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Assessment of the
Literature and Policy
Implications for Latin
American Pension Systems

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FOR LATIN AMERICAN PENSION SYSTEMS**

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ABSTRACT/RÉSUMÉ

Portfolio investment in an intertemporal setting: Assessment of the literature and policy implications for Latin American pension systems

Several countries around the globe have established mandatory pension systems based on personal savings accounts. In contrast to the pay-as-you-go (PAYG) financed pensions that these new systems have partly replaced, retirement benefits are the outcome of an investment process. As a result, the choice of investment instruments and the timing of those decisions are crucial determinants of pension benefits. Focusing on this issue, this paper reviews the literature on optimal long-term investment from an individual investors' perspective, assessing the intertemporal portfolio choice problem in a retirement context. The paper then draws lessons for mandatory personal account systems, focusing on the Latin American experience.

JEL codes: G23

Keywords: Pension funds, portfolio preferences, investment alternatives, investment limits, intertemporal choice.

Investissement de portefeuille dans un contexte inter-temporel: évaluation de la littérature sur le sujet et implications des politiques pour le système d'Amérique Latine.

Plusieurs pays dans le monde ont mis en place des régimes de retraite obligatoires qui reposent sur des comptes d'épargne individuels. Contrairement aux pensions financées par répartition que ces nouveaux régimes ont en partie remplacées, les prestations de retraite sont le produit d'un processus de placement. En conséquence, le choix des instruments de placement et le moment auquel ces décisions d'investissement sont prises revêtent une importance déterminante pour les prestations de retraite. Se plaçant du point de vue de l'investisseur individuel, le présent document se consacre à cette question et procède à une revue des publications consacrées à l'investissement optimal de long terme et analyse le problème du choix intertemporel de constitution d'un portefeuille appliqué à l'épargne retraite. Le document tire ensuite les leçons des régimes obligatoires reposant sur des comptes individuels et s'attache à l'expérience des pays latino-américains.

Classification JEL : G23

Mots clés : Fond de retraite, préférences de portefeuille, alternatives d'investissement, limites d'investissement, choix intertemporel.

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**PORTFOLIO INVESTMENT IN AN INTERTEMPORAL SETTING:
ASSESSMENT OF THE LITERATURE AND POLICY IMPLICATIONS FOR LATIN
AMERICAN PENSION SYSTEMS**

Guillermo Larraín Ríos¹

I. Introduction

Social security systems based on some form of pay-as-you-go (PAYG) financing are facing solvency problems, unless significant parametric changes are undertaken relatively soon. However, those changes are very difficult to implement at least for the following three political economy reasons.

The first is that there are *acquired rights*, ie., engagements made by past policymakers to current elderly persons. Those acquired rights were established in a different demographic context when massive younger cohorts could finance retired ones with reasonable contribution rates. Those contribution rates were, at the same time, a tax on labor. The rapid globalization process underway, where competition across countries is much more direct, makes taxes on labor a threat to country's international competitiveness. Therefore, both the demographic change and globalization have put harsh challenges to the PAYG systems. For different reasons, elderly people usually find it difficult, say impossible, to adapt to these developments and hence oppose the parametric reform.

The second reason why those reforms are complex to undertake is because they convey a massive *transfer* of resources between generations. Given the traditional formulas governing the definition of benefits in most PAYG systems, those transfers are only partially linked to some form of additional effort on the contributor's side. Therefore, they are keen to political manipulation from interest groups.

Finally, the third reason is that PAYG pension systems are a cornerstone of the welfare state which has been the umbrella for the development of social democratic parties and societies. The crisis of the PAYG therefore also represents a threat for those parties and a challenge for those societies.

As a response to these developments, several countries around the globe have started to construct mandatory systems based on personal savings. As opposed to the PAYG where pensions were the outcome of someone else's reduced consumption, the new systems are characterized by the fact that pensions are the outcome of an investment process. Contributions are used to purchase different financial instruments whose value change over time according to financial and macroeconomic conditions. It follows that the

¹ The views expressed herein are those of the author and do not necessarily reflect those of the OECD or the governments of its Member countries. The author is sole responsible of any errors. I acknowledge the very efficient research assistance of Pablo Castañeda on the financial literature. Constanza Hill prepared data on Chile and elaborated useful hypothesis for understanding portfolio choice in Chile and elsewhere in Latin America.

appropriate choice of instruments in which to invest and the timing of those decisions are crucial for maximizing the amount saved.

This paper seeks to assess the state of the art in terms of portfolio choice in an intertemporal setting. As suggested by the previous paragraphs, the underlying preoccupation is the increasing reliance of future pensioners on how well portfolio choices will be made in the future.

The intertemporal portfolio choice problem refers to the ways in which investors do or should make decisions concerning savings and investment over time. Applications that attempt to describe what investors do are examples of positive economics. Far more common, however, are normative applications, designed to prescribe what investors should do. There are several reasons to argue that a normative approach might be a more productive one. One of the most important is the fact that the complexity of financial markets has increased exponentially over the last ten years. Nowadays, the range of securities/contracts available to the common investor includes thousands of stocks and bonds to choose. In addition, as many savings plans allow some form of early retirement, deciding when to cease to work, ie, deciding when to exercise the option to sell the accumulated assets and buying a different financial instrument as annuities, is a complex financial decision. Retirement planning has thus become a subject where financial advice seems to be a must. This raises the need for investment advisers to understand the causes and implications of investor heterogeneity to provide their clients with sound advice.

Early papers by Mossin (1968), Merton (1969, 1971), Samuelson (1969, 1970) and Fama (1970) were the first to address the intertemporal portfolio choice problem in preference based theories. A few years after, Friend and Blume (1975) found that, consistent with average asset holdings, calibrated versions of these theoretical portfolio share rules imply a fairly even division of wealth between stocks and bonds, assuming moderate risk aversion. For the next several years portfolio choice was sought to be a largely solved problem.

Recently, however, there has been renewed interest in this area, much of which can be attributed to the apparent idiosyncrasies in individual behavior revealed by new data, and also to the increasing interest in the implications that features such as labor choice, market imperfections, borrowing constraints, and returns predictability, among other, absent from the previous models, have on individuals choices.

The economic theory underlying investor's optimal portfolio choice in highly stylized models is now well understood. In a world characterized by a constant investment opportunity set (i.e., constant interest rates, expected returns, dividends, and so on), a risk averse individual who derives utility from future financial wealth will allocate a fraction of his/her financial wealth into a combination of risky assets based on assets characteristics (i.e., mean-variance profile) and his/her own preferences (i.e., degree of relative risk aversion).

An individual exhibiting *constant* relative (or absolute) risk aversion, CRRA (resp. CARA), will allocate a constant share (amount) of his/her wealth in the risky assets over time as shown in Merton (1969). Additionally, for an individual exhibiting an *increasing* (resp. decreasing) degree of relative risk aversion (as a function of current wealth), the fraction invested in stocks will be a decreasing (resp. increasing) function of his/her current wealth.

