Intermediation, Choice Frictions, and Adverse Selection: Evidence from the Chilean Pension Market

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Abstract

This paper analyzes the consumer-welfare effects of intermediaries in a pension and annuity market with adverse selection. Intermediaries provide advice, helping individuals improve decisions when understanding products is complex and costly, but may introduce distortions due to agency problems. In an insurance market, intermediary effects on choices can impact adverse selection and, through it, prices. I document the importance of intermediation and its connection to adverse selection in the Chilean pension market, where products are complex and intermediaries have a financial incentive to steer consumers toward annuities. To quantify the effects of potential intermediary regulations, I develop and estimate a dynamic demand model that includes life-cycle decisions, product, and intermediation choices. I find intermediaries have the potential to improve welfare: retirees would give up around 250 USD a year to eliminate frictions in product choices. Despite intermediaries steering a majority of their customers into annuities, a ban on intermediation is approximately consumer-welfare neutral. The variety of annuities allows intermediaries to recommend close substitutes to the outside option, limiting the harm from misaligned incentives. Decision costs without intermediaries and annuity price increases due to adverse selection erode any gains from a ban. In light of policy concerns regarding the role of intermediaries, my results highlight the potential value provided by advisors – even with biased incentives – when choices are complex and stakes are high.

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1 Introduction

Annuities are common retirement and insurance products, with the U.S. annuity market generating 400 billion USD revenue in 2023.[1] While widely used, annuities are also complex financial products and their associated benefits and costs are difficult to understand.[2] Retirees making difficult choices about annuities therefore face a trade-off: they can either incur the costs of gathering information to ensure they choose the highest-value product, or else risk making a "mistake."

In financial markets, consumers often have an alternative: pay an intermediary to provide expert advice. In theory, hiring an intermediary allows the consumer to avoid decision-making costs. In practice, intermediaries have been a cause of policy concern. The financial incentives of intermediaries and consumers are often not aligned, which can lead intermediaries to steer consumers toward suboptimal but high-commission products.[3] In insurance markets, intermediaries' advice may increase the ability of individuals to select into coverages based on their private information, while steering may reduce this selection. Intermediation can therefore impact *adverse selection*, and through it, insurance costs and equilibrium prices.

In this paper, I assess the consumer-welfare effect of intermediaries in the Chilean pension and annuity market, where most retirees face a complex financial decision at retirement. I estimate a dynamic model of life-cycle decisions, product choices, and demand for intermediation. The central piece of the model is a choice friction capturing the complexity of retirement decisions. Retirees can either learn about the value of pension products on their own by incurring a cost, or they may hire an intermediary who eliminates information costs but distorts choices towards high-commission products (annuities). I use the model to evaluate the heterogeneous consequences of regulating intermediaries by quantifying choice frictions, intermediary distortions, and adverse selection into annuities based on life expectancy.

In my main counterfactual, I explore the impact of banning intermediaries. Despite intermediaries steering a majority of their customers into annuities, an intermediary ban would be approximately consumer-welfare neutral. The variety of annuity types allows intermediaries to distort consumers to an annuity that approximates their best option closely, limiting the harm

[1] IBISWorld (Maldonado, 2023).

[2] A vast literature shows consumers struggle to compare and evaluate annuities in lab settings (Brown, Kapteyn, Luttmer, and Mitchell, 2017; Brown, Kapteyn, Luttmer, Mitchell, and Samek, 2021; Luttmer, Oliveira, and Taubinsky, 2023), and highlights attention costs associated with solving complex problems e.g. Carvalho and Silverman (2019) and Bronchetti et al. (2023). This phenomenon extends to other insurance markets: examples of papers exploring choice frictions include Abaluck and Gruber (2011), Handel and Kolstad (2015), and Brown and Jeon (2023).

[3] See, for example, Egan (2019), Egan, Ge, and Tang (2020), and Bhattacharya, Illanes, and Padi (2020). The Biden administration is currently reviewing regulation that would extend fiduciary duty standards, see `https://news.bloomberglaw.com/daily-labor-report/biden-fiduciary-rule-redo-has-gone-to-white-house-for-review`.

from misaligned incentives. A ban introduces additional costs from forcing retirees to make decisions without advice and increases annuity prices by exacerbating adverse selection into annuities. The sum of these costs balance out the losses from distortions induced by intermediaries in the benchmark, yielding a negligible impact on consumer welfare.

To motivate the model, I begin by documenting three key facts on the Chilean pension market. Using detailed, individual-level administrative and survey data, I show (i) retirees face a difficult decision that leads to choice frictions, (ii) retirees demand advice from intermediaries, who are strongly predictive of consumers' pension product choices, and (iii) intermediaries reduce adverse selection into annuities.

I begin by providing evidence on the complexity of choices in the Chilean pension exchange. At retirement, individuals must convert their pension savings – often over 50% of their wealth – into a flow of payments to be paid over time. The outside option – called Phased Withdrawal – provides no insurance coverage but allows retirees to bequeath their outstanding pension wealth in case of an early death. Retirees can choose to purchase different types of annuities that insure against *longevity*, the risk of living too long and running out of savings. Annuities provide payments that continue until the retiree's death but generally eliminate any incidental inheritance of the pension savings. Within annuities, retirees can choose to contract guarantee periods, which allow for a partial bequest of savings while still insuring against longevity. The decision is complex, stressful, and high stakes. Choosing the "right" product requires understanding the characteristics of each option and how these interact with the individuals' survival expectations, taste for bequests, and risk aversion.

I document that intermediation plays a key role in the data. More than 60% of retirees hire intermediaries – independent advisors or sales agents – who have financial incentives to recommend annuities. Over 95% of intermediated retirees annuitize part of their savings, whereas only 45% of non-intermediated retirees do so. Observable characteristics explain some of the variation in the demand for intermediation – geography and pension savings play a role. Nevertheless, survey data and anecdotal evidence suggest the main driver for intermediation is retirees' demand for information and advice. Intermediaries help retirees figure out the optimal product given their individual preferences and financial situation.

Finally, I show that intermediation also interacts with selection on survival expectations, a relevant force in annuity markets. Retirees who die within two years of retirement are nearly 5 percentage points less likely to select into annuities than those who survive longer. This effect is driven entirely by non-intermediated retirees, which suggests intermediaries may be responding to their financial incentives and steering some shorter-lived retirees into buying annuities.

However, the data also show intermediaries lead retirees who die early into contracting guarantees, a "better" product within the space of annuities. This effect is consistent with advice allowing individuals to use private information to choose better – if still potentially suboptimal – annuities.

Assessing the impact of intermediation on consumer welfare requires understanding the demand for advice, the size and impact of frictions on choices, and the degree of substitutability across high- and low-commission products. To incorporate these channels, I develop a model of complex product choice and demand for intermediation that builds on rational-inattention and life-cycle-consumption frameworks. Retirees face a choice between different pension products, characterized by streams of payments and incidental inheritance paths. The value of these products depends on retirees' optimal consumption and savings choices given their survival expectations, taste for bequests, risk aversion, and financial situation.

The central force in the model is the complexity of figuring out product values. Retirees must trade off the costs from learning about product values, and incurring the risk of choosing "wrong."[4] As an alternative, retirees can hire an intermediary. Intermediation eliminates the cost of learning about the different products, but intermediaries charge a fee and have an incentive to steer consumers into annuities. When choosing under intermediation, the choice maximizes a weighted sum of retiree and intermediary utilities, leading to distortions away from the consumer's optimal product. Retirees decide whether to demand intermediation based on their expected utility from (not) receiving advice and the availability of intermediaries.

I estimate the model on the Chilean data. I recover parameters governing cognitive frictions, preferences, and intermediary distortions, using variation of choices across and within intermediation channels. The identification hinges on the assumption of choice frictions being uncorrelated with other unobservable characteristics – which the survey data support – and a stand on the prior or ex-ante beliefs of retirees about the optimal product. The model can accommodate different assumptions on these beliefs or inform them through survey data.

My estimates imply that on average, retirees would be willing to give up nearly 5% of their pension payments – around 250 USD a year – to eliminate all uncertainty from their decisions and avoid costs and mistakes when making choices. The estimates also imply substantial heterogeneity in retirees' life expectancy, along with a large taste for bequests. Given these preferences, the model predicts that intermediaries induce substantial distortions. For 70% of those intermediated, their optimal choice would have been the outside option (Phased Withdrawal), but they

[4]Throughout the paper, I refer to a "wrong" choice or a "mistake" as a choice that does not correspond to the product that maximizes the individual's life-cycle expected consumption utility, given their type and preferences. This choice is still "optimal", accounting for the frictions/information constraints faced by the retirees.

are instead steered into buying an annuity. Intermediated retirees leave on average the equivalent of 7.5% of their pension payments "on the table" from this suboptimal choice, with substantial heterogeneity across the life expectancy and savings distributions.[5]

Motivated by policy concerns over biased intermediaries, I explore the effects of regulating intermediation. First, I consider the effects of banning intermediaries altogether. I find a ban would lead to a substantial reduction in the high annuitization rate in Chile: from over 60% to around 40%, driven by a decrease in guaranteed annuities. The ban also exacerbates adverse selection into annuities. Without intermediary distortions, shorter-lived retirees switch from choosing annuities to the outside option, which increases the longevity of the insured pool. The increase in adverse selection induced by banning intermediaries leads to annuity costs increasing by up to 5% relative to the benchmark. On average, however, banning intermediaries has a negligible effect on consumer welfare. Although intermediaries steer retirees away from the outside option, the "best" annuity is often close in value to the optimal product, mainly due to the option to contract guarantee periods. Gains from avoided distortions under a ban are therefore offset by additional decision costs without intermediaries and higher annuity prices due to adverse selection.

Second, I consider de-biasing intermediaries. I specifically consider a subsidy to the commission of intermediaries that induces them to effectively have fiduciary duty. De-biasing intermediaries leads to a sizeable welfare increase for those intermediated, who now are perfectly driven to the optimal product in their choice set. However, it does not substantially increase the share of retirees who hire an agent or advisor, due to the role of intermediary availability. Consumer selection is further exacerbated, increasing annuities' costs by up to 8%.

My results also predict heterogeneous effects across consumers, in particular across the distribution of life expectancies and savings. Regulation tends to benefit shorter-lived retirees over those with longer lifespans, since the latter are more likely to prefer annuities. Similarly, wealthier retirees benefit less from both policies since they face on average smaller stakes from the decision and are more likely to find annuitization optimal.

In light of policy concerns regarding intermediaries, my findings highlight the importance of product complexity, consumer selection, and the substitutability of high- and low-commission products when considering the regulation of intermediation in insurance markets. Through the lens of the Chilean pension market, I show that the magnitude and interaction of these channels with intermediary incentives is key in determining policy outcomes.

[5] This expected loss is despite the retirees ex-ante rationally deciding to demand advice because they are too optimistic about the probability of being steered by the intermediary.

Related literature I contribute to an active recent empirical literature exploring the role of intermediaries (Gavazza and Lizzeri, 2021).[6] A series of papers empirically document the steering induced by intermediaries whose incentives are not aligned with their customers', raising policy concerns about their role and regulation (Bergstresser, Chalmers, and Tufano, 2009; Mullainathan, Noeth, and Schoar, 2012; Barwick, Pathak, and Wong, 2017; Anagol, Cole, and Sarkar, 2017; Egan, 2019; Egan, Ge, and Tang, 2020; Bhattacharya, Illanes, and Padi, 2020; Alcalde and Vial, 2021; d'Astous, Gemmo, and Michaud, 2023; Barbu, 2023).[7] A number of papers also emphasize the impact of intermediaries on broader market outcomes, especially through price competition (Robles-Garcia, 2020; Salz, 2020; Hastings, Hortaçsu, and Syverson, 2017; Grunewald et al., 2023). Close to this paper is Gruber et al. (2021), who show the effects of improving expert decisions through machine-learning tools in Medicare Advantage plans. I contribute by quantifying the value of intermediaries in *helping consumers learn about product match utilities* when making complex choices – even with imperfectly aligned incentives. This service provided by advisors is arguably individual-specific and therefore hard to replace or automatize.

The study of the consumer-welfare effects of intermediaries through their impact on adverse selection is also, to the best of my knowledge, novel in this literature. Adverse selection is a common feature of insurance markets that arises from private information that cannot be priced upon, such as life expectancy in the case of annuities and longevity insurance (Brugiavini, 1993; Finkelstein and Poterba, 2004; Einav, Finkelstein, and Schrimpf, 2010; Einav, Finkelstein, and Mahoney, 2021). Riskier individuals select into insurance coverage, increasing the average cost of providing insurance and leading to higher prices and even market unravelling. However, a necessary condition for selection is for consumers to be able to make choices based on this private information (Finkelstein and McGarry, 2006). Information frictions, switching costs and even advertising can therefore lessen selection (Handel, 2013; Handel, Kolstad, and Spinnewijn, 2019; Aizawa and Kim, 2018); advisors could exacerbate it if they allow consumers to better use their private information (Gruber et al., 2021). Intermediaries may also lessen selection if they have incentives to steer consumers into insurance regardless of their risk. I show evidence of both channels in retirees' choices of annuities and guarantee length in Chile, and my model quantifies their effect on prices in counterfactuals.

This paper also relates to a wide literature on frictions in consumer choices. Ample evidence

[6]Another large theoretical literature dates back to at least the seminal work of Crawford and Sobel (1982), and emphasizes the role of strategic interactions between firms, intermediaries and consumers (Lizzeri, 1999; Dessein, 2002; Li and Madarász, 2008; Inderst and Ottaviani, 2012a; Inderst and Ottaviani, 2012b)

[7]The Biden administration is reviewing regulation that would enforce stricter and wider fiduciary duty standards in retirement markets, see https://news.bloomberglaw.com/daily-labor-report/biden-fiduciary-rule-redo-has-gone-to-white-house-for-review.

shows systematic deviations from the predictions of the standard economic framework in insurance choices[8] and financial decisions (Handel and Schwartzstein, 2018; Beshears et al., 2018). In annuity markets, consumers are sensitive to salient characteristics and can have difficulties evaluating and comparing options (Benartzi, Previtero, and Thaler, 2011; Brown, Kapteyn, Luttmer, and Mitchell, 2017; Boyer, Box-Couillard, and Michaud, 2019).[9] I link these choice frictions to the high demand for intermediation in the Chilean pension market. In my model, consumers are rationally inattentive (Sims, 2003; Matejka and McKay, 2015): they are unable to observe their value of a product, but can pay to become informed about it. I show how the rational-inattention framework can be used to tractably model both intermediation by experts who eliminate attention costs, as well as demand for advice.[10]

Finally, this paper also relates to other work in the same setting – the Chilean pension and annuity market – that focuses on the value of annuity characteristics (Alcalde and Vial, 2022), the "annuity puzzle" (Illanes and Padi, 2021), the effect of transparency on adverse selection (Fajnzylber, Gabrielli, and Willington, 2023), competition of insurance companies (Aryal et al., 2021) and the effect of simplifying information (Duch et al., 2021). Closest to this paper is Alcalde and Vial (2021), who explore the effects of a change in intermediaries' incentives on their product recommendations, and through them, on firms' pricing strategies. I complement these studies by highlighting the role of choice frictions, the role of intermediaries in recommending across different products, and their connection to adverse selection in the market.

The paper proceeds as follows. Section 2 introduces the setting of the Chilean pension market and the data. Section 3 presents descriptive evidence on information frictions, intermediation, and their interaction with adverse selection. Section 4 presents the model, and section 5 discusses the estimation procedure. Section 6 discusses the results and section 7 presents the welfare impacts of regulating intermediaries, either banning or de-biasing them. Section 8 concludes.

[8] These patterns have been extensively documented in the health insurance context. Consumers struggle to choose the health plan that maximizes their expected utility (Abaluck and Gruber, 2011; Brown and Jeon, 2023) and are subject to inertia in plan switching (Handel, 2013; Handel and Kolstad, 2015; Ho, Hogan, and Morton, 2017).

[9] These frictions have been put forward as potential explanations of the "annuity puzzle". Fully rational arguments have also made in, e.g. Lockwood (2012) and Illanes and Padi (2021).

[10] The complex interaction between endogenous information acquisition and adverse selection has also been highlighted in Thereze (2023). Maccuish (2023) explores consumption decisions after retirement in a model with rational inattention about policies.

2 Setting and data

Chile has a fully-funded, defined-contribution pension market. Chileans contribute a mandatory 10% of their wages to a retirement savings account throughout their active working life. Savings accounts are managed by a private Pension Fund Administrator (PFA), who invests in stocks, mutual funds, and bonds. At the time of retirement – 65 years for men, 60 for women, or earlier if the individual has accumulated enough wealth, or in case of disability – individuals are required to transform their accumulated savings into a flow by choosing a pension product. Retirees are generally not entitled to lump-sum withdrawals.[11]

Pension products In a Phased Withdrawal (PW) product, retirees keep their PFA-managed savings account and steadily withdraw from it according to an actuarial formula defined by the government. The payment is updated yearly and is based on an actuarial mortality table for the Chilean population, a forecasted rate of return on savings, and whether the retiree has any legal dependents (a spouse or children under the age of 24). Under a Phased Withdrawal, the retiree retains ownership of the savings, which constitute an incidental inheritance in case of an early death. However, the individual is also exposed to longevity risk: as they age, their pension will decrease until their savings are exhausted.[12] The retiree also faces interest-rate risk, which can induce volatility in their pension savings. Figure 1 (a) and (b) show an example of the path of Phased Withdrawal pension payments and implied incidental bequests for a 65-year-old man without dependents in the data.

As an alternative to the Phased Withdrawal, the retiree can purchase an annuity from an insurance company (panels c and d). This choice entails the individual giving up ownership of their savings in exchange for longevity insurance: the insurance company contracts an obligation to pay a fixed, inflation-adjusted amount for the remaining duration of the retiree's lives. The retiree therefore transfers their longevity risk to the insurance company but gives up the possibility of bequeathing part of their pension savings.

Retirees can customize annuity contracts, in particular by choosing *guarantee* and *deferral* periods. A guaranteed period establishes a minimum number of months or years during which the annuity will pay out, therefore providing a way to insure against longevity risk while still generating a bequest in case of an early death (Figure 1 e and f).[13] A retiree can also use part of

[11]Some exceptions exist: those who can finance a pension that is within a certain range of their average income 20 years prior to retirement are allowed to withdraw a lump-sum amount. I exclude these retirees from my sample.

[12]For individuals who qualify for government subsidies, the pension amount is guaranteed not to drop below a minimum specified (*Pension Básica Solidaria*).

[13]If the retiree has a spouse or any legal dependents, they are only allowed to purchase a "joint" annuity, which will continue to pay out a defined fraction of the monthly payments to the dependents after the death of the retiree

their savings to contract a deferred annuity (g and h), which allows them to use the remaining funds to front-load payments. Deferrals and guarantees can also be combined.[14]

Retirees are able to request and receive quotes for different products through a centralized exchange, and make their decision by selecting a product from a document called *Offers Certificate* (Figure 2). The median retiree requests quotes for 10 product types and receives over 100 quotes for pension products. I describe the centralized exchange in detail in Appendix B.

The available products in this market pose a trade-off between higher initial payments, insurance against longevity, and bequeathed wealth upon death. The decision of which pension product to optimally select will therefore depend on the interaction of product characteristics with an individual's life expectancy, their desire to leave an inheritance, risk aversion and impatience. Figuring out "the right choice" implies not only understanding financial terms and implications, but also an introspection about preferences, expected lifespan, and the retiree's overall financial situation. The variety and complexity of involved factors,[15] along with the existing evidence of poor knowledge about the pension system,[16] suggest this process is intricate and mentally taxing for the retiree.

Intermediaries Two types of intermediaries operate in this market. The first type of intermediaru is a *pension* or *independent advisor*. Advisors are experts who provide advice during the retirement process. Their role is to accompany the potential retiree when navigating the centralized offer exchange, ensuring their customer receives all benefits they qualify for, and helping them make the best choice of pension product given their needs and preferences. Pension advisors are required to register with the regulatory agency and to pass a test on pension and financial knowledge. Advisors are also required to hold a liability insurance policy covering potential economic damages to retirees.[17]

Compensation takes place through a commission paid by the consumer and calculated as a *percentage of the total retirement savings*. Commissions are capped at 2% of savings for any type

(e.g., 60% for a spouse). In this case, a guarantee implies the dependents will instead be paid out 100% of the value of the annuity until the end of the guaranteed period, and the corresponding fraction after. If the retiree has no legal dependents, the retiree can choose a recipient of the remaining guaranteed payments.

[14]Another differentiating characteristic between annuities and the Phased Withdrawal is the irrevocability: a retiree who chooses a Phased Withdrawal can always choose to annuitize the remaining pension wealth after a few years, whereas once an annuity contract is signed, it is final. Chile has no secondary market for life annuities, and the market size (total premiums) of private annuities is negligible compared with pension annuities.

[15]For example, the suitability of each product in terms of bequest will not only depend on whether the retiree has heirs, but also on whether they own other assets. Another factor that may play a role in the complexity of the decision is people's aversion to thinking about their death. See, for example, Dor-Ziderman, Lutz, and Goldstein (2019).

[16]See, for example, SPS (2016) and FNE (2018a).

[17]This policy could be understood as introducing a form of fiduciary duty. In practice, however, market participants stated they were not aware of any case where this policy had actually been used.

Figure 1: Pension products for a single man, age 65 with USD 68,000 in pension savings

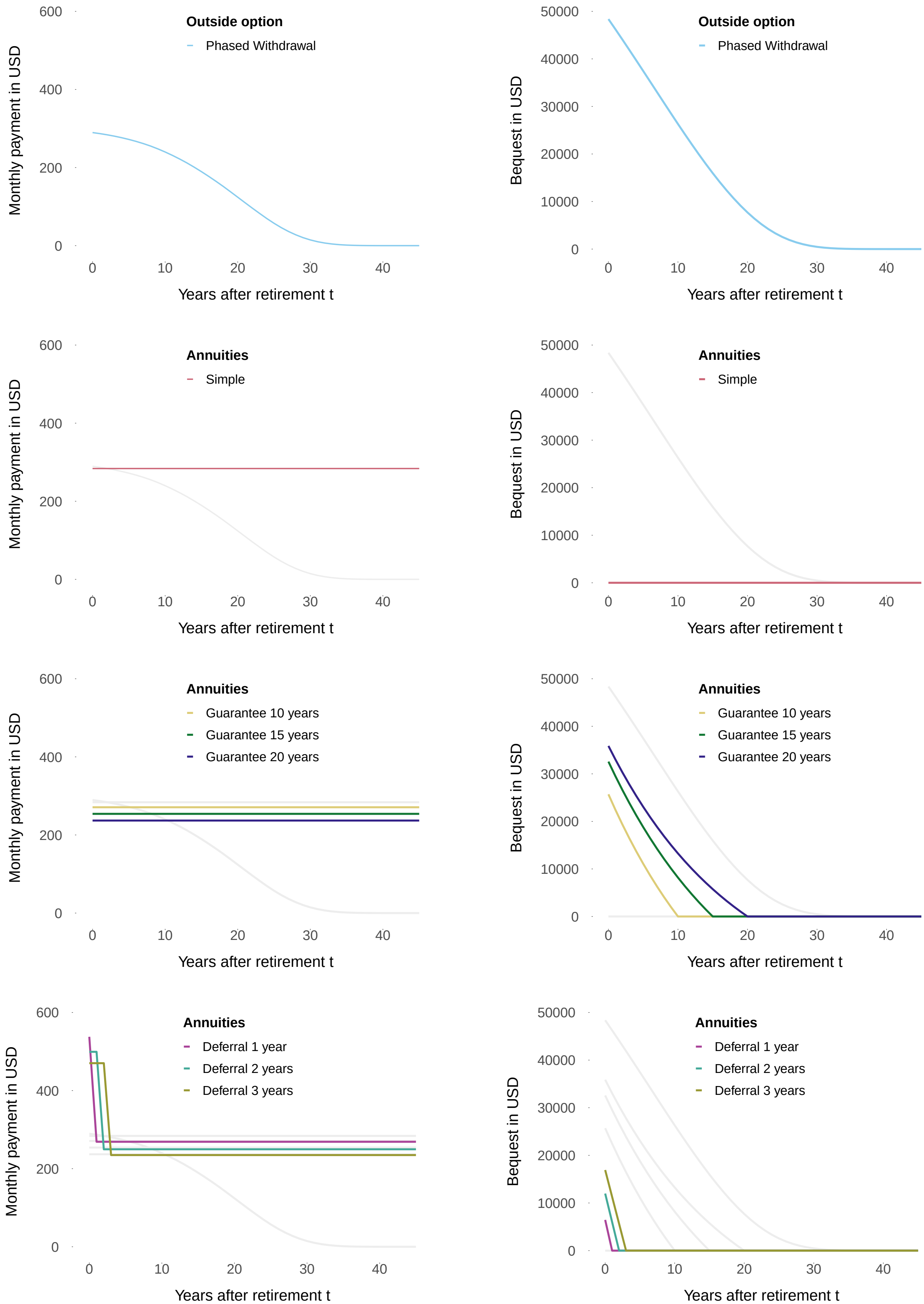
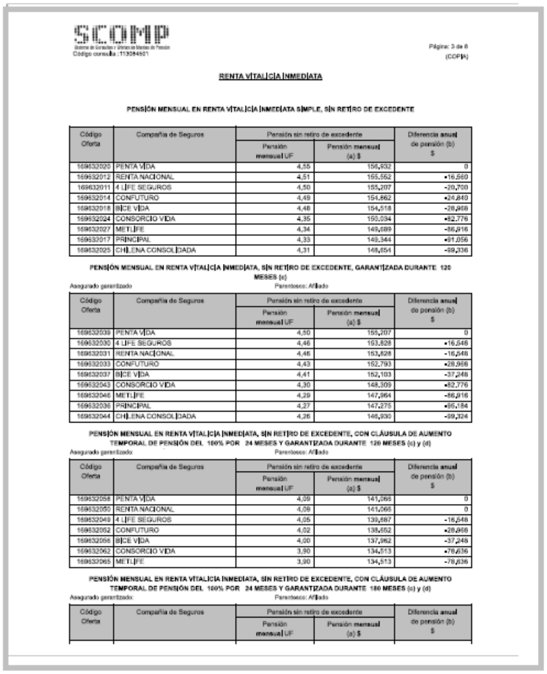


Figure 2: Sample *Offers Certificate*



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Página: 3 de 8
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RENTA VITALICIA INMEDIATA

PENSIÓN MENSUAL EN RENTA VITALICIA INMEDIATA SIMPLE, SIN RETIRO DE EXCEDENTE

Código Oferta	Compañía de Seguros	Pensión sin retiro de excedente		Diferencia anual de pensión (b) $
		Pensión mensual UF	Pensión mensual (a) $	
169632020	PENTA VIDA	4,55	156,932	0
169632012	RENTA NACIONAL	4,51	155,552	-16,560
169632011	4 LIFE SEGUROS	4,50	155,207	-20,700
169632014	CONFUTURO	4,49	154,862	-24,840
169632018	BICE VIDA	4,48	154,518	-28,968
169632024	CONSORCIO VIDA	4,35	150,034	-82,776
169632027	METLIFE	4,34	149,689	-86,916
169632017	PRINCIPAL	4,33	149,344	-91,056
169632025	CHILENA CONSOLIDADA	4,31	148,654	-99,336

PENSIÓN MENSUAL EN RENTA VITALICIA INMEDIATA, SIN RETIRO DE EXCEDENTE, GARANTIZADA DURANTE 120 MESES (c)

Asegurado garantizado Parentesco: Afiliado

Código Oferta	Compañía de Seguros	Pensión sin retiro de excedente		Diferencia anual de pensión (b) $
		Pensión mensual UF	Pensión mensual (a) $	
169632039	PENTA VIDA	4,50	155,207	0
169632030	4 LIFE SEGUROS	4,46	153,828	-16,548
169632031	RENTA NACIONAL	4,46	153,828	-16,548
169632033	CONFUTURO	4,43	152,793	-28,968
169632037	BICE VIDA	4,41	152,103	-37,248
169632043	CONSORCIO VIDA	4,30	148,309	-82,776
169632046	METLIFE	4,29	147,964	-86,916
169632036	PRINCIPAL	4,27	147,275	-95,184
169632044	CHILENA CONSOLIDADA	4,26	146,930	-99,324

PENSIÓN MENSUAL EN RENTA VITALICIA INMEDIATA, SIN RETIRO DE EXCEDENTE, CON CLÁUSULA DE AUMENTO TEMPORAL DE PENSIÓN DEL 100% POR 24 MESES Y GARANTIZADA DURANTE 120 MESES (c) y (d)

Asegurado garantizado: Parentesco: Afiliado

Código Oferta	Compañía de Seguros	Pensión sin retiro de excedente		Diferencia anual de pensión (b) $
		Pensión mensual UF	Pensión mensual (a) $	
169632058	PENTA VIDA	4,09	141,066	0
169632050	RENTA NACIONAL	4,09	141,066	0
169632049	4 LIFE SEGUROS	4,05	139,687	-16,548
169632052	CONFUTURO	4,02	138,652	-28,968
169632056	BICE VIDA	4,00	137,962	-37,248
169632062	CONSORCIO VIDA	3,90	134,513	-78,636
169632065	METLIFE	3,90	134,513	-78,636

PENSIÓN MENSUAL EN RENTA VITALICIA INMEDIATA, SIN RETIRO DE EXCEDENTE, CON CLÁUSULA DE AUMENTO TEMPORAL DE PENSIÓN DEL 100% POR 24 MESES Y GARANTIZADA DURANTE 180 MESES (c) y (d)

Asegurado garantizado: Parentesco: Afiliado

Código Oferta	Compañía de Seguros	Pensión sin retiro de excedente		Diferencia anual de pensión (b) $
		Pensión mensual UF	Pensión mensual (a) $	

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Página: 5 de 8
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RENTA TEMPORAL CON RENTA VITALICIA DIFERIDA

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Su monto definitivo es calculado por la AFP después de traspasar la prima para la Renta Vitalicia. Puede sufrir cambios por variaciones de los valores de la UF o de la cuota del Fondo de Pensiones, y por el pago de pensiones entre las fechas de la cotización y del traspaso efectivo de los fondos. Su monto estará afecto a la comisión mensual que cobre la AFP que usted seleccione,

El Periodo Diferido solicitado por usted es de 12 meses
Corresponde al período durante el cual se recibe la Renta Temporal en la AFP, A su término se iniciará el pago de la Renta Vitalicia Diferida,

PENSIÓN MENSUAL EN RENTA VITALICIA DIFERIDA SIMPLE, SIN RETIRO DE EXCEDENTE

Código Oferta	Compañía de Seguros	Pensión sin retiro de excedente		Diferencia anual de pensión (b) $
		Pensión mensual UF	Pensión mensual (a) $	
169632096	PENTA VIDA	4,31	148,654	0
169632088	RENTA NACIONAL	4,27	147,275	-16,548
169632090	CONFUTURO	4,26	146,930	-20,688
169632087	4 LIFE SEGUROS	4,26	146,930	-20,688
169632094	BICE VIDA	4,25	146,585	-24,828
169632100	CONSORCIO VIDA	4,13	142,446	-74,496
169632103	METLIFE	4,13	142,446	-74,496
169632093	PRINCIPAL	4,11	141,756	-82,776

PENSIÓN MENSUAL EN RENTA VITALICIA DIFERIDA, SIN RETIRO DE EXCEDENTE, GARANTIZADA DURANTE 120 MESES (c)

Asegurado garantizado: Parentesco: Afiliado

Código Oferta	Compañía de Seguros	Pensión sin retiro de excedente		Diferencia anual de pensión (b) $
		Pensión mensual UF	Pensión mensual (a) $	
169632115	PENTA VIDA	4,25	146,585	0
169632106	4 LIFE SEGUROS	4,22	145,550	-12,420
169632107	RENTA NACIONAL	4,21	145,205	-16,560
169632109	CONFUTURO	4,20	144,860	-20,700
169632113	BICE VIDA	4,16	143,481	-37,248
169632119	CONSORCIO VIDA	4,08	140,721	-70,368
169632122	METLIFE	4,07	140,376	-74,508

Notes: The figure shows a sample document for pension product decisions. Each pension product is represented by a table containing all offers from PFAs for the Phased Withdrawal and insurance companies for annuities. Tables are ordered, showing higher pension offers first.

of annuity and 1.2% for a Phased Withdrawal, with a maximum value of 60 *Unidades de Fomento* (UF)[18] for either product. For an individual around the median of the savings distribution (around 1800 UF), the commission paid is roughly equal to three monthly pension payments. The commission is paid from the retiree's savings as a lump sum to the advisor. As a result, the commission lowers the value of all future pension product payments. [19]

The second type of intermediary is a *sales agent*, employees of an insurance company who guide retirees through the pension process. Their role is to promote the annuities sold by their employer. If the retiree purchases an annuity from the represented firm, they pay the agent a commission of up to 2% of fraction of the wealth that is used to buy the annuity, or 60 UF.[20] Sales agents are only required to have completed a 40-hour course on pension products and the

[18]An *Unidad de Fomento* (UF) is a CPI indexed accounting unit used in annuity contracts. Its value as of August 14th, 2023 is of 42.00 USD.

