Retirement Forced Saving in Peru using Hyperbolic Discounting Functions: A Doctoral Research Proposal

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Abstract

Empirical and survey data related to voluntary pensions in the United States indicated that households have not been saving enough to cover later consumption requirements. This evidence has been analyzed using a conceptual framework named the hyperbolic consumption model that integrates a classical utility theory with behavioral concepts in order to explain some anomalies in consumption-saving decisions.

The proposed study will analyze the Peruvian situation applying the life-cycle framework, and using the discounted utility model with the exponential and the hyperbolic discounting models. This model requires quantitative information of longitudinal and cross-sectional data. The population included in this study will cover employed individuals who contribute to the Peruvian Private Pension Fund System and self-employed individuals, who are not forced to contribute to this pension system, yet are affiliated to this system. This situation offers a singular opportunity to compare the saving behaviors of both groups. The importance of the self-employed group has been reported in the literature; and their lack of contributions and saving requires an analysis of their behavior. The academic research into the saving behavior of both employed and self-employed will be an important contribution to the understanding of consumption-saving decisions.

Keywords: Pensions, Retirement, Hyperbolic Functions, Consumption, Saving, Time Preference.

CHAPTER I: INTRODUCTION

Individuals have to face intertemporal decisions of consumption and saving in different stages of their life. The classical utility theory explains that people should save enough to maintain consumption when they cannot generate income in the retirement phase. This approach assumes that individuals are rational planners of their consumption and saving, as the classical utility theory indicates. This framework was used to analyze consumption and saving behavior, in the sense that individuals save enough for pension financing.

Empirical and survey data related to voluntary pensions in the United States indicated that households have not been saving enough to cover later consumption requirements. This evidence has been analyzed using the behavioral economic approach, which indicates that individuals have behavior anomalies that affect their saving process for retirement support. Specifically, some academic authors have proposed a conceptual framework named the hyperbolic consumption model that integrates a classical utility theory with behavioral concepts in

order to explain some anomalies in consumption-saving decisions.

In Peru, the compulsory enrollment in and contribution to social security retirement for employees and the freedom given to self-employed people offer an important framework to study saving behavior, taking the defined contribution pension system as a reference to analyze this situation. Specific questions about saving in the retirement context, such as how much the compulsory saving of social security corrects behavioral anomalies or whether the compulsory participation in a private pension fund system can solve anomalies are expected to be answered in this research proposal.

Background of the Problem

The relation between the saving process and pension systems was remarked by Barr (2005) and Thornton (2001). According to these authors, from an individual perspective, the process of saving under defined contribution or individual saving accounts could be explained in terms of the life-cycle approach, which indicates that workers should save when they are young and reduce their saving during retirement. If the process of saving is not enough, the individuals will not support their own consumption, and government should protect them with budgetary resources (World Bank, 1994). Social security, designed and regulated by the government, is expected to assure that individuals will receive a pension at the age of retirement, after a contributing process during the active life-cycle stage (Holzmann & Hinz, 2005).

The role of government in forcing individuals to participate in a pension system has been a matter of scholarly analysis. One of the arguments proposed by academics to explain the presence of government was the myopia of workers. According to Valdéz-Prieto (2004), this concept means that individuals attribute greater value to present consumption and do not anticipate the necessities of retirement. Holzmann and Hinz (2005) also pointed out this aspect and explained that myopia "may be the result of an insufficient planning horizon or a high personal discount rate" (p. 40). This myopia is one of the arguments to justify government intervention forcing individuals to participate in social security and encouraging saving for retirement (Imbrohoroglu, Imbrohoroglu, & Jones, 2003).

In Peru, as in other countries, contribution to a pension fund and saving for retirement are mandatory for employed people. However, the legislation does not compel self-employed individuals to participate in and contribute to pension systems (Holzmann & Hinz, 2005, p. 145). This characteristic was mentioned by Barr and Packard (2003) in the sense that a substantial share of the labor force in Peru is free to choose whether to participate in the formal pension system. Besides, the authors found that self-employed individuals have different patterns of saving compared with those who are employed; and there is a negative relation between the share of their accumulated assets held in the form of fixed assets (known also as illiquid assets) and their contribution of a percentage of their monthly salary to the pension system (Barr & Packard, 2003, p. 17).

Considering this background, the proposed research will analyze how much the compelling role of government in retirement saving can shrink the anomalies in individual behavior. The possibility of distinguishing between two groups (those who are forced to contribute and those who are not) offers an important and particular opportunity to analyze and compare the individual's saving behavior and to apply the classical theory of utility and the behavioral economics approach, specifically the lack of self-control in consumption-saving decisions.

Academics have compared the classical discount function with self-control problems. Della Vigna and Malmendier (2004) contributed to the literature on the market interactions between rational and non-rational agents when they applied the self-control issues in marketing applications and contracts, in the sense that rational firms design specific contracts to time-inconsistent preferences of individuals. Gruber and Koszegi (2001) developed a model of addictive behavior, taking a standard rational model, incorporating time-inconsistencies preferences, and concluded some practical implications, for example, the optimal tax per pack of cigarettes should be at least one dollar higher than in a standard model. Based on a survey, Mayer and Russel (2005) found that if school teachers were rational, they should receive 10 payments and earn interest on their saving. Instead of that, half of the teachers surveyed preferred 12 monthly payments.

Statement of the Problem

The World Bank (2004) indicated that only 13% of Peru's workforce saves regularly in a pension system and are covered by retirement protection. The International Association of Pension Fund Supervisors (2006) reported that Peru has the lowest saving rate of Latin American countries with compulsory defined contribution systems considering both employed and self-employed covering less than 15% of the total number of individuals in their active working phase.

This particular framework draws attention to the following problems: (a) when an individual fails to save, government should spend budgetary resources to protect the individual in the stage of retirement, and "in view of the difficulty of raising taxes, governments in many developing countries choose to cut other social expenditures, typically expenditures for health and education" (Holzmann & Hinz, 2005, p. 24); and (b) the lack of knowledge about individual saving behavior limits the design of policies to promote saving or protect individuals for the future. If consumers are too myopic

to see their future financing of retirement, they cannot seek out explicit commitment devices to help themselves in the process of saving; or perhaps, instruments with commitment properties can be promoted explicitly for this saving purpose (Laibson, Repetto, & Tobacman, 1998). Besides, automatic deductions for self-employed individuals in defined contribution systems, specific features to induce saving may be encouraged to protect their future pension. These alternatives, their effects, and their implications should be understood before any policy design is implemented.