However, in opposition to the picture that emerges from early stylized models, the empirical literature on portfolio choice points towards considerable *heterogeneity* in portfolio allocations; see Guiso et al. (2001). While the majority of investors with significant net worth appear to hold diversified portfolios, households do not. Indeed, while a large number of households still hold no position in risky securities, others take significant undiversified positions in stocks. This lack of diversification sometimes is in the form of large holdings in an employer's stock. Both, the lack of risky assets or the inadequate

diversification across issuers is a reflection that the advice being given to many households has been probably poor.

Certainly, not all of those decisions are taken by the person herself as they are delegated to asset managers. The partial privatization of social security has resulted in an increased delegation of portfolio choices in the shoulders of asset managers. These latter ones find their task more complex due to two newly appeared elements: the massive character of this process, which imply the management of significantly more specific investment strategies, and the fact that the financial literacy of those new clients is reduced, implying that there are more asymmetries of information and simpler informational requirements. In any event, understanding the choices made by investors will shed light on the important factors explaining the pricing of risk in financial markets.

If the portfolio heterogeneity observed in the data is to be explained in a traditional utility maximizing framework, it must be accounted for by either heterogeneity in *preferences*, heterogeneity in *circumstances*, or a combination of both. Heterogeneity in preferences has been treated in economics literature extensively.

Heterogeneity of circumstances encompasses a wide range of potential explanatory factors including the presence of non-diversifiable risks, demographics, information asymmetries, and capital market frictions. Potential sources of non-diversifiable risks include labor income, proprietary business income, illiquid pension wealth, and owner-occupied real state. Demographic factors include age, occupation, inherited wealth, and education. Capital market frictions include taxes, trading costs, time costs of learning about asset markets, and borrowing constraints. In any event, the recent literature on portfolio choice has stressed both sorts of heterogeneity, preferences and circumstances.

To understand the portfolio allocations of households it is important to examine their financial positions beyond investment in marketable securities. For example a household's total net worth is well known to be a significant predictor of whether the household participates in financial markets. Beyond this, however, non-traded or background risks in the form of housing, privately held businesses, human capital and the like, are predicted to have an impact on portfolio choice.

The present assessment represents a brief review of the literature on portfolio choice. The reader should keep in mind though that portfolio choice is inserted in a much broader field of financial economics, called 'asset pricing'. Asset pricing refers to the process by which the prices of financial assets are determined and the resulting relationships between expected returns and the risks associated with those returns in capital markets. Evidently, these subjects are inextricably intertwined. Asset prices are determined as part of the process in which investors make portfolio choices. Moreover, the appropriate portfolio choice for an individual depends crucially on available expected returns and risks associated with different investment strategies, and these depend on the manner in which asset prices are set. Recent surveys on asset pricing by Campbell (2000) and Sundaresan (2000) can be read for further references.

II. Beyond Stylized Portfolio Choice Models

One of the most fundamental departures between the recipe that emerges from stylized models with a constant investment opportunity set, and popular financial advice, is the lack of 'time diversification', i.e., the belief that younger people is more risk-tolerant than those who are closer to retirement. An individual having preferences which exhibits constant relative risk aversion will set fixed portfolio weights in risky assets over his/her life cycle, a prediction that conflicts with the popular financial advice of decreasing the proportion invested in risky assets over time, in favor of long term bonds; see, e.g., Bodie and Crane (1997), and Canner et al. (1997). In order to reconcile popular investment advice with the predictions made by theoretical models it is necessary to go beyond the classical setting.

Stochastic investment opportunity set

A simple way to extend the classical setting, and validate popular investment advice, is to allow for a stochastic investment opportunity set. If short term interest rate, and expected returns, dividends and volatilities of risky assets depend on a single state variable (described by a stochastic process), it is possible to show that the optimal allocation in risky assets of an individual having time additive preferences contains two components: a mean variance component, which is mean-variance efficient in the sense of Markowitz (1952),² and a hedging component that accounts for expected fluctuations in the state variable that are correlated with short term interest rate and/or the “market price of risk” (the excess return over the risk-free asset, per unit volatility, of risky assets). These two components are such that the optimal allocation in risky assets minimizes fluctuations in consumption over time; see, e.g., Munk (2005). For the special case of log utility the hedging component vanishes, and the individual actually pursue a strategy that is mean-variance efficient in a single period problem. An individual having these preferences is also known as a myopic investor.

Over the past years some concrete examples have been developed in the context of a stochastic investment opportunity set. Samuelson (1991) obtained decreasing portfolio weights for CRRA preferences by assuming mean-reverting stock returns. Bajeux-Besnainou et al. (2003) were able to explain the asset allocation puzzle raised by Canner et al. (1997) by including stochastic interest rates in the analysis of the portfolio choice problem faced by a HARA (hyperbolic absolute risk aversion) investor in a Vasicek (1977) market. By explicitly including a redundant asset (a bond fund with constant maturity), they were able to decouple the “risk free asset” role played by the zero-coupon bond with maturity equal to the investment horizon, and the hedging role against interest rate fluctuations played by the bond fund of constant maturity. In the case of CRRA preferences, they show that the investor increases the fund bond-to-stock ratio over time, while for general HARA preferences a higher relative risk aversion coefficient is shown to magnify the effect.

Human capital

In addition to reconcile the predictions of theoretical models, another focus of attention has been given by the lack of realism of early models. This fact has motivated the inclusion of several additional features into otherwise standard portfolio choice models over the last 15 years. The first important extension was due to Bodie et al. (1992) who considered labor flexibility and stochastic labor income in a standard model. The allocation on risky assets was shown to depend positively on labor supply elasticity, and negatively on the correlation between labor income and stock return. These findings can be easily understood from first principles. If leisure is a normal good, a negative shock to financial wealth can be partially compensated by an individual who is willing to work additional hours. Additionally, compared with an individual that has a fixed labor supply schedule, the first individual is also wealthier (because of his/her adjustable human wealth). The second finding can be understood in terms of the desired holding of risky assets. If two individuals are identical in every aspect, except for the riskiness of their labor income, the one having a riskier labor income holds, in fact, a larger proportion of his/her wealth in risky assets, and therefore should decrease his/her ‘implicit’ exposure by holding less risky assets in his/her ‘explicit’ portfolio; see Gollier (2005).

Bodie et al. (1992) did not consider idiosyncratic risk in labor income that cannot be hedged using financial assets. Recent theoretical work shows that such background risk can have important effects on consumption and portfolio decisions. Viceira (2001) shows that labor income risk, uncorrelated with

² The problem postulated by Markowitz in the early 50s consisted in finding the portfolio weights that were the solution to the problem of minimizing the variance of the portfolio, subject to a given level of expected return.

financial asset risk, reduces the portfolio weight on risky assets but does not reverse it. This type of risk has also a large effect in stimulating wealth accumulation through precautionary saving as emphasized by Carroll (1997). Using calibrated models, several authors have shown that because the ratio of labor income to wealth rises early in adult life and then gradually declines, the willingness to take equity risk follows a similar pattern; see, e.g., Bertaut and Haliassos (1997), Heaton and Lucas (1997), Cocco et al. (1998), and Storesletten et al. (2001).