[19]The retiree can bargain with the pension advisor to lower the commission, which is unusual, however (FNE, 2018b, see also Figure A.16).

[20]In interviews with market participants, it was mentioned that some agents have an internal commission structure with their insurance company. This incentive allows agents to give up part of their commission to offer a more competitive quote to their customers, while still getting compensated. As see in Figure A.16, the vast majority of retirees still pay the maximum commission

pension system.

In 2018 around 600 pension advisors and 1250 sales agents were registered with the regulatory agency (see Figure A.17). Insurance companies are highly heterogeneous in their hiring of agents: their number has increased over time and oscillates between 0 and more than 200 across different companies. Whereas some insurance companies get more than 80% of their clients through sales agents, others sell over 50% of their annuities through independent advisors (FNE, 2018b). Intermediation of pension products is – both anecdotally and in the data (see Figure A.18) – a lucrative profession: the median intermediary earns more than twice the median income in Chile from commissions.[21] Concerns have been raised about intermediaries, in particular regarding the large commission payments and the apparent lack of competition in commissions (FNE, 2018b). In 2018, several advisors and agents were fined and suspended after forging SCOMP documents to "close cases" faster: statements from intermediaries highlight competition to be "first" in approaching and successfully getting the client through the pension process.

Data The data are public and come from three different sources. The first one is the centralized offer exchange database SCOMP, available from the regulating agencies,[22] which contains all retirees from August 2004 until July 2020. This database includes basic demographic information about retirees – age, gender, and legal dependents – total savings, geographic location at the city/precinct level. The data also record every offer received by each potential retiree, information about intermediation, pension product accepted, and commission paid. Finally, I also observe the date of death if it occurs before July 2021. I complement this information with publicly available reports on insurance companies' risk ratings, information about the number of intermediaries, and their registered locations. For a subset of the independent advisors, I also link scores obtained in the knowledge tests required for their certification after 2017. For most of the analysis, I restrict the sample to individuals retiring between 2010 and 2018, at or after legal age, and without legal dependents other than a spouse. This sample selection yields $\sim$150,000 observations.[23]

I also use data from two surveys. The Social Protection Survey is a representative panel survey conducted by the Department of Social Protection in Chile. Individuals are periodically

[21] An interviewed agent called the job "the most lucrative sales job you can have in Chile."

[22] Given the particular nature of the market, two different Chilean agencies oversee the retirement system, with overlap at some stages: the *Comisión para el Mercado Financiero*, a financial regulator that oversees banks and insurance companies – therefore annuities –; and the *Superintendencia de Pensiones*, which is exclusively dedicated to pension matters.

[23] The sample selection is chosen primarily for comparability of retirees and context of the choices. Independent advisors were established in 2009 and are only fully active starting in 2010. Toward the end of 2019, Chile went through a period of political instability, of which tensions around the pension system were a key element.

interviewed on work history, education, health, income, wealth, and information regarding social security, pensions, and their knowledge of the system. The second survey was conducted as part of the choice-architecture experiment of Duch et al. (2021), who elicit information about soon-to-be retirees' income, education level, financial literacy, risk preferences, and their plans for retirement. The survey also asks about preferences for different pension products after conducting an information intervention about their characteristics.

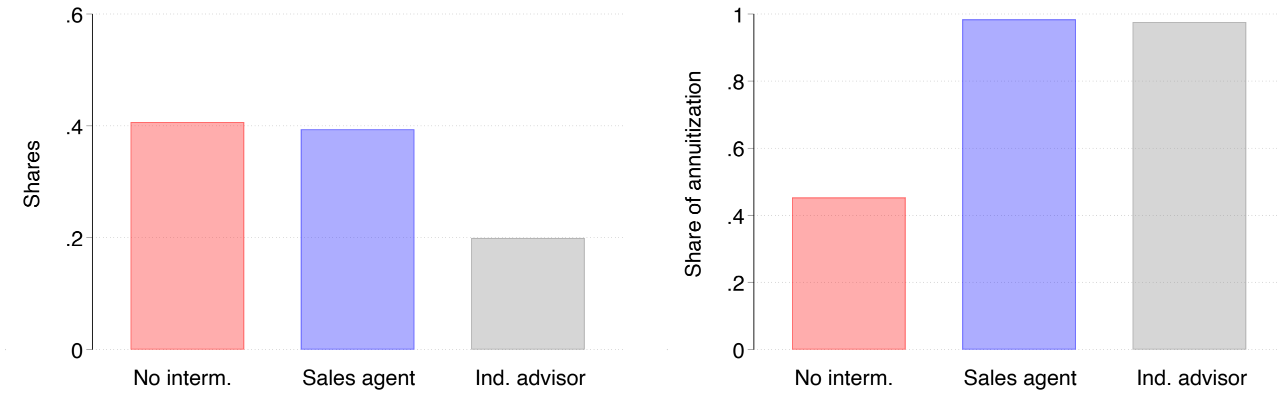
3 Descriptive evidence

The goal of this section is to describe key patterns in the data, including the relationship between choice frictions, intermediation, and consumer selection in the Chilean pension context. I start by highlighting the importance of intermediation in the setting: I show intermediation is prevalent and inherently linked to consumer choices of both products and insurance companies (in the case of annuities). I then turn to exploring what drives demand for intermediation and highlight the role of geography: individuals are more likely to choose intermediaries in locations with high intermediation rates in the past; anecdotally, the pattern reflects the importance of word of mouth. The data rejects the hypothesis that demand for intermediaries is determined solely by underlying taste for annuities. I argue the intermediaries' role is an *informational* one: both pension advisors and sales agents provide advice and support retirees in navigating the pension process and choosing the best option given their needs. The story is supported by both the survey and choice data. Finally, I highlight the interaction between intermediation and consumer selection. Individuals who die within two years of retirement are significantly less likely to buy an annuity, but no less likely to hire an intermediary. However, intermediaries seem to help individuals choose across annuity characteristics: intermediated retirees who die early select longer guarantee and deferral periods than those who do not. These patterns are suggestive of intermediaries steering consumers into annuities, but helping them choose correctly *within* the space of annuities.

Intermediation and product choices Figure 3a shows the shares of retirees using each intermediation channel. Around half of them hire an intermediary throughout the sample. Across the sample period, the share of the independent advisors remains mostly constant at 20%, while the share of sales agents oscillates between 20% and 40% (Figure A.19).

Figure 3b and 4 highlight the importance of intermediation for understanding choices in this market. Intermediated individuals choose annuities over the Phased Withdrawal over 95% of

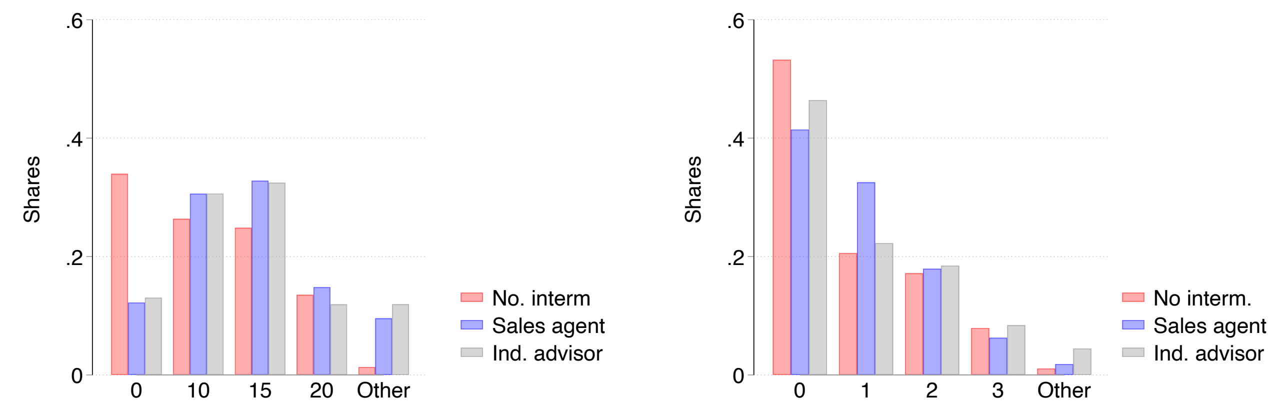
Figure 3: Intermediary and pension product shares



(a) Intermediation (b) Annuitization, by intermediary

Notes: Figure (a) show intermediation shares in the data. (b) show the share of retirees choosing an annuity, for each intermediation channel. Retirees choosing "normal" retirement (at or after retirement age) between 2010 and 2018, single or married with no other legal dependents.

Figure 4: Characteristics of chosen annuities



(a) Guarantee period (b) Deferral period

Notes: These figures show characteristics of annuities purchased by retirees using each intermediation channel. (a) shows the choice of guaranteed periods, (b) the choice of deferral length. "Other" includes all other lengths. Retirees choosing "normal" retirement (at or after retirement age) between 2010 and 2018, single or married with no other legal dependents.

the time. Those retirees making a decision alone choose annuities at a much lower rate, which oscillates between 20% and 60% throughout the sample (Figure A.20). Among those choosing an annuity, Figure 4 suggests intermediation is also linked to the type of annuity selected. Fewer than two-thirds of non-intermediated annuitants choose to guarantee, against almost 90% of those intermediated. Self-reliant annuitants are also slightly less likely to select deferred annuities. In the Appendix, I document that intermediation also affects the choice of insurance company selected: sales agents successfully sell their company's products, despite their higher prices. Independent advisors prioritize lower prices, sometimes at the cost of lower risk ratings (Figure A.21a and A.21b).

The large market shares of both the Phased Withdrawal (for the non-intermediated) and guaranteed annuities also suggest retirees generally value money after their death, for example, due to a value for bequests. Choices of self-reliant retirees appear more "extreme": they are more likely to choose both no insurance – in the form of the Phased Withdrawal – and the simple annuity, which corresponds to the "maximum" coverage against longevity. Intermediated retirees, on the other hand, seem to favor a compromise between insurance against longevity and the desire to ensure some bequests.

Intermediary incentives suggest a potential bias leading to them steering agents toward annuities. In light of these incentives, the large difference in annuitization rates between intermediated and self-reliant retirees could be a cause of concern. In particular, the high annuitization rate of intermediated individuals is clearly financially optimal for intermediaries, but may not be for the retirees. A key piece in assessing this concern is understanding the channels driving retirees to hire intermediaries in this setting. I explore these in the next subsection.

Demand for intermediaries The patterns in the data are consistent with different models of consumer behavior. On the one hand, the differences in choices across intermediation channels could be reflecting selection based on preferences: those seeking annuities – or particular types of annuities and insurance companies – also seek out intermediaries. The patterns are also consistent with distortions: intermediaries have a financial incentive to steer their customers towards annuities, or specific insurance companies in the case of sales agents.

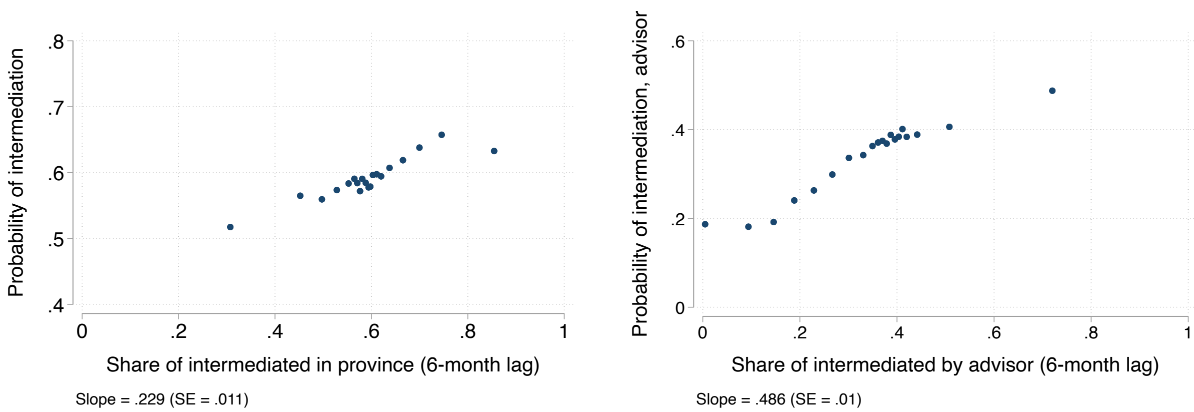
In Appendix A, I explore the correlations between intermediary choice and available observable characteristics. Those retirees choosing to obtain a pension at the legal retirement age are more likely to seek out intermediaries, as are those who are single or have higher savings. Variation in relative annuity prices[24] over time is suggestive of some selection into intermediation

[24] Relative to the Phased Withdrawal. The price of the PW is implicitly given by the interest rate used to calculate the payments to the retiree. The regulator sets this rate based on market expectations on the returns to pension funds,

based on prices. The survey data show only weak correlations of intermediation with bad health reports, the number of children, and educational level attained (Table A.24).

Interviews with the regulating agencies, advisors, and agents suggest intermediary outreach and networks play an important role in explaining selection into intermediation. Each month, the regulator publishes a list of retirees reaching legal retirement age during that period, which can be accessed by insurance companies, agents, and advisors. Intermediaries are therefore often the ones to initiate contact with the retirees by email, mail, phone, or even in person. Due to the structure of the incentives, agents and advisors benefit from targeting wealthier individuals who will pay a larger commission. Interviews also highlighted the role of "referrals" from former clients and word-of-mouth in reaching new customers.[25]

Figure 5: Geography and intermediation



(a) Probability of intermediation

(b) Intermediary type

Notes: These figures show the role of geography in determining probabilities of intermediation. Panel (a) shows the conditional correlation between the probability of a retiree being intermediated (y-axis) and the share of the population that used an intermediary in their province six months prior. Panel (b) shows the conditional correlation betwen an intermediated retiree using an independent advisor and the share of intermediated retirees hiring advisors (as opposed to agents) in their province one year prior. Controls include demographic characteristics (gender, age, pension savings) and year fixed-effects. A province is the second-largest geographical division in Chile. The 56 provinces are heterogeneous in their population size and surface area.

In line with the anecdotal evidence, Figure 5 shows the role geography plays in shaping demand for intermediation. The lagged share of intermediated individuals in a province is predictive of the probability of a retiree seeking intermediation. A 1-percentage-point increase in the share is associated with a 0.23- percentage-point increase in the probability of being intermediated[26]. Similarly, a 1-percentage-point increase in the share of intermediations conducted

calculated by adding the average realized excess return over risk-free assets to a yield curve.

[25] At the same time, the value of "a lead" was also emphasized: one intermediary spoke about arrangements where intermediaries would themselves refer a client to a colleague in exchange for a "share" of the commission.

[26] A potential concern with this regression is that it might pick up unobservable differences in taste for annuities

by independent advisors predicts a 0.48-percentage-point increase in the probability of the retiree selecting an advisor over an agent. These patterns are suggestive of the word-of-mouth mechanism: retirees are likely to encounter an intermediary through a referral, whether from a friend, relative, or co-worker. In Appendix A, I show these patterns are not driven by the location of the intermediaries themselves, which is itself only weakly predictive of the probability of intermediation.

Role for intermediaries Anecdotal evidence suggests the pension-product decision is a difficult one, given the complexity of the pension system and the population's lack of knowledge about its functioning. Surveys show only approximately 10% of the population can answer basic questions about the pension system or pension products. Only around a third of retirees seem to be able to name their chosen product correctly.[27] The stakes involved in the decision are substantial: over half of retirees hold more than 50% of their wealth in their pension savings.[28] The costs of making the "wrong" decision may be high.

The existence of intermediaries in this market is therefore linked to the existence of information frictions in the pension-product choice. Finding the "right" pension product is a difficult and cognitively taxing task. As argued in section 2, making the optimal decision in this context implies a complicated assessment of the interaction of product characteristics with individual preferences. Because this choice is a one-time decision,[29] scope for learning about it over time is minimal. Independent advisors interviewed emphasized that consumers arrive to them with little knowledge about their options and a general sense of uncertainty about what will happen with their pension. Intermediaries consider their fundamental role is guiding the choice of the optimal product given individual preferences. Advisors compile and review documents with their clients in which they compare the different products and their implications for payments and bequests in the future.[30] According to the advisors, this task is what justifies their commission: "the pensions obtained by the retirees [using an advisor] are the result of a complete analysis of their own particular situation, who must pay to have their personal requirements

across the different provinces. To control for this, I include province and year fixed effects, and control additionally for the share of annuitization among those not intermediated in that province. A similar concern can arise with unobserved taste for sales agents, or the companies they represent. FNE (2018b) show that 97% of annuitants do not hold any previous insurance product from the company they purchase an annuity from. I can also control for the share of each insurance company for non-intermediated retirees in the province (to be done). The pattern is mainly driven by across-provinces differences: Figure A.25 in the Appendix shows that adding province fixed effects substantially reduces the size of the effect while remaining statistically significant.

[27] Based on my calculations on SPS (2016).

[28] Idem, see Figure A.30.

[29] Save for those who decide for a Phased Withdrawal can decide to request and purchase an annuity anytime, which would mean they can go through the decision process twice. I exclude these individuals from my sample.

[30] For an example, see Figure A.29.

fulfilled."[31]

Insurance companies make a similar case for their sales force: "The agent accompanies their customer during the entire retirement process, explaining the menu of options and suggesting which one it is that best fits their personal needs and preferences."[32] The provision of information about how to fulfill individual needs is also highlighted, along with the complexity and stress related to the retirement decision, which "is surrounded by a strong lack of knowledge, uncertainty and anxiety by the customer."[33] This anxiety is also consistent with the importance of life expectancy for this decision, and the general aversion of individuals to think about their own death (Dor-Ziderman, Lutz, and Goldstein, 2019).

Assessing this mechanism in the data is a challenging task. Without data on retirees' beliefs and information before retirement, or random assignment of intermediaries to consumers, the informational value is hard to assess. Nevertheless, the data do provide some suggestive evidence on the information channel. In the choice-architecture experiment of Duch et al. (2021), individuals close to retirement age were asked about their knowledge about the different pension products, along with whether they intended to seek advice to make their decision.[34] Column 1 in Table 1 shows individuals who claim to be more knowledgeable about pension products are less likely to intend to seek advice for their pension decision.[35]

The data also rule out a selection story based entirely on preferences. During the course of the choice experiment, Duch et al. (2021) asked to-be retirees about the pension product they planned to choose for their retirement. After eliciting their responses, the authors provided them with information about each of the options and described the decisions made by fictional retirees, and their arguments for doing so. Finally, they asked respondents which of the model retirees' situations (and their decisions) was closest to their own. Columns 2 and 3 in Table 1 show those intending to buy an annuity are no more likely than those intending to buy a Phased Withdrawal to intend to seek advice. However, those who intend to buy "a mix between an Annuity and a Phased Withdrawal" are nearly 20 percentage points more likely to do so. This pattern suggests a taste for annuities by itself is not enough to justify seeking advice: an indecision or taste for a perhaps more complex, hybrid product are needed to justify seeking advice. Table 1 also shows that the ex-post preference for products only weakly correlates with intending to seek advice: once again, only those who think a two-year deferred annuity fits their situation best (but not,

[31] FNE (2018a, p.92).

[32] Idem, p.140.

[33] Idem, p.153.

[34] The exact wording of the question is "*Do you plan on requesting advice on pension matters?*"

[35] The friction at play seems to be somehow specific to the context: the intention to seek advice is not significantly related either to the individual's education level, nor to their financial literacy as elicited in the survey.

e.g., four-years) are more likely to do so.

The choice data reinforce this idea. Table 2 shows the difference in prices paid for an annuity through different intermediation channels, controlling for individual characteristics and product, year-month, and insurance-company fixed effects. On average, retirees who are intermediated pay around 1.2%-2% *more* for the same annuity product than those who are not – matching the amount paid approximately in commissions. This difference – robust across a number of specifications – emphasizes that someone who knows what pension product to buy should *not* hire an intermediary, because they will end up paying *more*. The intermediary's value must therefore lie elsewhere: it is natural to think that their value is therefore linked to figuring out the optimal product choice.

Table 1: Intention to seek advice (LPM)

	(1)	(2)	(3)
Pension knowledge	-0.077	-0.077	-0.076
	(0.019)	(0.019)	(0.019)
Ex-ante pension plan			
Phased Withdrawal		0.0	0.0
		(–)	(–)
Annuity		0.063	0.036
		(0.048)	(0.048)
Mix Phased Withdrawal-Annuity		0.197	0.176
		(0.047)	(0.05)
Ex-post pension plan			
Phased Withdrawal			0.0
			(–)
Annuity			0.053
			(0.055)
Deferred Ann (2Y)			0.135
			(0.067)
Deferred Ann (4Y)			0.025
			(0.05)
Demographic controls	✓	✓	✓
R^2	0.046	0.089	0.094
Observations	706	706	706

Notes: Data from Duch et al. (2021) choice architecture experiment. Standard errors in parentheses. Dependent variable is binary answer to question "*Do you plan on requesting advice on pension matters?*". Ex-ante and ex-post relate to the preference being stated before or after being presented with information about different pension products. Demographic controls include age, gender, financial literacy, risk aversion, and categories for income and education level. Excludes potential retirees who state already having received advice.

Table 2: Annuity prices paid

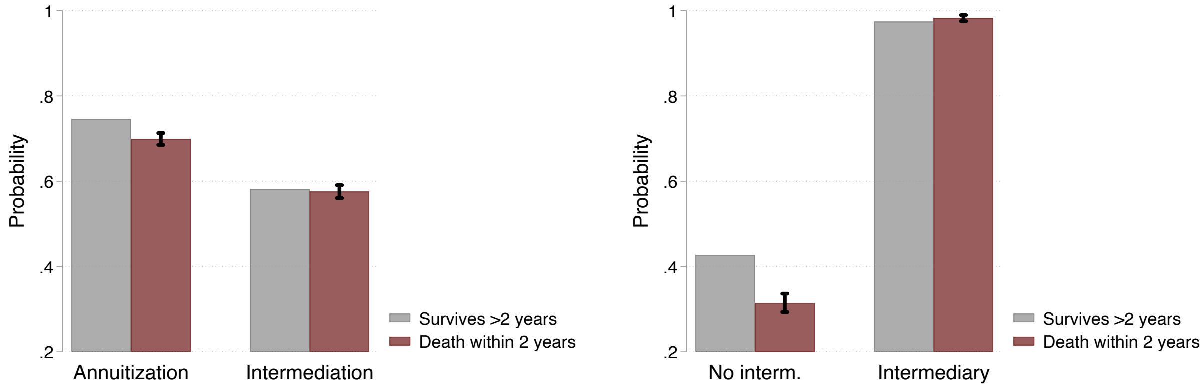
	(1)	(2)	(3)	(4)	(5)
Sales agent	0.0209	0.0192	0.0188	0.0207	0.0215
	(0.000210)	(0.000421)	(0.000387)	(0.000210)	(0.000409)
Ind. advisor	0.0132	0.0132	0.0127	0.0131	0.0152
	(0.000263)	(0.000513)	(0.000446)	(0.000252)	(0.000534)
Demographic controls	✓	✓	✓	✓	✓
Year-Month FE	✓	✓	✓	✓	✓
Saving ventile FE	✓	✓	✓	✓	✓
Cost ventile FE	✓	✓	✓	✓	✓
Annuity type FE	✓	✓			✓
Insurance company FE	✓	✓	✓	✓	✓
R^2	0.999	1.000	1.000	1.000	1.000
N	106059	14218	13712	41759	9777

Notes: Data from SCOMP, 2010-2018, annuitants. Columns (2) and (3) show the result for the most popular annuity types (10- and 15-year guarantee). Columns (4) and (5) restrict the sample to men aged 65 or 66 with and without a partner, respectively. Demographic controls include age, gender and a dummy for partner.

Finally, the data suggest intermediaries can help consumers select into products based on their private information – for example, about their expected survival. I explore this mechanism further in the next subsection. In line with the evidence in the data, the model will allow demand for intermediaries to depend on preferences and product prices, along with individuals' observable individual characteristics and locations that impact the availability of agents and advisors. However, the model will require retirees to additionally face a "cognitive friction" that justifies them requesting advice. Absent this cost, individuals will be better off making a decision on their own. The value of the intermediary will therefore lie in helping the consumer learn about their idiosyncratic value from each pension product.

Private information and intermediation Annuity products can be understood as a form of insurance against longevity. In particular, the survival-contingent stream of payments from an annuity insures individuals against the risk of living too long and running out of savings. As such, annuity markets can feature adverse selection if those who expect to live longer are more likeley to purchase them (Brugiavini, 1993). Selection can also occur across annuity characteristics, such as guarantees (Finkelstein and Poterba, 2004; Einav, Finkelstein, and Schrimpf, 2010) or deferrals. All else equal – and provided some taste for bequests – guarantees are more attractive

Figure 6: Selection into annuities and intermediation



(a) Population

(b) Annuitization – By intermediary

Notes: These figures show selection into annuities and intermediaries in the data. In (a), the light gray bars show the probability of annuitization (left) and intermediation for retirees surviving for more than 2 years after retirement. The dark red bars show the corresponding probabilities for retirees who die during the 2 years following their retirement. (b) shows adverse selection into annuities for non-intermediated (left) and intermediated retirees. Standard error bars are relative to the mean within the intermediation group. Retirees choosing "normal" retirement (at or after retirement age) between 2004 and 2018, single or married with no other legal dependents. 2.21% of sample dies within 2 years of retirement. Controls include demographics and savings, actuarial cost, year and province fixed effects.

for those at higher risk of dying early.[36] In this section, I explore the relationship between adverse selection – which has been documented in the Chilean retirement market (Illanes and Padi, 2021; Fajnzylber, Gabrielli, and Willington, 2023) – and intermediation.

Figure 6a shows the relationship between mortality and product/intermediary choices. To increase statistical power, I extend the sample window back to 2004, yielding around $170,000$ retirees.[37] The figure shows the differences in probability of purchasing an annuity or hiring an intermediary for individuals who die within two years of retiring, controlling for annuity prices, observable characteristics, and year fixed effects.[38] As expected, individuals appear to have some private information about their mortality risk and select into annuities based on it. Retirees who die within two years of retirement are 4.6 percentage points less likely to buy an annuity.

[36]Deferrals, on the other hand, allow for the frontloading of payments, which absent any lump-sum withdrawals in the Chilean setting, should also be preferred by those more likely to die early.

[37]The role of the independent advisor was only introduced in 2009. Before then, insurance brokers operated in the market: they were not tied to any particular insurance company. For all exercises in this section, I only consider intermediation without distinguishing the type.

