-contribution systems that impose or give an option to acquire a life annuity. The interest-rate risk corresponds to the changes in the purchase price of a lifetime annuity that occurs during periods of low interest rates (when the value of the future periods is high). The pension received in this case may be lower than that received by someone who retires when interest rates are higher. It is thus possible that the same amount of savings may give rise to pension amounts, depending on current interest rates. The variability of interest rates will therefore add volatility to the expected replacement rate if a lifetime annuity is acquired.

Finally, the main risk faced by members during the payout phase is longevity, which in the case of defined-benefit systems affects the financial viability of the sponsor and the plan. In defined-contribution systems the longevity risk means outliving the funds saved during active life. A previous publication by [BBVA Research](#) analyzes the form in which members of individual-capitalization systems face longevity risk. The level of exposure to this risk depends on certain characteristics of the system, including the different types of pensions available, whether there is a solidarity pillar, and what its requirements are.

In short, pension risk is the synthesis of factors that can affect the expected replacement rate because they lead to negative scenarios independently of the decisions taken by the members. Pension risk will depend on the system to which the pension belongs and the individual characteristics of its members.

Alternative methods of risk mitigation in pension systems

Pension systems have a number of different mechanisms to mitigate risks. One of the most important of these is solidarity pillars, which have been established in many pension systems of different characteristics to combat poverty in old age. They support the poorest members in their access to pensions even when they have not managed to accumulate sufficient savings or are ineligible for other reasons. A recent [Pension Watch published by BBVA Research](#) reviews the non-contributory pillars of pension systems in Latin America, focusing particularly on recent progress made in Peru.

The regulatory framework and the supervision structure are also important factors in risk mitigation of the system. The government is responsible for guaranteeing appropriate accreditation of contributions made, regulation of investments, and ensuring correct handling of the funds received.

Some defined-contribution systems offer alternatives to types of pensions, the two main types being programmed retirement and lifetime income. There is also a variety of other types resulting from the combination of these two alternatives. In programmed retirement the pensioner retains ownership of his or her pension fund, which continues to capitalize, and the pensions paid are charged against the fund. It is the pension-fund member who assumes longevity and market risk. In the life annuity type each member uses his or her savings to acquire from a life insurance firm a guaranteed payment of a defined pension on retirement¹ until death. In this case, the ownership of the savings is transferred to the insurance company and the longevity and market risks are assumed by the insurer.

Currently there is a debate about the creation of a new financial instrument to cover insurers for the population's aggregate longevity risk. More details on this instrument, known as the longevity bond, are available from [BBVA Research](#), where its characteristics and latest developments are covered.

The incentives for voluntary saving, whether through subsidies or tax benefits, help mitigate risks associated with the labor market such as low contribution densities in defined-contribution systems.

1: The pension that the life insurance company will have to pay may be protected against inflation or not. In Chile, for example, only inflation-linked life annuities can be marketed.

Table 1

Pension Risk in Pension Systems

		Defined Benefit	Defined Contribution	Mitigation Items
Active or accumulation stage	Unemployment/ Low contribution density	Risk of not meeting eligibility requirements, may choose to only a fraction of the pension or none	Risk of not accumulating sufficient savings for an adequate pension	DB and DC: Voluntary savings and a Solidarity Pillar
	Market risk or Investment risk	credit risk of the plan sponsor, which may be the State or a company	Risk of poor performance on the return of pension funds, which limits the possibility of receiving adequate pensions	DB: Usually, the state has the ability to use taxes to pay its commitments. DC: Regulation of investment funds and multifund pension schemes, which allows limited exposure to this risk in the period following retirement.
Age of retirement	Interest rate or reinvestment risk	Assumed by the sponsor of the plan	Risk of a low market rate at the moment that one wants to or should acquire an annuity (annual)	DC: Choice of pension arrangements. Flexible retirement age (can delay or advance)
Passive or disaccumulation stage	Longevity risk	Assumed by the sponsor of the plan, can lead to severe financial imbalances that threaten the solvency of the sponsor	Exposure depends on the type of pension; for a scheduled retirement, this risk is assumed by the pensioner and is converted into savings to survive. For annuities, the risk is assumed by the insurance company and affiliates are indirectly exposed to it due to credit risk that involves the Insurer	DB: Promotion of immigration, however, is a temporary solution, not final. DC: The different types of pensions, in particular those that combine annuities and retirement programs, allow members to choose the extent to which they assume risk. DB and DC: We study the possibility of issuing an instrument (longevity bond) to hedge longevity risk

Source: BBVA Research

The effect of the concept of pension risk on investment rules in a defined-contribution system

In a defined-contribution system one of the areas where the authorities are the most involved and have the most affect in the final amount of the pensions is in the supervision and regulation of the pension fund investments, given that returns have a significant impact on future pensions. The ideal **would be to regulate investments in a way that maximizes the expected returns subject to a limited level of pension risk**. A particularly aspect of investment regulation is the long-term focus of the risk to be limited, as the classic measures of financial risk are based on short-term asset-price volatility, which does not necessarily coincide with the objective of limiting pension risk.