Public pensions and family transfers

The existence of public pensions or other external sources of retirement finance (e.g., family transfers) can be thought of as a case where the investor is endowed with an income stream during a phase of the life-cycle. A public pension which is paid as an annuity can be seen as the holding of a bond portfolio, while a family transfer (inheritance, or state-dependence loan) probably acts as a collective insurance aimed at providing income in bad states. Hence, the effects of these sources of retirement finance on portfolio choice can be analyzed from an income and substitution perspective. On the one hand, a sizeable public pension makes the investor wealthier, which in turn may motivate a higher investment in stocks. This effect can be severely restricted by the extent to which the investor can actually borrow against this stream of future income in order to smooth his/her consumption. The same happens with the possibility of a family inheritance, or a collective insurance aimed at providing a reliable source of income during the retirement phase. On the other hand, a liquid source of retirement income, as long as it can be replicated by existing financial assets, represents an ‘implicit’ holding of a given portfolio, and therefore, the investor may be motivated to take a more conservative portfolio depending on the characteristics of the implicit position held by the external sources of income.

Retirement decision

The combination of portfolio choice and retirement behavior has not received an in-depth treatment in the literature until fairly recently. Early papers on life-cycle labor supply and retirement behavior made diametrically opposed assumptions about household’s ability to borrow and save. At one extreme, Burtless (1986) and Gustman and Steinmeier (1986) assume that household can perfectly smooth consumption by borrowing and lending without limit in a single asset (i.e., there was no portfolio allocation decision). At the opposite extreme, Stock and Wise (1990) and Rust and Phelan (1997) assume that households cannot borrow or save, thus allowing no intertemporal consumption smoothing.

In recent years, these two strands of the literature have started to merge producing models capable of considering both portfolio choice and retirement behavior in a unified framework. In this vein, the papers by Lachance (2004) and Farhi and Panageas (2005) are among the most promising works. Lachance studies the problem of optimal timing of retirement, where retirement is modeled as an absorbing state, in an otherwise classical infinite horizon Merton’s setting with constant labor income. By the simplicity of the economic environment the solution is provided in closed-form. The main findings are given by the determination of a wealth threshold at which the individual optimally retires from the labor market. This phenomenon is supported by some recent empirical evidence; see, e.g., French (2005). Additionally, Lachance shows that the fraction of wealth invested in risky asset is higher when the timing of retirement can be freely adjusted. This fraction is also shown to be (locally) decreasing in the expected retirement date, and increasing in the individual’s current wealth and labor income.

Farhi and Panageas study a similar problem that additionally considers the effects of borrowing constraints on the optimal timing of retirement. They show that when individual preferences are of the CRRA class, a coefficient of relative risk aversion above unity can help to explain the so-called retirement-savings puzzle raised by Banks et al. (1988). Additionally, liquidity constraints (i.e., the restriction to

borrow against future labor income) are shown to decrease the wealth threshold that triggers optimal retirement.

More general preferences

Another important extension of the classical setting has been the consideration of more general preferences. One specific direction is based on the notion of “internal” habit formation utility functions, where past consumption of the individual enters explicitly into the contemporaneous utility index; see, e.g., Constantinides (1990), Sundaresan (1989), and Detemple and Zapatero (1991, 1992).³ In a recent paper, Bodie et al. (2004) show that the optimal portfolio choice of an individual with habit forming preferences, labor flexibility, and exogenous timing of retirement, during the accumulation phase, includes hedging components that account for shifts in the opportunity set (wages, consumption, habits, etc.) which affect retirement consumption, and fluctuations in the cost of sustaining current and future habits in the retirement phase.

A number of authors have also pursued specifications such as stochastic differential utility (SDU), a kind of preferences that allows to disentangle risk aversion from intertemporal substitutability; see Epstein and Zin (1989), Duffie and Epstein (1992). In this vein, Schroder and Skiadas (1999) have shown that for a special class of homothetic SDU, the assumptions of time additive preferences and logarithmic SDU, and deterministic investment opportunity set, deliver an identical mean-variance efficient portfolio. An interesting observation is that for logarithmic SDU and a constant opportunity set, the optimal holding of stocks for younger investors is lower and changes deterministically over time approaching the Merton solution (i.e., the mean-variance efficient portfolio) toward the end of the planning horizon.

Behavioural finance

Another line of research that studies the interaction between portfolio choice and non-traditional preferences is the growing field of behavioral finance. In particular, we emphasized the case of loss-averse preferences. Loss aversion refers to the phenomenon that decision makers are distinctly more sensitive to losses than to gains. This phenomenon introduces a kink in the utility function (that is, a jump in marginal utility) at the reference point distinguishing gains from losses. Loss aversion plays a central role in prospect theory (Kahneman and Tversky, 1979) and is supported by lots of experimental evidence; see, e.g., Tversky and Kahneman (1991). Berkelaar et al. (2004) show that, in a framework with a constant investment opportunity set, the optimal holding of stocks of an investor with preferences described by a power utility function, with a kink at the reference point, is heavily reduced in intermediate states of the world (states where the investor ends up with average wealth), it approaches Merton’s solution at the very good states of the world, and it is heavily increased in bad states of the world, where the investor is willing to hold more stocks. This behavior is due to the fact that the kink in the utility function creates a local convexity in the investor preferences (i.e., a risk loving behavior) near the reference point. The authors also show that loss-averse preferences in this simple framework are in line with popular investment advice of decreasing the fraction invested in stocks over time.

Durability of consumption goods

Another area of research has been to consider the durability of consumption goods, which produces a flow of services, thereby establishing an intertemporal link (e.g., housing). The theoretical effects of

³ There is also a literature on “external” habit forming preferences, where utility of current consumption is compared with an exogenous benchmark (e.g., average aggregate consumption). This literature has been mainly focused on explaining empirical regularities which are at odds with standard time separable preferences; see, e.g., Mehra and Prescott (1985), Abel (1990), and Campbell and Cochrane (1999).

durability on portfolio choice have been studied by Grossman and Laroque (1990), Hindy and Huang (1993), Detemple and Giannikos (1996), Hindy et al. (1997), Cuoco and Liu (2000) and by Damgaard et al. (2003). In a constant investment opportunity set environment, it has been shown that an investor with preferences of the CRRA class defined over both a perishable and a durable good will find optimal to set constant portfolio weights over the time. The optimal portfolio exhibits two-fund separation between the mean-variance portfolio and a durable hedge portfolio (i.e., the portfolio with the highest possible correlation with the price of the durable good). When a proportional transaction cost is attached to durable good adjustments, some of the components that were initially constant in the case with no transaction costs (e.g., risk aversion of the value function, portfolio weights, etc.) become state-dependent functions of the financial wealth-to-housing wealth ratio and the no-durable trade region that emerges as a result of the transaction cost. Overall, an individual having a sizeable fraction of his/her total wealth in housing should invest less in risky assets when housing price is correlated with risky asset prices.

These results have been recently confirmed by Cocco (2004) and Yao and Zhang (2005) through calibrated models. Yao and Zhang analyze the portfolio implications of housing services in a model where individuals can either rent or buy their houses. They show that when borrowing constraints and a down payment are present in the individual's problem, house-owners reduce the equity proportion in their net worth, reflecting the substitution effect between home equity and stocks. Additionally, transaction costs attached to housing trade create a no-adjustment region for housing services. When the individual is near the boundary of this region it tilts his/her portfolio towards liquid risky securities, confirming previous theoretical results.