Purpose of the Study

The purpose of the proposed study is to analyze saving behavior under two different applications of the life-cycle framework, which has been used to study consumption and saving in different stages of life. According to Browning and Crossley (2001), this framework can be used to integrate specific aspects of behavior research and can be applied to the analysis of saving and retirement.

As the life-cycle process involves decisions of consumption and saving, the discounted utility model introduced by Samuelson (1937) and cited in Ho, Lim, and Camerer (2006) can be used to study intertemporal choices. This model considers that individuals make choices that maximize the discounted sum of utilities in future times, and it has been used with different assumptions. The classical assumption is that individuals discount the future utility by an exponential discount factor (that considers a constant rate of discount), because this implies that individuals make plans, as with saving, for example, based on anticipated future substitution, and when the future arrives, they make the same decision. This behavior is also known as time-consistency. The exponential discounting function comes from the classical theory of utility and assumes that individuals save the same proportion of their salary to finance their future pension.

On the other hand, another assumption is that individuals prefer instant gratification at the present time rather than in the future. This behavior can be an extension of the exponential discounting function, and the assumption is that individuals do not save the same percentage of their salary during their life-cycle, because they prefer present consumption instead of saving for future. This behavior is known as myopia or a self-control problem and was incorporated in the life-cycle approach by Laibson et al. (1998) and Angeletos, Laibson, Repetto, and Tobacman (2001) using a hyperbolic discounting model.

The proposed study will apply the life-cycle framework, using the discounted utility model with the exponential and the hyperbolic discounting models. This model requires quantitative information of longitudinal and cross-sectional data. The logic of the study will be deductive, and the process of the research will be based on data provided by official surveys about household income and consumption patterns. The population included in this study will cover employed individuals who contribute to the Peruvian Private Pension Fund System and self-employed individuals, who are not forced to contribute to this pension system, yet are affiliated to this system. The enrollment into a private pension system within the Peruvian legal framework offers a unique opportunity to compare individuals who are forced to save (exponential discounting function) with those who are not (hyperbolic discounting function). It is expected that the retirement forced saving for employees mimics a rational behavior of individuals explained under the exponential discounting function and the freedom to save for retirement explained under the hyperbolic discounting function.

Significance of the Study

This study will analyze and compare the saving behavior of two main groups of people: employed and self-employed. This comparison has not been studied in the Peruvian context, and the possibility of studying these groups complements the singular context of the compulsory affiliation for employees and the freedom for the self-employed.

The significance of the study is based on the finding of a possible preference for present consumption instead of retirement saving, known by academics as myopia or a self-control problem. The results of this research will contribute to explaining how much the compulsory saving promoted by the government corrects behavioral problems and helps to promote saving.

Academics and government policy makers will benefit from the outcomes, and the application of the methodology will make an original contribution to the understanding of saving in Peru and to the evaluation of policies to promote saving. The importance of knowing individuals' behavior as a prerequisite step to designing an adequate saving policy was cited by Altman (2003). For that reason, the outcome of the research would also help to design effective financial instruments with commitment properties, for example, illiquid assets as fixed assets, or to implement automatic deductions for self-employed individuals in defined contribution systems to encourage saving.

Nature of the Study

The paradigm of this quantitative, analytical and predictive research is to consider the proof of hypotheses about exponential (from the classical theory of utility) or hyperbolic (from behavioral economics) saving behavior of individuals affiliated to the Peruvian Private Pension Fund System.

The data will be provided by the Peruvian National Household Survey of Life Conditions and Poverty (ENAHO) from 1997 to 2006 and complemented with information

provided from the Social Risks Management Survey (PRIESO) of Peru, developed in April – May 2002 and based on the ENAHO survey of 2002 (Barr & Packard, 2003).

Among previous contributions about the saving behavior of Peruvian households is the research of Saavedra and Valdivia (2003). The authors applied the life-cycle approach with official surveys from 1985 to 1997 but did not use behavior anomalies such as myopia or discounting functions. Barr and Packard (2003) analyzed saving behavior in the context of social security with a cross-sectional method using information from the year 2002 and focused on self-employed workers.

Both these research studies will be used as a background, and this study will use longitudinal panel data information from Peruvian household official surveys. The hyperbolic discounting approach was used in research related to social security (Imbrohoroglu et al., 2003) but applied by defined benefit systems, instead of defined contribution systems. The Peruvian private pension system is based on defined contribution.

Research Questions

The research questions that flow from the problem statement are as follows:

1. Does the compulsory contribution of employed workers to the Peruvian Private Pension Fund System smooth consumption and convert their saving behavior in exponential discounters?
2. Is the optional contribution of self-employed workers to the Peruvian Private Pension Fund System explained under the hyperbolic discount?
3. Are there differences in the saving behavior of employed and self-employed workers?

Hypotheses

The hypotheses tested in the proposed study are as follows:

$H_0 1$: The discount function for employees enrolled in the Peruvian Private Pension Fund System is not exponential.

$H_a 1$: The discount function for employees enrolled in the Peruvian Private Pension Fund System is exponential.

$H_0 2$: The discount function for self-employed workers enrolled in the Peruvian Private Pension Fund System is exponential.

$H_a 2$: The discount function for self-employed workers enrolled in the Peruvian Private Pension Fund System is hyperbolic.

$H_0 3$: The short-time discount rate of self-employed workers is not higher than the later discount rate.

$H_a 3$: The short-time discount rate of self-employed workers is higher than the later discount rate.

Theoretical Framework

According to Holzmann and Hinz (2005), pension systems were created to protect individuals from events such as disability and retirement, and they are part of social security protection. These systems were implemented by governments forcing workers to enroll and to contribute with a percentage of the monthly salary. The employer has been in charge of the payment of the retention and also forced to contribute with a percentage of the salary of the worker. The traditional mechanism of financing pension systems administered by governments was collective capitalization, also known as the pay-as-you-go or defined-benefit pension system.