[38]The difference between the bars is the coefficient β in the regression

$$\mathbb{1}(\text{Outcome}_i) = \alpha + \beta \mathbb{1}(\text{Death within 2 years of retirement}_i) + \text{Controls}_i + \varepsilon_i.$$

Similarly, when cutting by intermediary, I run

$$\mathbb{1}(\text{Outcome}_i) = \alpha + \beta \mathbb{1}(\text{Interm}_i) + \gamma \mathbb{1}(\text{Death within 2Y}_i) + \delta \mathbb{1}(\text{Interm}_i) \times \mathbb{1}(\text{Death within 2Y}_i) + \text{Controls}_i + \varepsilon_i.$$

The differences are then given by γ and $\gamma + \delta$, respectively.

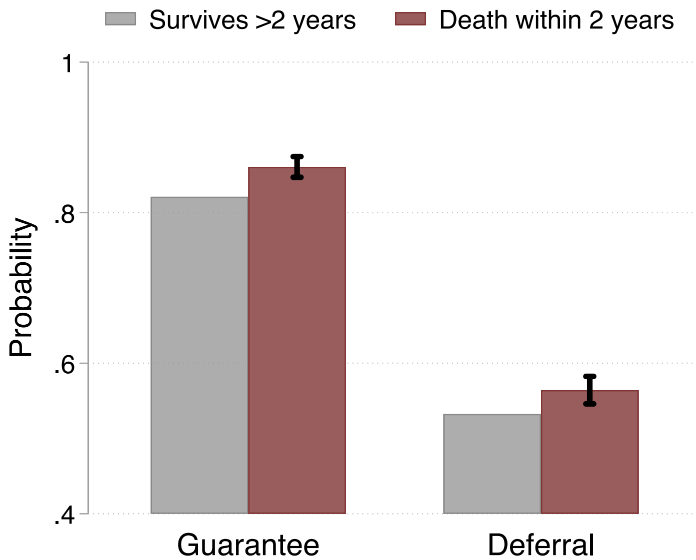
However, these individuals are not significantly less likely to be aided by an intermediary than those who survive longer. These results suggest (a) selection is driven by individuals dying early opting out of annuities, and (b) this pattern is quantitatively driven by retirees who are not intermediated, and not by the selection into advisors and agents itself.

Figure 6b reinforces this point by cutting choices by intermediary. Within the group of retirees who make the retirement decision themselves, those dying early are 11.24 percentage points less likely to purchase an annuity than those who survive for longer. By contrast, among those who use intermediaries, those dying early are marginally *more likely* (0.82 pp.) to do so than those who survive for longer. This stark difference in behavior is suggestive of the intermediaries steering those individuals who would have optimally chosen a Phased Withdrawal into annuities. These selection patterns also suggest that intermediaries might be *lessening* selection by steering both long- and short-lived individuals into annuities.

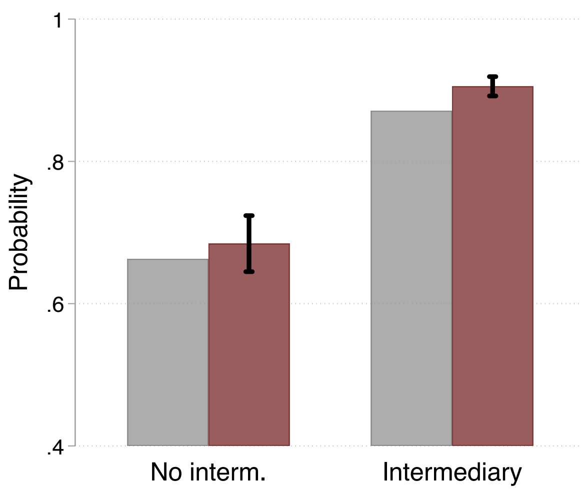
Turning to the choices of annuity characteristics, the data again point toward the informative role of intermediaries. Figure 7a shows that early mortality predicts an extensive-margin effect on contracting both guarantees and deferrals for annuitants (3.96 pp. and 3.20 pp., respectively). Figures 7b and 7c show that on this margin, selection extends to both intermediated and non-intermediated individuals. Self-reliant and intermediated retirees dying early are 2.14 and 3.45 percentage points more likely to choose a guarantee (respectively) than those who survive longer. Similarly, across both groups, individuals who die early are also more likely to choose deferral periods (6.52 and 1.88 pp., respectively).[39] This pattern points in particular towards the use of private information by intermediaries: across products where their incentives are aligned with their customers', intermediaries help retirees use their private information to select into products. The consumer selection within annuity types is crucial. The pattern not only reinforces the role of intermediaries in helping retirees find an adequate product, but also suggests the harm from steering consumers toward annuities might be limited by the variety of annuity types. In particular, if the guaranteed annuities are a close substitute for the Phased Withdrawal, the financial harm from the steering might be relatively small.

The model will account for adverse selection by explicitly modelling the (unobservable) survival expectations of retirees and allowing these to affect the value of different pension products. The model also captures both the distortions from the intermediaries' biases toward annuities and their value in providing advice that leads to a choice that is optimal *within* annuities. These mechanisms allow me to quantify the effective costs and benefits of using an intermediary, as

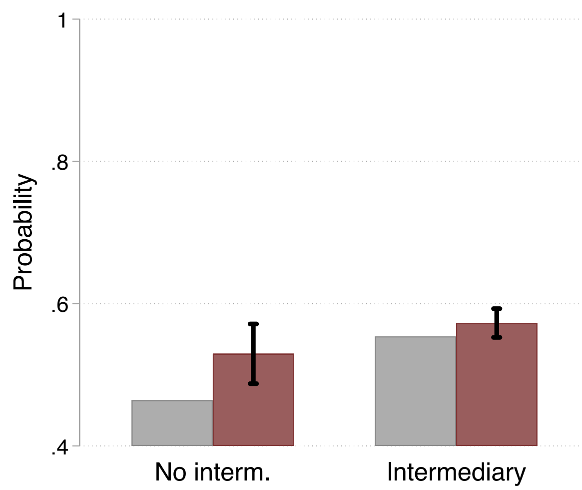
[39] In Figure A.28in Appendix A, I show that conditional on a positive guaranteed period, self-reliant, intermediated, short- and long-lived individuals make remarkably similar choices on average.



(a) Population



(b) Guarantee – by intermediary



(c) Deferral – by intermediary

Figure 7: Selection into annuity characteristics

Notes: These figures show adverse selection into annuity characteristics for retirees choosing annuities using a linear probability model. (a) shows the probability of contracting guarantees or deferrals for retirees who die within two years of retirement (dark red bars) and survive for longer (light gray bars). (b) and (c) show these probabilities by each intermediation channel. Standard error bars reflect the comparison within an intermediation channel. Retirees choosing "normal" retirement (at or after retirement age) between 2004 and 2018, single or married with no other legal dependents. 2.21% of sample dies within 2 years of retirement. Controls include demographics and savings, actuarial cost, year and province fixed effects.

well as to account for the consumer-welfare effect of increased or reduced adverse selection in counterfactuals.

Need for a model The empirical exercises provide evidence on the importance of intermediation for understanding pension-product choices, along with several important mechanisms in the data. Differences in choices between intermediated and self-reliant retirees are stark. The large presence of intermediaries in the market seems to be justified by choice frictions that lead consumers to value advice from agents and advisors. Demand for advice is also affected by individuals' characteristics and their geographic location, likely due to word of mouth effects and intermediary outreach. Finally, selection patterns on survival after retirement are suggestive of intermediaries steering customers away from the outside option and towards annuities, but recommending the optimal product – a guarantee – within that set.

The descriptive evidence does not offer a clear insight on whether differences in choices across intermediaries are due to preferences, choice frictions, informative intermediary advice, or steering by the intermediaries. This decomposition is crucial for evaluating the impact of intermediary regulation, such as a ban or attempts to reduce steering. Fundamentally, the primary challenge lies in understanding how retirees' choices and utilities – from pension-product choices and the costly decision itself – would change absent the possibility of requesting advice. Tackling this question requires quantifying the substitutability of pension products, the friction that drives retirees to demand intermediation, and the intermediary's steering. Given the nature of the market, a second challenge is to account for the impact of a policy on adverse selection and, through it, on prices. In the next section, I develop a model that can flexibly address these challenges, while remaining tractable enough to be taken to the data to assess the impact of intermediary regulation on consumer welfare.

4 Empirical framework

Overview This section presents an empirical model of pension product and intermediary choice. At and after retirement, individuals derive consumption value while alive and bequest utility upon death. Pension products are characterized by a stream of payments and incidental bequests across time. Given these streams, retirees therefore optimally decide how much to consume and save throughout their life cycle. Optimal decisions depend on their beliefs about survival probabilities, preferences for bequests, risk aversion, and wealth other than pension savings. The optimal consumption and savings path determine the value of the pension product to the individual.

The key force in the model is a *choice friction*: at the time of retirement, consumers cannot perfectly observe their idiosyncratic value of a pension product. The choice friction therefore represents the complexity of choosing a product, either due to the difficulty of understanding the products' financial characteristics, or how they interact with a retiree's type and preferences. Consumers are rationally inattentive: thet can "pay" a cost to become informed about the values of products. Before acquiring information, consumers have prior beliefs about the value of the different products in their choice set, which captures both their ex-ante knowledge and the degree of perceived uncertainty.

As an alternative to choosing on their own, a consumer can hire an intermediary. The intermediary – a sales agent or an independent advisor – allows the consumer to perfectly observe the value of products in their choice set. However, intermediation reduces the value of some products, due to commission payments. Intermediaries also introduce *distortions*: their financial incentives lead them to push some products (annuities) over others (Phased Withdrawal). The consumer is aware of this distortion ex-ante but unable to undo this ex-post.[40]

The consumer optimally chooses whether to hire an intermediary by comparing the expected value of making a decision alone against using an intermediary. The fundamental trade-off is between incurring costs of information and potentially making "mistakes" if choosing alone, or paying a commission and risk being directed towards a suboptimal product by an intermediary. Resolving this trade-off yields the optimal intermediation channel. Retirees face hurdles in finding an intermediary, which reflects agents' and advisors' outreach, a function of the retirees' savings and their location.

The model presented here maps closely to the empirical setting of the Chilean pension market and the empirical evidence presented in the previous section. Individuals make two sequential choices: first, which intermediation channel to use; second, what pension product – Phased Withdrawal or annuity type – to select.[41][42] I first describe the consumption-savings model that represents the value of a pension product. I then outline the pension-product choice, first for

[40]Anecdotally, retirees have difficulty, for example, not buying from the insurance company recommended by a sales agent. Doing so would imply the agent does not get any compensation after having helped them make a decision.

[41] The structure of the choice, albeit arguably rigid, has a natural counterpart in the empirical setting. Most individuals contact an intermediary before beginning the process of requesting offers for pension products. The structure of the pension products document in Figure 2 suggests the decision to be made in two stages: first, the pension product is selected, and then – if choosing an annuity – the insurance company is chosen. One of the independent advisors interviewed also described their advising process as following precisely those steps: "first we figure what the pension product is that you want, and then we see who to buy it from." In Appendix C.7, I introduce an extension to the model that incorporates the choice of insurance company as a third and final choice.

[42]I do not model the choice of which pension products to request offers from. In my sample, more than 50% of retirees receive offers for more than 10 products: the averages are similar across intermediation channels, with a larger variation among non-intermediated retirees.

self-reliant, and then for intermediated retirees. Next, I turn to the choice of intermediary, and discuss identification.

Pension product value I model the value of a pension product k for individual i as an aggregate of the underlying individual offers for that pension product,[43] given by

$$\xi_{ik} = \zeta_{ik} + \varepsilon_{ik}, \tag{1}$$

where ζ_{ik} denotes the financial value of the product and ε_{ik} is an idiosyncratic taste shock.[44] The financial value ζ_{ik} of a pension product defined as the utility derived from the optimal expected consumption path attained under that product. As such, this value depends on the interaction of the pension products characteristics – payment flows and incidental bequests – with the retirees' preferences, such as their expected survival, their taste for bequests, risk aversion, and financial situation.

To define ζ_{ik}, let d_t be a random variable describing whether the retiree dies in period t. The uncertainty over the variable is represented by a vector of hazards / mortality probabilities $\{\mu_t\}_{t=0}^{T}$, assuming $\mu_t = 1$ for some finite T. Therefore,

$$d_t = \begin{cases} 1 & \text{w/ prob. } \mu_t, \\ 0 & \text{otherwise.} \end{cases}$$

Let $s_t \in \{0,1\}$ describe whether the retiree is alive or dead at period t. The variable evolves according to d_t,

$$s_t = \begin{cases} 1 & \text{if } s_{t-1} = 1 \text{ and } d_t = 0, \\ 0 & \text{otherwise.} \end{cases}$$

As shown in Figure 1, a pension product (Phased Withdrawal/Annuity) can be characterized by a stream of payments p^t if the retiree is alive at time t and implied bequests b^t if the retiree dies at time t

$$\{p_{ik}^t, b_{ik}^t\}_{t=0}^{T}.$$

[43] For example, as seen in Figure 2, a retiree will usually receive many offers for a 10-year guaranteed annuity, which I aggregate to an index for the estimation. I discuss details of the implementation in section 6.

[44] The model can also accommodate characteristics of pension product k assumed to be easily observable, V_{ik}. See Appendix C.7 for a micro-foundation for this variable as a composite of all underlying offers pension product k.

Products differ in the values, but also the paths of p^t and b^t. For example, annuities without guarantees or deferral will have $p^t = \bar{p}$ and $b^t = 0$ for all t. By contrast, a Phased Withdrawal offers a positive, but decreasing path of both p^t and b^t.[45]

Denote consumption in period t as c_t and savings as a_t. Define "money in the bank" m_t as total funds available to the retiree at period t, either from savings or pension payments. Similarly, define f_t to be the total bequeathed wealth – either from savings or, incidentally, from the pension product – if the retiree dies in period t. Denoting R as the risk-free interest rate,

$$\begin{aligned} m_t &= a_{t-1} \cdot R + p^t_{ik}, \\ f_t &= a_{t-1} \cdot R + b^t_{ik}. \end{aligned}$$

Following Einav, Finkelstein, and Schrimpf (2010) and Illanes and Padi (2021), I model utility as CRRA contingent on survival and upon death:

$$u(c_t, f_t | s_t, d_t) = \begin{cases} \frac{c_t^{1-\gamma}}{1-\gamma} & \text{if } s_t = 1 \quad \text{(alive at period } t\text{)}, \\ \delta_{\text{beq}} \left(\frac{f_t^{1-\gamma}}{1-\gamma} \right) & \text{if } d_t = 1 \quad \text{(death in period } t\text{)}, \\ 0 & \text{otherwise (death before period } t\text{)}. \end{cases}$$

The value of a product is then given by the value of the optimal solution to the consumption-savings problem subject to a borrowing constraint

$$\begin{aligned} \zeta_{ik} = \max_{\{c_t, a_t\}_{t=0}^T} \ & \mathbb{E}_{d_t} \left[\sum_{t=0}^{T} \beta^t u(c_t, f_t | s_t, d_t) \right] \\ \text{s.t.} \quad & a_t = m_t - c_t, \qquad m_{t+1} = a_t R + p^{t+1}_{ik}, \\ & f_{t+1} = a_t R + b^{t+1}_{ik}, \qquad a_t \geq 0 \quad \forall t, \\ & m_0 = w. \end{aligned} \tag{2}$$

The assumption of the borrowing constraint follows Einav, Finkelstein, and Schrimpf (2010) and Illanes and Padi (2021); the latter argue that this assumption is adequate in the Chilean setting, where access to credit for retirees is difficult.

[45] In estimation, I also account for government subsidies that may affect the value of p^t and b^t. I do not observe whether a retiree qualifies for a subsidy; however, I do observe recipients of subsidies in the data, and calculate stream values assuming perfect take-up of subsidies at time of retirement. Appendix F (in progress) describes this system in Chile, which is also detailed in Appendix B of Illanes and Padi (2021). An important concern is whether the take-up of subsidies is related to the role of intermediaries: some agents and advisors mentioned the application for subsidies and related paperwork as part of their role. Controlling for pension savings, I do not find a significant relationship between intermediary use and subsidy take-up.

The value will be determined both by the financial characteristics of the pension products, and the idiosyncratic preferences and survival beliefs of the individual. The latter are reflected either in their utility function $u(\cdot)$, their initial assets, or the expectation $\mathbb{E}_{d_t}$. Risk aversion γ and taste for bequests δ_{beq}[46] are embedded in the definition of $u(\cdot)$. Wealth other than pension savings is captured as assets at the beginning of retirement, $m_0 = w$. Finally, the retiree's life expectancy – knowledge about $\{\mu_t\}_{t=0}^{T}$ – is captured by $\mathbb{E}_{d_t}$.[47] The consumption-savings problem flexibly captures the relative value of the different pension streams, allowing consumers to optimally decide to consume or save depending on their individual type and preferences. The relative values will determine the substitutability across products, which will be key in assessing potential benefits and losses from intermediation. The value of products will crucially depend on the individual's life expectancy, creating the possibility of (adverse) selection into pension products. Intuitively, those retirees expecting to live longer will derive more value from an annuity.

The life-cycle model may not be flexible enough to accommodate some of the mechanisms that will plausibly determine preferences for different pension products, for example, previous financial commitments (e.g. a mortgage), liquidity needs, or forecasted financial shocks. I therefore allow for an unobserved shock ϵ_{ik} to the product value. The interpretation of the shock need not be financial, but I assume the shock is part of utility that is costly to observe for the retiree, as detailed in the next section.

Theoretical foundations for product choice I model the pension product choice as a rational-inattention problem. For all pension products k, the individual cannot observe ξ_{ik}: they do not know exactly how the characteristics of each product interact with their preferences, but can pay a cost to learn about them. This cost captures both the cognitive effort of understanding product characteristics, the anxiety derived from making an important financial decision, or the stress from thinking about a complex and uncomfortable topic such as their life expectancy. Retirees have ex-ante beliefs about the value of each product, which intuitively capture the potential "returns" to learning. Individuals optimally trade off the costs of acquiring information against the expected increase in utility from making a more informed decision. Resolving the trade-off yields the optimal amount of information acquired and the probability of choosing each

[46] As emphasized in Einav, Finkelstein, and Schrimpf (2010), the interpretation of the parameter δ_{beq} is ambiguous. Generally, it captures the value of "money after death," which can be attributed to an altruistic weight on the utility of heirs, or to a "regret" motive associated with the purchase of insurance (Braun and Muermann, 2004).

[47] Implicit in this formulation is both the assumption that these beliefs are "correct" – they correspond to the actual probabilities of the outcomes – and that the value ξ_{ik} is computed assuming that a retiree's information set at the time of the decision contains exactly the vector of mortality probabilities $\{\mu_t\}_{t=0}^{T}$. This assumption rules out perfect foresight about the time of death.

product.[48]

Formally, each individual has a prior G on $\boldsymbol{\zeta}_i$, the vector of realizations of all ζ_{ik}. Individuals can acquire information in the form of signals about the true value of $\boldsymbol{\zeta}_i$. Concretely, they can devise a signal structure or strategy – a mapping from values of $\boldsymbol{\zeta}_i$ to signals – to become informed. The rational-inattention framework imposes two assumptions on the problem described above. First, it allows individuals to freely design a signal structure: it imposes no restrictions on *what* and *how* exactly the individual will learn about each product. Second, it assumes the cost of acquiring information is proportional to the expected *reduction in entropy* $H(\cdot)$ from the devised strategy.[49]

The classic formulation of the rational-inattention problem due to Sims (2003) reads

$$\begin{aligned} \max_{F(\mathbf{s}|\boldsymbol{\zeta}_i)} \quad & \int_{\boldsymbol{\zeta}_i} \int_{\mathbf{s}} \max_{k \in \{1,\dots,N\}} \mathbb{E}_{F(\boldsymbol{\zeta}_i|\mathbf{s})}[\zeta_{ik}] F(\mathrm{d}\mathbf{s}|\boldsymbol{\zeta}_i) G(\mathrm{d}\boldsymbol{\zeta}_i) \quad - c(F), \\ \text{s.t.} \quad & \int_{\mathbf{s}} F(\mathrm{d}\mathbf{s}|\boldsymbol{\zeta}_i) = 1 \quad \forall \boldsymbol{\zeta}_i \in \mathbb{R}^N, \end{aligned}$$

where $\mathbf{s}$ is a vector of signals and $c(F)$ is the mutual information cost function for a given signal distribution $F(\cdot|\mathbf{s})$,

$$\begin{aligned} c(F) &= \lambda_i \Big(H(G_i) - \mathbb{E}_{\mathbf{s}} \left[H\big(F(\cdot|\mathbf{s})\big) \right] \Big), \\ H(F) &= - \int_{\mathbf{x}} f(\mathbf{x}) \log f(\mathbf{x}) \mathrm{d}\mathbf{x}. \end{aligned}$$

λ_i can be interpreted as the individual shadow or marginal cost of acquiring information. A key output of the model will be a distribution for this parameter, which will intuitively capture the heterogeneity in retirees' ability to make decisions.

Matejka and McKay (2015) show that, for choices between discrete alternatives, as in this setting, the problem can be written in terms of the *probability of choosing each k given a realization*

[48] I do not specify the underlying randomness that gives rise to the ex-ante beliefs. In the rational-inatention literature, the prior is often interpreted as representing the distribution of state-dependent realizations of utility. The interpretation in my setting is closer to the *subjective* prior of Joo (2023) or Brown and Jeon (2023). See the discussion on identification and Appendix C.5.

[49] Mackowiak, Matejka, and Wiederholt (2023) discuss these assumptions, their implications and potential generalizations.

of $\boldsymbol{\xi}_i$, $\mathcal{P}_{ik}(\boldsymbol{\xi}_i)$. The problem of the individual then reads

$$\max_{\{\mathcal{P}_{ik}(\boldsymbol{\xi}_i)\}_{k=1}^N} \left(\sum_{k=1}^{N} \int_{\boldsymbol{\xi}_i} \xi_{ik} \mathcal{P}_{ik}(\boldsymbol{\xi}_i) G(\mathrm{d}\boldsymbol{\xi}_i) \right) - \lambda_i \kappa(\mathcal{P}_i, G), \tag{3}$$
$$\text{s.t.} \quad \mathcal{P}_{ik}(\boldsymbol{\xi}_i) \geq 0 \ a.s., \qquad \sum_{k=1}^{N} \mathcal{P}_{ik}(\boldsymbol{\xi}_i) = 1 \ a.s.,$$

where $\kappa(\cdot)$ is the mutual information cost written in terms of the discrete actions,

$$\kappa(\mathcal{P}_i) = \left[-\sum_{k=1}^{N} \mathcal{P}^0_{ik} \log \mathcal{P}^0_{ik} + \int_{\boldsymbol{\xi}_i} \left(\sum_{k=1}^{N} \mathcal{P}_{ik}(\boldsymbol{\xi}_i) \log \mathcal{P}_{ik}(\boldsymbol{\xi}_i) \right) G(\mathrm{d}\boldsymbol{\xi}_i) \right], \tag{4}$$

and $\mathcal{P}^0_{ik}$ is the *unconditional* or ex-ante probability of choosing k,

$$\mathcal{P}^0_{ik} = \int_{\boldsymbol{\xi}_i} \mathcal{P}_{ik}(\boldsymbol{\xi}_i) G(\mathrm{d}\boldsymbol{\xi}_i).$$

This formulation has the intuitive interpretation of the individual choosing *how close to the optimal choice to get*. If $\lambda_i = 0$ (no cost of acquiring information), the individual would always choose the product k that yields the highest utility with probability 1. When the cost of acquiring information is positive, the decision-maker instead chooses the *probability* of picking the optimal product – and all others – given a realization of the vector $\boldsymbol{\xi}_i$.

Product choice without intermediary Building on the insights from Matejka and McKay (2015), Brown and Jeon (2023) show that a specific parametrization of the prior $G(\cdot)$ leads to a tractable equation for the optimal choice probabilities that solve equation (10). Assuming $G_{\lambda_i}(\cdot)$ is independent across all products k with means ξ^0_{ik} and constant variance σ_i^2, and follows the conjugate to the EV(I) distribution yields the optimal choice probabilities

$$\mathcal{P}^*_{ik}(\boldsymbol{\xi}_i) = \frac{\exp\left(\frac{\xi_{ik}}{\lambda_i} + \frac{\xi^0_{ik}}{\lambda_i(\ell_{\lambda_i,\sigma_i^2} - 1)} \right)}{\sum_{n=1}^{N} \exp\left(\frac{\xi_{in}}{\lambda_i} + \frac{\xi^0_{in}}{\lambda_i(\ell_{\lambda_i,\sigma_i^2} - 1)} \right)}, \quad \ell_{\lambda_i,\sigma_i^2} = \sqrt{\frac{6\sigma_i^2}{\lambda_i^2 \pi^2} + 1}. \tag{5}$$

The shape of the prior ensures the probabilities retain a tractable form,[50] in which the decision can be interpreted as being based on a weighted average of the product's *prior mean value* $V_{ik} + \xi^0_{ik}$

[50]The required assumption is that $\frac{\xi_{ik}}{\lambda_i}$ has the unique distribution – also called Cardell distribution – such that if $\epsilon \sim$ EV(I), then $\frac{\xi_{ik}}{\lambda_i} + \epsilon \sim$ EV(I). The required prior distribution changes as λ_i increases or decreases, even if we hold its mean and variance fixed. This feature essentially implies the assumption of a friction *structure* for each individual which is described by both λ and $G_\lambda(\cdot)$. In Appendix C.2 I characterize and discuss the implications of this assumption.

and the *true* value $V_{ik} + \xi_{ik}$. The weights depend on both the cost of information λ_i and the variance of the prior σ_i^2, which can be interpreted as a measure of the *stakes* (Brown and Jeon, 2023).

The limiting cases are useful in developing intuition. As λ_i goes to zero, $\lambda_i(\ell_{\lambda_i,\sigma_i^2} - 1) \to \sqrt{\frac{6\sigma^2}{\pi^2}}$ and the consumer chooses the best product with probability 1, completely disregarding the prior. As $\lambda_i \to \infty$, $\lambda_i(\ell_{\lambda_i,\sigma_i^2} - 1) \to 0$, and the consumer chooses the product with the highest prior mean with probability 1. When σ_i^2 increases, $\ell_{\lambda_i,\sigma_i^2}$ increases and the consumer puts relatively more weight on the true value of the product – a higher variance implies a higher return to becoming informed. On the other hand, as $\sigma_i^2 \to 0$, $\lambda_i(\ell_{\lambda_i} - 1) \to 0$ and the consumer chooses entirely based on the prior, because the expected returns to learning about different products are low. Finally, when the prior means are identical across the product dimensions $\xi_{ik}^0 = c_i \ \forall k$, the prior becomes interchangeable across dimensions and the choice probabilities reduce to (Matejka and McKay, 2015)

$$\mathcal{P}_{ik}^*(\boldsymbol{\xi}_i) = \frac{\exp\left(\frac{\xi_{ik}}{\lambda_i}\right)}{\sum_{j=1}^N \exp\left(\frac{\xi_{ij}}{\lambda_i}\right)}.$$

At first glance, the pension-product decision could appear as an unintuitive application of the rational-inattention framework, which more often is used to describe a complex strategy built to employ in repeated decisions (Mackowiak, Matejka, and Wiederholt, 2023). Nevertheless, the framework describes the mechanisms that are important in this setting. The rational-inattention model accurately reflects the spirit of the friction at hand: the idea that making a decision is a complex process, even when all products are readily available. The model also allows for an endogenous choice to "overcome" the friction, depending on both a fundamental cost of information and prior beliefs, in particular regarding the stakes at hand. The framework therefore explicitly and intuitively captures the role of key levers in this context. The assumption on the prior, while rigid, ensures the model remains tractable.

Product choice with intermediary Under a pension advisor or sales agent, the retiree essentially "delegates" the decision to the intermediary. When intermediated, the retiree no longer maximizes their own utility, but rather a weighted average of their own value and the financial utility of the advisor, whose commission depends on the product chosen.[51] The bias toward

[51]As in Robles-Garcia (2020), this joint maximization could be justified by, for example, bargaining between the consumer and the advisor. Alternatively, the assumption can be interpreted as the intermediary learning about the consumers' values for each product, and only revealing their recommendation to their customer. As outlined in the theoretical literature (e.g. Dessein, 2002), the complete delegation of the decision to an intermediary can be optimal

annuities due to the intermediaries' financial incentives is captured in a reduced form by the variable c^I. Additionally, because the commission is discounted from the retirees' savings, the annuity payouts and the utility derived from them are reduced, which is captured by ξ^I_{ik}. The value of hiring an intermediary lies in them perfectly learning about the different product values: up to the bias c^I_k, the agent or advisor is able to direct the consumer to the optimal product in their choice set. The problem solved with an intermediary is then

$$\max_{\{\mathcal{P}_{ik}(\boldsymbol{\xi}_i)\}_{k=1}^N} \left(\sum_{k=1}^N \int_{\boldsymbol{\xi}_i} \big(\xi^I_{ik} + c^I \mathbb{1}(k \text{ is annuity})\big) \mathcal{P}_{ik}(\boldsymbol{\xi}_i) G(\mathrm{d}\boldsymbol{\xi}_i) \right)$$
$$\text{s.t.} \quad \mathcal{P}_{ik}(\boldsymbol{\xi}_i) \geq 0 \textit{ a.s.}, \qquad \sum_{k=1}^N \mathcal{P}_{ik}(\boldsymbol{\xi}_i) = 1 \textit{ a.s.}$$

Given the information cost is zero, the solution is

$$\mathcal{P}^{*,I}_{ik}(\boldsymbol{\xi}_i) = \mathbb{1}\big(\arg\max_k \xi^I_{ik} + c^I \mathbb{1}(k \text{ is annuity})\big). \tag{6}$$

The consumer derives utility ξ^I_{ik} from this choice. The distortion in choices induced by the intermediary comes from the fact that, in general, the product that maximizes the *joint* utility may not be the one that maximizes the *consumers'* utility. If the financial incentives of the intermediary are not perfectly aligned with those of the consumer, the choice made can be "suboptimal" for the consumer.