Capital market frictions

Another important extension has been the introduction of capital market frictions, such as taxes, transactions costs, incomplete markets and portfolio constraints, and liquidity constraints.

a. Taxes on capital gains

Dammon et al. (2001) explore the role of *capital gain taxes* (U.S. tax code) in a computable life-cycle model. They find that the U.S. tax code deters elderly investors from selling stocks due to the "reset provision at death", and thus increases their average allocation to equities. They also show that capital gain taxes incentive investors to shift their portfolio towards equity due to tax treatment of capital gains relative to interest income.

b. Transaction costs

The interaction between *transaction costs* and portfolio choice has been studied by Constantinides (1986), Davis and Norman (1990), Dumas and Luciano (1991), Shreve and Soner (1994), Cuoco and Liu (2000), Liu and Loewenstein (2002), and Liu (2004). In the classical setting of Merton (1969, 1971), the optimal portfolio policy requires an infinite amount of trading, in order to continuously rebalance the optimal portfolio weights which are set constant over time.⁴ In the case of proportional and fixed transactions costs such a policy is no longer optimal. Transaction costs create a no-trade region inside of which the portfolio allocation is kept fixed. The optimal allocation in risky assets is shown to be increasing in transaction costs.

⁴ For the case of CRRA preferences the optimal fraction of wealth invested in risky assets is constant, while con the CARA preferences, the optimal amount of wealth invested in risky assets is constant.

c. Incomplete markets and portfolio restrictions

The role of *incomplete markets* and *portfolio restrictions* has been studied by He and Pearson (1991), Karatzas et al. (1991), Fleming and Zariphopoulou (1991), Grossman and Vila (1992), Zariphopoulou (1994), Cuoco (1997), Vila and Zariphopoulou (1997), and more recently by Chacko and Viceira (2005), Liu (2005), and Detemple and Rindisbacher (2005). He and Person and Karatzas et al. have shown that when the sources of uncertainty are finite, an incomplete financial market (i.e., an environment where not all sources of uncertainty can be hedged) can be thought of as a (dynamically) complete financial market with some portfolio restrictions, such that a subset of the assets cannot be held. Portfolio restrictions affect the holding of risky assets by two different channels. On the one hand, they modify the level of the traditional mean-variance and hedging components, and on the other hand, they create new hedging components.

Early papers on portfolio constraints that considered portfolio restrictions related to the investor's financial wealth, in environments with a constant investment opportunity set, such as Grossman and Vila, and Vila and Zariphopoulou, have shown that when intermediate consumption enters into the utility function the optimal portfolio is more conservative, while when the individual's problem has a bequest motive (preferences for terminal wealth) the optimal portfolio will be inclined towards bonds or stocks depending on the risk preferences of the investor. In terms of the new hedging components that arise as a consequence of portfolio restrictions in general environments, they are related to the fluctuations in the shadow prices of the specific constraints. The exact behavior of each additional component depends highly on the model; see Detemple and Rindisbacher.

d. Liquidity constraints

Another strand of the literature has been devoted to *liquidity constraints*, i.e., restrictions to borrow against future streams of income; see, e.g., He and Pages (1993), El Karoui and Jeanblanc-Picque (1998), and Detemple and Serrat (2003). For an individual with CRRA preferences, which is endowed with a flow of risky labor income, it has been shown that his/her optimal portfolio policy contains, in addition to the mean-variance and hedging component related to labor income fluctuations, a liquidity hedge component. The mean variance component is reduced (increased) at times when liquid wealth is reduced (increased), while the liquidity hedge may amount to tilt the portfolio towards stocks or bonds, depending on whether an innovation on stock return has a positive or negative impact on the likelihood of a future binding state. When a positive innovation in stock return induces a positive effect on the optimal consumption-to wealth-ratio (i.e., a reduction in the likelihood of a binding state), the optimal portfolio involves a reduction in stock holdings, due to the fact that the stock tends to pay off in unconstrained states. Similar results has been obtained in portfolio problems with restrictions placed on liquid financial wealth; see, e.g., El Karoui et al. (2005).

Parameter uncertainty and learning

In recent years, researchers have been directing their efforts towards the issues of parameter uncertainty and learning.⁵ In a continuous time framework in which the securities prices follow diffusion processes, Genotte (1986) and Feldman (1992) have shown that the effects of parameter uncertainty are different from those previously reported in static settings. A myopic investor ignores parameter uncertainty entirely in her/his portfolio decision, while a non-myopic investor must take into account parameter uncertainty, not because it affects the instantaneous mean variance efficient portfolio, but because she/he learns about the parameters as time passes. The estimates of the unknown parameters act

⁵ In the context of equilibrium asset pricing models, parameter uncertainty with learning is also termed "asset pricing with heterogeneous beliefs," see Basak (2005) for a recent survey on this topic.

as “states-variables” in her/his dynamic optimization problem, and hence, the need to hedge the fluctuations that affect optimal portfolio decisions emerges.

Xia (2001) shows that the hedging component associated with the uncertain parameters plays a predominant role in the optimal strategy, and is the major component of the horizon effect (i.e., the dependence of the portfolio weights from the state variables), which is present even in the case where stock returns are in fact IID. When stock return is possibly predictable, the optimal portfolio weights are horizon dependent: the optimal stock allocation can increase, decrease, or vary monotonically with the horizon, because parameter uncertainty induces a state-dependent hedging component that varies with the investment horizon.

Additionally, the relation between the optimal portfolio allocation and the predictive variable depends crucially on future learning and investment horizon. Without learning, the optimal allocation increases monotonically with the current predictive variable, because the investor takes advantage of return predictability by investing more in the stock when the expected return is high. When learning is present, however, the optimal allocation is less sensitive to and no longer monotone in the predictive variable, because as the expected return becomes higher, the negative amount of stock the investor uses to hedge parameter uncertainty eventually dominates.

In addition, the horizon effect of market timing (the dependence of the portfolio allocation on the predictive variable) depends on whether the investor faces parameter uncertainty. When the predictive relation is known with certainty, the portfolio allocation is more sensitive to the predictive variable for a long-horizon investor than that for a short horizon investor. When uncertainty in the predictive relation is present, the allocation becomes less sensitive to the predictive variable for a long-horizon investor. Simulated results using both historical and artificially generated data show that investors who ignore market timing can incur very large opportunity costs.

A special case of parameter uncertainty and learning is provided by regime shifts in assets prices.⁶ Guidolin and Timmermann (2005) employ a four regime model to capture the joint distribution of bonds and stocks, and numerically assess the importance of regime shifts. They show that asset allocation differs strongly across regimes. Stocks are attractive to short-to-medium term investors in the bull state, because the probability of staying in such a state is high, but they are far less attractive in the crash state even though this state is not very persistent. This is so, even though investors never know with certainty which regime the economy is currently in; beliefs about state probabilities become important to the asset allocation.