Nevertheless, the aging of the population, the financial crises of these systems, and the permanent requirements of fiscal resources to finance workers' pensions required the reform of government pension systems (Holzmann & Hinz, 2005; Schwarz, 2006). This situation was characteristic of Latin American countries, and pension reforms were implemented as a solution.

A pension reform consists in the creation of a private pension fund system (also known as a fully funded or defined contribution system) with the following characteristics: (a) the worker contributes with a defined and constant percentage of the salary which is saved in an individual account administered by pension fund administrators (mainly managed by the private sector); (b) the administrators invest the funds in a portfolio, carefully regulated by a government agency; (c) the future pension (financed with personal contributions and its returns) has no limits (the pay-as-you-go pension system sets a pension ceiling) and the amount depends on accumulated fund, actuarial calculus related to age of retirement, marital status, and other factors.

During the last 20 years, some Latin American countries decided to implement structural pension reform: Chile in 1981, Colombia and Peru in 1992, Argentina in 1993, and, subsequently, most of the Latin American countries. Besides these experiences, countries from Eastern Europe decided to implement pension reforms following the same pattern (Müller, 2001). It is important to mention that in Peru, the legislation does not force employers to contribute to the pension system or to match employee contribution, as in other countries.

As has been mentioned, in almost all countries, workers are forced to enroll in a pension system. Various arguments are put forward to justify this compulsory enrollment. The World Bank (1994) and Valdéz-Prieto (2004) mentioned three arguments: (a) myopia of the worker, since the individual attributes greater value to the present consumption and it does not anticipate the necessities of retirement; (b) moral risk, because a segment of the population contribute only in the last years prior to retirement and finance a future pension near entrance to it (i.e. they contribute five years to access a pension right

for 20 years); and (c) deficiency of information for long-term financial planning does not help individuals to save. This compulsory affiliation and contribution is applied to employed workers, because government also constrains employers to retain the percentage of the salary, as a part of their obligation, as taxes and other payments. However, in the case of self-employed workers, this obligation is difficult to implement, because there is no a permanent or stable labor relation with one employer. Holzmann and Hinz (2005) mentioned that the self-employed are not always required to participate in pension systems. Considering this, the higher the participation in the labor force of self-employed workers, the greater the importance of designing incentive mechanisms to promote saving behavior in self-employed workers.

Both groups of workers will be analyzed under the life-cycle framework. Authors like Cagetti (2003) used the life-cycle framework to explain individual saving in the context of the retirement process. Besides, the life-cycle model allows one to apply the classical model of discounting utility and the hyperbolic model and allows one to evaluate the behavior of individuals. Both models could help to understand saving behavior of individuals and contribute to the design of adequate mechanisms to promote saving (Laibson et al. 1998; and Angeletos et al., 2001).

Definition of Terms

The terminology used in this research proposal is related to the theoretical framework, specifically that of economics and pension systems. The first term is *pension system*, which is defined as the mechanism designed to "provide an income to individuals who suffer a loss in earnings capacity through advanced age, the experience of a disability, or the death of a wage earner in the family" (Schwarz, 2006, p. 5). With regard to financing mechanisms of social security, a *pay-as-you-go* financing mechanism is one in which workers make contributions based on their current salary that are used to pay benefits for current retirees. *Fully funded* is an alternative mechanism characterized by the investment of a worker's contribution in a specific fund, rather than spending it, and the investment earnings are an integral part of the benefits that will be paid in the future (Schwarz, 2006). In the Peruvian situation, these investments are managed by a private agency.

Two terms are related to paying benefit mechanisms. The first is *defined benefit* that identifies a pension system in which the pension received is usually a fixed percentage of average income earned in the last years prior to retirement. The second term is *defined contribution*, referring to a pension system in which the worker's contribution is a percentage of the salary and specified by the government, in which the final pension is determined by the balance in the individual account at the time of retirement. This balance is the amount generated by contributions and the investment earnings of those contributions. In the Peruvian case, the current rate of contribution to the Peruvian Private Pension Fund System is 10% of monthly income, although the government decided to reduce this rate to 8% in the period between 1995 and 2004. Typically, defined benefit systems are a characteristic of pay-as-you-go schemes, and defined contribution systems are a characteristic of fully funded schemes (Schwarz, 2006). In addition, a common instrument used in social security is the replacement rate, which is a ratio equal to pension versus labor income.

The *life-cycle* framework, used to analyze pension systems, is a standard way that economists think about the intertemporal allocations of time, effort, and money (Browning, Deaton, & Irish, 1985; Gourinchas, and Parker, 2002). This framework is wide and includes many empirical models (Browning & Crossley, 2001).

The life-cycle terminology covers terms such as *consumption smoothing* which "addresses issues of saving and allocation of resources, transferring resources from a period of economic activity and earnings to a period of retirement" (Holzmann & Hinz, 2005, p. 27). Browning and Crossley (2001) emphasized the application of smoothing, in the sense that it does not mean keeping consumption constant. Instead, it means that individuals try to keep the marginal utility of money constant over time. Intertemporal choices are decisions in which the timing of costs and benefits are spread out over time (Loewenstein & Thaler, 1989).

The term *myopia* is defined as an individual preference for financing present consumption compared with future consumption, and it is represented by the utility discount function (Valdez-Prieto, 2004).

Assumptions

The following assumptions attempt to deal with heterogeneity, an important issue when researchers are dealing with microeconomic information that will be used in the methodology: (a) consumers cannot borrow against future labor income, (b) the contribution rate remains constant, (c) individuals begin their active working life at age 20 and retire between 60 and 65 years old, (d) individuals receive bequests, and these depend on the age, (e) individuals are informed of and have access to different financial alternatives, (f) households are of fixed size, and all members die when the household head dies, and (g) there are no saving processes after and before the active working life. The assumption of constant relative risk aversion was made to facilitate comparison with previous studies.

Limitations and Delimitations

The study has a time limitation based on ENAHO survey information from 1997 to 2006. As the Peruvian

Private Pension Fund System began to operate in June 1993, this period will be enough. This public survey covers all Peruvian regions and makes generalization to the labor force possible. The study will focus on individuals, and it is limited to employed and self-employed individuals enrolled in the Peruvian Private Pension Fund System. The self-employed represent an important segment of the Peruvian labor force (Peru - Minister of Economics and Finance, 2004b). Another limitation is that the study is focused on individuals affiliated to the private pension system and does not consider other specific pension systems because this private pension system is the most important in the Peruvian context (Peru - Minister of Economics and Finance, 2004).