The regulation of investments in a defined-contribution and individual-capitalization system tends to use a variety of tools:

- Establishment of maximum investment limits by instruments or class of instrument. The aim is to guarantee adequate diversification of investment by limiting non-systematic portfolio risk, as well as reducing exposure to certain classes of assets that may be considered as riskier (e.g. equity).
- Creation of multi-funds, which provide alternative portfolios for members to capitalize their savings. The differences between the types of funds come from the different risk-return combinations².
- Capital requirements: In the case of privately administered systems an alternative to aligning the incentives of the administrator with those of the members is to establish minimum capital requirements. This means the administrator has to maintain a certain amount of its own capital invested in the pension funds.
- Minimum return: this establishes a certain minimum return that the administrators must achieve for each fund. This can be established against a benchmark or in relation to the average performance of the system. There are problems associated with establishing a minimum return according to the average return of the system, as it creates incentives for herd behavior and privileges minimizing short-term risk over long-term risk.

2: The system may allow members to choose the type of fund in which to capitalize their savings, as in Chile, or it may assign members to a particular fund according to their age, according to a life-cycle model, as in Mexico. When individuals are allowed to choose the type of fund, a default assignment based on the life cycle is established for those members who do not exercise their right to choose.

Challenges and reflections

The challenge lies in how to measure pension risk, particularly how to apply it when formulating public policies and creating a regulatory structure for pension systems. The core objective of the regulatory authority should be to mitigate pension risk and ensure that public policies limit it.

The optimum portfolio is determined by a number of factors that vary according to members; for example, the investment horizon is fundamental, and this depends on the age of the individuals. For individuals who are close to retirement age the short-term volatility of security prices is a source of pension risk, as it could affect the replacement rate achieved; while for young members the short-term market risk does not necessarily represent a source of pension risk, given that the temporary falls in income will not affect the value of pensions that still have a long investment horizon. Some instruments have a very low long-term risk but present significant short-term volatility, such as long-term fixed-income; while other instruments such as short-term fixed income are fairly stable over short periods, but present a considerable volatility over longer terms.

Market risk **measures that use the short-term volatility of financial markets would not therefore be suitable for measuring pension risk caused by the market risk for most members (those with a long-term investment horizon). Only events that affect expected long-term returns would be a source of pension risk.** The above represents a challenge for the regulators of individual-capitalization pension systems, given that typically the financial risk has been measured at relatively short horizons, or the measuring techniques may be highly influenced by recent events. In a [publication by the Central Bank of Chile](#) describing different alternatives for risk evaluation for investment portfolios, recent events can be seen to have an excessive influence on the calculations.

For example, in Mexico the **Valuation at Risk (VaR)** methodology is used to establish maximum financial risk to which retirement funds may be exposed. VaR consists of a measure of potential loss in negative scenarios with a certain probability of occurrence. This risk indicator may incorporate a number of factors that lead to negative scenarios, and each can be weighted by the probability of its occurrence. In this aspect this methodology is consistent with the concept of pension risk, in the sense that it enables a synthesis to be made of different risk factors. It is important to note that if the probabilities of individual factors that determine negative factors are independent, the VaR will be lower than the simultaneous occurrence of the two negative risk factors, as the probability of the latter scenario is lower, so it is extremely important to establish correlations between events to calculate this indicator.

The problem of using the VaR methodology is that it gives a high weighting to recent events, and does so persistently. Thus when there is a crisis, the negative event (fall in the price of financial instruments) increases the ex post risk indicator; in other words after the negative event, since the evaluation of the security falls. So a regulation that uses this indicator as an evaluation of risk will tend to reduce exposure to the asset whose weight has fallen. This may actually lead to a permanent loss of value and have a significant impact on final pensions and be a strategy associated with greater pension risk. In addition, given that the presence of the negative factor takes time to disappear, due to the use of average prices of financial instruments, the recommendation to reduce exposure will be persistent and will only be reversed once prices have recovered, which does not result in a good financial strategy.

Other individual factors that influence the design of an optimum portfolio include the degree of risk aversion, the presence of other types of savings or wealth, the level of human capital and the rate at which this capital depreciates. If the administration, information and oversight costs of the system are not taken into account, in the extreme it can be argued that there should be as many types of funds as there are fund members. However, the design of the system has to consider both benefits and costs, and this limits the number of funds available.

A recent study by the Superintendency of Pensions (2008) evaluates pension risk in the Chilean system from the perspective of the contributor's life cycle. It analyzes the distribution of the density of probabilities of the replacement rate and the changes in this rate with different investment strategies. Four sources of pension risk are considered: market risk, accumulated volatility of the investment strategy chosen, the risk of unemployment (contribution density) and interest-rate or reinvestment risk. It argues that "the appropriate measurement [of pension risk] results from the marginal effect of carrying out a certain investment strategy on the expected replacement rate, the dispersion around this expected value and the form adopted by its density function." The results support the theory that with a longer investment horizon it is advisable to capitalize savings for the pension in a more aggressive portfolio in terms of risk return, and as the age of retirement approaches the volatility of this, risk should be reduced.

It is still necessary to continue making progress towards regulation of investments according to the impact on the replacement rate and its volatility. Although the study represents significant progress in terms of developing a methodology for evaluating the multi-fund scheme from the perspective of pension risk, this analysis still has to be carried out for other aspects of the regulation of investments, such as the limits of type and location.

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