I allow for the commission and the bias to vary by the intermediary type, captured by $\{\xi^{PA}_{ik}, c^{PA}\}$ and $\{\xi^{SA}_{ik}, c^{SA}\}$. In practice, the incentives for sales agents and intermediaries are different, because agents are biased not just toward annuities, but rather toward those sold by a specific insurance company. In the extension in Appendix C.7, I explicitly incorporate the bias towards a specific insurance company while retaining the convenient additive form of utility.

Intermediary choice The choice of intermediation is governed by the expected utility – chosen product value net of costs – of making a decision using each channel given the retiree's information cost λ_i and their prior $G_{\lambda_i}(\cdot)$ over product values $\boldsymbol{\xi}_i$. The value of the intermediary accounts for the steering toward annuities at this stage: the retiree knows the utility maximized in the product choice is not theirs, but rather the weighted average in equation (6). The value of each

even when strategic communication is possible.

intermediation channel then takes the form

$$
\begin{aligned}
U_i^{NI} &= \mathbb{E}[U_{\text{No intermediary}}] = \sum_{k=1}^{N} \int_{\boldsymbol{\xi}_i} \xi_{ik} \mathcal{P}^*(\boldsymbol{\xi}_i)\ G_{\lambda_i}(\mathrm{d}\boldsymbol{\xi}_i) - \lambda_i \kappa \left(\mathcal{P}_i, G_{\lambda_i}\right), \\
U_i^{PA} &= \mathbb{E}[U_{\text{Advisor}}] = \sum_{k=1}^{N} \int_{\boldsymbol{\xi}_i} \xi_{ik}^{PA} \mathcal{P}^{*,PA}(\boldsymbol{\xi}_i)\ G_{\lambda_i}(\mathrm{d}\boldsymbol{\xi}_i), \\
U_i^{SA} &= \mathbb{E}[U_{\text{Sales Agent}}] = \sum_{k=1}^{N} \int_{\boldsymbol{\xi}_i} \xi_{ik}^{SA} \mathcal{P}^{*,SA}(\boldsymbol{\xi}_i)\ G_{\lambda_i}(\mathrm{d}\boldsymbol{\xi}_i).
\end{aligned}
$$

The imposed assumption on the prior G_λ yields a closed-form solution for the expected value without an intermediary, which reads

$$
U_i^{NI} = \lambda(\ell_{\lambda_i,\sigma_i^2} - 1) \log\left(\sum_{k=1}^{N} \exp\left(\frac{\xi_{ik}^0}{\lambda_i(\ell_{\lambda_i,\sigma_i^2} - 1)}\right)\right).
$$

Unfortunately, no closed-form expression exists for the expected utility using an intermediary. For the purposes of tractability in estimation, I approximate the value of intermediation for retirees integrating over an EV(I) prior for $\boldsymbol{\xi}_i$ – instead of $G_{\lambda_i}(\cdot)$ – to compute the expected value of using an intermediary. This approximation only changes the *shape* of the distribution while keeping the mean $\xi_{ik}^{0,PA}, \xi_{ik}^{0,SA}$ and the variance σ_i^2 constant.[52] The expressions above then reduce to (Train, 2015)

$$
\begin{aligned}
U_i^{PA} &= \sqrt{\frac{6\sigma_i^2}{\pi^2}} \log \sum_{k=1}^{N} \exp\left(\frac{\xi_{ik}^{0,PA} + c^{PA}\mathbb{1}(k \text{ is annuity})}{\sqrt{6\sigma_i^2/\pi^2}}\right) - \sum_{k=1}^{N} \mathcal{P}^{0,*,PA} c^{PA} \mathbb{1}(k \text{ is annuity}), \\
U_i^{SA} &= \sqrt{\frac{6\sigma_i^2}{\pi^2}} \log \sum_{k=1}^{N} \exp\left(\frac{\xi_{ik}^{0,SA} + c^{SA}\mathbb{1}(k \text{ is annuity})}{\sqrt{6\sigma_i^2/\pi^2}}\right) - \sum_{k=1}^{N} \mathcal{P}^{0,*,SA} c^{SA} \mathbb{1}(k \text{ is annuity}),
\end{aligned}
$$

where

$$
\mathcal{P}_{ik}^{0,*,PA} = \frac{\exp\left(\frac{\xi_{ik}^{0,PA} + c^{PA}\mathbb{1}(k \text{ is annuity})}{\sqrt{6\sigma_i^2/\pi^2}}\right)}{\sum_{j=1}^{N} \exp\left(\frac{\xi_{ij}^{0,PA} + c^{PA}\mathbb{1}(j \text{ is annuity})}{\sqrt{6\sigma_i^2/\pi^2}}\right)}, \quad \mathcal{P}_{ik}^{0,*,SA} = \frac{\exp\left(\frac{\xi_{ik}^{0,SA} + c^{SA}\mathbb{1}(k \text{ is annuity})}{\sqrt{6\sigma_i^2/\pi^2}}\right)}{\sum_{j=1}^{N} \exp\left(\frac{\xi_{ij}^{0,SA} + c^{SA}\mathbb{1}(j \text{ is annuity})}{\sqrt{6\sigma_i^2/\pi^2}}\right)}.
$$

Some comparative statics are useful to gain intuition here. The values of each intermediation channel U_i^{SA}, U_i^{PA} are constant across individuals with different λ_i, whereas the expected value

[52] The EV(I) distribution is the limit of the prior distribution when $\lambda_i \to 0$. A different interpretation of this approximation is as a behavioral assumption implying an effective "change in the shape of beliefs" when evaluating an intermediary. In Appendix, C.2 I discuss the difference induced in the prior distributions, the quality of the approximation, and the consequences and potential micro-foundations for this assumption.

of making a decision alone U_i^{NI} decreases in λ_i, implying retirees with high λ_i will value intermediation more. Given the retiree is ex-ante aware of the bias of each intermediary, larger values of c^{PA}, c^{SA} decrease the value of intermediation. The comparative statics with respect to the prior means and variances are subtle. Under certain conditions, the value of intermediation will increase in the prior mean value of the distorted products. For the variance of the prior – the "stakes" – the relationship is non-monotonic: a higher σ_i^2 makes learning about the products more valuable (and more costly given any λ_i), but it also means the distortion introduced by the intermediary is potentially more costly. I discuss these comparative statics in detail in Appendix C.3 (in progress).

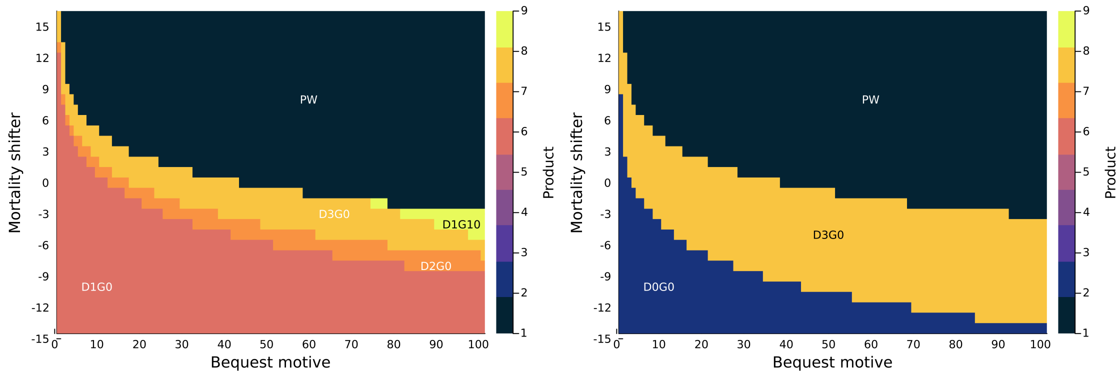
The data and anecdotal evidence suggest networks, word-of-mouth, and geographic location play a significant role in the selection into an intermediary. I therefore model demand for intermediaries in a simple sequential-search framework à la Hortaçsu and Syverson (2004). Retirees always have the option to go through the pension-product process alone but need to pay a search cost to find an intermediary. These assumptions yield intermediary market shares s_{NI}, s_{PA}, s_{SA} that depend on both the expected utilities U_{NI}, U_{PA}, U_{SA} and the sampling probabilities of the intermediaries, a function of a retiree's location and wealth. I derive the full model in Appendix E.1.

Identification The fundamental challenge for the model is to distinguish between three forces: (i) preferences, (ii) distortions induced by intermediaries, and (iii) information costs. In this subsection, I provide intuition for the identification of each of these mechanisms.

The main identification assumptions relate to the unobservable characteristics and the structure of the ex-ante beliefs of intermediaries, the prior. I assume the information cost λ_i is *uncorrelated* with other unobservable preferences of retirees.[53] I discuss benchmark prior assumptions further below: the identification arguments are conditional on a given assumption of the prior distribution, means, and variance.

Figure 8 shows the identification of preferences – latent mortality risks m and preferences for bequests δ_{beq} – in the life-cycle model, which has been previously established in this literature (Einav, Finkelstein, and Schrimpf, 2010; Illanes and Padi, 2021). In general, annuities are an attractive choice for retirees expecting to live long, whereas guarantees provide higher value to those with high taste for bequests. The identification arguments are only partially modified under the presence of information costs, "mistakes," and distortions. Intuitively, identification of

[53] The assumption is justified by anecdotal and survey evidence of this setting, that suggest the complexity in understanding the value of products is pervasive and not immediately linked to variables such as educational level or financial literacy. See, for example, Table A.24.



(a) Individual 1

(b) Individual 2

Figure 8: Identification of preferences

Notes: The heatmaps represent the optimal product choice – according to the life-cycle model – at different values of life expectancy (mortality shifter) and bequest motives. The colors and labels describe a pension product: for example, "D1G10" is an annuity deferred by 1 year and with a guarantee length of 10 years. Variation in prices and choice sets across time induces variation in optimal choices for retirees with identical preferences. The substitution patterns are therefore informative about the joint distribution of mortality shifters and bequest motives.

preferences relies on comparing individuals *within* an intermediation channel. For example, intermediated individuals will choose perfectly within the set of undistorted products (annuities). Variation across individual choice sets and prices of annuities faced – due to changing financial market conditions and interest rates, and regulations such as official mortality tables – will imply individuals with similar levels of savings will face different optimal choices given the same preferences. Changes in the choice probabilities will therefore be informative about the joint distribution of survival expectations and bequest motives. Additional identification comes from the correlation of choices and realized mortality outcomes, as in Einav, Finkelstein, and Schrimpf (2010). However, in this setting, the mortality data are censored at two years after retirement, substantially reducing their identification power.

Having pinned down preferences using within-intermediary comparisons, we can compare choices *across* intermediaries to identify intermediary distortions c^I and the distribution of information costs λ_i. Figure 9 shows the intuition behind this identification. The model compares ex-ante identical individuals who vary exclusively in their information costs, which creates differential demand for intermediation. This variation is informative about both the size of the information costs and the distortions induced by the intermediary. We can similarly use the realized choice probabilities of self-reliant and intermediated individuals: the intuition is similar to the "experts" approach in Bronnenberg et al. (2015). Absent any choice frictions and intermediary distortions, these choice probabilities should look identical for individuals across intermediation channels. Information costs will create noise in the choice probabilities, centered around prod-

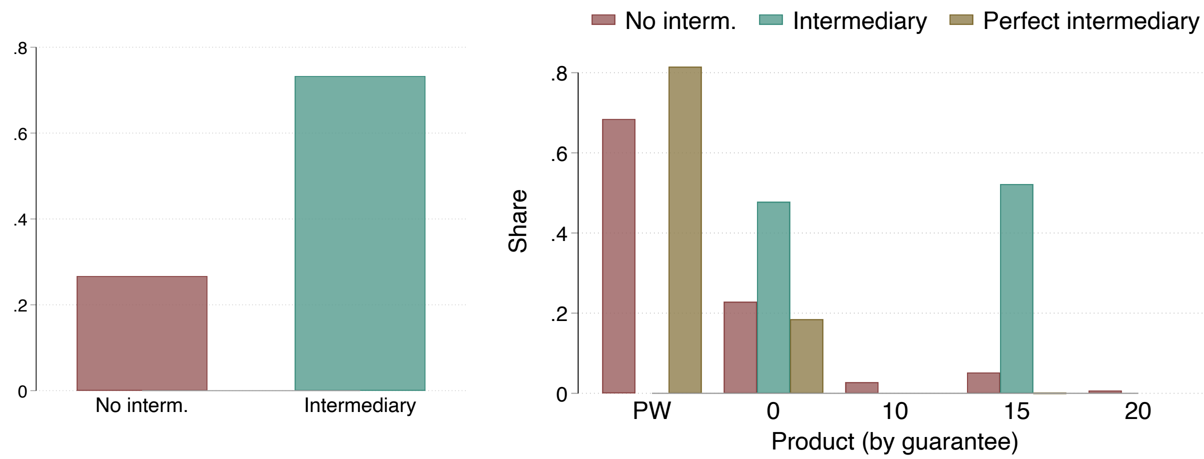


Figure 9: Identification of distortions and information costs

Notes: The bar graphs show the demand for intermediation and choice probabilities of intermediated and non-intermediated retirees for a given distribution of decision costs λ_i and preferences, and intermediary biases c^I. Intuitively, the model informs the size and distribution of the information costs λ_i from the share of retirees selecting into an intermediary, as well as from the differences in the choice probabilities, knowing intermediaries choose perfectly except for their bias toward annuities. Choice probabilities of self-reliant retirees are concentrated around products that are ex-ante (beliefs) or ex-post (actual values) high-value.

ucts with high value or high *expected* (prior) value. The intermediary's bias will reduce the share of the distorted product, the Phased Withdrawal. The model can essentially "reconstruct" the optimal intermediary's choice from a guess on the distortions, and use it to compare intermediated and non-intermediated choices to measure both information costs and biases.[54]

In the data, we do not observe the same individual more than once. We do observe individuals who may differ in terms of other unobservable characteristics. The assumption that unobservable preferences are uncorrelated with the information costs, together with the specified selection process, means the model can still compare individuals across intermediation groups, and use their selection patterns along with the realized choice probabilities to gain information about the size of the information frictions and the biases induced by the intermediaries. An additional source of identification comes from geography: as emphasized previously, retirees located in "high-intermediation" areas are more likely to use intermediaries. This variation in "exposure," arguably otherwise uncorrelated with taste for specific products, informs distortions and informational gains introduced by intermediaries. The search model parametrizes exactly this variation – and otherwise unexplained differences across the savings distribution – as shifters in the probability of accessing intermediaries.[55]

[54] The model will also use selection patterns into intermediation to get a sense of preferences: the stakes in the decision must be significant enough for intermediation to be valuable for retirees in light of commission payments.

[55] Without an exogenous shifter on intermediation it is not possible to identify the entire distribution of λ_i; only the

Choice of prior My benchmark results assume a *flat* prior, with retirees being ex-ante agnostic about which product is better or worse for them. This assumption implies that the individuals have a sense of the stakes implied in the decision, which can change with prices in the counterfactual. For the prior variance, I assume it is given by the variance of the true values of the products in the retirees' choice set.[56]

Two reasons guide the choice of the flat prior. First, anecdotal suggests this may not be an unreasonable starting point: a number of intermediaries interviewed suggested people are often unaware of their options when they first initiate the intermediation.[57] Second, the assumption serves as a natural benchmark for evaluating the distortions of intermediaries, because it limits selection based on preferences. Intuitively, this assumption should *reduce* the value of intermediaries in the model. The limiting case where the retirees' prior beliefs about product values correspond *exactly* to the actual realizations would necessarily imply intermediaries are consume- welfare improving (absent any price effects from adverse selection). This implication follows from retirees selecting into intermediaries based on their expected values.

5 Estimation

The goal of estimation is to recover parameters governing life-cycle utilities – distributions for preferences over bequests δ_{beq}, mortality expectations m and outside wealth w –, the distribution of the information costs λ_i, the intermediary biases c^{SA} and c^{PA} and parameters governing the intermediary search model.

Estimation requires solving for two consumer decision problems: the life-cycle, consumption-savings problem – which yields the financial value of the pension products – and the intermediary and pension product choice under cognitive frictions.

Estimation sample I focus on men retiring between 2010 and 2018 at age 65 or older, with no legal dependents (a spouse or children under 24 years old). The selection is made primarily for tractability and identification purposes. The life-cycle problem of a single agent is considerably easier to solve than a joint one, easening the computational burden on estimation. Men face higher mortality risk that women: I therefore observe more deaths over the observed sample that

distribution above a the cutoff $\bar{\lambda}$ that determines who would seek out intermediation.

[56]Brown and Jeon (2023) make a similar assumption, which resembles that of individuals being aware of price or value distributions in search models.

[57]The survey data of Duch et al. (2021), on the other hand, suggests that retirees who initially state an intention to buy a Phased Withdrawal or annuity are more likely to also state a preference for that product after the information intervention. I am currently working on estimating a version of the model that uses these survey results to calibrate beliefs. The model can accommodate a number of additional prior assumptions, which I discuss in Appendix C.5.

can discipline estimation of life expectancies. The restriction to the 2010-2018 period is made to ensure comparability in the choice environments: pension advisors are only firmly established in Chile starting in 2010, while the political situation in the country becomes complex in 2019. This selection procedure yields a sample of 13,420 individuals, who are heterogeneous in terms of age, wealth, survival 2 years after retirement, and time – therefore conditions – of retirement.

Life-cycle model As highlighted before, the financial utility of pension products is determined by the solution to the life-cycle model in equation (2), plus the idiosyncratic shock.

I allow for unobserved heterogeneity in three dimensions: mortality risks m, taste for bequests δ_{beq} and wealth outside the pension system at retirement w_0. I follow Illanes and Padi (2021) in modelling taste for bequests as multiplicative factors on the utility at death, and heterogeneity in mortality expectations based on "shifters" from the official Chilean mortality tables. For example, an individual aged 65 with a mortality shifter m faces the mortality risk of a $65 + m$-year old according to the mortality table at the time of their retirement. I set the discount factor β to 0.97 and the risk free real interest rate R to 1.03.[58] Finally, I model outside wealth w as proportional to pension savings. Given that I focus on the choice of pension products – and not each of the underlying offers –, I average payments p^t and implied bequests b^t to construct the streams that characterize each product.

I do not estimate a coefficient or a distribution for risk aversion. Two reasons guide this choice. First, the separate identification of risk aversion, survival probabilities, bequest motives, and the idiosyncratic shock (see below) is challenging. Second, in the choice model the *scale* of utility matters for decisions through the notion of the decision stakes. In turn, the scale then impacts information acquisition, choice probabilities and demand for intermediation. Incorporating risk aversion heterogeneity requires the scale of utility to change across individuals, therefore blurring the interpretation (and identification) of the information cost λ_i. I therefore set the risk aversion coefficient γ to 1.7, the mean value recovered in Illanes and Padi (2021).[59] In Appendix C.6, I discuss an alternative specification of product values ξ_{ik} in terms of wealth equivalence that would allow for heterogeneity in the risk aversion coefficient.

Because the borrowing constraint plausibly binds for pension products such as the Phased Withdrawal in a relevant part of the state space, I solve the model by backwards induction using the Endogenous Gridpoint Method (Carroll, 2006). However, this solution method, while

[58]The model is specified in real terms since pension payments are inflation-adjusted. The value of R is slightly larger than the inflation-adjusted return to 30-year bonds in Chile during the sample time period. I am currently working on robustness assessing the sensivity of results to the specification of this rate.

[59]The estimation sample this value is recovered from is however different, since it comprises single women retiring between 2004 and 2013.

efficient, is infeasible within the estimation routine for the choice model. Estimation would require solving the life-cycle problem for more than 100,000 pension products at every guess of the distribution of these parameters. Therefore, and given the dimensionality of the problem, I follow a similar approach to Einav, Finkelstein, and Schrimpf (2010) and solve the life-cycle problem for every individual and every product in their choice set offline on a fixed grid of mortality shifters m, bequest motives δ_{beq} and outside wealth w. Since the full choice model predicts decisions to be a function not only of the maximum value, but of the full vector $\boldsymbol{\xi}_i$, I interpolate across this grid to find values outside it in the estimation routine. In Appendix D, I argue that the value of each product evolves continuously with respect to the value of the parameters of interest, making the interpolation an attractive choice.[60]

Choice model I use Simulated Maximum Likelihood to jointly estimate the choice of intermediary and pension product. I impose parametric restrictions on the distributions of unobservables. For information costs λ_i, I estimate the mean of an Exponential distribution $\bar{\lambda}$. I estimate a Normal distribution of mortality shifters,

$$m \sim \mathcal{N}(\mu_m, \sigma_m^2).$$

I impose two additional restriction on the distribution of mortality shifters: first, I restrict their values to be exactly on a fine grid of integers between -15 and 15. Second, I additionally impose a moment restriction, the expected mortality in the sample (integrating over the distribution of m) be equal to the share of realized deaths in the data. This restriction implies I only estimate σ_m^2, and adjust μ_m to fulfill this restriction. In estimation, I also used the realized 2-year mortality outcome of each individual to update the probability of each mortality shifter m using Bayes' rule. Calling $D_i \in \{0, 1\}$ the mortality outcome of individual i,

$$\mathbb{P}(m|\mu_m, \sigma_m^2, D_i) = \frac{\mathbb{P}(D_i|\mu_m, \sigma_m^2, m)}{\sum_{m' \in M} \mathbb{P}(D_i|\mu_m, \sigma_m^2, m')}.$$

For the distribution of bequests – and based on the evidence in Illanes and Padi (2021) and Aryal et al. (2021) – I estimate a mean bequest motive μ_{beq} and a mass of retirees with zero bequest motives Z_{beq}.[61] Finally, for the distribution of outside wealth w, I construct and use an empirical

[60]Similarly, to get the value of each pension product with commissions or at different annuity prices, I solve the life-cycle once for each individual and choice of parameters and use Taylor approximations to obtain other values. For a grid of 1690 points, a full run of the life-cycle solution for 13,420 retirees choosing between a total of 100,000+ products takes approximately a day on a 32-core machine.

[61]I attempted to estimate a joint Normal distribution for unobservable bequest motives and mortality shifters. However, the estimation results suggested that the variance of the distribution σ_{beq}^2 could not be identified from the

counterpart from the Social Protection panel survey (Figure A.30).

As previewed in section 6, I set the mean across prior dimensions to the sample mean of true values and the variance of the prior to the sample variance

$$\xi_{ik}^0 = \frac{1}{N}\sum_{k=1}^{N}\xi_{ik} =: c_i, \qquad \sigma_i^2 = \mathrm{var}(\xi_{ik}) = \frac{1}{N}\sum_{k=1}^{N}\left(\xi_{ik} - c_i\right)^2.$$

As highlighted in the previous section, this assumption implies that the choice probabilities are independent of the prior G_λ. Still, this specification allows the stakes of the decision to change with the prices of different annuity types in the counterfactual. I also simplify the search model for intermediaries by considering the limiting case of search costs being infinitely large. Intermediary choices are then completely determined by the sampling probabilities of each intermediary, and the expected utility derived from each channel. The empirical model is in Appendix E.3.

Idiosyncratic shock I allow for an idiosyncratic shock ε_{ik} that impacts the financial value of a product $\xi_{ik} = \zeta_{ik} + \varepsilon_{ik}$. In Appendix C.4, I show that assuming the same distribution for this shock as for the prior maintains the tractability of the model – yielding closed form probabilities for the choices of those intermediated and not intermediated.[62] The assumption comes at a cost: similar to the assumption on the prior, the assumption on the shocks implies that their distribution – in particular, moments other than the mean and variance – varies across individuals with different information costs λ_i, as well as across intermediation channels. I estimate the scale of this shock as a fraction of the stakes σ_i^2. In Appendix C.2 and C.4, I explore the quantitative difference and consequences of this assumption. In the counterfactual, I account for the change in the distributions when computing consumer welfare measures.

6 Results

Parameter estimates Table 3 shows the estimated parameters. I estimate significant heterogeneity in retirees' mortality expectations, as depicted in Figure A.31. As in Aryal et al. (2021) and Illanes and Padi (2021), I find a mass of retirees who have no bequest motives (around 5% in this case). The mean bequest motive is large, in line with the values found in Einav, Finkelstein, and Schrimpf (2010) and Illanes and Padi (2021). As expected, both intermediaries are biased toward

variation in the data. A correlation ρ also appeared infeasible. This lack of identification could be explained by the estimation of the variance α_{σ^2} of the idiosyncratic shock ϵ_{ik} absorbing part of the variation.

[62] The taste shock is also particularly useful in the estimation, given the rigidity of the life-cycle model and the assumption on intermediaries choosing perfectly across annuities. Absent a shock, the SMLE procedure would have trouble maximizing over essentially 1s and 0s predicted choices under the intermediary.

selling annuities — the sales agents more so than the advisors.

Table 3: Selected parameter estimates

Parameter	Value	SE	Description
$\bar{\lambda}$	15.634	0.689	Information costs, Exponential distribution
c_{PA}	0.417	0.034	Bias of pension advisor
c_{SA}	0.734	0.019	Bias of sales agent
σ_m^2	26.594	3.508	Variance of mortality shifter distribution
μ_m	0.964	–	Implied mean of mortality shifter distribution
μ_{beq}	324.136	19.700	Mean bequests motive
Z_{beq}	0.047	0.010	Mass at 0 for bequest motive
α_{σ^2}	0.280	0.013	Variance of idiosyncratic shock (fraction of prior variance σ_i^2)

Notes: Results from Simulated Maximum Likelihood estimation. Sample of 13,420 men as described in section 5, with a total of 10,000 latent heterogeneity points of information costs, survival expectations, bequest motives, and wealth outside pension savings. Standard errors computed using "sandwich" formula $\hat{H}^{-1}\hat{G}\hat{H}^{-1}$, with $\hat{H}$ an estimate of the Hessian, $\hat{G}$ an estimate of the outer product of the scores.

The information cost distribution can only be interpreted relative to the individuals' beliefs given by their prior distribution. In particular, given the assumption on its shape, the mean and the variance of the prior will determine individuals' optimal information-acquisition strategy, and the expected value of that strategy vis-à-vis employing an intermediary.

One way to measure the size of these frictions is by computing the individuals' willingness to pay for the "perfect" intermediary – that is, a completely unbiased decision-maker that faces no information costs. My results imply the average (median) individual would give up around 5.3% (4.2%) of their pension payments to have access to the perfect intermediary.[63] For the mean annuitant in the sample, this percentage corresponds to around 250 USD a year.

Individuals vary in their willingness to pay to eliminate the friction: by construction, this amount is increasing in the information cost λ_i. The willingness to pay increases with the prior variance σ_i^2 – the "stakes" – both due to the entropy cost increasing and the larger incurred losses in case of making a suboptimal choice. Retirees who face larger choice sets find acquiring information relatively costlier. Finally, the measure of the value of the perfect intermediary is relative to the marginal utility derived from increasing pension payments, which is heterogeneous across individuals in the wealth and mortality distributions.

[63] With flat priors, this amount is given by the difference in expected utilities under the perfect intermediary and given the information cost λ_i, which yields

$$\sqrt{\frac{6\sigma_i^2}{\pi^2}\log N + \xi_i^0} - (\lambda_i(\ell_{\lambda_i,\sigma_i^2} - 1)\log N + \xi_i^0),$$

where N is the size of the choice set. I can then use the life-cycle model to translate this number from utils into pension payments or wealth.

I find retirees with higher savings face decisions involving relatively smaller stakes but larger choice sets,[64] which leads to substantially higher willingness to pay for intermediation — up to 8% of pension payments. I also find a non-monotonic relationship of expected survival with willingness to pay to eliminate the friction: the effective stakes faced are high for individuals living for a very long period of time as well as for those living for a very short period. The pattern is intuitive: for those expecting to die shortly, some products (annuities) are clearly suboptimal, and the short period of survival prevents smoothing. For those living very long, retirees' ability to save throughout the life cycle smooths out differences between products. However, stakes might also become larger once differences in attainable consumption levels are compounded over many periods.

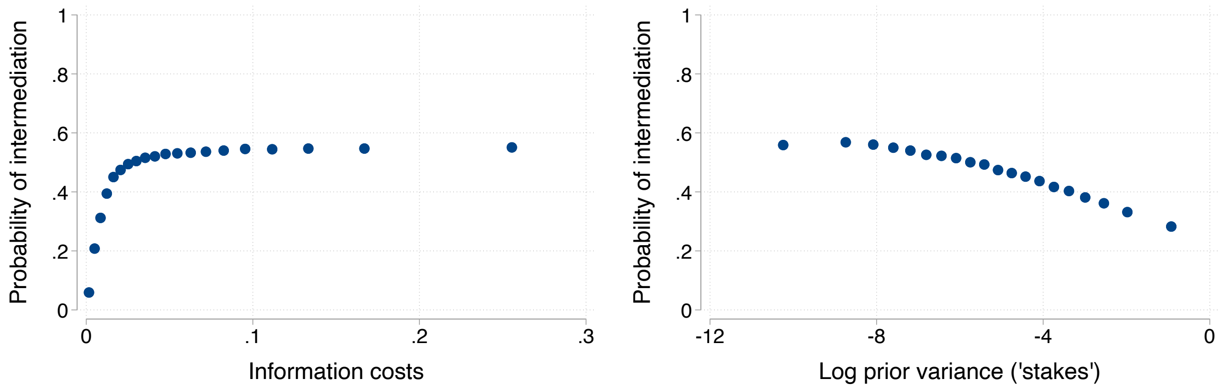
Figure 10 shows how these forces translate into demand for intermediaries in the model. As expected, the probability of selecting into intermediation increases when the information cost is higher. The comparative statics with respect to the prior mean are non-monotonic, as argued before: the "cheap" information the intermediary provides is more valuable when the stakes are higher, but steering is also more costly. Figure 10 shows the distortion motive dominates in the data: retirees are less likely to seek intermediation as a result. Given the flat priors, selection based on preferences occurs solely through this margin: intermediated individuals live slightly longer, have similar taste for bequests, and are richer than those who make decisions by themselves.