It is important to indicate that the sample from 1996 to 2000 was based on the National Population Census of 1993, while the ENAHO survey from 2001 till 2006 used as a basis the results of the 1999 Peruvian household census, increasing the urban areas covered and the number of households. As the methodology is the same, academic researchers about life-cycle such as Deaton (1985) solved this limitation with a specific method for these cases, named pseudo panel, that will be presented in the methodology section. According to the Peru - National Institute of Statistics and Systems (2004), the ENAHO data are weighted to be representative of the Peruvian population and generally linked to the individuals affiliated to the private pension system.

Conclusions

The context of a forced social security affiliation and saving for employed workers contrasts with the freedom for self-employed individuals. This situation offers a singular opportunity to compare the saving behaviors of both groups. The importance of the self-employed group has been reported in the literature; and their lack of contributions and saving requires an analysis of their behavior. The academic research into the saving behavior of both employed and self-employed will be an important contribution to this specific arena.

Recent studies about saving behavior in Peruvian experiences considered the life-cycle framework, and the latest research in Peruvian situation by Saavedra and Valdivia (2003) indicated the importance of continuing research in this direction. One of the approaches to apply is the hyperbolic discounting model, used to analyze possible inconsistencies in individuals' preferences. This behavior has important implications for economic choices; researchers applied this model to retirement timing, employment, and undersaving, and it could make an important contribution to understanding saving in Peru.

The enrollment in the private pension system and the presence of two groups (forced and not forced to save) offers the opportunity to evaluate how much compulsory

saving corrects this inconsistency. This study will contribute to the understanding of saving and promote the possibility of evaluating and designing commitment devices to encourage saving in the Peruvian population.

CHAPTER II: LITERATURE REVIEW

The literature review is mapped on the relation between two main topics: (a) saving and social security and (b) the life-cycle approach to analyzing retirement saving behavior and intertemporal preferences.

Saving and Social Security

Mitchell and Utkus (2004) mentioned that academic research about individual saving is an issue of central importance to policy makers. This issue has been a matter of academic interest since the germinal contribution of Ramsey (1928). Browning and Lusardi (1996) made an important selection about saving literature, pointed out a group of reasons that explained savings of individuals, and summarized a list of saving motives, suggesting that all of them are complementary, with some psychological explanations. Cagetti (2003) and Samwick (2003) indicated that there are two important reasons to save: (a) to finance expenditures after retirement, analyzed under the life-cycle hypothesis and (b) to protect consumption against unexpected shocks or events.

Retirement Saving

Selnow (2004) mentioned some exceptional characteristics related to retirement saving that differentiate it from consumption decisions: (a) the payoff for reducing consumption to save for tomorrow is quite uncertain; (b) workers do not easily buy the idea of payoff in the distant future; (c) the promise of pleasure tomorrow means effort today; (d) the decision to consume today yields instant gains; (e) there is no immediate reward for retirement saving; (f) saving decisions can be postponed without immediate penalty; and (g) there are not functional deadlines for saving. Considering these factors, in a freedom situation, it is possible that individuals may not prefer to save for retirement at the beginning of the life cycle, and the creation of social security becomes an important policy to promote retirement savings.

Social Security and Compulsory Saving

The relation between savings and social security is mentioned by Gill, Packard, and Yermo (2003), Holzmann and Hinz (2005), Schwarz (2006), and the World Bank (2004). These authors indicated that two of the objectives of retirement social security are to smooth consumption over the life cycle and to insure workers against risks,

specifically the uncertainty of life expectancy after retirement or of disability situations. The smoothing consumption is achieved by transferring resources from a period of economic activity and earnings to a period of retirement.

The role of government in social security has been was a matter of analysis and discussion. Holzman and Hinz (2005) mentioned that the compulsory contribution to social security by government or public intervention is based on factors such as myopia, a relatively high preference for financing consumption now compared to consumption in the future, the absence of financial products, the need for regulation and supervision, the desire to distribute income more equitably, and solidarity. Valdéz-Prieto (2004) discussed justifications for introducing a mandate pension system based in factors such as myopia, moral hazard (individuals that did not contribute take advantage of the pension subsidy of government financed by taxes), improvidence (known as a systematic mistake by workers about their future, in the sense that they will begin to save when they are too old), political incentives to make future generations pay for pension transfers to current generations, and adverse selection in annuity markets, when better-informed workers in the voluntary insurance market take advantage of their prospective longevity to assess their expected gain from the insurance contract. Other authors, for example, Tezel (2006), pointed out that as a consequence of the uncertainty of income of life-cycle tendency, social security will not be enough and government should implement additional polices to promote savings besides social security.

Imbrohoroglu et al. (2003) discussed the fact that the lack of individual foresight to save adequately for retirement as a justification for mandatory pension systems can be explained under behavioral analysis. An alternative approach to modeling a strategy for analyzing and explaining the presence of social security is found in literature related to time-inconsistent behavior (Imbrohoroglu et al., 2003, based on Akerlof, 1991).

Thaler and Benartzi (2004), based on empirical observations, indicated that saving for retirement requires self-control and the behavior of individuals confronts the assumptions of the classical theory. Thaler and Benartzi analyzed the implementation of an automatic enrollment saving program, named Save More Tomorrow (SMarT), which is a saving program implemented in three companies, where workers were committed to save a percentage of their future salary in the program. According to Thaler and Benartzi, this simple automatic enrollment "should help people approximate the life-cycle saving rate if they are unable to do so themselves" (p. 169). The results of the program showed that SMarT participants almost quadrupled their saving rates and suggested that commitment devices can be used to design effective prescriptive programs for important economic decisions. Thaler and Benartzi explained saving behavior

of households that appeared not to save enough for retirement by means of psychological concepts such as lack of self-control.

