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Auctioning annuities

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What makes a market for annuity contracts successful? What are the key demand and supply constraints that affect the performance of such a market? And how should those constraints determine the answer to the first question? For instance, is it better to structure the market as post-your-price, where firms post the pension they can offer and retirees pick and choose? Or should we use an auction instead, or allow retirees to bargain with the firms, or, something else, and why? In many countries, such questions are becoming increasingly important subjects of policy debates on pension reforms that promote public-private partnerships as a way to improve the financial security of its retiring workforce.

Economic theory alone cannot help us because the answers to the above questions are theoretically ambiguous as they depend on the relative importance of different factors that determine demand—such as the presence of intermediaries (i.e., sales agents, advisors), retirees' abilities to process information, preferences for leaving bequests, risk aversion, the force of mortality—and supply for annuities—such as firms' annuitization costs and the extent to which only the firms know their costs and the degree of competition. All of these factors are unobserved to researchers, so to answer the aforementioned questions we need empirical study of the market.

So, first and foremost we have to estimate these factors that affect the demand and the supply of annuity contracts. With these estimates, we can simulate counterfactual market outcomes under different rules, one at a time, and compare the outcomes with each other to quantify how the equilibrium pensions and retirees' welfare depend on these rule(s). Using these measures, we can determine whether the current market is efficient and, if not, the extent and causes of inefficiencies, and then suggest ways to improve the market.

In our research paper entitled "***Auctioning Annuities***," we study these, and other related questions, using rich and unique data on over a decade of annuity contracts that were bought and sold in Chile from 2007 to 2018. Chile is one of the first countries to use a public-private system to provide annuity pensions to its retirees, where the market is structured as *first-price-auction-followed-by-bargaining*.

In this system, a retiree selects a firm that offers the highest utility and not just the highest pension because, besides the pensions, retirees may also care about the bequests they leave for their spouses and about the firm's risk ratings, which proxy firms' financial health. Yet, we almost always evaluate the success of a market based on the pension. The Chilean pension system has reached a large share of retirees, but the level of retirement income is very low. For instance, the median replacement rate in Chile (ratio of initial pension to the last wage) is 44%, which is substantially lower than the International Labor Organization recommended 70%. This comparison, however, ignores the utility comparison, and in this research paper, we make those utility comparisons. This system is widely known as the "Chilean model," and it has been adopted by more than 10 countries. So, the empirical lessons from using Chilean data can be useful to policymakers beyond Chile, including the United States.

The Chilean model

In the early 1980s, Chile implemented a major reform in its pension system and replaced the pay-as-you-go system with a system of privatized individual accounts that are managed by private pension funds (henceforth, AFPs). Under the new system, every worker in a formal sector must contribute 10% of their monthly earnings into their accounts, up to a maximum contribution, which in 2018 was US$2,319. These savings accumulate tax-exempted returns until the worker reaches the minimum retirement age, which is 60 for women and 65 for men.

Upon reaching the minimum retirement age, and if their total savings are larger than a threshold set by the government, workers have to choose between either an annuity or the programmed withdrawal (henceforth, PW). Those with lower savings are entitled to supplementary income from the government.

We focus only on those retirees who choose annuities. The government regulates and supervises AFPs during the accumulation stage and regulates the life insurance companies who provide the annuity contracts during the decumulation stage.

The annuity insurance industry is heavily regulated by the Chilean government, where the main concern is to manage risks that are associated with longevity and reinvestment. The government regularly assesses the risk of reinvestment via the Asset Sufficiency Test established in 2007. Under this regulation, every insurance company is required to establish additional technical reserves if and when there are insufficient asset flows.

The government also provides information about companies' financial health to avoid undue uncertainty about the future. Bankruptcy among life insurance companies is historically rare in Chile, but the government still guarantees that even after bankruptcy every retiree will get pensions up to 100% of the basic solidarity pension, and 75% of the excess pension over this amount, up to a ceiling. Thus, there is enough structure in this market for retirees to feel protected from firms' financial problems.