Even in the absence of predictor variables, they show that their model imply that investors’ asset allocation varies over time. This is due to the state-dependent opportunity set they consider and the fact that investors revise their beliefs about the state probabilities. Horizon effects also vary across states. Since stocks are not very attractive in the crash state, investors with a short horizon hold very little in stocks in this state. At longer investment horizons, there is a high probability that the economy will switch to a better state and so investors allocate more towards stocks. In the crash state the allocation to stocks is therefore an increasing function of the investment horizon. In the more persistent slow growth and bull states, investors with a short horizon hold large positions in stocks. At longer horizons investment opportunities will almost surely worsen so investors hold less in stocks, thereby creating a downward sloping relation between stock holdings and the investment horizon. In addition to these horizon effects, they find interesting substitution effects among small and large stocks. As the horizon increase, the allocation to small stocks typically declines, while the allocation to large stocks increases.

⁶ The case where asset returns exhibit regime switching and the true data generating process is known, is a particular case of a financial market with a stochastic investment opportunity set.

Robust portfolio rules

In a different vein Maenhout (2004) has shown that when parameter uncertainty is considered in the utility assessment of the investor, as a joint problem, the classical Merton result suffers a very simple modification. The constant fraction invested in risky assets (CRRA preferences) is reduced by a parameter that acts as a shifter of the parameter of relative risk aversion. The higher the parameter uncertainty the lower the fraction invested in risky assets. This rather expected result is shown to be observationally equivalent to a case in which the investor's preferences are of the SDU type. Additionally, this robust portfolio choice setup is shown to shed light on the equity premium puzzle raised by Mehra and Prescott (1985).

III. Portfolio choice in Chile and Latin America

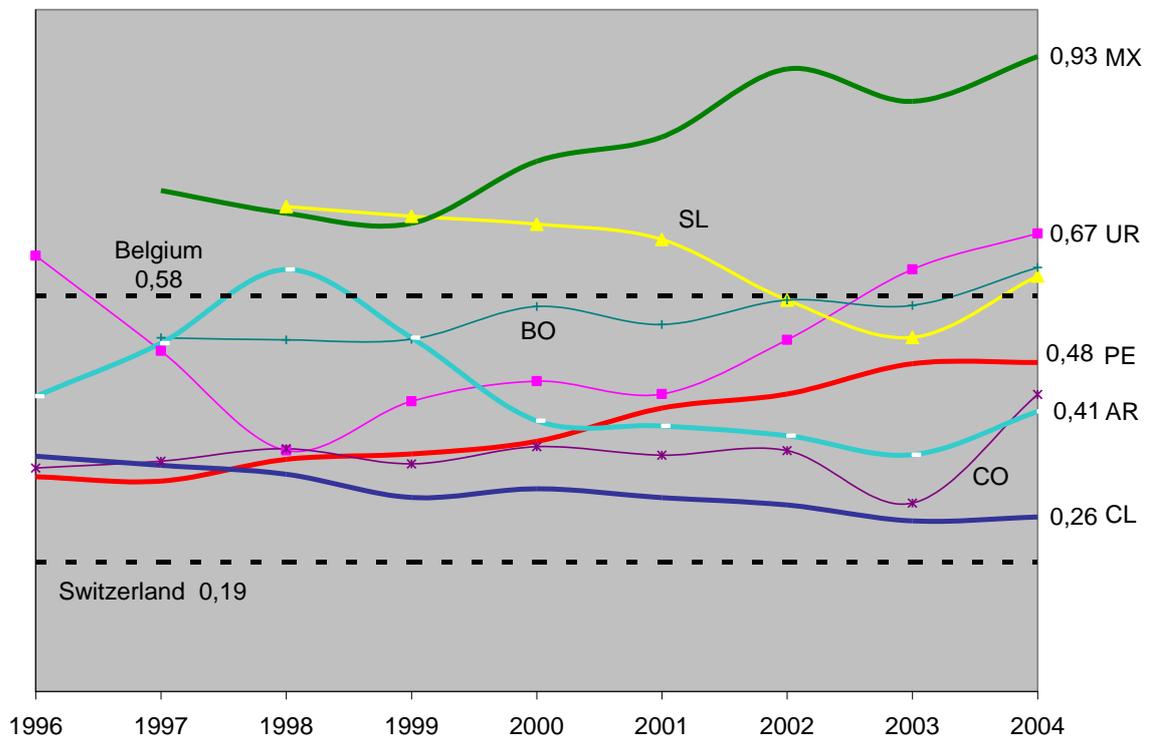
We have seen that an adequate portfolio choice is a key element in order to maximize expected savings. However, a key prerequisite of all the previous analysis is that there are financial instruments among which an optimal portfolio choice strategy can be implemented. Latin American countries are displaying problems in this respect. Let's start describing the facts and then let's move on to elaborate some hypothesis.

Dismal diversification in Latin America: facts

The following graph shows a Herfindhal index of portfolio concentration in Latin American countries. As a reference, the same indicator has been constructed for OECD countries (with a similar aggregation of assets) but only Switzerland and Belgium are reported as they represent the most and the least diversified portfolios respectively in the OECD context.

What can be seen is that LA countries show a quite poor diversification of portfolios, with the exception of Chile. Mexico appears as the least diversified portfolio, even though as the data cover only until 2004, the permission to invest abroad has implied some diversification since 2005. It seems worrisome that several countries display a worsening situation in recent years. Peru, Uruguay, Argentina, Colombia, Costa Rica and El Salvador are in that situation. In some of those countries, the latter concentration period was preceded by an important diversification. To some extent, 2003 appears as a turning point concerning diversification in Latin American portfolios.

Figure 1: Herfindhal index of asset concentration in Latin America



Source: own elaboration based on data in websites of AIOS, FIAP and the OECD.

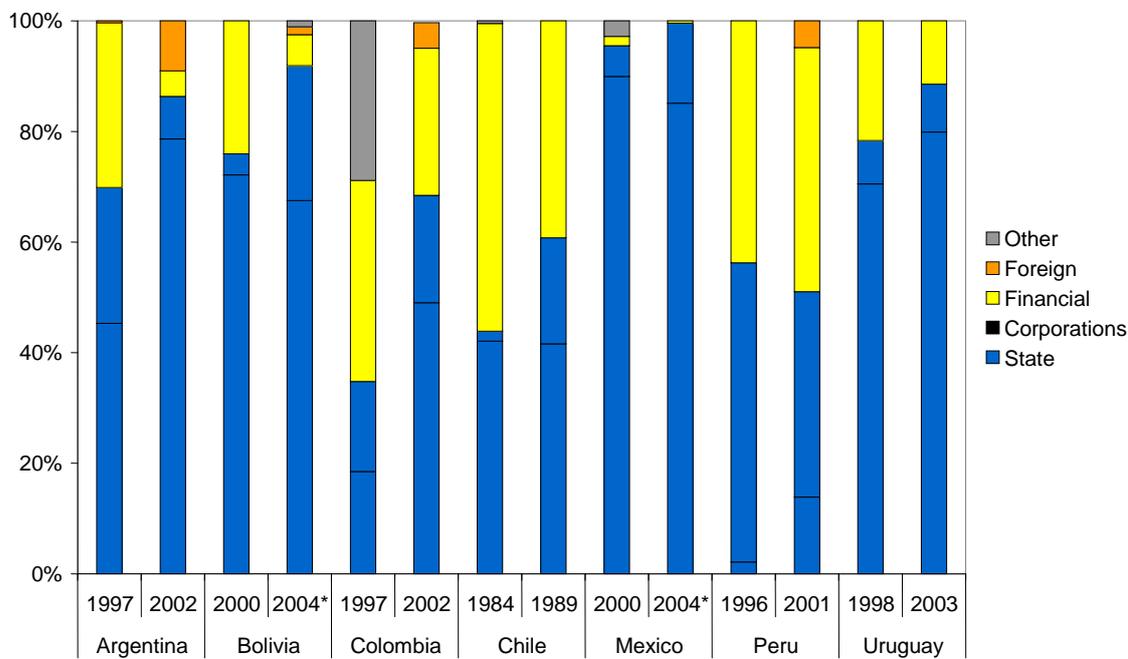
To some extent, this signals that Pension Funds are not being able to find investment opportunities from which to maximize an investment strategy. However, this may be influenced by the fact that reforms have been adopted in different periods with heterogeneous initial levels of developments in their capital markets. For instance, Chile has had the reform implemented for 25 years whereas Mexico for just 9 years.