Models to Analyze Behavior

The integration of economic assumptions with psychological factors mostly revolves around the concept of rationality. Kahneman (2003a) indicated that the assumption of rationality is an approximation and involves the maximization of the utility. Since the initial formulation of the theory of utility, academics have introduced variations with behavioral implications and provided the framework to analyze psychological aspects. This perspective is consistent with "fundamental economic propositions that people can and do to maximize their self-interest, but less-than-perfect outcomes" (Mitchel & Utkus, 2004, p. 3).

Ho et al. (2006) reviewed research developments in behavioral economics, an "approach that integrates psychological insights into formal economic models" (p. 307). This framework is important and has been applied in business disciplines and organizational behavior. Ho et al. specified the generalized utility functions of economic models, with references extracted from the behavioral arena: (a) the standard expected utility hypothesis expanded with the new specification named reference-dependent preferences, proposed by Kahneman and Tversky (1979) to analyze loss aversion; (b) pure self-interest extended to inequality aversion, involved with fairness and social preferences; and (c) exponential discounting extended to hyperbolic discounting proposed by Laibson (1997) and related with preferences or instant gratification applied to savings.

Discounting Models

The seminal contribution of Samuelson (1937) offered a general model to describe a decision maker's intertemporal preferences over consumption profiles under the classical economic assumptions of perfect rationality. This model, known as the discounted utility model, is used in many fields involved with intertemporal choice and assumes that individuals make decisions to maximize the discounted sum of instantaneous utilities in future periods, discounted by an exponential factor (Ho et al., 2006, p. 315). Frederick, Loewenstein, & O'Donoghue, (2002) mentioned that the simplicity and elegance of Samuelson's model allowed the possibility of using it as a framework of choice for analyzing intertemporal decisions.

The discounted utility model can be described as the following discrete equation:

$$U^t (u_t, u_{t+1}, ..., u_T) \int u_t + \sum_{\tau = t+1}^{T} \delta^{\tau - t} u_\tau \qquad (1)$$

where δ^t is an exponential discount factor (where $0 < \delta < 1$), and u_τ is the instantaneous utility of an individual at time τ, and with intertemporal utility in period t, and U^t is the intertemporal utility in period t. The exponential function $d(t) = \delta^t$ is the only possibility that satisfies time-consistency, "that is, when agents make plans based on anticipated future trade-offs, they still make the same trade-offs when the future arrives" (Ho et al., 2006, p. 315).

Strotz (1956) was the first author that detected an anomaly in behavior and found that interest rate of discount functions is not constant but varies over time, in contrast to the classical model assumption. Strotz proposed a theory of behavior in which individuals appear to discount the near future more rapidly than the distant future, which means that people are impatient at present but claim to be patient in the future. This kind of preference was modelled with alternative models of discounting, named hyperbolic discounting models, and was applied to experiments and mathematical functions with field data (Frederick et al. 2002, Ho et al., 2006; Laibson et al., 1998). Frederick et al. and Laibson indicated that some academic researchers, based on empirical evidence, documented some anomalies of individual behavior and demonstrated the inadequacy of this classical model of discounting utility.

The model that approximates hyperbolic discounting implies the introduction of one additional parameter into the standard classical framework: β -δ quasi-hyperbolic model. Phelps and Pollak (1968) introduced this factor; and Laibson (1997) applied this concept. It is important to mention that Laibson proposed a discrete time discount function known as "quasi-hyperbolic" for methodological purposes. Under quasi-hyperbolic discounting, the individual's weights on current time (time t) utility is 1, while the weight on period τ 's utility ($\tau > t$) is $\beta\delta^{\tau - t}$. This intertemporal utility in period t, named U^t can be represented by the following equation:

$$U^t(u_t, u_{t+1}, ..., u_T) \int u_t + \beta \sum_{\tau = t+1}^{T} \delta^{\tau-t} u_\tau \qquad (2)$$

In the $\beta - \delta$ model, the parameter δ captures the long-term preferences, while β (where $0 < \beta < 1$) measures the immediate gratification or the degree of short-term gratification. If β is low, this implies that immediate preference is more valued. Besides, it is important to consider that (a) the discount factor placed on the next period after the present is $\beta\delta$ and (b) the incremental discount factor between any two periods in the future is

$$\frac{(\beta\delta^{t+1})}{\beta\delta^t} = \delta \qquad (3)$$

In the equation (3), individuals act at the present time as if they will be more patient in the future (using the ratio δ), and before the future arrives, the discount factor is $\beta\delta$. When $\beta=1$, this model is converted in the classical

discounting utility framework. The hyperbolic agents have a gap between their long-term goals and their short-term behavior. This behavior has important implications for economic choices, and researchers applied this model to explain a variety of fields related to social security, such as retirement timing, employment, undersaving, and other aspects of business applications.

Life-Cycle Approach and Hyperbolic discounting

The life-cycle framework has its roots in the contributions of Ramsey (1928) and Modigliani and Brumberg (1954). This approach predicts "borrowing prior to labor market entry, wealth accumulation during the working life, and dissaving in retirement" (Browning & Crossley, 2001, p. 14). Browning and Crossley pointed out that in every stage of the life cycle, there are challenges for this model that are based on micro-level data, because life-cycle framework allows the possibility to integrate many aspects of behavior in a coherent and disciplined way. For example, portfolio choice, demographic issues, and retirement behavior are included in consumption and saving patterns. (Samwick, 2006; Shiller, 2005)

For Thaler and Benartzi (2004), the life-cycle hypothesis is an example of a normative theory of saving because it is based on the solution to a lifetime consumption-smoothing problem (p. 166). It is difficult to reject the basic premise of life-cycle saving which is that the current saving correctly anticipates future needs and smoothes consumption (Attanasio & Browning, 1995; Browning & Lusardi, 1996). The recent work of Altman (2003) serves as a reference for individual saving over the life cycle. Besides, the life-cycle approach is a coherent framework, can be used with different models that can be tested or rejected, and has been used with different applications (Browning and Crossley, 2001). One of the research areas to be applied is the difference between different assets that a household can handle, and this confirms the possibility of incorporating the liquid and illiquid assets that hyperbolic consumers hold.