Pension products

There are three types of retirement products: programmed withdrawal (PW), immediate annuity, and deferred annuity. Under PW, savings remain under AFP management and are paid back to the retiree following an actuarially fair benefit schedule. In the event of death, remaining funds are used to finance survivorship pensions or become part of the retiree's inheritance. PW benefits are exposed to financial volatility and do not provide any longevity insurance so that, barring extraordinarily high returns, pension steadily decreases over time.

If the retiree chooses an annuity, either immediate or deferred, her savings are transferred to an insurance company of her choosing. That company will provide

her and her surviving beneficiaries an inflation-indexed monthly pension. In the deferred annuities, payments are contracted for a future date (usually between one and three years), and in the meantime, she can receive a temporary benefit that can be as high as twice her pension.

Annuities may also include a special coverage clause called a guaranteed period (GP). For instance, if there is a 10-year guaranteed period, then the full pension will be paid for 10 years, either to the annuitant or her eligible beneficiaries upon her death. Once the guaranteed period is reached, the contracts revert to the standard conditions. Among the retirees who choose annuity contracts with GP, most (99.9%) choose 0, 10, 15, or 20 years of GP.

Putting together, the main trade-off between an annuity and a PW is that while an annuity provides insurance against longevity risk and financial risk, choosing an annuity is an irreversible decision. Under the PW, in case of an early death all the savings are bequeathed to the heir, and a retiree can start with a PW and switch to an annuity contract at a later date.

Retirement process

The process of buying an annuity contract begins when a worker communicates her decision to retire to her designated AFP. She can use one of the four intermediaries (AFP, insurance company, sales agent, and an independent advisor) to help in her decision process. Two out of these four channels (sales agent and independent advisor) charge fees which are automatically deducted from the savings account.

The retiree must also disclose information on all of her eligible beneficiaries. The AFP then shares this information along with her demographic information with all the insurance companies in the market. This decision process can be described in the following steps:

1. Retiree requests offers for different types of annuities. Insurance companies have just over a week to submit a bid (i.e., pension) for some or all of these annuities, if at all.
2. These offers are collected and presented to the retiree as a *Certificate of Quotes*.
3. The retiree chooses from the following five options:
   i. postpone retirement;
   ii. fill a new request for quotes;
   iii. choose PW;
   iv. accept one of the first-round offers; or
   v. initiate a second-round negotiation with the companies.

Intermediary channels

As we mentioned before, a retiree can avail herself of the service of an intermediary channel to help her in her decision process. There are four options to choose from. A retiree can either use one of the AFPs who manage a savings account, or she can approach an insurance company directly, or she can use a sales agent, who is employed by a possibly different insurance company, or she can use an independent financial advisor.

The first two options are free, but the second two options have fees associated with them.

Intermediaries can play an important role by helping retirees make an informed decision. An annuity is a complex financial product that requires retirees to make careful comparisons of present discounted expected utility under different types of annuities from different firms. If, however, the objectives of intermediaries do not align with those of a retiree, then retirees do not always choose the “best” option. The misalignment of incentives may be particularly relevant for sales agents, who receive their intermediation fee only if the retiree chooses the sales agent’s firm.

In our sample, we observe a total of 238,548 retirees. Out of those, 109,786 choose AFP, and within this subgroup, only 25.1% choose the second-round bargaining option, and most choose PW. Only 2,169 retirees directly contact the insurance companies, 79,120 choose a sales agent, and the remaining retirees choose an independent advisor. To determine

if any of the observed socioeconomic characteristics of retirees is correlated with an intermediary channel, using multinomial logit regression we estimated the log-odds ratio of having one of the three intermediary channels relative to the AFP. The estimates suggest that those who have lower savings, or retire early, or are male, or are unmarried, are more likely to use sales agents relative to the AFP.