Year of Pension Reform	
Country	Year
Chile	1981
Peru	1993
Argentina	1994
Colombia	1994
Mexico	1997
Uruguay	1995
Bolivia	1997
El Salvador	1998
Costa Rica	2000
Dominican Republic	2003

In order to control for that, we may analyze portfolio composition of countries after 3 and 8 years of the reform. The following graph illustrates both portfolio compositions. After 3 years of reform Colombia seems to be the most diversified country while Peru appears with the smallest share of public sector instruments. Mexico, on the contrary, appears to be the less diversified and the one most dependent on

securities issued by the public sector. Eight years after the reform, Colombia and Peru appear with the most diversified portfolios followed by Chile while Mexico appears to be the less diversified.

Figure 2: Portfolios in Latin America, 3 and 8 years after pension reform



Therefore, it cannot be excluded that the fact that Chile appears in Graph 1 with the most diversified portfolio can be driven by the simple fact that the Chilean reform is older and more mature than their counterparts in Latin America. Unfortunately, there seem to be other factors to explain that situation.

Dismal diversification in Latin America: hypothesis

In all Latin American countries, pension reforms took place close to a major crisis (before or just after)⁷ or when domestic capital markets were still underdeveloped. The corollary is that what initially prevailed was cautiousness. Regulators wanted to gradually promote some prudent-man asset management but avoiding any scandal that could shed shadows on how the worker's savings were invested. Managers did share the same feeling as well. Legislators eventually mistrusted the system and required strict limitations on how managers could invest. In particular, almost all countries initially did not allow investments abroad. On top of that, domestic financial markets displayed very limited investment opportunities away from public debt.

Therefore, initially portfolios were highly concentrated and, with the exception of Peru and to some extent Chile, the largest share of assets normally consisted in public debt. How long should have passed for having had more diversified portfolios? How long did the financial market need for increasing the supply of instruments? Those are questions difficult to answer but it seems that it might have taken too long and in any case, as shown in Graph 1, in recent years it appears to be a deterioration of the diversification. Hence, even if a highly concentrated portfolio could be understandable in the short run, it is not so after so many years. Which are other reasons that may explain this? I will argue, in line with the discussion on portfolio choice, that there remain two general sets of problems: the rigidity of the regulatory framework and the business culture in Latin American countries.

Demand: Regulatory framework

The regulatory framework in which pension regulation is immersed in Latin America has several peculiarities. Latin American countries do not belong to the common law tradition where the law is an ongoing process based on past experience and court decisions. On the contrary, in many of them, especially in matters related to administrative law, and normally investment regulation belongs to this category, what private agents can do is not what they desire but what they are allowed to do by law originated in Congress. Therefore starting from the spirit of the law, it can be seen that active portfolio choice has limitations in itself.

Hence, in Latin America investment regulation has consisted mainly in setting a quite dense quantitative maximum limits on investment by asset category⁸ as opposed to risk-based-supervision where the manager normally have more discretion but is also more accountable. In that case, it appears that portfolio choice in Latin America may be relatively more influenced by political decisions reflected in new laws sent to Congress rather than rational decisions made by responsible asset managers. To some extent, this may even had implied some transfer of responsibility from the managers into the regulator.

This can be seen by looking at the maximum limits in the different regulations. Table 1 illustrates well this point.

⁷ Chile had a major crisis one year after the reform. Argentina had an hyperinflation episode four years before and the year after was the Tequila crisis. Mexico reformed its system only two years after that same crisis. Peru suffered from high inflation periods at the end of the eighties.

⁸ Usually investment regulation consisted not only in limits by asset classes but also on specific assets (not just classes), issuers and group of issuers.

Table 1: Portfolio ceiling by main asset classes in selected Latin American countries

	Government securities	Financial Institutions	Stocks	Corporate bonds	Investment funds	Foreign securities
Argentina	50 %	40 %	50 %	40 %	20 %	10 %
Bolivia	None	20 %-50 %	20 %-40 %	30 %-45 %	5 %-15 %	10 %-50 %
Chile	40 %-80 %	40 %-80 %	0 %-80 %	30 %-60 %	0 %-40 %	30 %
Colombia	50 %	30 %	30 %	40 %	5 %	10 %
Mexico	None	10 %	15 %	5 %-No limit	-	20 %
Peru	30 %	40 %	35 %	40 %	15 %	10.5 %

Source: OECD, 2007

It can be seen that the legislator in several cases has not allowed that pension funds could invest in some securities, in particular, in foreign assets. At the same time, it has allowed in many cases up to 100% of pension savings that could consist in public debt instruments. Therefore, it should not be a surprise that portfolios look closer to this regulatory design.

The fact that in many cases these quantitative limits are set or partially set in Parliament has at least two implications. One is that any reform proposal intended to modify the structure of limits enters into the broader range of political negotiations. This makes the final outcome less predictable from the point of view of the regulator. Therefore, even if she wished, it is not clear how optimal could be to send a reform proposal to Congress. The other point is that in most Latin American countries the regulator does not have legislative initiative. This means that in order to send a project of law, the regulator must convince the government to give priority to this particular project. A crucial aspect appears at this point: the consistence of public policies. As in some cases the discussion of laws is initiated in one government but must be continued and eventually concluded in the following one, if the latter do not assign the same priority to the project sent by the regulator, then there may not be a law at the end. If in addition we consider that in practice institutions are imperfect, and that no law is able to resolve all the challenges faced by a given institution, such as a pension system, then the temporal consistency of public policies is crucial to attain a higher degree of development of those institutions.

For this reasons the regulatory regime is rigid and has not evolved in the sense of giving managers more space in which to adopt better portfolio decisions.

Supply: Corporate governance

So far we have discussed the demand side of the market, ie, why the demand for securities arising in Pension Funds has not been able to promote adequate portfolio selection. But it appears that there are also problems in the supply side of the market. After all, Pension Funds have space to invest in other securities but they actually do not do it. The following Table shows that, on average, pension funds are using only 18% of the allowed limit on shares (82% of that limit is available to increase investments in shares), 20% of the limit in corporate debt and 37% of the limit in financial sector instruments. These are investment opportunities allowed by the regulator, but Pension Funds do not use them. Why is that so? Why do firms not choose to issue bonds and shares as means of financing?