Considering the flexibility of the life-cycle model, Laibson et al. (1998) applied the hyperbolic discounting function in the specific case of saving-generated empirical predictions that allowed the possibility of differentiating the model from the standard one with exponential discounting. Angeletos et al. (2001) showed four characteristics to draw the application of the hyperbolic discounting model applied to saving behavior: (a) hyperbolic households will hold their wealth in an illiquid form as a mechanism to protect from consumption requirements when the future arrives; (b) households with hyperbolic discount functions usually have a high level of revolving debt, despite the high cost of credit card borrowing; (c) hyperbolic households have little liquid wealth, and they are unable to smooth consumption, generating a

parallel between income and consumption, making this predictable; and (d) the previous relation between income and consumption will stand out around retirement, when labor income falls and the lack of liquid wealth generates a necessary fall in consumption and a loss of illiquid assets (p. 49). These characteristics allowed the differentiation between the classical exponential discounting model and the hyperbolic discounting model.

Besides the application of Laibson et al. (1998), there were other hyperbolic applications to household saving patterns and social security. Imbrohoroglu et al. (2003) analyzed the public pension system with individuals with time-inconsistent preferences. Their findings showed that unfunded social security reduces the capital stock, output, and consumption for time-inconsistent individuals. Eisenhauer and Ventura (2006) found that less than a quarter exhibited hyperbolic discounting, with an emphasis on young, urban, and least educated individuals. Besides, Eisenhauer and Ventura established that hyperbolic discounters save less than exponential discounters. Besides, individuals do force themselves to save in instruments, as fixed assets, to constrain their consumption. Diamond and Koszegi (2003) applied this model to the consumption patterns and found that the hyperbolic discounter may be different from that with exponential discounting.

Summary

Part of the literature focused on the compulsory saving behavior encouraged by the government and was based on different arguments related to anomalies in the behavior of individuals. The academic contributions of Strotz (1956), Laibson (1997), and Thaler and Benartzi (2004) offered an alternative to incorporate anomalies in individual behavior such as lack of self-control. The model used as a framework is known as hyperbolic discounting. The importance of saving was focused in the context of social security, specifically under pension systems based on individual accounts, in which individuals must contribute a percentage of their salary during the active stage in order to finance a pension in the retirement phase. This issue has been analyzed under different approaches, of which the life-cycle approach has been the most important.

Conclusion

The analysis of hyperbolic discount functions and its applications has been a matter of recent development. The Peruvian experience, which provides for compulsory contributions from employees with formal contracts to individual accounts to finance a future pension, but does not require contributions from self-employed workers, offers the opportunity to analyze how much the compulsory saving can reduce the self-control distortions in individual behavior. The literature review documents that the hyperbolic model could be a framework to analyze

and evaluate both profiles, because of its integration with life-cycle framework and its application to the social security saving process. Finally, it is important to mention that this issue has not been analyzed before in the Peruvian context.

CHAPTER III: METHODOLOGY

This section will present the methodology of the proposed research and a consideration of the information that will be provided by public surveys and the instrumentation extracted from the work of Laibson et al. (1998) and Angeletos et al. (2001). This last issue will be adapted to Peruvian characteristics, because the authors applied their model to the American market with different characteristics and information.

Research Design

The paradigm of this analytical and quantitative research is to consider the proof of hypotheses about an exponential or hyperbolic saving behavior of individuals affiliated to the Peruvian Private Pension Fund System and to apply concepts of behavioral economics with concepts of self-control proposed by the literature. The enrollment into the Peruvian private pension system will offer the opportunity to compare individuals who are forced to save with those who are not. The longitudinal panel data information of Peruvian households of 10 years will permit application of the exponential and hyperbolic life-cycle models, because the intertemporal decisions and life-cycle approach involve more than three periods, as Laibson et al. (1998) recommended.

The models that will be used in this study come from the research of Laibson et al. (1998) and Angeletos et al. (2001). The models allow the evaluation and analysis of both exponential and hyperbolic discounters. From the results of this quantitative research, an attempt will be made to determine whether the compulsory saving of governments converts individuals in exponential discounters.

Appropriateness of the Design

The methodology implies the application of a simulation model of the behavior of consumers, based on the information of the ENAHO survey. This model was proposed by Laibson et al. (1998) and Angeletos et al. (2001) and will allow the possibility of quantitative empirical predictions of hyperbolic behavior, and it will be compared with the exponential consumption model. The model will estimate time preference parameters for the exponential discount function and hyperbolic discount function.

The other possibility to evaluate hyperbolic discount is

offered by experimental surveys, although this is limited to a specific group and does not involve intertemporal effects; and field data has greater validity than abstract and unfamiliar laboratory decisions (Laibson, Repetto, & Tobacman, 2005)

Research Questions

The methodology and the model will answer the following research questions: (a) does compulsory contribution of employed workers at Private pension system smooth consumption and convert their saving behavior in exponential discounters?, (b) is the optional contribution of self-employed workers at Private pension system explained under the hyperbolic discount?, (c) do the employed workers affiliated to the Peruvian private pension fund system base their saving behavior only in the contribution rate to the private pension system?, (d) are there differences in the saving behavior of employed and self-employed workers?, and (e) how do self-employed workers affiliated at the Peruvian private pension fund save to their retirement?

Population

The population will be composed of workers enrolled to the Peruvian Private Pension system. In order to consider the proof of hypotheses and the methodology it will be considered both employed and self-employed workers. The field data will come from the ENAHO survey and will be complemented with the Peruvian PRIESO (Encuesta sobre Prevision de Riesgos Sociales) developed by Barr and Packard (2003). The surveys are complementary because the PRIESO survey was developed in 2002 and involved 1002 individual respondents randomly drawn from the list of Lima residents, based on the ENAHO survey conducted in 2001.

Sampling Frame

The ENAHO surveys provide information about income, pension systems, consumption, and assets. The structure of the information allows a stratification division between employed and self-employed individuals. The PRIESO survey will be used to extract more detailed information and the results of an economic experiment, in which the respondents were confronted with a gamble framed first as an investment decision and then as an insurance decision (Barr & Packard, 2003). The PRIESO survey has been provided with permission given by the authors.

The ENAHO survey has panel data of 6,146 households, and the distribution of the data has a mean age of 37 years; the average holdings of assets, other than accrued pension rights or savings, are around USD11, 000.

Confidentiality

There is no possibility of accessing and identifying individuals and households considered in ENAHO survey. According to the technical annex of ENAHO (Peru – National Institute of Statistics and Systems, 2004) the information is anonymous and represented by codes.