Finally, the model predicts a substantial friction of selecting into intermediaries: over 80% of retirees would find it ex-ante optimal to select into an intermediary, but only about 50% end up finding one. The model therefore assigns a large weight to the availability of intermediaries, as can be seen in Figure A.32.

Model fit To assess model fit, I sample each individual 100 times, drawing the unobservable information cost λ_i, mortality shifter m, taste for bequests δ_{beq}, and wealth outside pension savings w each time. Figure 11 shows the predictions for intermediary and pension-product choices. The model matches most aggregate statistics, including the share of people intermediated by an independent advisor as opposed to an agent, which is controlled by their relative bias as well as the sampling probabilities of each intermediary type across savings and locations. The model

[64] For tractability in the model, I do not endogenize the choice of product requests that constitutes the choice set although it is a decision variable in this setting. In the data, the average number of products requested by retirees is similar across intermediation channels, although with a larger variance for those who make their retirement decision on their own. However, retirees with lower savings are sometimes not able to afford a guarantee or a deferral annuity, which restricts their choice set. In general, we see a relationship between savings and size of the choice set; see Figures A.33 and A.34 in Appendix A. This reason also motivates the split of annuity pricing into savings quartiles in the counterfactual: see section 7 for details.

Figure 10: Demand for intermediaries (model)



Notes: The figures show determinants of demand for intermediation in the model. The y-axis shows the probability of seeking intermediation; the x-axis the marginal information cost λ_i in (a) and the log of the prior variance σ_i^2 in (b). Sample restricted to individuals age 65 for comparability in counterfactual.

also matches the high share of annuitization in the data, along with the broad characteristics of the annuities purchased. In particular, the model predicts a substantial difference between the probability of choosing a guarantee across intermediaries. The model also broadly fits the adverse selection patterns we see in the data. Table 4 shows the model successfully replicates the adverse selection into annuities.

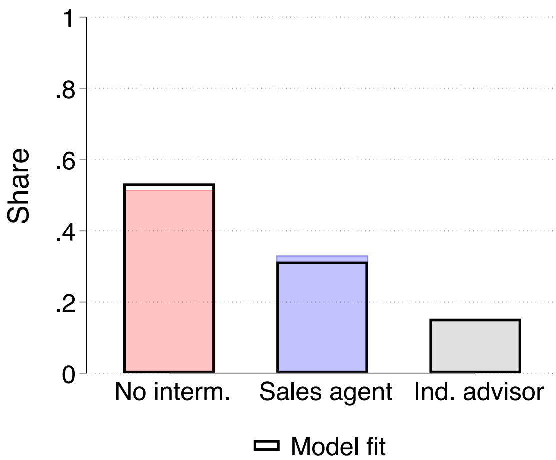
Table 4: Model fit (age 65)

	Data	Model
Share of intermediated	0.49	0.46
Share of pension advisors	0.16	0.15
Share annuities	0.66	0.65
Simple	0.078	0.072
Guaranteed	0.25	0.24
Deferred	0.060	0.089
Guaranteed and deferred	0.28	0.25
2-year mortality	0.028	0.029
Phased Withdrawal	0.036	0.034
Annuities	0.024	0.027

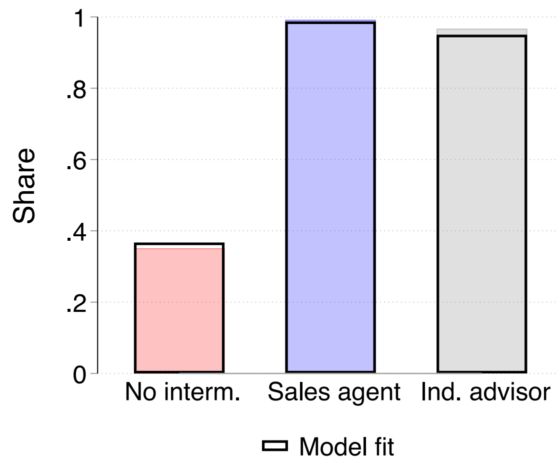
Notes: Model statistics generated by sampling each individual in the estimation 100 times, drawing information costs λ_i, mortality shifters m, taste for bequests δ_{beq}, and wealth other than pension savings w, drawing from the model-estimated distributions. Sample restricted to individuals age 65 for comparability in counterfactual.

Model implications The model implies a notion of "incorrect" choices: when an individual does not select the pension product that gives them the highest utility within their choice set (under full information). Incorrect choices arise from two sources in the model: for self-reliant

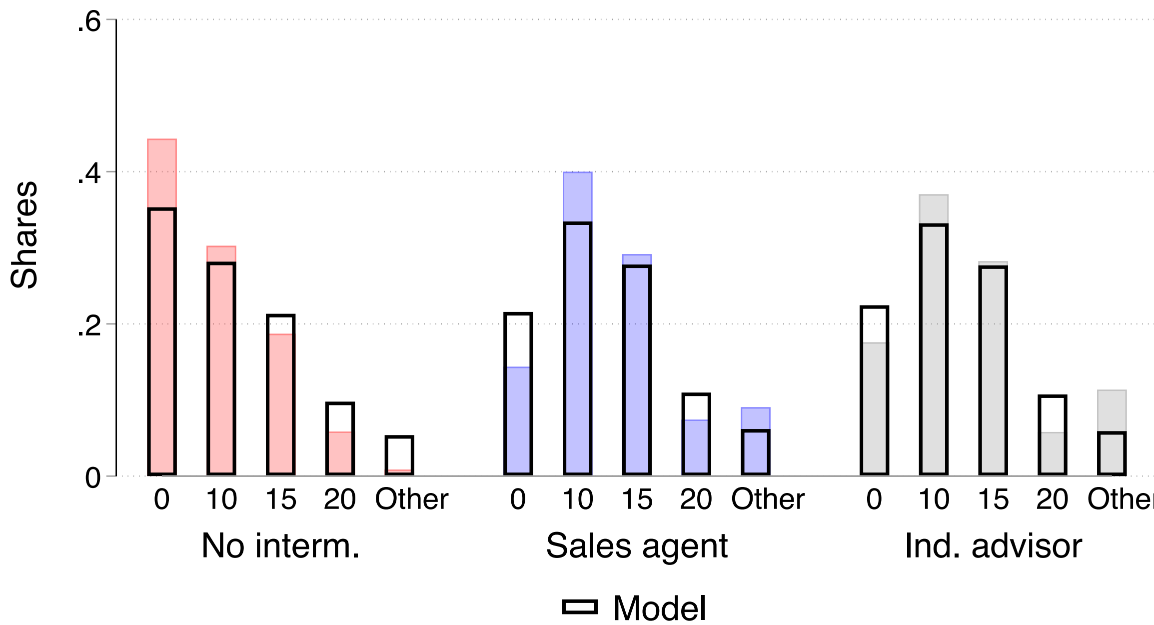
Figure 11: Model fit



(a) Intermediary shares



(b) Annuitization rates



(c) Annuity guarantee length (years)

Notes: Model fit. Sample restricted to individuals age 65 for comparability in counterfactual.

individuals, they arise as a consequence of the information cost and the design of an optimal strategy that involves only partial information acquisition – I call these choices "mistakes."[65] For individuals using an intermediary, on the other hand, mistakes arise from the intermediary giving biased advice and steering them toward a (suboptimal) annuity over a Phased Withdrawal: I refer to these choices as "distortions."

Table 5 shows the model predicts a substantial role of both mistakes and distortions. One in fice retirees not using an intermediary ends up choosing a suboptimal product – often an annuity – from their choice set. The model predicts individuals facing higher stakes optimally gather more information: in particular, low-survival, higher-bequest retirees, as well as those with lower savings. However, those with lower savings face smaller choice sets. They therefore find learning about the products less costly. Column 1 shows that, on average, retirees' loss from not choosing the best option in their choice set equals 2.4% of their pension payments: this percentage is slightly higher for shorter-lived individuals and lower for those with less savings. In terms of cognitive/information costs, the model implies retirees not using an intermediary pay an average of 2.4% of their pension payments to make their choices. The higher expected prior variance of low-survival individuals is reflected in their substantially higher costs paid. By contrast, wealthier retirees incur similar attention costs to those of less wealthy ones: this pattern again points to the role of the number of products in the choice set.

Distortions, on the other hand, arise from the intermediaries' incentives not being sufficiently aligned with those of their customers. Retirees who optimally should choose annuities – long-lived, wealthy individuals – benefit from intermediaries, who direct them toward the best product. Similarly, retirees for whim a distortion would be extremely costly – very short lived and not wealthy – still purchase the optimal product, due to the agents and advisors putting weight on their customers' preferences. The remaining 70% of intermediated individuals are distorted: they should optimally have purchased a Phased Withdrawal and the intermediary steers them towards purchasing an annuity. Note that, as a consequence, the model predicts that Chile's high annuitization rate is largely a product of cognitive frictions and the intermediaries' misaligned incentives.

Column 1 in Table 5 shows the costs retirees incur from these distortions: the average is 7.5% of pension payments before commissions. The losses are larger for retirees with low savings or low survival probabilities, for whom the model predicts annuitization is rarely the optimal choice. The distortions are also predicted to have a significant impact on retirees' choices of an-

[65] Choices of retirees not using an intermediary are optimal given the information acquisition constraint but might still be a "mistake" since they do not correspond to the choice a fully informed individual would make.

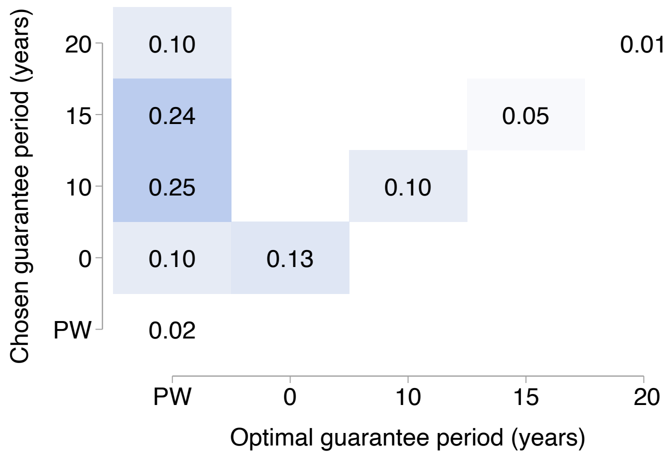
Table 5: Costs of mistakes and distortions (age 65)

	Benchmark	Ban	Ban (prices)	De-bias	De-bias (prices)
Share of right choices	0.53	0.65	0.70	0.86	0.88
Not interm. (in benchmark)	0.73	0.73	0.76	0.73	0.78
Intermediated (in benchmark)	0.30	0.57	0.62	1.0	1.0
Average cost of mistakes (in %)	4.8	3.0	3.3	1.2	1.3
Not interm. (in benchmark)	2.4	2.4	2.6	2.3	2.5
Low survival	2.7	2.7	2.7	2.6	2.7
High survival	2.0	2.0	2.3	2.0	2.3
Low savings	1.9	1.9	2.0	1.8	1.9
High savings	3.0	3.0	3.3	3.0	3.3
Intermediated (in benchmark)	7.5	3.8	4.1	0.	0.
Low survival	11	4.5	4.7	0.	0.
High survival	3.3	2.9	3.5	0.	0.
Low savings	9.1	3.3	3.5	0.	0.
High savings	6.5	4.1	4.5	0.	0.
Information costs (in %)	2.4	2.4	2.7	2.1	2.6
Not interm. (in benchmark)	2.4	2.4	2.7	2.1	2.6
Low survival	3.1	3.1	3.4	2.8	3.3
High survival	1.5	1.5	1.8	1.3	1.7
Low savings	2.4	2.4	2.7	2.1	2.4
High savings	2.3	2.3	2.7	2.2	2.8
Intermediated (in benchmark)	–	3.2	3.8	–	–
Low survival	–	4.6	5.3	–	–
High survival	–	1.6	2.1	–	–
Low savings	–	3.7	4.2	–	–
High savings	–	2.9	3.4	–	–

Notes: Model-implied mistakes, distortions, and information costs, computed based on estimated latent distributions of frictions and preferences. Mistakes and information costs are shown in terms of % of pension payments. Low survival is defined as below-median life expectancy given the realization of the mortality shiter m. Low savings is defined as below-median pension savings in the sample. Sample restricted to individuals aged 65 for comparability in counterfactual.

nuity types. Figure 12 shows the relationship in the model between the *optimal* (highest utility ξ_{ik}) and *chosen* guarantee length for retirees using an intermediary. According to the model, retirees are steered toward the best possible annuity in terms of guarantee and deferral lengths available in their choice set. For guarantees, the distortion away from the Phased Withdrawal implies a large share of the 10-, 15-, and 20-year guarantee lengths: as seen in Figure 1, guarantees are a way of ensuring money for an individual's heirs while still annuitizing. Given that the model estimates a substantial taste for bequests, the guarantee turns into a "second-best." For example, out of the 11% of intermediated retirees who choose a 20-year guarantee in the baseline, the model predicts the vast majority have been suboptimally steered into it by the intermediary. Crucial for the cost of this distortion is the ability of retirees in the life-cycle model to endogenously react to the chosen stream of payments by adjusting consumption and savings choices. Intuitively, this mechanism *reduces* the extent of the harm from a suboptimal choice: in the case of bequest

Figure 12: Optimal and chosen guarantee length under intermediaries (model)



Notes: This figure shows choice patterns for intermediated retirees in the model. The x-axis denotes the "optimal" or highest value ξ^{I}_{ik} pension product, the y-axis the chosen product. The number in each cell represents the share of retirees with that combination in simulated data from the model. Sample restricted to individuals aged 65 for comparability in counterfactual.

motives, retirees are able to offset the lack of implicit bequests in annuities through an increase in their savings.

7 Counterfactuals

I explore the impacts of two policies aimed at regulating intermediaries in the market. First, I ban all intermediaries and force retirees to make decisions on their own. Second, I de-bias intermediaries, giving them equal incentives to sell the Phased Withdrawal to the annuities.[66] Given that I am not explicitly modelling the supply side, I restrict the analysis to exploring how the policies impact ex-ante and ex-post (relative to information acquisition) consumer welfare.

For both policies, I first consider both a "naïve" counterfactual (Handel, 2013) in which I allow for changes in retirees' decisions – but not annuity prices – from changing intermediary incentives. I then allow the prices of different types of annuities to adjust to the new patterns of selection – and therefore costs – of retirees. I abstract from modelling competition across insurance companies and instead focus on the prices of different annuity types. Therefore, I assume

[66] This counterfactual amounts to setting the bias parameters c^{SA}, c^{PA} of both intermediaries to zero. This change does not account for price changes in the Phased Withdrawal annuities due to the commission: it is therefore akin to the government providing a subsidy that makes intermediaries indifferent between selling all pension products. These subsidies are arguably part of the consumer-welfare calculation: I return to this point in the discussion of these results. I am currently working on generating the counterfactual that accounts explicitly for the additional commission payment.

markups are proportional and held constant in the counterfactual when re-pricing annuities.[67] For any annuity type k and an observably similar group – say, in terms of age and pension savings –, the model predicts a distribution of mortality risks m of retirees who select into buying that product at a given set of prices. Assuming a discount rate R_0, I compute the average cost of providing a unit of annuity payments to this group, both in the benchmark and the counterfactual. I then adjust the prices of each annuity type by the relative cost change, and let retirees re-optimize. Iterating on this procedure yields a counterfactual where the increase or decrease in annuity prices is consistent with the selection patterns it induces.

To operationalize the counterfactual, I group individuals by observable characteristics that are known to insurance companies at the pricing stage. I consider only retirees age 65 for this exercise, and split them into four groups according to their savings quantiles.[68] The aggregation level at which to compute the average costs and markups of annuities is not obvious: the right level depends on the competition and pricing behavior of the insurance companies, which is beyond the scope of this paper. To allow for differences across types of annuities while keeping a large sample size in each group, I group annuities into four bins by whether they include a guarantee and/or a deferral period. Given the Phased Withdrawal does not constitute an insurance product and is priced by the regulator based on market conditions and population survival rates, I hold its value fixed for all counterfactuals.

"Naïve" counterfactual Columns 2 and 4 in Tables 5 and 6 and columns 1 and 3 in Table 7 show the impact of the policies on money left on the table, information costs, and consumer welfare in the market. Banning intermediaries leads to a small consumer welfare gain of 0.5%, driven entirely by the intermediated individuals. The welfare gain comes from two sources: individuals are no longer paying commissions, and they make better choices as they avoid being distorted by intermediaries, resulting in close to 60% of them making the "right" choice. On average, gains from the improved choices are equivalent to a 4% increase in pension payments. The annuitization rate drops from over 60% to 38%, driven overwhelmingly by a reduction in the share of guaranteed annuities: this finding is in line with the intuition of the market shares of these products being driven by intermediary distortions.

However, the welfare gains from a ban are almost completely offset by cognitive costs. Making

[67] The assumption is strong – in particular, it rules out any type of supply-side response to the changing level of information acquired by consumers, and the restriction on competition through the deployment of sales agents. I discuss some of these limitations in the next section.

[68] Illanes and Padi (2021) show implied markups differ strongly across the pension-savings distribution: they suggest insurance companies find lower-savings individuals are more costly, because they often receive subsidies that require coordination with the government.

Table 6: Counterfactuals: Choices and 2-year mortality (age 65)

	Benchmark	Ban	Ban (prices)	De-bias	De-bias (prices)
Share of intermediated	0.46	0.	0.	0.54	0.54
Share of pension advisors	0.15	–	–	0.17	0.17
Share annuities	0.65	0.42	0.36	0.32	0.23
Simple	0.072	0.061	0.070	0.059	0.067
Guaranteed	0.24	0.16	0.12	0.11	0.070
Deferred	0.089	0.076	0.075	0.061	0.046
Guaranteed and deferred	0.25	0.13	0.091	0.093	0.051
2-year mortality	0.029	0.029	0.029	0.029	0.029
Phased Withdrawal	0.034	0.033	0.032	0.033	0.031
Annuities	0.027	0.024	0.023	0.022	0.022

Notes: Model statistics generated by sampling each individual in the estimation 100 times, drawing information costs λ_i, mortality shifters m, taste for bequests δ_{beq}, and wealth other than pension savings w, drawing from the model-estimated distributions. Columns 2 and 4 show the counterfactuals of banning and de-biasing intermediaries holding prices fixed. Columns 3 and 5 account for changing costs due to selection being passed through to prices as described in section 7 of the main text. Sample restricted to individuals age 65 for comparability in counterfactual.

decisions alone is especially costly for intermediated retirees, who are selected on their high information costs λ_i. Absent intermediaries, this selection implies retirees "spend" almost 3% of pension payments in acquiring information. Therefore, the net gain from a ban for intermediated individuals is of just 1.0%. The small gain stands in contrast to the ex-ante effect of banning intermediaries: given retirees select into intermediation based on expected benefits, the policy must ex-ante seem harmful to retirees that optimally chose to seek out advice. Indeed, consumers perceive the policy as a 5% reduction in the prior expected pension payment. The difference between the two results comes from two sources: the perceived *distribution* of utilities $\boldsymbol{\xi}_i$ – which, because it represents the fundamental uncertainty about the stakes, does not directly find a counterpart in the realized values – and the flat prior means c_i. Although over 70% of retirees maximize their utility by choosing a Phase Withdrawal, ex-ante they believe all products are equally good for them. Retirees therefore overestimate the value from intermediation.

Note, however, that despite the model's adversarial stance toward intermediaries[69] the welfare gain predicted from a ban is small. Two forces can explain this result. On the one hand, the information costs estimated are substantial: they imply that when left to make decisions alone, consumers often make mistakes that are quite costly. Absent intermediaries, retirees only manage to reduce the money left on the table to about half of the loss incurred from steering in the benchmark.

On the other hand, the estimated substitutability of the Phased Withdrawal with annuities – in particular, *guaranteed* annuities – plays a key role. As highlighted in section 6, the implied average

[69] See discussion in section 4.

Table 7: Counterfactual: Consumer welfare

	Ban	Ban (prices)	De-bias	De-bias (prices)
Consumer welfare changes (in %)	0.5	-0.4	3.6	2.6
Not intermediated in benchmark	–	-0.8	0.3	-0.9
Information costs	–	-0.1	0.2	-0.0
Choices	–	0.2	0.1	0.4
Commissions	–	0.0	-0.0	-0.0
Taste shock	–	0.0	0.1	0.1
Price changes	–	-0.9	0.0	-1.3
Intermediated in benchmark	1.0	-0.0	7.5	6.5
Information costs	-2.8	-2.9	0.0	-0.0
Choices	3.6	4.0	7.5	7.3
Commissions	0.5	0.5	-0.0	-0.0
Taste shock	-0.3	-0.3	0.0	0.0
Price changes	0.0	-1.3	0.0	-0.8

Notes: Columns 1 and 3 show the counterfactuals of banning and de-biasing intermediaries holding prices fixed. Columns 2 and 4 account for changing costs due to selection being passed through to prices as described in section 7 of the main text. De-biasing counterfactuals do not show implicit commission subsidy costs in the counterfactual; see footnotes 66 and 70. "Taste shock" captures the consumer-welfare effect implied by the distribution of the taste shock changing with the intermediation channel; see Appendix C.2 and C.4 for details.

difference between the Phased Withdrawal and the best annuity is 7.5%. This loss is twice the average cost of mistakes absent intermediaries (see Table 5). However, the loss is substantially smaller than the difference between the best and the worst annuity, which is on average 20% of pension payments. Therefore, the ability of the intermediary to offer a sufficiently "close" substitute to the Phased Withdrawal substantially limits the harm from steering. This intuition is in line with the empirical evidence in section 3, in particular the patterns in Figure 4 and Figure 7.

In the benchmark, the intermediaries' distortions act toward reducing adverse selection into annuities. A ban therefore leads to an exacerbation: annuitants are 1 percentage point less likely than non-annuitants to die within the first two years, a 0.3-percentage-point increase over the baseline. However, the selection *across* annuity characteristics is lessened relative to the benchmark, in particular for guaranteed annuities (see Table A.32). The intuition is in line with that of Figure 6a and 7a. In the benchmark, intermediaries distort short-lived individuals into buying guaranteed annuities. Upon a ban, these retirees instead select into the Phased Withdrawal. The survival risk of retirees choosing guarantees in the counterfactual is then more similar to the risk of those choosing other types of annuities.

In the model, de-biasing intermediaries should always lead to a consumer-welfare improvement before price adjustments. The effect predicted is a 3.6% increase in consumer welfare, driven again overwhelmingly by those who are intermediated in the benchmark. Fixing the intermediaries' incentives eliminates all money left on the table for intermediated retirees, who now make perfect choices at the cost of a commission payment.[70] Individuals who switch to being intermediated – an additional 8% relative to the benchmark – also marginally gain from reduced information costs paid and better choices. In general, the de-biasing policy leads to similar patterns relative to banning intermediaries in terms of the reduction of the shares of annuities, especially those with a guarantee period.

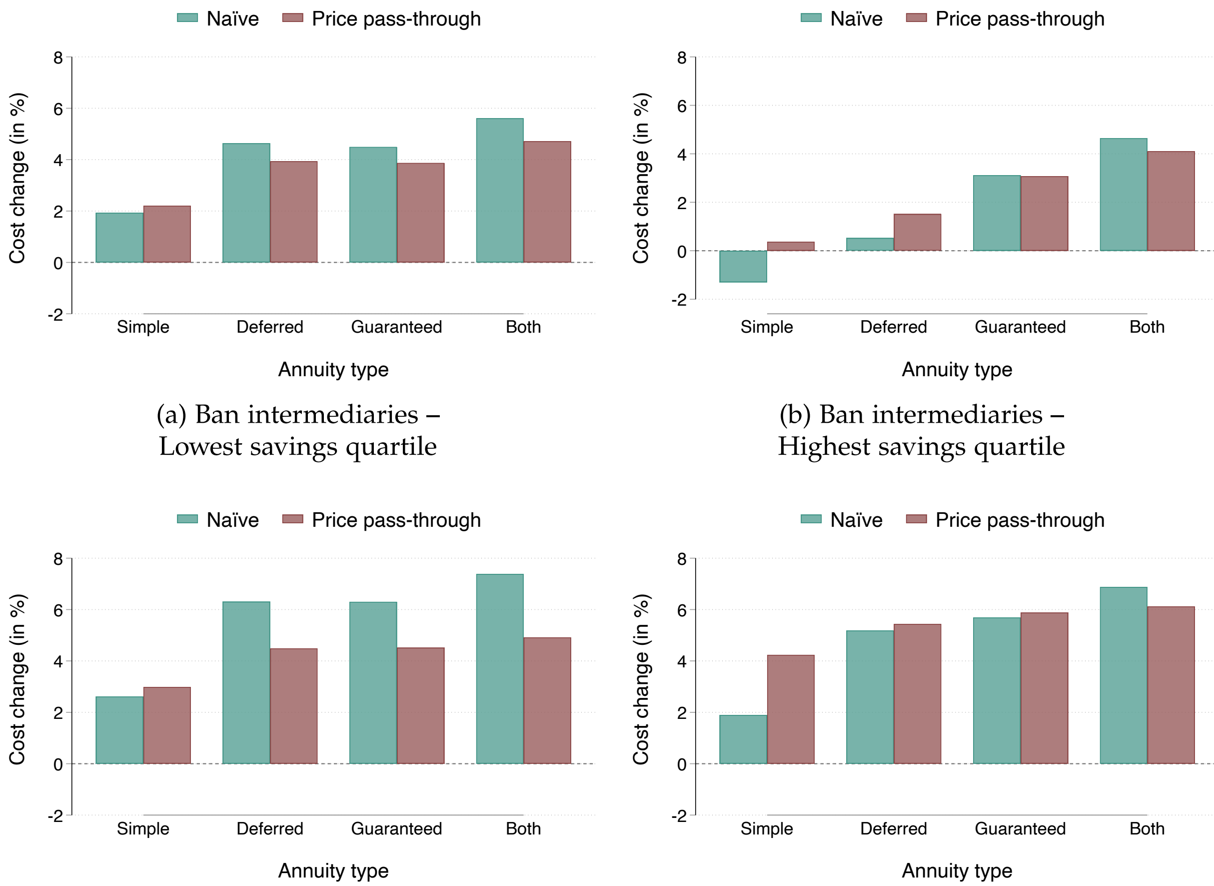
The exercise of de-biasing the intermediaries points towards another strong force for the model: the frictions in the demand for intermediation. At the benchmark commission prices and biases of intermediaries, the model predicts that nearly 80% of retirees would be ex-ante willing to hire an intermediary (even though ex-post a significant share is better off without advice). However, upon de-biasing the intermediaries, holding the networks or word-of-mouth forces fixed, a significant number of retirees who would ex-post benefit from intermediation do not end up being able to use it. Switchers only marginally benefit from intermediation: they are those with larger variances, lower information costs, and smaller choice sets. Those retirees who would benefit most from intermediation in the baseline are already attempting to find advice but being prevented from accessing it, due to the frictions. Therefore, individuals who manage to find an intermediary are a *positively* selected sample: they only now consider it optimal to seek intermediation, and tend to benefit relatively *less* from it.

Price adjustment Figure 13 shows how costs of annuities change in the naïve counterfactual. As a first-round effect from the new selection patterns, the cost of most types of annuities goes up, reflecting the increased selection into all types of annuities. Cost changes range from -1% to above 6% across products, with the higher end being concentrated on annuities with both guarantees and deferrals. Table A.32 shows the estimated life expectancies of retirees selecting into different products. Although the change in the risk pool for deferred annuities is smaller than for guaranteed ones, the latter are less sensitive to risks changing, given that their payments are not life-contingent during the guarantee period. The simple annuities see the smallest changes in risk pools, consistent with the intuition on the product being the least substitutable with Phased Withdrawal.

The dark bars show the cost adjustments, having iterated the cost adjustments to be internally consistent with the selection patterns they induce. Across the board, prices of simple annuities increase while annuity types with deferrals, guarantees, or both decrease marginally. As the prices of annuities – and, in particular, of the contract characteristics – increase, more retirees sub-

[70] Accounting for the commission subsidy implicit in this counterfactual – see footnote 66 – would reduce this number by up to 1% considering a 2% commission given the share of annuitization and of intermediated retirees.

Figure 13: Cost changes in counterfactual



(a) Ban intermediaries – Lowest savings quartile

(b) Ban intermediaries – Highest savings quartile

(c) De-bias intermediaries – Lowest savings quartile

(d) De-bias intermediaries – Highest savings quartile

Notes: Cost changes computed using recovered mortality expectations as described in the main text. "Naïve" bars (light teal) show the implied cost changes from allowing choices – but not prices – to change in the counterfactual. "Price pass-through" (dark red) shows the cost changes, assumed to be passed entirely to prices, that yield a fixed point or internally consistent "equilibrium". The selection patterns induced by the price changes in turn are the ones that induce the cost changes.

stitute into the Phased Withdrawal, and from deferred/guaranteed into simple annuities. This effect rebalances costs increases. The cost adjustments affect product shares, further reducing the annuitization share by 5 percentage points when banning intermediaries, and by 7 percentage points when de-biasing them. The price adjustments lead to an increase in the stakes of the decisions: with the prices increasing, choosing the wrong annuity is "worse" than in the benchmark. This effect leads to both an increase in the average cost of mistakes and in the realized costs of acquiring information.