Our empirical framework can capture the effect of channels on outcomes. In particular, we posit that channels affect the cost of acquiring information about the importance of risk rating. For instance, we allow those retirees who use sales agents to act "as if" they have a higher cost of acquiring information about the trade-off between risk rating and pensions. We operationalize this idea by assuming that in the first stage, retirees are rationally inattentive concerning their preference for risk ratings, but in the second stage, they know their preference. To capture the effect on the decision process, in our estimation we allow preferences for risk ratings and information processing costs to depend on the channel.

Life insurance companies

The supply side in Chile appears to be very healthy and competitive. Twenty life insurance companies participate in the annuity market. However, at any given time, not all of those 20 firms are active, and even if they are active in a given month, not all active firms participate and make offers to all the retirees who look for quotes in that period.

On average, a retiree has 11 life companies to choose from. The market is competitive even if we look at the market share. The quarterly Hirschman-Herfindahl Index, measured at the level of annuity type and the channel, is almost always below 1900. In the paper, we say that a firm is active in a month if that firm has made at least one other retiree in the same month. Using this definition, we find that the number of potential bidders can be either 13, 14, or 15.

We explore if there are any systematic differences in the observable characteristics of retirees when a firm makes the participation decision. For instance, we ask ourselves: Are firms more likely to participate in an annuity auction if the retiree is a male? The answer to this question helps us choose a parsimonious model of firm behavior. We find that although the firms' decision to participate is endogenous and depends on the unobserved (to us, researcher) annuitization costs, there is no selection on other observed characteristics.

Using a Poisson regression of the number of participating firms on the retiree characteristics, we find that one standard deviation increases in savings, which is approximately US$87,000, which is associated with roughly one more entrant. And women have 0.61 additional participating companies than men, while sales agents and advisors are associated with approximately 0.19 fewer participants than the other two channels. We also find that once we control for savings, mortality risks, and the choice of an intermediary channel, the firms are symmetric in terms of their cost distribution. One of our objectives is to estimate the distributions of firms' annuitization costs.

Demand

In our paper, we restrict our attention to retirees who do not have eligible children and who are considering retirement within 10 years of normal retirement age. As we mentioned before, our sample includes a total of 238,891 retirees, out of which almost one-third choose programmed withdrawal, and two-thirds choose an annuity. And among those who choose an annuity, there is an even split between immediate annuities and deferred annuities.

Retirees differ from one another in several dimensions, some of which are observed in the data and others are unobserved. For example, for every retiree, we observe her marital status, gender, savings, year of retirement, and age at the time of retirement. We observe that close to 56% retire at normal retirement age, and almost 80% retire at or at most within three years after normal retirement age. And half of the retirees we observe are married men.

The average savings in our sample is US$112,471, while the median savings is US$74,515, which suggests that the savings distribution is skewed. In particular, the

interquartile range of savings is US$85,907. We also find that the men have larger savings than women, and those who retire early tend to have larger savings still.

Choices

As we mentioned before, on average each retiree gets offers from close to 11 firms. A retiree can request offers for different types of annuity contracts. And there is variation in the offered pensions, both across firms (holding retiree fixed) and across retirees. The average offered pension for an immediate annuity contract is US$570 and for deferred annuities is US$446.

The offers also differ by gender. The average monthly pension offer to a woman for an immediate annuity contract is US$479, and for deferred annuities is US$412. For males, these numbers are US$631 and US$473, respectively. This is consistent with men having higher savings and shorter life expectancy than women. Our empirical model can rationalize this variation in pensions by allowing firms to have heterogeneous and retiree-specific annuitization costs.

It is more likely that only a firm knows its annuitization costs. We will work under the assumption that annuitization costs are firms' private information.

Our sample spans a decade, and in this period the market interest rate varies for reasons that have nothing to do with the annuity market. This variation induces an exogenous variation of the firms' annuitization costs over time and thus provides helpful identifying variation.