Geographic Location

The research will focus on the Peruvian population affiliated to the Peruvian Private Pension Fund System. This pension system is the most important in the country (Peru – Minister of Economics and Finance, 2004a) and has affiliates in all regions of Peru.

Instrumentation

The model used by Laibson et al. (1998) has seven domains, demographics, income, bequests, asset allocation, taxes, preferences, and equilibrium, and will be adapted to the Peruvian situation. According to Laibson et al., the demographics, income, bequests, and asset allocation will use the classical analysis of intertemporal consumption, and the preferences and equilibrium domains will be used to analyze an individual's behavior.

Demographics

The demographic domains cover the population in the working phase and the retirement phase. The working phase will be from age $20 \leq t \leq T$, where t is the age, and T is the age of retirement. According to Peruvian legislation, the age of retirement is 65, but it also allows the possibility of early retirement. The official statistics showed that as of 2006, 45% of retirees retired at 65 years old and 55% at 60 years old. The retirement period is from age $T \leq t \leq T + N$, where N is the number of survival years of the retiree. The number of survival years will be estimated with the survival rates taken from the Peruvian mortality table approved by the government agency responsible for insurance and pension fund supervision. Besides, the model assumes that households are of fixed size and all members die when the household head dies.

Following Laibson et al. (1998) and Angeletos et al. (2001), the intention in this study is to divide the population into three educational categories: high school dropout, high school graduate, and college graduate. The same consideration was made by Saavedra and Valdivia (2003) with Peruvian information. The relation between savings and educational degree was cited and documented in Browning and Lusardi (1996).

Income

In the case of labor income Y_t, the research will

consider the life-cycle approach that relates income as a function of age. The information will be expressed in real terms and will take the year 2006 as a basis. The division into educational categories will help to differentiate levels of income.

The panel regression model for labor income will be

$$y_{it} = \alpha_1(FS)_{it} + \alpha_2(age) + \alpha_3(TE)_{it} + \alpha_4 \text{(cohort dummies)} + \xi_{it} \quad (4)$$

where labor income (y_{it}) expressed as the natural log of non-asset income on household i in year t will be the independent variable. The dependent variables will be the family size (*FS*), a polynomial in age (age), a time effect (*TE*), and five years cohort effect.

The equation will be estimated by weighted least squares, and the polynomial will be specified as cubic for preretirement regression and linear for the postretirement regression. Besides, the coefficient α will be estimated using the generalized method of moments, and the stochastic component ξ_{it} will be estimated with a first autoregressive process. These techniques recommended by Laibson et al. (1998) will be applied to panel data information from the ENAHO survey.

Bequests

The third domain is the bequests that individuals receive, and was used by Dynan, Skinner, and Zeldes (2002). Laibson et al. (1998) and Angeletos et al. (2001) assumed that bequests at time t do not depend on a prior history of bequest. The estimation of the possibility of receiving a bequest will be estimated with a standard probit formulation:

$$p(t) = Prob(q < h(t) \mid q \sim N(0, \sigma^2)) \quad (5)$$

where h(.) is a cubic polynomial on time, and the bequest (B) process will be estimated by

$$b(t) = g(t) + \eta_t. \quad (6)$$

where ln(B) $\int$ b(t), g(t) is a cubic polynomial in age and η_t is distributed $N(0, \sigma_B^2)$. The independent variables are third degree polynomial in age.

Asset and Dynamic Budget Constraints

The fourth domain is compounded by the total assets of individuals, both liquid and illiquid assets. The liquid assets (convertible in cash immediately, as banking saving accounts) holdings at age t will be represented by X_t, and the illiquid assets (not convertible in cash at short term, as housing, durable goods, and retirement savings) holdings at age t will be represented by Z_t. The dynamic budget constraints will be the sum of both types of assets:

$$X_{t+1} + Z_{t+1} = R(X_t + Y_t + Z_t + I_t - C_t - T_t + B_{t+1}) \quad (7)$$

where Ct is the consumption level a age t, I_t is compounded by the contributions to the private pension systems at age t, which is illiquid because an individual cannot dispose or borrow against that sum of money, according to Peruvian legislation, and R is equal to 1+r. Equation (7) means that assets of the individuals increase as assets, income minus savings, with the corresponding interest rate. The model uses liquid assets and illiquid assets, which includes the defined contribution pension system plan, and incorporates the savings.

$$Z_{t+1} = R(Z_t + I_t) \quad (8)$$

The illiquid assets Z_t will be conformed by the defined contribution individual account, because it cannot be retired until the individual retires, and fixed assets as housing, and other durable goods; and It represents the worker contribution, a percentage of the salary, to the private pension system.

Taxes

The model will incorporate taxes estimated under Peruvian tax legislation. In this particular case and according to Peruvian legislation, the worker's contributions to the Private Pension Fund System are not tax deductible, and the taxable income will be:

$$Y_t + \left(\frac{r}{R}\right)X_t \quad (9)$$

Preferences

The preferences domain will be modeled with the utility model, in which exponential individuals have the coefficient β equal to 1, and hyperbolic consumers have a coefficient β less than 1, meaning that they have a short-term discount rate greater than the long-term discount rate:

$$U^t = u(C_t) + \beta \sum_{i=1}^{T+N-t} \delta^i (\prod_{j=1}^{i} s_{t+j}) \, u \, (C_{t+i}) \quad (10)$$

where u(.) is an utility function with coefficient of relative risk aversion ρ; s is the probability of surviving at age t conditional on being alive at age t-1.

Equilibrium

In order to find the equilibrium of the set of equations, it is necessary to model the consumption choices C_t in all the period observed from 20 years to T + N, considering the restrictions of liquid and illiquid assets. According to Laibson et al. (1998), the decision to consume should be treated as an intrapersonal game. Each individual will take a strategy for time t that will be optimal from

his particular perspective. The equilibrium will be a fixed point and will be restricted to Markov strategy, and the equilibrium will be solved using a numerically implemented backwards induction algorithm, as Laibson et al. recommended. The maximization of C_t that contains the dynamic inconsistency in preferences β is presented in the following equation:

$$uC_t + \beta\delta s_{t+1} \, E_t \, [V_{t,t+1} \, (X_{t+1}, \, Z_{t+1}, \, Y_{t+1})] \qquad (11)$$

where X_t represents liquid asset holdings at the beginning of period t; Z_t represents illiquid asset holdings at age t. Laibson (1997) used a quasi hyperbolic function to simplify the algorithm, because it can be expressed as a discrete time function.