Price adjustments render the effect of banning intermediaries essentially consumer welfare neutral. Formerly intermediated retirees lose all their small gains from price increases due to selection. Non-intermediated retirees, on the other hand, lose the equivalent of 1% of pension payments from annuity price increases. Intuitively, the intermediary ban provides no benefit for this group, but the increase in prices leads to a direct harm to annuitants. Note that self-reliant retirees endogenously react to the price increases by acquiring more information about products: the effect is due to the stakes of the decision increasing. A similar pattern emerges from the de-biasing of intermediaries. Although the consumer-welfare gains for those intermediated is still substantial, those not benefitting from advice are again hurt by the annuity price increases, leading to a net average loss of around 1% and an overall reduced gain in the population of 2.6%.[71]

Heterogeneity The counterfactuals affect retirees differentially by their latent types – survival expectations and cognitive frictions –, as well as their geographic location and savings. As highlighted before, indidivuals who are intermediated in the benchmark – on average, those with larger information frictions, higher savings, and geographic "exposure" to them – are the ones who gain across counterfactuals. The effect is driven both by the ex-post benefit of avoiding the intermediary's distortion, and the large benefit that comes from their incentives being aligned with their customers'.

Table 8: Counterfactuals – by life expectancy (age 65)

	Ban	Ban (prices)	De-bias	De-bias (prices)
Consumer welfare changes (in %)	0.5	-0.4	3.6	2.6
Low survival	1.4	0.9	5.3	4.8
Information costs	-1.7	-1.8	0.1	0.0
Choices	3.1	3.5	5.2	5.4
Commissions	0.2	0.2	-0.0	-0.0
Taste shock	-0.2	-0.2	0.1	0.1
Price changes	0.0	-0.7	0.0	-0.6
High survival	-0.6	-2.0	1.7	-0.1
Information costs	-0.8	-0.9	0.1	-0.0
Choices	0.0	0.3	1.6	1.5
Commissions	0.2	0.2	-0.0	-0.0
Taste shock	-0.1	-0.1	0.0	0.0
Price changes	0.0	-1.5	0.0	-1.6

Notes: Low survival defined as below-median life expectancy given the realization of the mortality shifter m.

[71] This percentage would be further reduced by up to 1% if incorporating the subsidy cost into the consumer-welfare analysis. The gain for the previously intermediated group is still substantial. Note also that in this counterfactual, some previously intermediated retirees switch to non-intermediation in response to annuity price increases. Given that this is a very small percentage, Table 5 does not show information costs or mistakes for this group, as the averages would be subject to severe sampling bias.

Table 9: Counterfactuals – by savings (age 65)

	Ban	Ban (prices)	De-bias	De-bias (prices)
Consumer welfare changes (in %)	0.5	-0.4	3.6	2.6
High savings	-0.2	-1.2	3.6	2.2
Information costs	-1.5	-1.6	0.0	-0.1
Choices	1.2	1.5	3.6	3.6
Commissions	0.3	0.3	-0.0	-0.0
Taste shock	-0.2	-0.2	0.0	0.1
Price changes	0.0	-1.2	0.0	-1.3
Low savings	1.1	0.3	3.7	2.9
Information costs	-1.1	-1.2	0.1	0.0
Choices	2.1	2.4	3.5	3.6
Commissions	0.2	0.2	-0.0	-0.0
Taste shock	-0.1	-0.1	0.1	0.1
Price changes	0.0	-0.9	0.0	-0.8

Notes: Low savings defined as below-median pension savings in the sample.

In terms of survival expectations, Table 8 shows price-adjusting counterfactuals predict an average loss for longer-lived individuals, both intermediated and not intermediated. Neither of these groups benefit from the policies: in particular, those who optimally tend to choose annuities do not get affected by the biased incentives of agents and advisors. Therefore, their consumer-welfare impacts are driven by the loss in access to cheaper information technology and by the price increases and the elimination of implicit subsidies. The combination of both effects leads to a 2.0% consumer-welfare loss on average from banning intermediaries. The same individuals' gain from de-biasing is limited, given the mostly aligned incentives with intermediaries in the first place: the effect after accounting for selection is essentially zero. On the other hand, shorter lived retirees are the largest winners from either policy: they ex-post are the most hurt from intermediary distortions, and their selection out of annuities prevents them from being affected by price adjustments.

Turning now to savings, Table 9 also shows a clear division. High-savings retirees are more likely to be intermediated and their losses from distortions are smaller, both from a higher optimal annuitization share and from the smaller difference between the Phased Withdrawal and the "best" annuity. They on net benefit little from a ban: the gains in terms of avoided distortions are offset by costlier mistakes and higher information costs, partly driven by their costlier decisions in larger choice sets, as discussed in section 6. These effects turn into a net consumer welfare loss of about 1.2% after adjusting for prices. Given their smaller annuitization shares, less wealthy retirees benefit more ex-post from a ban on intermediaries, due to avoiding distortions and being less impacted by the subsequent increase in annuity prices – their annuitization rate is 26% against 40% of high-savings retirees after prices updating. Gains from de-biasing intermediaries are similar, reflecting the fact that the money left on the table is overall similar across groups.

8 Conclusion

In this paper, I present a tractable framework that helps assess the role of intermediaries in a selection market where cognitive frictions are prevalent. Consumers are not able to fully assess the value of a product, due to a lack of understanding of either product characteristics or how these characteristics map into their preferences. I show the role of intermediaries is inherently linked to this friction in the Chilean pension market, which therefore plays a substantial role in shaping market outcomes. My model suggests that the choice frictions that the intermediaries' existence greatly shape the impact of policies in this market. Given a conservative assumption on retirees' beliefs, banning intermediaries is ex-ante consumer-welfare decreasing but ex-post neutral: the distortions induced by intermediaries are entirely offset by an increase in retirees' mistakes, costs spent on cognitive effort, and prices increases from the exacerbated selection patterns. The effectiveness of de-biasing intermediaries, on the other hand, is curtailed by frictions in finding intermediaries.

The analysis of this paper constitutes only the first step in assessing the equilibrium effects of intermediaries in selection markets. Three important mechanisms could affect the results in meaningful ways. First, insurance companies can respond through adjusting prices in response not only to the selection patterns, but also to the elasticity of demand. The model presented here suggests eliminating or de-biasing intermediaries leads to an increase in retirees' annuity price elasticity, potentially applying downward pressure to prices. Across insurance companies offering annuity products, the data suggest sales agents make retirees respond less to prices, whereas advisors have the opposite effect. In Appendix C, I discuss an extension to the model that incorporates the choice of insurance company and explicitly models the incentive of the sales agent to sell products of their own company.[72]

Second, insurance companies seem to have an important competition margin in the use and deployment of sales agents. The evidence suggests agents create market power for their insurance company after successfully approaching a customer, which can impact equilibrium pricing strategies. In the data, insurance companies differ in the size of the sales force: whereas several

[72]Note I abstract from modelling an equilibrium game between the intermediary and their customer. As Alcalde and Vial (2021) argue, when commissions affect the recommendations of intermediaries and intermediated consumers only choose based on the advice provided, changes in the commission structure can lead to *less price-elastic* retirees.

sell a majority of their products through agents, others do not hire any and rely on direct or advisor-mediated sales. The importance of frictions in finding intermediaries, local networks, and word-of-mouth imply that the allocation of agents across space can be another important dimension of competition. Banning intermediaries or eliminating sales agents could therefore change the core firm strategies in the market and lead to exacerbated welfare impacts.

Third, and given the role of cognitive frictions in this environment, a supply side reaction in terms of the product space would be another concern. The current equilibrium could be driven by the fact that self-reliant consumers and intermediaries are "sophisticated" enough to prevent predatory financial products. Absent intermediaries, insurance companies could have an incentive to attempt to extract more surplus from those retirees who face larger choice frictions.

In the particular case of the Chilean pension market, a reform addressing the intermediaries' incentives would likely additionally impact the distribution of administrative work associated with retirement. Currently, most of these costs are carried by the Pension Fund Administrators (PFA), which administer workers' savings and offer the Phased Withdrawal. Insurance companies take over part of these tasks – in processing an individual's offer requests and passing it on to SCOMP –, which would also fall increasingly onto the PFAs were sales agents to disappear. Anecdotally, part of advisors' and agents' informational role is also related to claiming subsidies and other government benefits,[73] along with dealing with paperwork.

De-biasing intermediaries has been proposed in the Chilean setting. The regulator justifies the asymmetry in advisors' incentives given the possibility of those choosing a Phased Withdrawal to purchase an annuity later in their retirement: the law caps the *total* commission a retiree can pay at 2%, which means someone choosing a PW still constitutes a paying client for an advisor if they intend to buy an annuity later on. Given my results, it would seem reasonable to evaluate the gains from that policy against the distortions created by the asymmetric incentives, and potential gains from unbiased intermediaries.

Finally, the model takes as given a constraint imposed by the government in this setting, which prevents retirees from withdrawing their pension savings and freely disposing of them – a counterfactual explored in Illanes and Padi (2021). A consumption-savings model would predict the free disposal to be weakly welfare improving, especially for those retirees whose expected survival is very low. The existence of this constraint is likely justified based on present bias or a moral hazard argument: retirees could have an incentive to overspend, whereas the government has no credible mechanism to commit to not providing subsidies later on. An interesting question

[73] I do not find significant differential effects in claiming benefits with or without an intermediary after controlling for their income.

is whether the design of the system – and in particular intermediaries' incentives – constitutes a second best. The government might have a preference for retirees choosing annuities, therefore transferring the longevity risk from themselves (and/or the government) to an insurance company. Structuring intermediary commissions in this way might therefore be understood as a compromise between a more draconian measure – for example, a mandate – and no intervention, potentially leading to high levels of longevity risk for the government.

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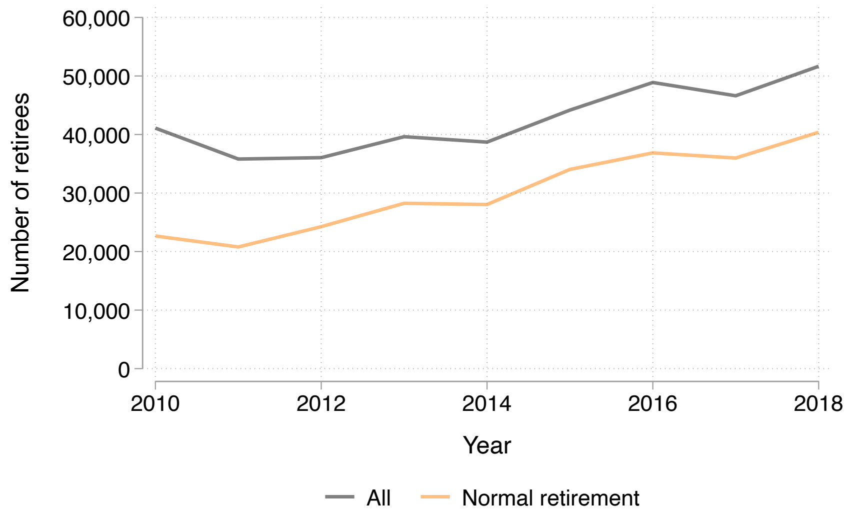
Appendix

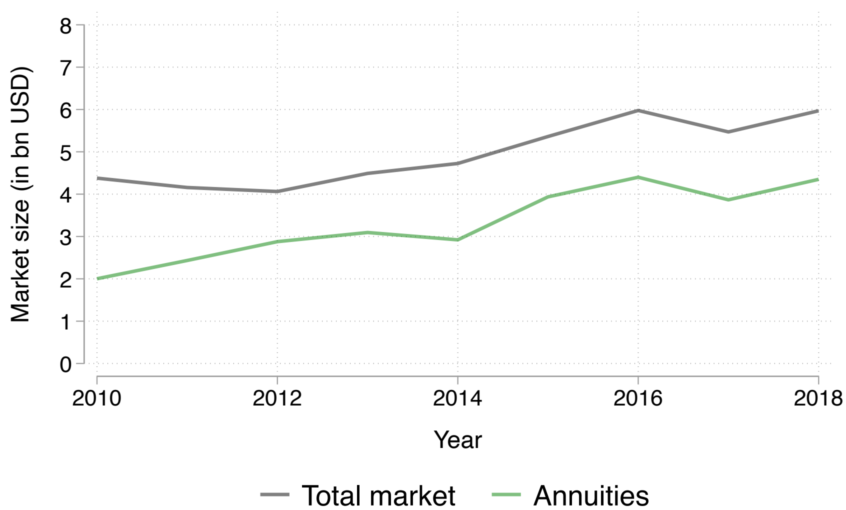
A Additional tables and figures

Figure A.14: Number of retirees



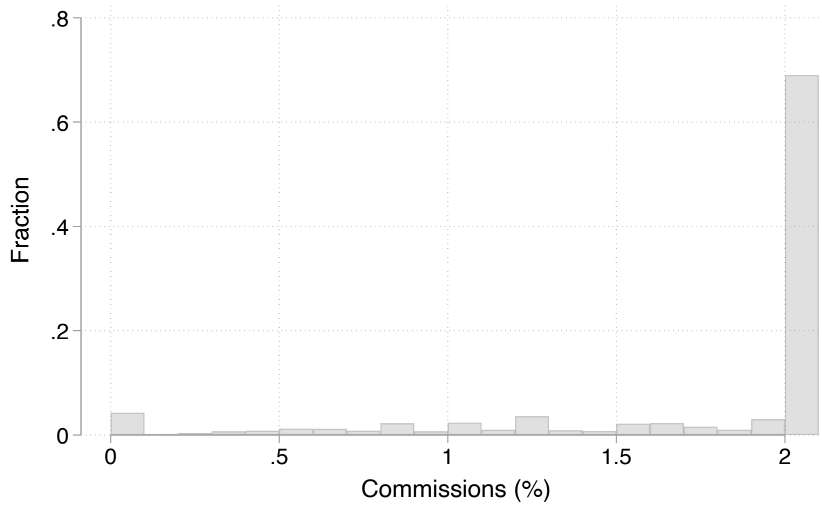
Normal retirement: at or post legal retirement age. All includes early retirement and disability pensions.

Figure A.15: Market size



Excludes survivor's benefits.

Figure A.16: Commissions paid



All retirees excluding survivor's benefits, 2010 to 2018.

Figure A.17: Number of intermediaries

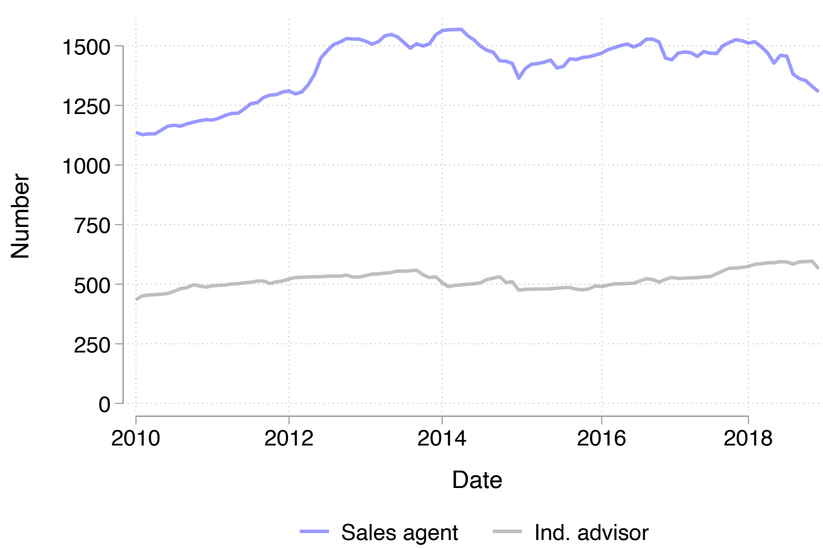
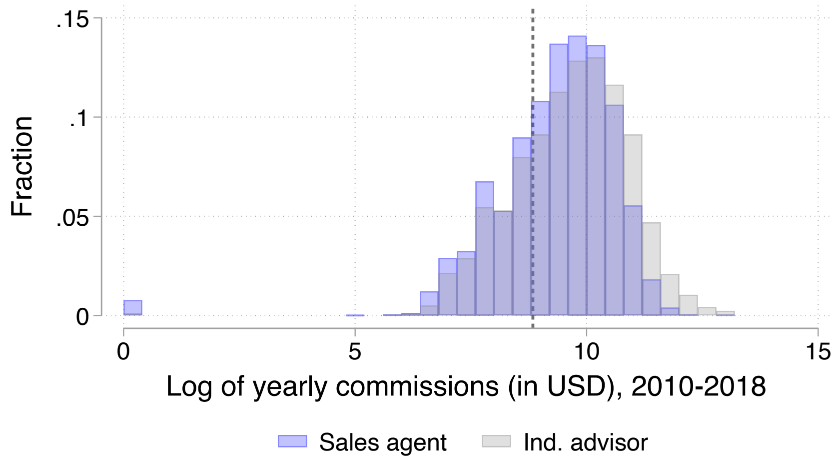


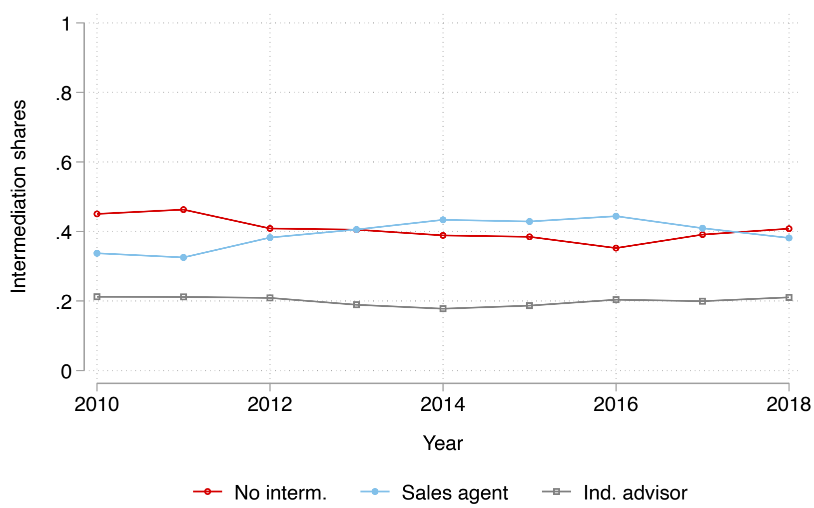
Figure A.18: Intermediary income from commissions



Agents: median = 13352, mean = 19469, p10 = 2328, p90 = 44611. Observations = 12160.

Advisors: median = 17350, mean = 30102, p10 = 2711, p90 = 67684. Observations = 4198.

Figure A.19: Intermediation shares across sample period



Normal retirement between 2010 and 2018, single or married with no other legal dependents.

Figure A.20: Annuitization shares across sample period, by intermediary

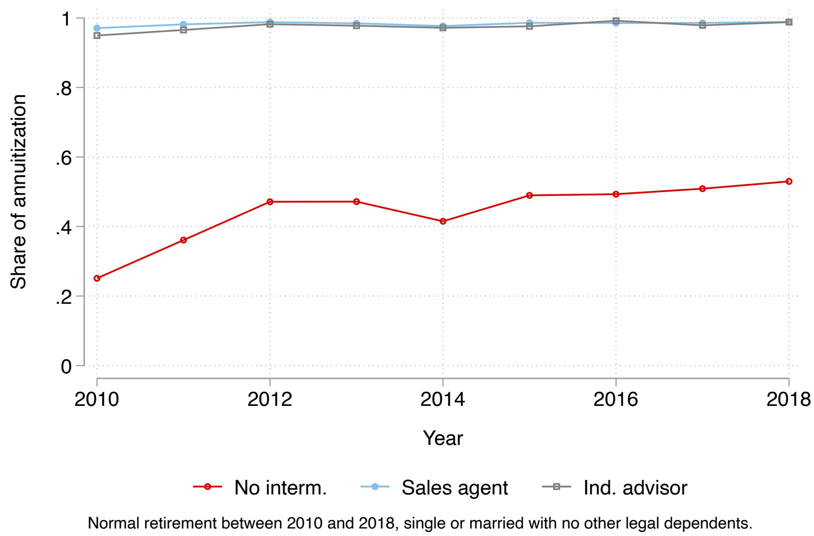
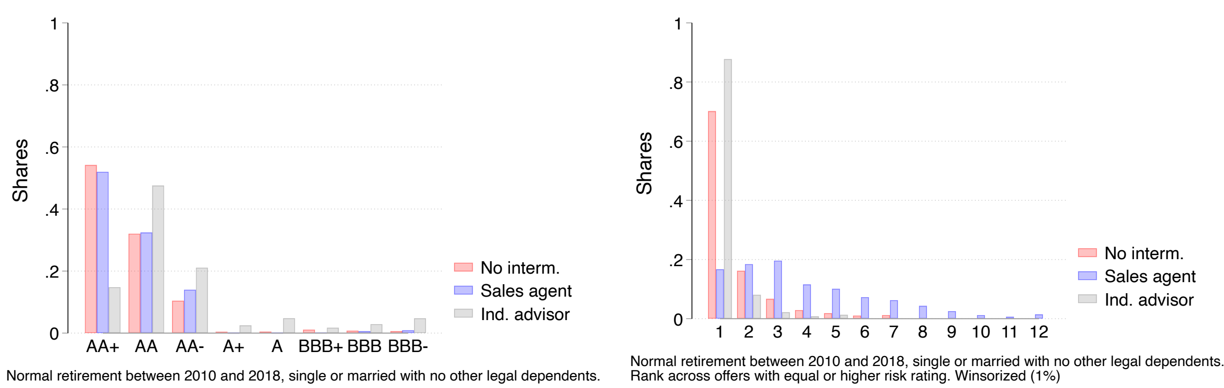
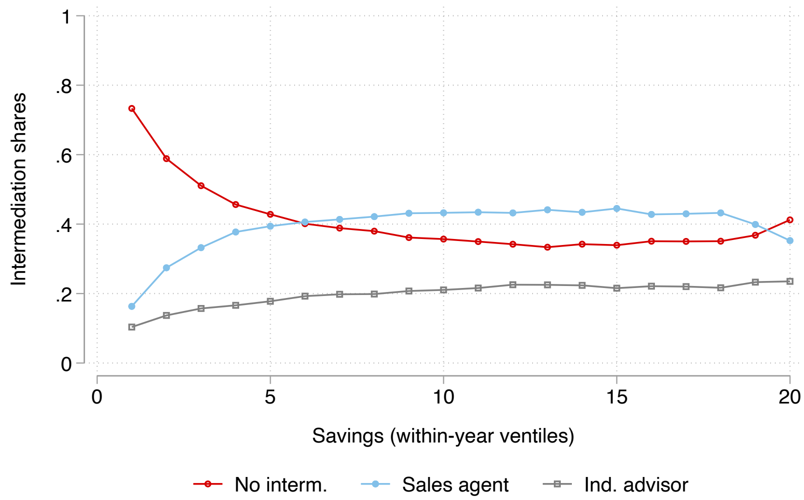


Figure A.21: Choice of insurance company by intermediary (annuitizers)



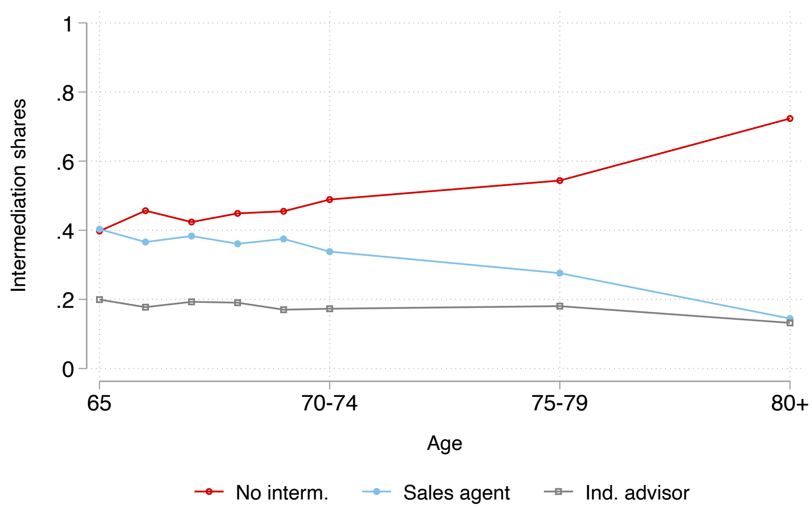
(a) Risk rating (b) Rank

Figure A.22: Intermediation shares by yearly pension savings ventile



Normal retirement between 2010 and 2018, single or married with no other legal dependents.

Figure A.23: Intermediation shares by age (men)



Normal retirement between 2010 and 2018, single or married with no other legal dependents.

Figure A.24: Intermediation shares by age (women)

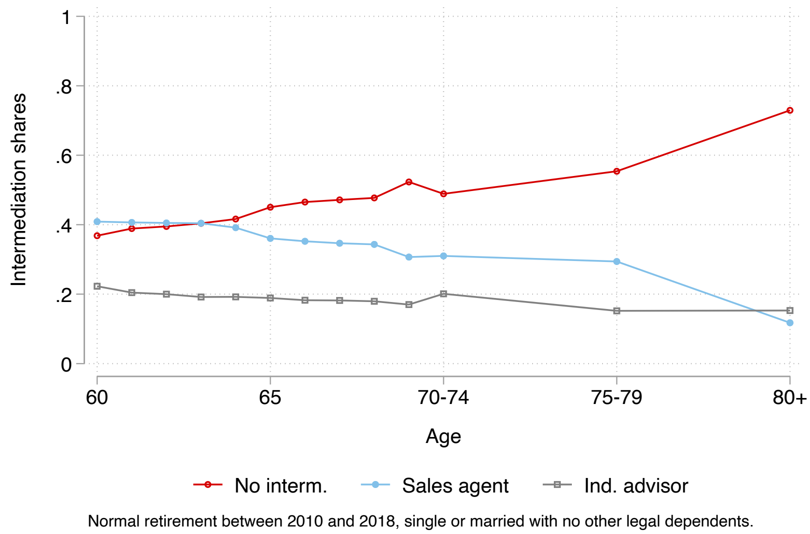
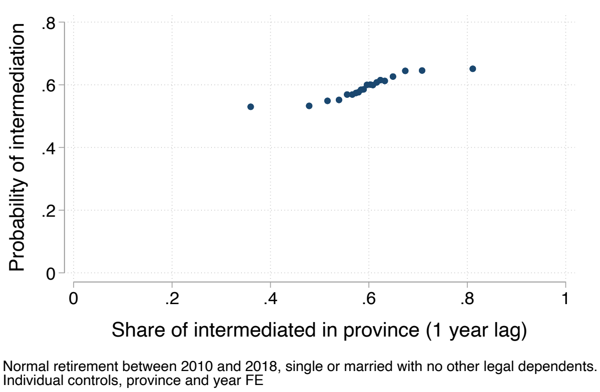
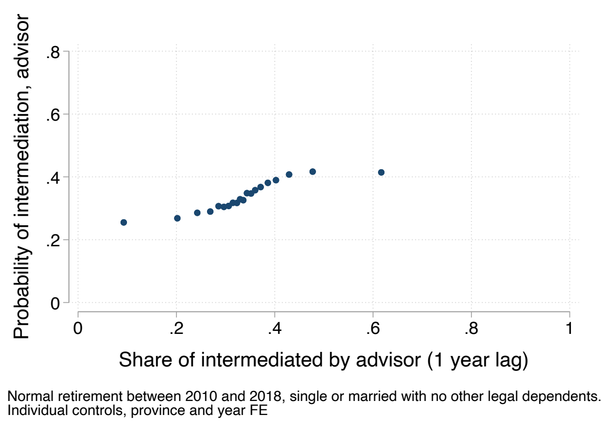


Figure A.25: Geography and intermediation



(a) Probability of intermediation



(b) Intermediary type

Notes: These figures show the role of geography in determining probabilities of intermediation. Panel (a) shows the conditional correlation between the probability of a retiree being intermediated (y-axis) and the share of the population that used an intermediary in their province one year prior. Panel (b) shows the conditional correlation betwen an intermediated retiree using an independent advisor and the share of intermediated retirees hiring advisors (as opposed to agents) in their province one year prior. Controls include demographic characteristics (gender, age, pension savings), province, and year fixed-effects. A province is the second-largest geographical division in Chile. The 56 provinces are heterogeneous in their population size and area.

Table A.24: Selection on observables – choice data

	(1) Intermediation	(2) Annuitization
Annuity price (rel. to PW)	-0.126	-0.859
	(0.0278)	(0.0244)
High risk PFA fund	0	0
	(.)	(.)
Medium risk PFA fund	-0.0261	-0.0219
	(0.00354)	(0.00293)
Low risk PFA fund	0.0179	0.0266
	(0.00397)	(0.00318)
Female	0	0
	(.)	(.)
Male	0.834	-0.119
	(0.877)	(0.807)
Female $\times$ Age	-0.0964	-0.0351
	(0.0176)	(0.0159)
Male $\times$ Age	-0.110	-0.0287
	(0.0201)	(0.0187)
Female $\times$ Age squared	0.000654	0.000191
	(0.000133)	(0.000121)
Male $\times$ Age squared	0.000683	0.000130
	(0.000142)	(0.000133)
No partner	0	0
	(.)	(.)
Has partner	-0.00751	0.00846
	(0.00444)	(0.00365)
Constant	3.699	1.076
	(0.581)	(0.522)
Saving ventile FE	✓	✓
Cost ventile FE	✓	✓
Province FE	✓	✓
R^2	0.057	0.120
N	134782	134782

Notes: Data from SCOMP, 2010-2018. PFA risk to the investment strategy for retirement savings chosen by the individual until before retirement (C, D and E), excluding those choosing the highest two levels of risk.