Table 2: Space for better portfolio allocation in Latin America

Country	Public Debt	Financial Institutions	Shares	Corporate bonds	Investment Funds	Foreign Securities
Argentina	4,1%	91%	91%	97%	94%	56%
Bolivia	31%	63%	100%	70%	100%	97%
Chile	40%	32%	67%	82%	88%	19%
Colombia	38%	37%	90%	45%	100%	55%
Costa Rica	NA	95%	100%	93%	100%	not allowed
El Salvador	15%	64%	98%	99%	100%	not allowed
Mexico	17%	79%	not allowed	85%	not allowed	not allowed
Peru	68%	40%	11%	67%	93%	4%
Uruguay	15%	-32%	100%	83%	not allowed	not allowed
Average	28%	63%	82%	80%	96%	46%

Source: Author's calculation based on data from AIOS and FIAP.

There are a number of reasons to explain why pension funds do not use those opportunities. Among them, I would like to highlight the following:

Tax disincentives: in many countries interests paid on bank loans are deductible from the tax base whereas that is not the case with interests on bonds or dividends. Therefore, there are disincentives that promote that firms finance investment projects from one source instead of another.

Costs of issuance: given the small size of Latin American economies and the often high fixed costs associated to the registration of a given issuance, many small and medium size investment projects find it more attractive to look for bank finance instead of issuing financial instruments.

Macroeconomic instability: as it is well known, macroeconomic instability discourages investment on the first place and therefore has an impact on the depth and liquidity of financial markets.

However, I would like to emphasize the arguments that arise from the corporate governance of domestic companies. In many respects, this is harder to change and therefore requires more judgment.

Latin American companies, compared with their counterparts elsewhere in the OCDE countries, display in general a much more concentrated ownership structure. The next Table shows that on average the biggest shareholder concentrates well above 50% of the shares with the exception of Colombia which only has 44%. The three OCDE countries shown as reference have, at the most, 22% in the case of Germany, a country reputed for having a bank-based financial system. Colombia doubles that figure and the rest is even more concentrated.

What is also an important feature of Latin corporations is that in many countries, notably in Peru and Mexico, there may be a significant proportion of shares without voting rights. On the one hand this may be signaling a poor regulation of minority shareholder's rights, which in itself may be an indication of the pressure of interest groups not concerned in such regulation. On the other, if such rights are not well granted, there will be no interest by investors in financing those projects and companies will have to recur to other sources of financing.

Table 3: Corporate ownership structure and characteristics in Latin American countries

	% main shareholder	% 3 biggest shareholders	% of firms with shares without voting rights
Argentina	61	82	3,9
Chile	55	74	7,2
Colombia	44	65	7,1
México	52	73	37,8
Perú	57	78	61,0
Average	53	73	34,0
Japan	7		
Germany	22		
USA -UK	5		

Source: Majluf et al

All of the above is compounded by the presence of family businesses which tend to exacerbate the problems faced by companies with concentrated ownership in the context of poor regulation of minority shareholders rights. The outcome of the above is that Latin American capital markets are often thin and illiquid. The next Table shows that clearly.

Table 4: Depth and liquidity of Latin American capital markets in 2004

Country	Stock Market Capitalization (% of GDP)	Stock Market Total Value Traded (% of GDP)	Stock Market Turnover Ratio	Private Bond Market Capitalization (% of GDP)	Public Bond Market Capitalization (% of GDP)
Argentina	28,2%	5,0%	17,8%	9,0%	6,4%
Bolivia	18,7%	0,1%	0,3%		
Chile	108,6%	12,3%	11,3%	22,5%	21,8%
Colombia	20,3%	1,5%	7,4%	0,5%	26,9%
Costa Rica	10,0%	0,7%	6,6%		
Ecuador	7,9%	0,3%	4,2%		
El Salvador	18,9%	3,1%	16,5%		
Mexico	21,9%	6,3%	28,9%	3,0%	21,1%
Peru	26,6%	1,6%	6,2%	4,0%	4,8%
Uruguay	1,9%	0,0%	0,0%		
Venezuela	4,6%	0,4%	9,1%		
Average	24,3%	2,9%	9,8%	7,8%	16,2%
Netherlands	96,8%	104,7%	108,1%	62,9%	47,9%
Switzerland	217,6%	202,5%	93,1%	36,2%	31,4%
United Kingdom	123,0%	173,4%	141,0%	16,1%	27,8%
United States	131,6%	165,8%	126,0%	111,8%	45,4%
Average	142,2%	161,6%	117,0%	56,7%	38,1%

Source: World Bank Indicators, 2005

The general picture is that developed capital markets are deeper in the sense that the market capitalization is higher than in less developed countries in all different markets, share and bonds. At the same time, liquidity in the former is much reduced compared to the latter. An interesting case is Chile,

which has higher stock market capitalization than the Netherlands and higher private bond market capitalization than the UK. As market capitalization is concerned, Chile is quite competitive for world standards. However, those are very illiquid markets compared with developed ones.

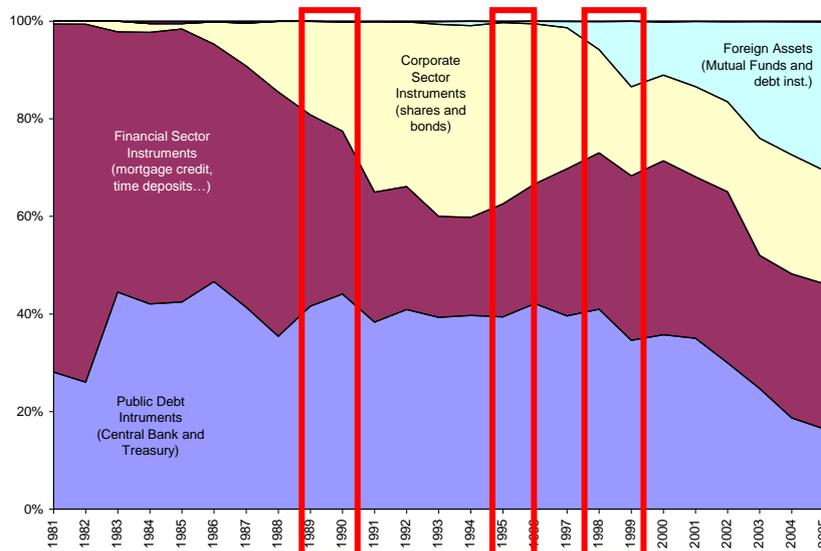
Diversification in Chile: analysis of three shocks

As many pension reforms in Latin America are simply too recent so as to make a satisfactory analysis of portfolio choice in those countries, we shall analyze with some more detail the case of Chile during three important and quite dissimilar shocks faced by pension funds:

- the transition to democracy in 1990, which was surrounded by the perception of some increased country risk,
- the tequila crisis in 1995, which induced large capital inflows into the country and created the image of Chile as a safe haven,
- the Asian crisis and the Russian devaluation of 1998 with the significant financial turmoil they created that year and a mild recession in 1999.

The following graph shows the most aggregated view of Chilean pension funds portfolio. Each rectangle illustrates the episodes just mentioned.