$V_{t,t+1}$ represents the time t+1 continuation payoff function of individual t, and maximizes equation (10). In the time t continuation payoff function of individual t-1 can be calculated by:

$$V_{t-1,t}(X_t, Z_t, Y_t) = uC_t + \delta s_{t+1} \, E_t \, [V_{t,t+1} \, (X_{t+1}, \, Z_{t+1}, \, Y_{t+1})] \quad (12)$$

in which the factor β does not appear. The solution for equilibrium requires an iteration of equations (11) and (12).

Data Collection

The information will be taken from the ENAHO survey from 1997 to 2006 and complemented with the PRIESO survey. The ENAHO survey has been elaborated since 1997 by the National Institute of Statistics and Systems (NIS), the government agency responsible for the Peruvian official statistics (Peru – National Institute of Statistics and Systems, 2004). This survey contains public information about Peruvian households.

Data Analysis and Procedures

The ENAHO surveys have 10 years of field data, but according to methodology, NIS changed the sample in 2002, and as a consequence of that, there are two panel data. In order to have 10-year panel data, the research will apply a pseudo panel technique, as was proposed by Browning, Deaton, and Irish (1985) and Deaton (1985). This method was also used by Gardes, Duncan, and Gaubert (2005) to estimate income on a pseudo panel, even when data panels exist, to estimate longer periods. Pseudo panel data will be constructed from a time series of surveys elaborated under the same methodology but in different periods (Gardes et al., 2005). Huang, Liu, and Zhu (2006) used this technique to have information covering a longer time span to analyze self-control behavior, as does the current approach of the research proposal.

The beginning of the working life will be assumed at age 20, and the survival age will be the determined with the mortality life tables approved for the private pension system. As recommended by Laibson et al. (1998), households are of fixed size, and for simplicity, the study will not simulate the mortality of spouses.

The individual account at the Peruvian Private Pension Fund System is an illiquid asset and will be estimated using the life-cycle earnings and an annual rate of return of 5%, according to recommendations of the Actuarial Standards Board (1999) and the American Academy of Actuaries (2001) for long-term projections, and a contribution rate of 10% of the labor income will be used, as Peruvian legislation stipulates. The unemployment periods will be taken from the statistics of the NIS.

The stochastic component ξ_{it} of equation (4) will be modeled following the recommendations of Laibson et al. (1998) as the sum of an individual fixed effect, a first order autoregressive process, and a purely transitory shock (p. 111).

The estimation of bequests will be done with previous revision of data from the PRIESO survey. With the available information and according to Laibson et al. (1998), the estimation will be done with a probit regression.

The utility function of equation (10) will have a constant coefficient of relative risk aversion (CRRA). This variable measures risk aversion, prudence, and willingness to substitute consumption intertemporally (Laibson et al., 1998). In order to estimate the preference parameters, the study will follow the recommendations of Laibson (1997) and incorporate a CRRA of 1 and 3. According to Angeletos et al. (2001), the CRRA is set between 1 and 5. Then "if a household has a CRRA of 2, then a household is indifferent between sure consumption of US$ 66,667 and a 50/50 gamble between US$ 50,000 and 100,000 of consumption" (p. 54).

The time preference parameters will be used using a two-stage method of simulated moments (MSM) procedure as proposed by McFadden (1989) and used by Gourinchas and Parker (2002) and Laibson et al. (1998). This procedure extends the generalized method of moments (GMM) to account for numerical simulation error. In the first stage of the MSM procedure, study inputs to the life-cycle model will be estimated, including the parameters of the stochastic labor income process. In the second stage of the MSM procedure, the simulation model will be used to estimate time preference parameters. The parameters of the discount function in the second stage of an MSM procedure will be estimated using the procedure of Gourinchas and Parker (2002), as applied by Laibson et al. (1998). This method will permit evaluation of the predictions of the model, to formally test the nested null hypothesis of exponential discounting and to perform specification tests. Following the recommendations of Laibson et al., the use of MSM is preferred over GMM because MSM allows incorporation of additional uncertainty from simulation errors.

According to Laibson et al. (1998), the equations (6) and (7) will be solved using a solution algorithm based

on local grid searches, which iterates the equations with nonstandard properties documented in Laibson et al.

In order to find the main characteristics to help in the design of the model, the SPSS will be used. For the estimation, the study will use EViews, a quantitative software designed to work with time series, cross-section, or longitudinal data. Besides, the codes produced by Carroll (2006) in his estimating procedures in Matlab will be used.

Validity and Reliability

The validity and reliability of the model is based on its application in the context of the United States and Europe with testing and calibration procedures. The model adapts the life-cycle approach, which framework allows the possibility of incorporating different assumptions and extensions. The findings of the authors were confirmed and calibrated. Besides, the model proposed by Laibson et al. (1998) and Angeletos et al. (2001) followed the academic contributions and findings of Engen, Gale, and Scholz (1994) and Gourinchas and Parker (2002), using the method proposed by McFadden (1989).

The reliability of the parameters will be tested using both t-tests and over- identification tests. The MSM will allow application and testing of the chi-squared distribution (McFadden, 1989).

Summary

This quantitative study will use the model proposed by Laibson et al. (1998) and Angeletos et al. (2001), based on longitudinal panel data information from the Peruvian ENAHO survey about income and consumption. The validity of the model has been tested in other countries, and it will allow the evaluation and analysis of both exponential and hyperbolic discounters. Besides, this model has been calibrated in other latitudes, and from the results of this quantitative research, an attempt will be made to determine whether the compulsory saving of governments converts individuals in exponential discounters.

Finally, the contribution of this research will be the application of the life-cycle model, with both exponential and hyperbolic functions, to model the behavior of individuals affiliated to the Peruvian private pension system and its adaptation to the Peruvian situation. The results of the study should provide an important contribution to the understanding of saving behavior in Peru.

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Footnotes

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