Table A.24: Selection on observables – Survey data

	(1) Intermediation	(2) Intermediation	(3) Intermediation	(4) Annuitization	(5) Annuitization	(6) Annuitization
Bad health	-0.0289			-0.00867		
	(0.0224)			(0.0208)		
No children		0			0	
		(.)			(.)	
Has children		-0.124			-0.283	
		(0.161)			(0.0516)	
Primary ed.			0			0
			(.)			(.)
Secondary ed.			0.119			0.140
			(0.0497)			(0.0452)
Tertiary ed.			0.0446			0.133
			(0.0611)			(0.0532)
Demographic controls	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓
R^2	0.038	0.037	0.046	0.064	0.071	0.083
N	612	613	610	612	613	610

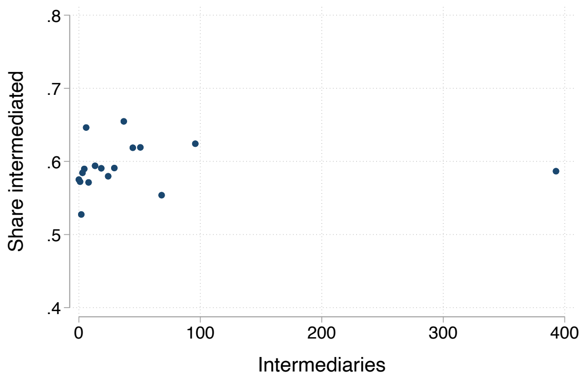
Notes: Data from SPS, 2010-2018. Demographic controls are gender, age and age at survey answer interacted with gender, dummy for partner, pension savings and other wealth.

Table A.32: Life expectancies (age 65)

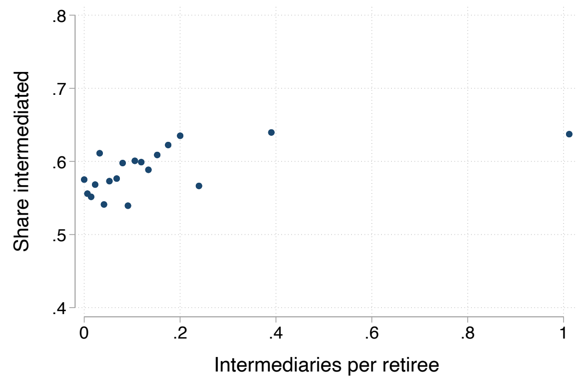
	Benchmark	Ban	Ban (prices)	De-bias	De-bias (prices)
Life expectancy	84.0	84.0	84.0	84.0	84.0
Not interm.	83.9	84.0	84.0	84.0	84.0
Intermediated	84.1	–	–	84.0	84.0
Phased Withdrawal	82.5	82.6	82.8	82.7	83.1
Annuities	84.8	86.0	86.1	86.7	86.8
Simple	87.1	87.1	87.4	87.7	88.0
Deferred	86.3	86.6	86.7	87.4	87.3
Guaranteed	84.7	85.9	85.8	86.7	86.5
Deferred and guaranteed	83.7	85.2	85.0	85.8	85.4

Distribution of mortality shifters estimated from the model.

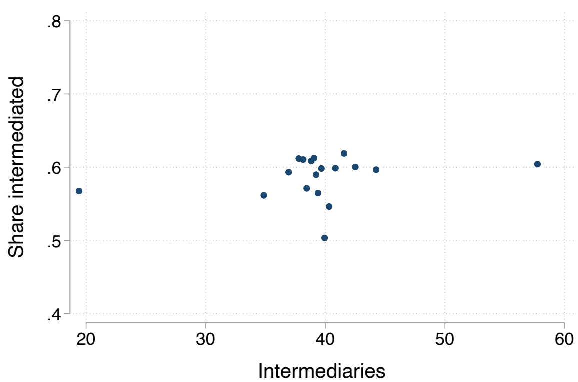
Figure A.26: Number of intermediaries and intermediation



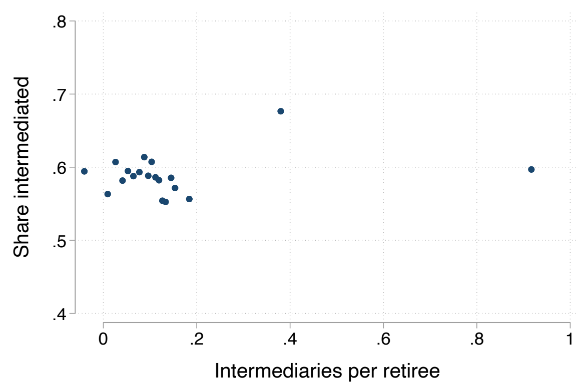
(a) Number of intermediaries



(b) Intermediaries per retiree



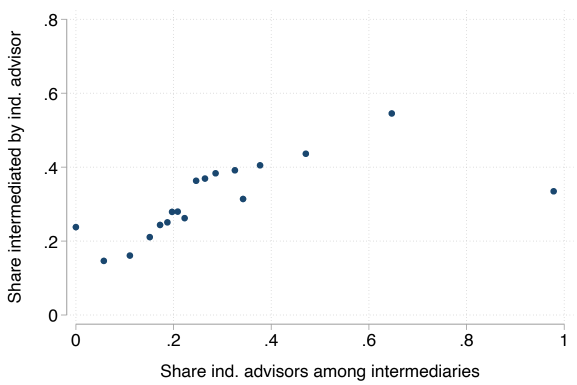
(c) Number of intermediaries (province FE)



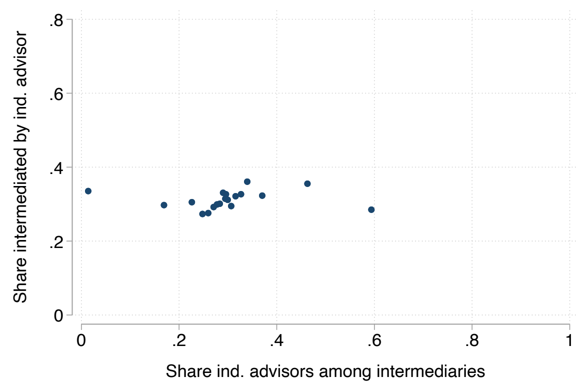
(d) Intermediaries per retiree (province FE)

Notes: These figures show the role of density of intermediaries in determining probabilities of intermediation. An observation is a province-year. Panel (a) shows the fraction of intermediated retirees (y-axis) and the number of intermediaries registered in that province-year. Panel (b) shows the fraction of intermediated retirees (y-axis) and the number of intermediaries per retiree in that province-year. Panels (c) and (d) control for province fixed effects. A province is the second-largest geographical division in Chile. The 56 provinces are heterogeneous in their population size and area.

Figure A.27: Type of intermediaries and intermediation



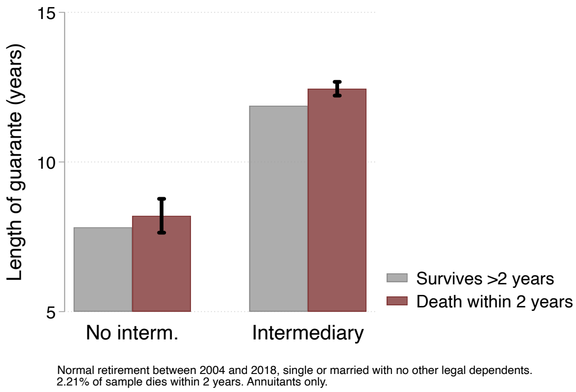
(a) No controls



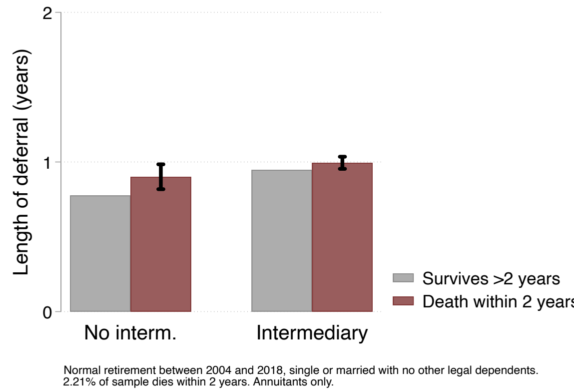
(b) Province FE

Notes: These figures show the role of density of intermediaries in determining probabilities of intermediation. An observation is a province-year. Panel (a) shows the fraction of retirees intermediated by independent advisors (y-axis) and the share of all intermediaries registered as independent in that province-year. Panel (b) controls for province fixed effects. A province is the second-largest geographical division in Chile. The 56 provinces are heterogeneous in their population size and area.

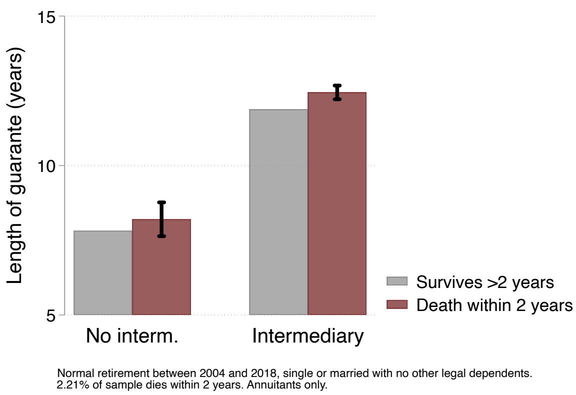
Figure A.28: Selection into annuity characteristics



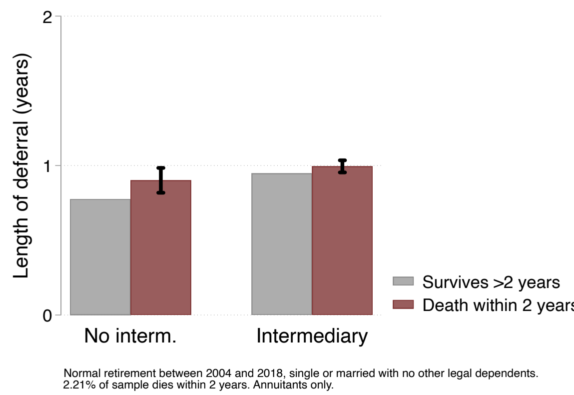
(a) Guarantee length (unconditional)



(b) Deferral length (unconditional)



(c) Guarantee length (conditional)



(d) Deferral length (conditional)

These figures show selection into annuity characteristics by intermediary. (a) and (b) show the unconditional mean guarantee and deferral length across intermediary channel (left and right) and survival after retirement (light gray and dark red bars). (c) and (d) show the mean guarantee and deferral length conditional on contracting a positive length. Standard errors reflect comparison within an intermediation channel. Retirees choosing "normal" retirement (at or after retirement age) between 2004 and 2018, single or married with no other legal dependents. 2.21% of sample dies within 2 years of retirement.

Figure A.29: Sample pension advisor document (CMF, 2019)

R E S U M E N P E N S I O N E S L I Q U I D A S (Descontado 7% salud)
Puede optar:

CIA. SEGUROS PENSION RENTA VITALICIA
INMEDIATA - SIN PERIODO GAR. ***U.F.12,45 = $ 312.548***

CIA. SEGUROS PENSION RENTA VITALICIA
INMEDIATA - P. GAR. 10 AÑOS (120 MESES) ***U.F. 12,35 = $ 310.037***
(GARANTIA AÑO 2018 A AÑO 2028) Desde mayo de por vida *

CIA. SEGUROS PENSION RENTA VITALICIA
INMEDIATA - P. GAR. 14 AÑOS (168 MESES) ***U.F. 12,25 = $ 307.527***
(GARANTIA AÑO 2018 A AÑO 2032 Desde mayo de por vida *

CIA. SEGUROS PENSION RENTA VITALICIA
INMEDIATA - P. GAR. 192 AÑOS (16 MESES) ***U.F. 12,19 = $ 306.021***
(GARANTIA AÑO 2018 A AÑO 2034 Desde mayo de por vida *

*Significa que una vez que traspasen los fondos previsionales desde la A.F.P. a la Compañía de Seguros quedará pactada la pensión de por vida y se reajustará mensualmente según valor U.F.

Rentas vitalicias inmediatas sin E.L.D.
Capital $ 81.402.845- U.F. 3.015,61

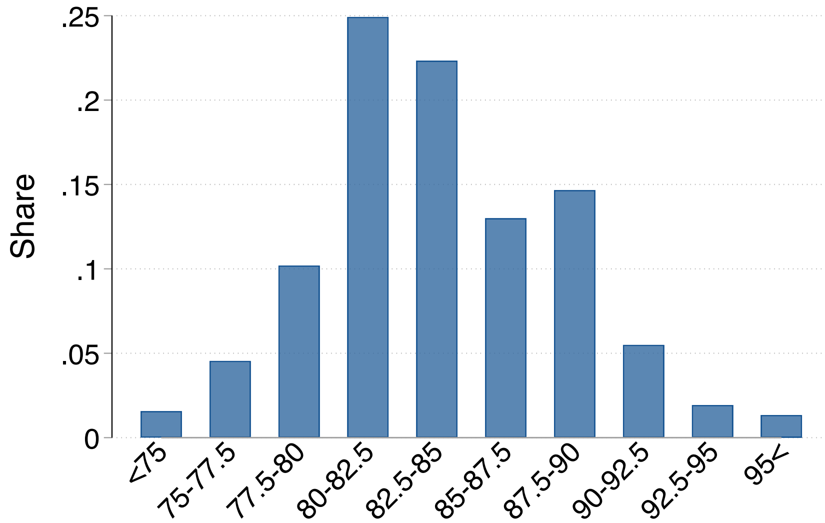
Período garantizado	Pensión U.F. - $(líquida)	Porcentaje	Monto a recupera U.F. - $	Diferencia capital/recuperación
Sin período garantizado o simple	U.F. 12,45 $ 312.548	0	0	0
En 120 meses (10 años) garantiza un capital de U.F.	U.F. 12,35 $ 310.037	49,14 %	U.F. 1.482 $ 40.004.870	<U.F. 1.533,61 < $ 41.398.022
En 168 meses (14 años) garantiza un capital de U.F.	U.F. 12,25 $ 307.527	68,80 %	U.F. 2.074,8 $ 56.006.819	<U.F. 940,81 <$ 25.396.074
En 192 meses (16 años) garantiza un capital de U.F.	U.F. 12,19 $ 306.021	77,61 %	U.F. 2.340,48 $ 63.178.542	<U.F. 675,13 <$ 18.224.351

Notes: Example of document prepared by an independent advisor to help their customers. The bottom table compares annuities with different guarantee lengths, showing how much of the initial capital is "recovered" in case of an early death.

Figure A.30: Wealth in pension savings (Social Protection Survey)

Notes: Individual wealth in Social Protection Survey. Wealth measure per individual; married individuals' wealth is divided by 2. Wealth includes housing, durable goods, and financial savings. Excludes debt.

Figure A.31: Estimated mortality distribution (individuals 65 at retirement)



Notes: Distribution of mortality shifters estimated from the model.

Figure A.32: Demand for intermediaries (model and data)

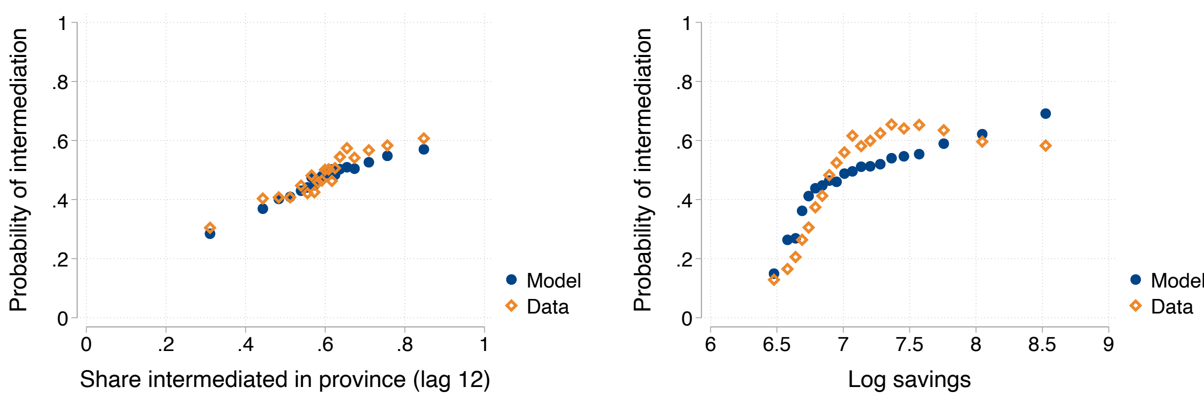
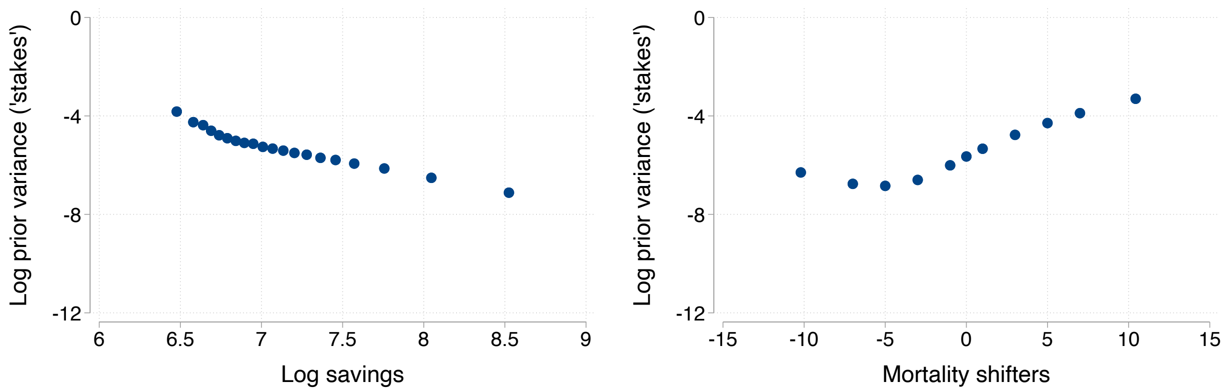
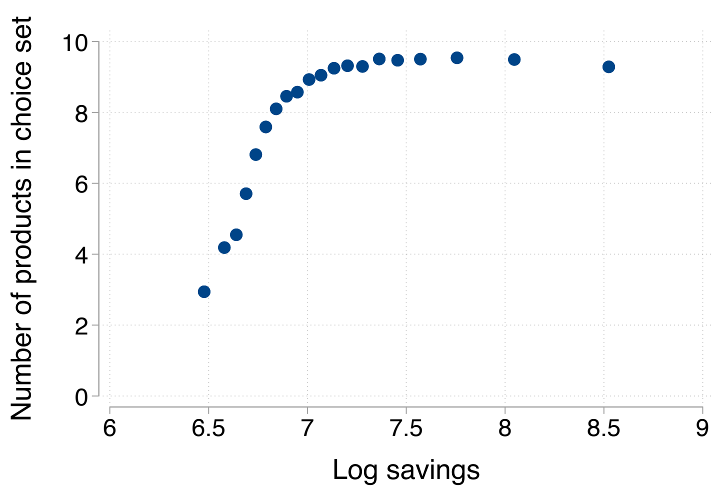


Figure A.33: Predictors of prior variance/decision "stakes" (model)



Notes: Relationship between decision "stakes" and model variables (savings and mortality shifters). See main text for a description of the intuition behind the patterns.

Figure A.34: Number of products and savings (estimation sample)



Notes: Relationship between number of pension products in choice set (products for which the retiree requested offers) and pension savings.

B Setting

Centralized exchange Pension products in Chile are sold through a centralized exchange called SCOMP.[74]. The exchange was introduced in 2004 to improve the information available to retirees about their options, as well as to streamline the process of acquiring and comparing offers from different insurance companies and PFAs[75] (CMF, 2019). An individual will request offers or quotes for annuities[76] with varying deferral and guaranteed periods. These requests are then sent to all insurance companies in the market, along only with the retiree's age, gender and total savings. Each insurance company then decides whether to offer a quote for each of the pension products requested. All offers – from the PFAs for the Phased Withdrawal, and from all insurance companies for annuities – are summarized in a document called *Offers Certificate*, which is mailed to the retiree. They can then either accept any of the offers, desist and postpone the decision to a later stage, or bargain with insurance companies individually to obtain an improvement upon an existing offer. The median retiree requests quotes for 10 product types and receives over 100 quotes for pension products. Figure 2 shows sample documents: the language is technical and the description of the offer characteristics sparse.

The number of retirees using SCOMP has increased through time, reaching over $50,000$ in 2018, at which point the annual value of the pension market was over 6 billion dollars (see Figure A.14 and A.15). From 2004 onwards, 19 insurance companies have participated in the annuity market. For a majority of them, annuities constitute an important business line, making up over 60% of both revenues and liabilities (add Appendix Figure). Insurance companies are differentiated by their risk rating, an evaluation of their creditworthiness assessed periodically by two independent agencies. The regulator explicitly forbids the bundling of pension products with other types of insurance. Nevertheless, insurance companies might also differ in terms of their customer service, office locations and brand appeal.

[74] *Sistema de Consulta y Oferta de Montos de Pensión* The centralized exchange is only relevant for the fraction (around 30-40%) of retirees that have enough savings to purchase an annuity which is at least as large as the minimum government subsidy. All other retirees face no true choice and are defaulted into a Phased Withdrawal

[75] Another part of the motivation was to address conflicts of interest in the acquisition of the quotes by intermediaries.

[76] When deciding for a Phased Withdrawal, the only choice to be made is which Pension Fund Administrator to select, all of which are automatically included in the offers presented to the retiree. PFAs differ in terms of the commission charged to manage funds, as well as in their returns. Evidence shows that individuals might be subject to significant switching costs in this decision (Illanes, 2017; Luco, 2019).

C Choice model

C.1 Derivations

C.1.1 Optimal choice probabilities

This section is based on Brown and Jeon (2023).

From Lemma 2 in Matejka and McKay (2015), we know that the solution to the rational inattention choice among products in choice set $\mathcal{J}$ (indexed from 1 to N) under the prior G is given by the solution to

$$\begin{aligned} \mathcal{U} := \max_{\mathcal{P}_1^0,\dots,\mathcal{P}_N^0} \int_{\xi_i} \lambda_i \log\left(\sum_{k=1}^N \mathcal{P}_k^0 \exp\left(\frac{V_{ik}+\xi_{ik}}{\lambda_i}\right)\right) \, \mathrm{d}G(\mathrm{d}\boldsymbol{\xi}_i), \\ \text{s.t. } \forall k \quad \mathcal{P}_k^0 \geq 0, \qquad \sum_{k=1}^N \mathcal{P}_k^0 = 1, \end{aligned}$$

where $\mathcal{P}_k^0$ denotes the prior/unconditional probability of choosing product k, fulfilling

$$\mathcal{P}_k^0 = \int_{\xi_i} \mathcal{P}_k(\boldsymbol{\xi}_i) G(\mathrm{d}\boldsymbol{\xi}_i) = \int_{\xi_i} \frac{\mathcal{P}_k^0 \exp\left(\frac{V_{ik}+\xi_{ik}}{\lambda_i}\right)}{\sum_{j\in\mathcal{J}} \mathcal{P}_j^0 \exp\left(\frac{V_{ij}+\xi_{ij}}{\lambda_i}\right)}.$$

Assume first that the optimal solution for $\mathcal{P}_{i1}^0, \dots, \mathcal{P}_{iN}^0$ is interior, such that $\mathcal{P}_{ik}^0 > 0 \; \forall k$. We can then write

$$\begin{aligned} &\int_{\xi_i} \lambda_i \log\left(\sum_{k=1}^N \mathcal{P}_k^0 \exp\left(\frac{V_{ik}+\xi_{ik}}{\lambda_i}\right)\right) \, \mathrm{d}G(\mathrm{d}\boldsymbol{\xi}_i) \\ &\quad = \int_{\xi_i} \lambda_i \log\left(\sum_{k=1}^N \exp\left(\frac{V_{ik}+\xi_{ik}}{\lambda_i} + \log \mathcal{P}_{ik}^0\right)\right) \, \mathrm{d}G(\mathrm{d}\boldsymbol{\xi}_i) \end{aligned}$$

Define $\varepsilon \sim \mathcal{G}(m, \beta)$ to be a Gumbel random variable with location m and scale β. We have that

$$\mathbb{E}[\varepsilon] = m + \beta\gamma^{EM}, \quad \mathbb{E}[(\varepsilon - \mathbb{E}[\varepsilon])^2] = \frac{\pi^2}{6}\beta^2,$$

where γ^{EM} is the Euler-Mascheroni constant. By properties of the Gumbel distribution (Small and Rosen, 1981), we have that

$$\begin{aligned} &\lambda_i \log\left(\sum_{k=1}^N \exp\left(\frac{V_{ik}+\xi_{ik}}{\lambda} + \log \mathcal{P}_{ik}^0\right)\right) \, \mathrm{d}G(\mathrm{d}\boldsymbol{\xi}_i) \\ &\quad = \lambda_i \mathbb{E}_{\xi_i,\varepsilon}\left[\max_{k\in\mathcal{J}} \frac{V_{ik}+\xi_{ik}}{\lambda_i} + \log \mathcal{P}_{ik}^0 + \varepsilon_{ik}\right] - \lambda_i\gamma^{EM}, \end{aligned}$$

where $\varepsilon_{ik} \overset{\text{i.i.d}}{\sim} \mathcal{G}(0,1)$.

We assume that the distribution of ξ_{ik} is independent across dimensions, has mean ξ_{ik}^0 and variance σ_i^2 across all dimensions and follows – up to a shifter – the distribution of a scaled log positive/one-sided stable distribution with parameter $\rho_{\lambda,\sigma_i^2} = \frac{1}{\ell_{\lambda,\sigma_i^2}} \in (0,1)$ (Cardell, 1997; Galichon, 2021),

$$\xi_{ik} \sim \lambda_i \log X(\rho_{\lambda_i,\sigma_i^2}).$$

Decomposing ξ_{ik} into

$$\xi_{ik} = \xi_{ik}^0 - \lambda_i \gamma^{EM}(\ell_{\lambda_i,\sigma_i^2} - 1) + \xi_{ik}^s,$$

this yields (Galichon, 2021)

$$\frac{\xi_{ik}^s}{\lambda} + \varepsilon_{ik} = \ell_{\lambda_i,\sigma_i^2} e_{ik} \sim \mathcal{G}(0, \ell_{\lambda_i,\sigma_i^2}),$$

where we have

$$\begin{aligned} \mathbb{E}\left[\ell_{\lambda_i,\sigma_i^2} e_{ik}\right] &= \gamma^{EM}(\ell_{\lambda_i,\sigma_i^2} - 1) + \gamma^{EM} = \gamma^{EM} \ell_{\lambda_i,\sigma_i^2}, \\ \mathrm{Var}\left(\ell_{\lambda_i,\sigma_i^2} e_{ik}\right) &= \frac{\sigma^2}{\lambda_i^2} + \frac{\pi^2}{6} \overset{!}{=} \frac{\pi^2}{6} \ell_{\lambda_i,\sigma_i^2}^2. \end{aligned}$$

The first line shows precisely the mean of a $\mathcal{G}(0, \ell_{\lambda_i,\sigma_i^2})$ random variable. For the variance of the second one to be as desired, we set

$$\ell_{\lambda_i,\sigma_i^2} = \sqrt{\frac{6\sigma_i^2}{\lambda_i^2 \pi^2} + 1},$$

which pins down the parameter $\rho_{\lambda_i,\sigma_i^2}$ of the scaled log positive stable distribution.