Once the participating companies make first-round offers, one for each type of annuity the retiree requests quotes for, she can either choose from one of those offers or she can buy PW or initiate the second-round bargaining phase. Like previous research in annuity and financial contracts, we see that some retirees *do not* choose the annuity with the highest pension. One reason is that besides pensions, retirees also care about bequests and firms' risk ratings, where the risk rating is a proxy of firms' financial health. So, a retiree may get larger utility from an annuity with lower pensions from healthier firms than from an annuity with a higher pension from a less-healthy firm.

To evaluate the efficiency of this market, we have to estimate the trade-off between pensions and risk rating and determine if it varies across retirees. In particular, we want to determine if the weight that retirees put on risk rating changes with their savings. On the one hand, because of the regulation, those with lower savings are less exposed to the risk of firms defaulting than those with higher savings. Those with higher savings should care more about the risk ratings than those with lower savings. On the other hand, because savings is positively correlated with education, those with higher savings will be able to determine the actual likelihood of default, which in the case of Chile suggests that retirees should not care much about risk ratings. Which of these two forces dominate is an empirical question that requires us to estimate a model of demand and supply of annuities.

Mortality

A key determinant of the demand for an annuity contract by a retiree is her expected mortality. All else equal, those who have shorter expected life at retirement might prefer programmed withdrawal to an annuity because under the former contract the retiree can at least bequeath a large portion of her savings.

So, to model the decision process of a retiree, we have to also determine her expected life at the time of retirement. Since this belief is unobserved, we estimate it using the demographic characteristics and information about retiree's death. We observe every death that occurs before December 2017. Using this information, we estimate the force of mortality under the assumption that the conditional probability of death given retiree's sociodemographic characteristics (such as age, gender, marital status, savings, and the year of birth, which captures cohort-specific variations across time) follows Gompertz distribution.

We use the proportional hazard model to estimate the conditional probability of survival. The maximum likelihood estimates of this force of mortality suggest a smaller hazard risk associated with younger cohorts, individuals who retire at a later age, with females, those who are married, and those with higher savings. Using the estimate of mortality, we can estimate the expected age at death given the retiree is alive at retirement.

Overall, we find that 50% of males expect to live until age 86 and 50% of females expect to live until age 94.9.

Empirical findings

To capture key data features, we model each retiree as a risk-averse auctioneer who "auctions" her savings to participating life insurance companies. Therefore, each auction is different in terms of the savings, estimated expected longevity, and the retiree's preferences for bequest and the firms' risk ratings.

In Chile, there is significant uncertainty about the role of firms' risk ratings. So, it is not clear how much such retirees care about the risk rating. On top of that, bankruptcy of life insurance companies is rare, and as we mentioned before most firms have high risk ratings, and the government guarantees a minimal pension should a firm fail. To capture the uncertainty about this preference, we posit that retirees are *rationally inattentive* decision makers, and they incur some cost to process information and update their beliefs about the role of risk ratings.

We assume that her choice of annuity product depends, among other things, on her preference for leaving a bequest, but conditional on choosing an annuity product she chooses the firm that maximizes her expected present discounted utility.

On the supply side, we assume that life insurance companies observe everything about the retiree and their annuitization cost before deciding to participate in a retiree auction. We express the per-dollar annuitization cost of a firm as the *Unitary Necessary Capital* (henceforth, UNC). UNC captures the cost of promising a survival-contingent stream of payments to retirees and is the expected amount of dollars required to finance a stream of payments of one dollar until the retiree›s death and any proportional obligations to her surviving relatives, if any. For example, if the UNC is 200, then it means that the expected cost for the firm to provide a pension of US$100 is US$20,000. Firms first decide whether to participate and, conditional on participating, they bid simultaneously on all of the annuity products that the retiree has requested quotes for. If the retiree chooses from the first round, the game ends, or else bargaining ensues among firms who have private information about their annuitization costs.

Our demand-side parameters include retirees' information processing costs, conditional distributions of preferences for firms' risk ratings, and conditional distributions of preference for a bequest. And our supply-side parameters are the conditional distributions of firms' annuitization costs given the retirees' savings.