Figure 3: Pension Funds portfolio composition in Chile, 1981-2005



Source: Superintendencia de AFP, Chile.

This panoramic view can be zoomed for the three periods as it is done in the next Table. The aggregate classifications correspond to the definitions already shown in the Graph. The last columns for each episode show the change in portfolio composition between the two years. Finally, the securities whose participation increased is highlighted and the one whose participation declined is signalled with a rectangle. On the basis of this Table we shall briefly analyze pension fund portfolio behaviour in Chile.

Table 5: Portfolio composition of Chilean Pension Funds in Specific Shocks

(% of all assets each year and change between years)

	Shock 1: Political uncertainty due to return to democracy			Shock 2: Chile as safe haven for foreign capital flows			Shock 3: Asian and Russian crisis induced financial contagion, mild recession a year later				
	Dic-89	Dic-90	90/89	Dic-94	Dic-95	95/94	Dic-97	Dic-98	Dic-99	98/97	99/98
Public Debt	41,6	44,1	2,5	39,7	39,4	-0,3	39,6	41,0	34,6	1,4	-6,4
Central Bank of Chile	38,1	42,5	4,4	38,5	37,5	-1,0	36,4	37,5	31,0	1,1	-6,5
Treasury	3,4	1,5	-1,8	0,2	0,1	-0,1	0,0	0,0	0,0	0,0	0,0
Recognition bonds	0	0	0,0	1,0	1,8	0,8	3,2	3,4	3,6	0,3	0,2
Other public bonds	0,1	0,1	0,0	0	0	0,0	0	0	0	0,0	0,0
Financial Sector Instruments	39,2	33,4	-5,8	20,1	23,1	3,0	30,1	32,0	33,7	1,9	1,7
Mortgage credit	17,7	16,1	-1,6	13,7	15,8	2,1	17,0	16,6	15,1	-0,4	-1,5
Time deposits	20,8	16,3	-4,6	4,8	5,3	0,5	10,7	13,6	16,1	3,0	2,5
Bonds of financial institutions	0,7	1,1	0,4	1,5	1,3	-0,2	1,7	1,5	2,0	-0,3	0,6
Equity of financial institutions	0	0	0,0	0,1	0,7	0,6	0,8	0,4	0,5	-0,4	0,1
Forwards	0	0	0,0	0	0	0,0	0,0	0,0	0,0	0,0	0,0
Corporate Sector Instruments	19,2	22,4	3,2	39,3	37,2	-2,1	29,0	21,2	18,3	-7,8	-2,9
Equity	10,1	11,3	1,2	32,1	29,4	-2,7	22,6	14,5	11,9	-8,1	-2,6
Bonds	9,1	11,1	2,0	6,3	5,2	-1,1	3,3	3,8	3,8	0,5	0,0
Investment funds	0,0	0,0	0,0	0,9	2,6	1,6	3,1	2,9	2,6	-0,2	-0,3
Foreign Investments	0	0	0,0	0,9	0,2	-0,7	1,2	5,7	13,4	4,5	7,7
Mutual funds and shares	0	0	0,0	0	0	0,0	0,9	3,9	8,9	3,1	5,0
Direct investment abroad (*)	0	0	0,0	0	0	0,0	0,1	0,2	0,2	0,0	0,0
Debt instruments	0	0	0,0	0	0	0,0	0,1	1,5	4,2	1,4	2,6
Forwards	0	0	0,0	0	0	0,0	0,0	0,0	0,0	0,0	0,0
Other	0	0	0,0	0	0	0,0	0,1	0,1	0,2	0,0	0,1
Disposable assets	0,0	0,1	0,1	0,0	0,1	0,1	0,1	0,1	0,0	0,0	-0,1

Source: Author's calculation based on SAFF

Shock 1: Political uncertainty in 1990

The return to democracy in Chile was preceded by a period in which the government tried to convince people that in case the opposition wins, instability would come back to the country. Therefore, some political uncertainty would have appeared. Normally, during uncertain periods, portfolio managers look for quality and/or safety. As it is apparent in the previous data, pension funds behaviour was different.

Indeed, pension funds increased their participation in corporate sector instruments, basically shares at the time, and some increase in public debt. But interestingly enough, they significantly decreased the participation of the most liquid asset, deposits in the financial sector, and did not increase their exposure to foreign risk. Maybe the uncertainty was not as much.

Shock 2: Chile as safe haven during the Tequila crisis

At the end of 1994 Mexico suffered an important balance of payment crisis coupled with increased country risk which triggered a recession in 1995. This increased financial and political risk perception in Mexico had an unexpected consequence, as the capitals flew from Argentina as well inducing there a recession the same year and some financial turmoil elsewhere in Mercosur countries. On the contrary, that year Chile enjoyed renewed interest to invest and received significant capital inflows as a result of which the Chilean peso strengthened by 3,3% in real terms in the 12 months that followed the Mexican devaluation.

This availability of foreign capital did not imply that pension funds moved towards corporate, state or foreign assets but to financial sector instruments, the most liquid of all. Was the positive shock perceived to be temporary? Was it unexpected and pension funds cashed-in the money to see if the private sector reacted issuing more equity or debt?

Shock 3: The Asian and Russian crisis

Contrary to the Tequila crisis, in the Asian and Russian cases the external shock was amplified by errors in macroeconomic management⁹. In the two previous years Chile had received significant capital inflows. Only in 1997 they reached 22% of GDP in gross terms. This induced an important overvaluation of the peso and an unsustainable current account deficit, in spite of the fact that terms of trade were quite favourable. The Asian crisis first changed drastically the terms of trade, in itself inducing a real depreciation of the currency. International uncertainty mounted and international capital flows decreased. This reinforced the need for depreciation. Finally, the Russian default triggered a worldwide liquidity squeeze which induced flight to safety.

From the very beginning the Central Bank did not allow the currency to depreciate in spite of the fact of having an exchange rate policy consisting in a band, quite popular then, that gave it in principle room to accommodate depreciation. The reason was the inflationary consequence of the depreciation. This induced speculation that the true ceiling of the band was closer to the actual exchange rate levels. Three speculative attacks took place in 1998 as a result of which interest rates skyrocketed.

Pension funds rushed for safety and quality. First, they increased their holdings of liquid domestic financial instruments. Second, they started investing heavily abroad. This is surprising as they had been allowed to invest abroad since 1995. To some extent, pension fund portfolio choice was procyclical in this period.

IV. Concluding Remarks

The renewed interest in portfolio choice problems follows the relatively recent empirical evidence of time-varying return distributions (e.g., predictability and conditional heteroskedasticity) and has been fuelled by realistic issues including model and parameter uncertainty, learning, background risks, and frictions. The general focus of the current research is to identify key aspects of real-world portfolio choice problems and to understand qualitatively as well as quantitatively their role in the optimal investment decisions of individuals and institutions.

These new theories offer a great range of possible answers to the observed heterogeneity in portfolio allocations. What is left is to discriminate among competing theories in order to disentangle what are the real sources behind the low participation in financial markets, and the diverse composition in household portfolios.

⁹ See Ffrench-Davis and Larrain (2003) for a discussion of that period for the cases of Argentina (pegged exchange rate regime), Chile (exchange rate band) and Mexico (floating regime)

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