We use the fact that, in equilibrium, the observed pensions decrease with the unobserved costs to express the truncated distribution of annuitization costs as a function of the observed distribution of chosen pensions. To identify the weights that retirees put on risk ratings, we use the fact that the firms' risk ratings are exogenous. In particular, suppose we observe two retirees who are identical in terms of their socioeconomic characteristics but vary in terms of the firm they choose. Suppose the first one chooses an annuity contract from a firm one with a monthly pension of US$X and the second retiree chooses from firm two an annuity contract that pays US$Y, which is less than the first pension. And suppose firm one's risk rating is greater than firm two's risk rating. Then, we can say that the trade-off between pension and risk rating for this retiree is worth (US$X-US$Y).

In terms of the preferences for risk ratings, our estimates suggest an interesting pattern that is consistent with *steering*. We find that those who use sales agents or directly contact insurance companies behave as if they care a lot more about risk rating than others. We also find that those with lower savings care more about the risk ratings than those with higher savings. This result is counterintuitive because those with larger savings stand to lose more and so they should care more about the risk ratings than those with lower savings.

One possible interpretation of this result is that while everyone starts with a prior that puts a lot of weight on the risk ratings, those with lower information processing cost revise their preferences and put lower weight on the risk ratings. So, the next step for us is to estimate the channel-specific information processing costs.

To identify the retirees' information processing costs, we use the fact that the elasticity of choice probability with respect to the offered pensions is inversely proportional to the information processing cost. Those who are less responsive to pensions are ascribed to have a higher cost of processing information. Our estimates suggest that those who have higher savings have lower information processing costs, which is consistent with the fact that those with larger savings tend to be more educated.

To identify the distribution of bequest preferences, we show that it suffices to consider the polytomous choices across different types of annuities. All else equal, retirees with stronger bequest preferences are more likely to choose products with a larger present expected value of the bequest, i.e., annuities with longer guaranteed periods. Conditional on choosing an annuity and holding the firm that was finally chosen fixed, we find that close to 50% of retirees show no preference for a bequest, except for those with the highest savings quintile. Our estimates of the distribution, however, suggest that there is considerable heterogeneity among retirees who value leaving bequests to their heirs. For instance, those in the lowest savings quintile, on average, care 1.92 times more about their heirs than themselves, and it increases to 2.82 for those in the highest savings quintile. The standard deviation and the interquartile range also increase with savings, which is consistent with the idea that bequest is a "luxury good" that only people with enough savings can afford.

Using the estimates of the mortality forces, and market interest rate, we also estimate the present discounted months the retiree is expected to live. All else equal, the longer the retiree is expected to live, the more expensive the annuitization cost. We find significant heterogeneity in annuitization costs across retirees and that the cost increases with savings.

Policy interventions

The first question we ask is, "What is the role of asymmetric information?" If the firms' annuitization costs were publicly known and if we shut down the risk rating, how would that affect the equilibrium pensions? And who would benefit the most—those with lower savings or those with higher savings? We find that the gap between the observed pensions and the pensions under *complete information* is the largest for those in the highest savings quintiles.

This suggests that firms are more efficient in annuitizing larger savings than smaller savings, even though those with larger savings live longer and therefore are costlier.

The estimates suggest that an obvious way to improve the market would be to increase the effective competition. One way would be to shut down risk rating and implement a simpler rule such as the English auction, where the firms compete by outbidding each other. If we shut down the risk rating, then the winning firm is the one that offers the highest pension (not the utility). Comparing the pension under English auction with asymmetric information relative to the pension under complete information, we find that using English auction increases pensions but most of the gain accrues to retirees with higher savings. If we include optimally chosen reserve price, the pensions increase slightly but the gain is minimal.

Retirees are risk-averse, so instead of only looking at pensions, we also consider the effect of these new mechanisms on the ex-post expected present discounted utility. First, we find that even though there is a substantial gap between first-best pensions and observed pensions, the gap in utilities is negligible, especially for those with higher savings because of the diminishing marginal utilities. We find that implementing these changes does not hurt retirees, and even though utilities increase, the improvement is minimal.

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