Hence, we write

$$\begin{aligned} &\lambda_i \mathbb{E}_{\xi_i,\varepsilon}\left[\max_{k \in \mathcal{J}} \frac{V_{ik} + \xi_{ik}}{\lambda_i} + \log \mathcal{P}_{ik}^0 + \varepsilon_k\right] - \lambda_i \gamma^{EM} \\ &= \lambda_i \mathbb{E}_{\xi_i,\varepsilon}\left[\max_{k \in \mathcal{J}} \frac{V_{ik} + \xi_{ik}^0 - \lambda_i \gamma^{EM}(\ell_{\lambda_i,\sigma_i^2} - 1)}{\lambda_i} + \log \mathcal{P}_{ik}^0 + \ell_{\lambda_i,\sigma_i^2} e_{ik}\right] - \lambda_i \gamma^{EM} \\ &= \lambda_i \ell_{\lambda_i,\sigma_i^2} \mathbb{E}_{\xi_i,\varepsilon}\left[\max_{k \in \mathcal{J}} \frac{V_{ik} + \xi_{ik}^0 - \lambda_i \gamma^{EM}(\ell_{\lambda_i,\sigma_i^2} - 1)}{\ell_{\lambda_i,\sigma_i^2} \lambda_i} + \frac{\log \mathcal{P}_{ik}^0}{\ell_{\lambda_i,\sigma_i^2}} + e_{ik}\right] - \lambda_i \gamma^{EM}. \end{aligned}$$

Finally, using the Small and Rosen (1981) transformation one more time, we obtain

$$\begin{aligned} &\lambda_i \ell_{\lambda_i,\sigma_i^2} \log \sum_{j \in \mathcal{J}} \exp\left(\frac{V_{ik} + \xi_{ik}^0 - \lambda_i \gamma^{EM}(\ell_{\lambda_i,\sigma_i^2} - 1)}{\ell_{\lambda_i,\sigma_i^2} \lambda_i} + \frac{\log \mathcal{P}_{ik}^0}{\ell_{\lambda_i,\sigma_i^2}}\right) + \lambda_i \gamma^{EM}(\ell_{\lambda_i,\sigma_i^2} - 1) \\ &= \lambda_i \ell_{\lambda_i,\sigma_i^2} \log \sum_{j \in \mathcal{J}} \exp\left(\frac{V_{ik} + \xi_{ik}^0}{\ell_{\lambda_i,\sigma_i^2} \lambda_i} + \frac{\log \mathcal{P}_{ik}^0}{\ell_{\lambda_i,\sigma_i^2}}\right). \end{aligned}$$

The original problem therefore simplifies to – taking a monotone transformation of the objective function –

$$\max_{\mathcal{P}_1^0,\ldots,\mathcal{P}_N^0} \sum_{j\in\mathcal{J}} \exp\left(\frac{V_{ik}+\xi_{ik}^0}{\ell_{\lambda_i,\sigma_i^2}\lambda_i} + \frac{\log \mathcal{P}_{ik}^0}{\ell_{\lambda_i,\sigma_i^2}}\right)$$
$$\text{s.t.} \sum_{k=1}^{N} \mathcal{P}_{ik}^0 = 1.$$

Since we have assumed that the solution is interior, the FOCs with respect to $\mathcal{P}_k^0$ $\forall k$ are necessary and sufficient. Denoting the Lagrange multiplier as η and writing $\ell := \ell_{\lambda_i,\sigma_i^2}$ for ease of notation, we have

$$\begin{aligned} \frac{\partial}{\partial \mathcal{P}_{ik}^0} &= \frac{1}{\ell}\left(\mathcal{P}_{ik}^0\right)^{\frac{1}{\ell}} \exp\left(\frac{V_{ik}+\xi_{ik}^0}{\lambda_i \ell}\right) - \eta \stackrel{!}{=} 0, \\ \implies \quad \mathcal{P}_{ik}^0 &= (\eta\ell)^{\frac{\ell}{1-\ell}} \exp\left(\frac{V_{ik}+\xi_{ik}^0}{\lambda_i(\ell-1)}\right). \end{aligned}$$

Using the constraint, we obtain an expression for $\eta^{\frac{\ell}{1-\ell}}$,

$$\begin{aligned} \sum_{j\in\mathcal{J}} \mathcal{P}_{ik}^0 &= \sum_{j\in\mathcal{J}} (\eta\ell)^{\frac{\ell}{1-\ell}} \exp\left(\frac{V_{ij}+\xi_{ij}^0}{\lambda_i(\ell-1)}\right), \\ \implies \quad \eta^{\frac{\ell}{1-\ell}} &= \frac{1}{\sum_{j\in\mathcal{J}} \ell^{\frac{\ell}{1-\ell}} \exp\left(\frac{V_{ij}+\xi_{ij}^0}{\lambda_i(\ell-1)}\right)}. \end{aligned}$$

Hence, we obtain an expression for $\mathcal{P}_k^0$,

$$\mathcal{P}_{ik}^0 = \frac{\exp\left(\frac{V_{ik}+\xi_{ik}^0}{\lambda_i(\ell-1)}\right)}{\sum_{j\in\mathcal{J}} \ell^{\frac{\ell}{1-\ell}} \exp\left(\frac{V_{ij}+\xi_{ij}^0}{\lambda_i(\ell-1)}\right)},$$

and optimal choice probabilities

$$\mathcal{P}_{ik}(\boldsymbol{\xi}_i) = \frac{\exp\left(\frac{V_{ik}+\xi_{ik}^0}{\lambda_i(\ell_{\lambda_i,\sigma_i^2}-1)} + \frac{V_{ik}+\xi_{ik}}{\lambda_i}\right)}{\sum_{j\in\mathcal{J}} \exp\left(\frac{V_{ij}+\xi_{ij}^0}{\lambda_i(\ell_{\lambda_i,\sigma_i^2}-1)} + \frac{V_{ij}+\xi_{ij}}{\lambda_i}\right)}.$$

It remains to be shown that the optimal solution is indeed interior under the assumption on the prior.[77] From Proposition 1 in Caplin, Dean, and Leahy (2019), a necessary and sufficient condition for the optimal

[77] I thank Giovanni Montanari for helpful discussions on this point. A different proof is provided by Bertoli, Moraga, and Guichard (2020).

policy is given by

$$\int_{\xi_i} \frac{\exp\left[\frac{V_{ik}+\xi_{ik}}{\lambda_i}\right]}{\sum_{j\in\mathcal{J}} P^0_{ij}\exp\left[\frac{V_{ij}+\xi_{ij}}{\lambda_i}\right]}\ G(\mathrm{d}\boldsymbol{\xi}_i) \leq 1 \quad \forall k, \tag{C}$$

with equality for all k such that $\mathcal{P}^0_{ik} > 0$. Let us show that assuming a corner solution leads to a contradiction under the assumed prior. Wlog, assume the corner is attained for product 1. We then must have

$$\int_{\xi_i} \frac{\exp\left[\frac{V_{i1}+\xi_{i1}}{\lambda_i}\right]}{\sum_{j\in\mathcal{J}\setminus\{1\}} P^0_{ij}\exp\left[\frac{V_{ij}+\xi_{ij}}{\lambda_i}\right]}\ G(\mathrm{d}\boldsymbol{\xi}_i) \leq 1.$$

The assumption on the prior is that $\bar{\xi}_{in} = \lambda_i \log X(\rho) + C$, where C is some constant. Hence,

$$\int_{\mathbf{x}} \frac{\exp\left[\frac{V_{i1}}{\lambda_i}\right]\cdot x_1(\rho)}{\sum_{j\in\mathcal{J}\setminus\{1\}} P^0_{ij}\exp\left[\frac{V_{ij}}{\lambda_i}\right]\cdot x_j(\rho)}\ F(\mathrm{d}x),$$

where the support of the integral is now the positive real line.

Notice that $\frac{V_{ik}}{\lambda_i}, \mathcal{P}^0_{ik}$ are constants, with $\mathcal{P}^0_{ik} > 0$ for all k. From Feller (1966), the positive/one-sided stable distribution does not have any finite moments.[78] Given the $x_i(\rho)$ are i.i.d. one-sided stable distributions, we can split the integral into two parts at some constant $C_0 \in \mathbb{R}_+$,

$$\begin{aligned}
&\int_{(x_1,x_j\in[0,C_0]\forall j\setminus i)} \frac{\exp\left[\frac{V_{i1}}{\lambda_i}\right]\cdot x_1(\rho)}{\sum_{j\in\mathcal{J}\setminus\{1\}} P^0_{ij}\exp\left[\frac{V_{ij}}{\lambda_i}\right]\cdot x_j(\rho)}\ F(\mathrm{d}x) + \int_{(x_1,x_j\in[C_0,\infty)\forall j\setminus i)} \frac{\exp\left[\frac{V_{i1}}{\lambda_i}\right]\cdot x_1(\rho)}{\sum_{j\in\mathcal{J}\setminus\{1\}} P^0_{ij}\exp\left[\frac{V_{ij}}{\lambda_i}\right]\cdot x_j(\rho)}\ F(\mathrm{d}x) \\
&> \int_{(x_1,x_j\in[0,C_0]\forall j\setminus i)} \frac{\exp\left[\frac{V_{i1}}{\lambda_i}\right]\cdot x_1(\rho)}{\sum_{j\in\mathcal{J}\setminus\{1\}} P^0_{ij}\exp\left[\frac{V_{ij}}{\lambda_i}\right]\cdot C_0}\ F(\mathrm{d}x),
\end{aligned}$$

as the second integral is bounded below by zero. The last term diverges due to the unboundedness of the mean of $x_1(\rho)$. This is a contradiction – the optimal solution is therefore interior.

[78] VI.1, p.169 in the 1966 edition. The statement is that all absolute moments less than α exist, where $\alpha \in (0,1)$ is the parameter of the distribution. Here is be a proof using a statement from the same page. We have that for $\{X_i\}_{i=1}^n$ i.i.d. positive stable with parameter $\alpha < 1$,

$$\mathbb{E}\left[X_1\right] = \mathbb{E}\left[\frac{X_1+\cdots+X_N}{n}\right] = \mathbb{E}\left[X_1 n^{-1+1/\alpha}\right] = \mathbb{E}[X_1]n^{-1+1/\alpha},$$

by the defining property of the positive stable distribution, as quoted in Galichon (2021). But since the mean cannot be zero – the distribution takes positive values with positive probability and its support is $[0,\infty)$ –, we see that the last expression diverges with n. Therefore, the mean is unbounded.

C.1.2 Expected value

To obtain the closed form for the expected value from making a choice without an intermediary, we plug in the optimal solution for $\mathcal{P}_{ik}^0$ into the original problem. We obtain

$$
\begin{aligned}
&\lambda_i \ell_{\lambda_i,\sigma_i^2} \log \sum_{j \in \mathcal{J}} \exp\left(\frac{V_{ik}+\xi_{ik}^0}{\lambda_i \ell_{\lambda,\sigma_i^2}} + \frac{\log \mathcal{P}_{ik}^0}{\ell_{\lambda_i,\sigma_i^2}}\right) \\
&= \lambda_i \ell_{\lambda_i,\sigma_i^2} \log \sum_{j \in \mathcal{J}} \exp\left(\frac{V_{ik}+\xi_{ik}^0}{\lambda_i \ell_{\lambda_i,\sigma_i^2}} + \frac{1}{\ell_{\lambda_i,\sigma_i^2}}\left(\frac{V_{ik}+\xi_{ik}^0}{\lambda_i(\ell_{\lambda_i,\sigma_i^2}-1)} - \log \sum_{j \in \mathcal{J}} \exp\left(\frac{V_{ij}+\xi_{ij}^0}{\lambda_i(\ell_{\lambda_i,\sigma_i^2}-1)}\right)\right)\right) \\
&= \lambda_i \ell_{\lambda_i,\sigma_i^2} \log \frac{\sum_{j \in \mathcal{J}} \exp\left((\ell_{\lambda_i,\sigma_i^2}-1)\frac{V_{ik}+\xi_{ik}^0}{\lambda_i \ell_{\lambda_i,\sigma_i^2}(\ell_{\lambda_i,\sigma_i^2}-1)} + \left(\frac{V_{ik}+\xi_{ik}^0}{\lambda_i \ell_{\lambda_i,\sigma_i^2}(\ell_{\lambda_i,\sigma_i^2}-1)}\right)\right)}{\exp\left(\frac{V_{ij}+\xi_{ij}^0}{\lambda_i(\ell_{\lambda_i,\sigma_i^2}-1)}\right)} \\
&= \lambda_i(\ell_{\lambda_i,\sigma_i^2}-1) \log \sum_{j \in \mathcal{J}} \exp\left(\frac{V_{ij}+\xi_{ij}^0}{\lambda_i(\ell_{\lambda_i,\sigma_i^2}-1)}\right).
\end{aligned}
$$

C.2 Prior distribution assumption

Preliminaries The assumption on the distribution of the prior G for an individual with marginal cost of information λ with arbitrary mean ξ_k^0 and variance σ^2 is that ξ_k follows the unique distribution such that (Cardell, 1997)

$$\frac{\xi}{\lambda} + \varepsilon_k$$

is also distributed Gumbel with some location and scale. Galichon (2021) shows that this distribution is a scaled log positive (or one-sided) stable distribution,

$$\xi \sim \lambda \log X(\rho), \qquad \rho = \sqrt{\frac{\lambda^2 \pi^2}{6\sigma^2 + \lambda^2 \pi^2}} \in (0,1),$$

where $X(\rho)$ is defined by the Laplace transform

$$\mathbb{E}_X[\exp(-tX)] = \exp\left(-t^\rho\right),$$

and the property that for $X_1, \ldots, X_N$ i.i.d. draws of the distribution and positive reals $\alpha_1, \ldots, \alpha_N$

$$\frac{\alpha_1 Z_1 + \ldots \alpha_N Z_N}{(\alpha_1^\rho + \cdots + \alpha_N^\rho)^{\frac{1}{\rho}}} \sim X(\rho).$$

However, the log one-sided stable distribution is *not* part of a location-scale family. In particular, for some constant c and $\lambda_2 = c\lambda_1$, the distribution required to keep the variance of the prior fixed at σ^2 will not be the same,

$$\lambda_1 \log X(\rho_1) \not\sim \lambda_2 \log X(\rho_2).$$

The change in the shape of the distribution G_λ with λ can be assessed by simulation.[79] Kanter (1975) shows the density of G_λ is unimodal. He also shows that a one-sided stable distribution $X(\rho)$ can be simulated using the following algorithm

1. Sample an exponential variable $L \sim \text{Exp}(1)$ and a uniform variable $U \sim [0, \pi]$.
2. Compute

$$a(U) = \left(\frac{\sin \rho U}{\sin U}\right)^{\frac{1}{1-\rho}} \left(\frac{\sin(1-\rho)U}{\sin \rho U}\right).$$

[79] Alternatively, one can also derive further moments of the distribution from the conjugate property (in progress).

3. Set

$$X = \left(\frac{a(U)}{L}\right)^{\frac{1-\rho}{\rho}} \sim X(\rho).$$

Since the one-sided stable distribution does not have any finite moments, the direct simulation of X often leads to overflow. It is therefore convenient to simulate the log positive stable distribution directly

1. Sample an exponential variable $L \sim \mathrm{Exp}(1)$ and a uniform variable $U \sim [0, \pi]$.

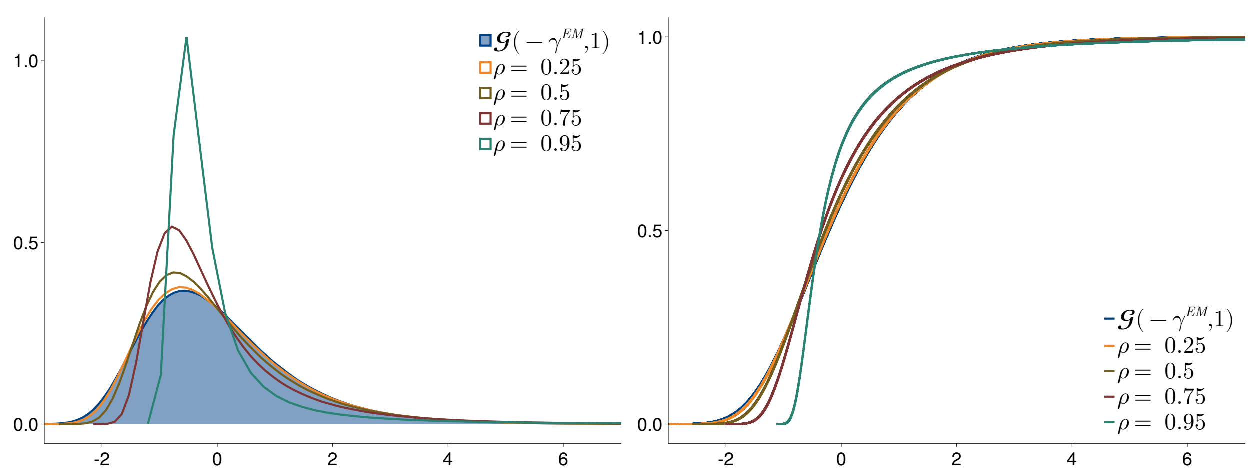
2. Compute

$$\begin{aligned} l_a(U) &= \frac{1}{1-\rho}\log\left(\frac{\sin\rho U}{\sin U}\right) + \log\left(\frac{\sin(1-\rho)U}{\sin\rho U}\right) \\ &= \frac{1}{1-\rho}\log\left(\frac{\sin\rho U}{\sin U}\right) + \log\left(\frac{\sin(1-\rho)U}{\sin\rho U}\right). \end{aligned}$$

3. Set

$$\log X = \frac{1-\rho}{\rho}\left(l_a(U) - \log L\right) \sim \log X(\rho).$$

Figure C.35: Prior G_λ



(a) PDF (b) CDF

This figure shows the assumption on the prior distribution for different values of $\rho = \sqrt{\frac{\lambda^2\pi^2}{6\sigma^2+\lambda^2\pi^2}}$. For a given variance σ^2, the required shape of the prior – here centered around zero – concentrates around the mode and increases the right tail as the cost of acquiring information λ_i increases. For relatively low values of ρ the distribution is practically indistinguishable from an EV(I) (Gumbel) distribution with variance σ^2 $\left(\text{scale } \sqrt{\frac{6\sigma^2}{\pi^2}}\right)$.

Simulations Figure C.35 shows the shapes of a mean zero prior with variance $\frac{\pi^2}{6}$. The limiting case with $\lambda \to 0$ corresponds to the "standard" Gumbel distribution $\mathcal{G}(-\gamma^{EM}, 1)$. As λ increases, so does ρ and the shape of the prior changes: the right tail become fatter and more of the mass is concentrated around the mode.

The assumption that yields the closed-form, "logit"-like choice probabilities therefore links together the *shape of the prior* and the cost of information λ_i. Individuals who face larger marginal costs of information are assumed to also have priors that are more concentrated, but with more significant outliers. Taken at face-value, this assumption implies a degree of "confidence" by retirees with high λ_i, for whom becoming informed is more costly: they face a relatively more certain choice, but with the potential for realizations so extreme that justify some information acquisition even when the cost is extremely large.

Assumption and choice probabilities To assess how the assumption impacts choice probabilities, we can examine how these compare to the optimal choice probabilities for a decision-maker facing information costs λ under a different prior, for example, the Gumbel benchmark above. Note that the shape assumption does not impact choice probabilities under the benchmark beliefs, as the independence across dimensions combined with equal means makes the prior dimensions *interchangeable*. Optimal choice probabilities are then independent of the prior as described in Matejka and McKay (2015).

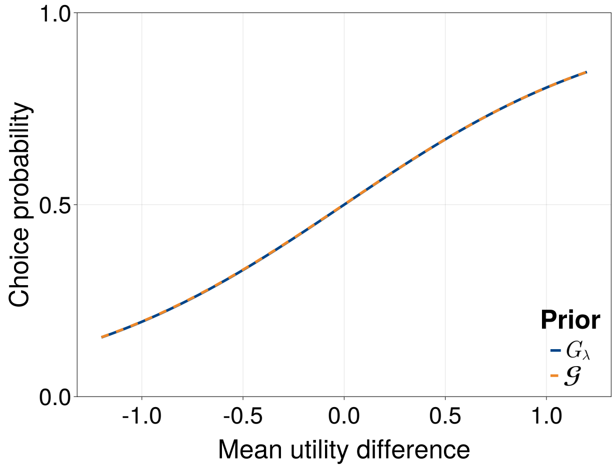
Figure C.36 shows how the prior assumption impacts choice probabilities relative to an EV(I) prior in a two product case. The decision-maker faces two choices with identical and independent marginal distributions, but different means. I show the choices for four different values of ρ, representing increasing values of the information cost λ. The solid blue line plots the theoretically derived choice probability under the prior G_λ from the closed form expression in equation (5). The dashed orange line shows the optimal choice for an EV(I) prior, obtained using the Blahut-Arimoto algorithm as described in Caplin, Dean, and Leahy (2019).

For moderate values of ρ choice probabilities under both priors are nearly identical. For large values of ρ, the assumption on the prior smooths out the choice probabilities and prevents the attaining of a corner. This pattern is in line with the result in Appendix C.1.1: G_λ is "engineered" to prevent the decision-maker from optimally choosing a corner solution even when facing large information costs. The increasingly fat tail as λ diverges ensures this will be the case.

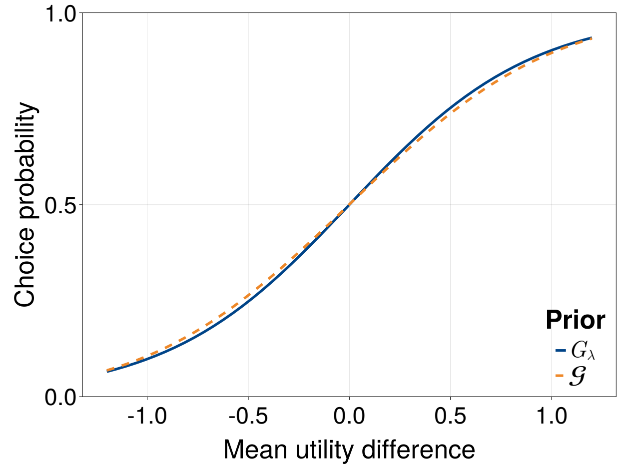
Assumption and intermediary choices As outlined in section 4, I approximate the expected value of the decision under an intermediary by replacing the prior G_λ by a Gumbel distribution when evaluating the integral. That is, to compute

$$
\begin{aligned}
U_i^I = \mathbb{E}[U_{\text{Intermediary}}] = \int_{\xi_i} \xi_{ik}^I \mathcal{P}^{*,I}(\boldsymbol{\xi}_i)\ G_{\lambda_i}(\mathrm{d}\boldsymbol{\xi}_i),\\
\mathcal{P}_{ik}^{*,I}(\boldsymbol{\xi}_i) = \mathbb{1}(\arg\max_k \xi_{ik}^I + c_k^I),
\end{aligned}
$$

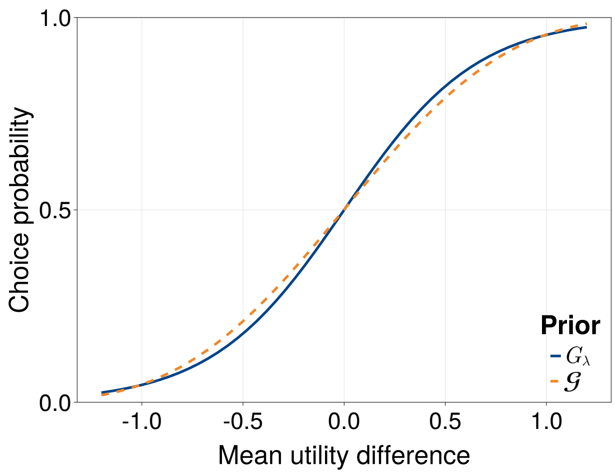
Figure C.36: Choice probabilities with two products



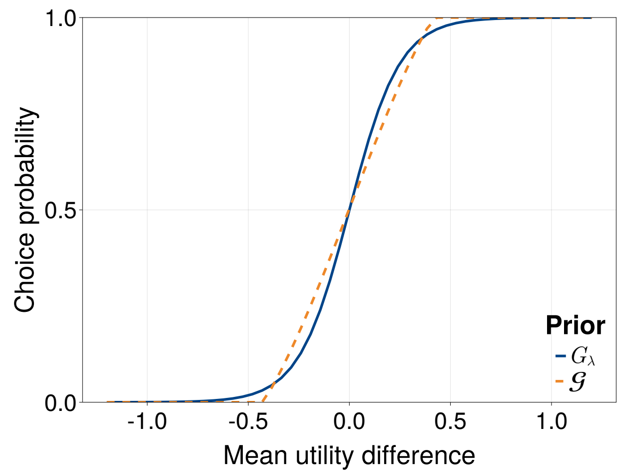
(a) $\rho = 0.1$



(b) $\rho = 0.4$



(c) $\rho = 0.7$



(d) $\rho = 0.95$

This figure shows a comparison of optimal choice probabilities under an EV(I) (Gumbel) and the log positive stable prior G_λ that yields a closed form for a given cost of information λ. The x-axis shows the difference in mean expected utilities between product 1 and product 2, the y-axis shows the optimal probability of choosing product 1.

I replace G_{λ_i} by a Gumbel distribution with the same variance, see Figure C.35. This change then yields a closed form expression for the expected utility using an intermediary,

$$U_i^I = \sqrt{\frac{6\sigma_i^2}{\pi^2}} \log \sum_{k=1}^{N} \exp\left(\frac{\xi_{ik}^I + c_k^I}{\sqrt{6\sigma_i^2/\pi^2}}\right) - \sum_{k=1}^{N} \mathcal{P}^{0,*,I} c_k^I.$$

This is done purely for convenience in estimation: it allows me to circumvent a multi-dimensional integral.

There are two potential interpretations for this assumption. One is *behavioral*, implying retirees evaluate the benefits of intermediation under a different prior than they do their own decisions. In turn, this would imply that retirees expect the values of pension products to be different when they are intermediated and when they are not. If retirees expect the intermediary to somehow meaningfully affect the value of products, this assumption would be reasonable. Another rationalization for this assumption could come from tweaking the cost function – away from entropy-based – to preserve the closed form solutions for the rational-inattention problem under an EV(I) prior [in progress].

A different interpretation of the prior "swap" is as an *approximation* to the true value of the integral. The question is then what the bias of this approximation is and how it may affect the results of the estimation. This involves comparing the expected value of the maximum under an EV(I) and under G_λ.

In simulations, the expected value of the max of an EV(I) is *larger* than a G_λ if the prior mean is equal across dimensions and the prior dimensions are interchangeable. For different means, the difference between the approximation and the true value can be either positive or negative. The intuition for this is once again the long right tail of G_λ as λ and ρ increase. With unequal means and independent draws, the individual gets to take advantage of the very large realizations.

Sketch of proof for equal means across dimensions Assume X_1, X_2 are i.i.d. λ- scaled log positive stable with variance $\sigma^2 = \frac{\pi^2}{6}$ and implied parameter ρ,

$$X_1 \sim \lambda \log X(\rho), \qquad \rho = \sqrt{\frac{\lambda^2\pi^2}{6\sigma^2 + \lambda^2\pi^2}} \in (0,1)$$

and Y_1, Y_2 are i.i.d. EV(I). Wlog normalize the mean to zero. To be shown is that

$$\mathbb{E}[\max\{X_1, X_2\}] \leq \mathbb{E}[\max\{Y_1, Y_2\}] = \log 2,$$

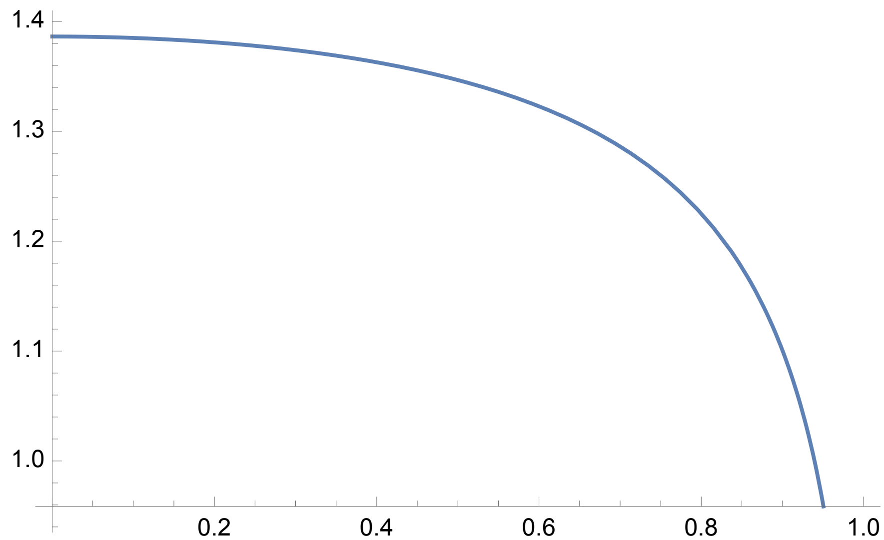
where the last equality is due to the EV(I), Since X_1 is mean zero, we can write

$$\mathbb{E}[\max\{X_1, X_2\}] = \mathbb{E}[\max\{X_1 - X_2, 0\}].$$

$X_1 - X_2$ is mean zero and symmetric due to the i.i.d. property, which implies

$$\mathbb{E}[\max\{X_1 - X_2, 0\}] = 2\int_0^\infty (x_1 - x_2)\ \mathrm{d}F(x_1 - x_2).$$

Figure C.37: Value of $\mathbb{E}[\max\{X_1 - X_2, 0\}]$ as a function of ρ (WolframAlpha)



Theorem 2.1 and Theorem 2.2 in Cardell (1997) imply that for $Z_i(\rho)$ a positive stable distribution, then $\rho \log Z_1(\rho) - \rho \log Z_2(\rho)$ has a pdf f_ρ reading

$$f_\rho(x) = \frac{1}{\exp x + 2\cos \pi\rho + \exp -x} \frac{\sin \pi\rho}{\pi\rho}.$$

We therefore have that for $W = X_1 - X_2$

$$2\int_0^\infty w \, \mathrm{d}F(w) = 2\frac{\lambda}{\rho}\int_0^\infty w \frac{1}{\exp w + 2\cos \pi\rho + \exp -w} \frac{\sin \pi\rho}{\pi\rho} \, \mathrm{d}w.$$

This yields

$$\frac{\lambda}{\rho} \frac{i\left(\mathrm{Li}_2\left(-e^{i\rho\pi}\right) - \mathrm{Li}_2\left(-e^{-i\rho\pi}\right)\right)}{\pi\rho},$$

where Li is the dilogarithm function. Inspection of this expression (see Figure C.37) for any ρ and implied $\lambda = \sqrt{\frac{\rho^2}{1-\rho^2}}$ shows that its value is bounded above by $\log 2$, as desired.

To extend this to more than two values, define $m_{Y_1,\ldots,Y_N} := \max\{Y_1, \ldots, Y_N\}$. Similar calculations and inspections suggest that if one were to show as an induction step that

$$\int \max\{Y_1, m_{Y_2,\ldots,Y_N}\} \leq \log N - 1 \quad \implies \quad \int \max\{Y_1, m_{Y_2,\ldots,Y_{N+1}}\} \leq \int \max\{Y_1, Y_2 + \log N\},$$

one could repeat the arguments above, taking the appropriate integral bounded below at $\log N$ to attain the same result.

C.3 Comparative statics

In this section, I outline some of the comparative statics of the intermediation model.

Comparative Static 1 *The expected value of a decision without intermediation is weakly decreasing in the cost of information* λ_i

In RI model This result is intuitive from the formulation of the rational-inattention problem. λ_i is a multiplier on the entropy cost: as it decreases, the individual must be weakly better off making decisions without intermediation. Formally, define $\mathcal{U}_i^{NI}$ as

$$\mathcal{U}_i^{NI} = \max_{\{\mathcal{P}_{ik}(\boldsymbol{\xi}_i)\}_{k=1}^N} \left(\sum_{k=1}^N \int_{\boldsymbol{\xi}_i} (V_{ik} + \xi_{ik}) \mathcal{P}_{ik}(\boldsymbol{\xi}_i) G(\mathrm{d}\boldsymbol{\xi}_i) \right) - \lambda_i \kappa(\mathcal{P}_i),$$
$$\text{s.t.} \quad \mathcal{P}_{ik}(\boldsymbol{\xi}_i) \geq 0 \ a.s., \qquad \sum_{k=1}^N \mathcal{P}_{ik}(\boldsymbol{\xi}_i) = 1 \ a.s..$$

Suppose the value of $\mathcal{U}_i^{NI}$ is higher for $\lambda' > \lambda$. Then we could take the strategy that is optimal for λ' and use it when the information cost is λ: this must yield a higher value given the first term (utility gained) is identical, and the information cost lower. But this is a contradiction to the maximization behavior.

Given prior assumption G_λ Given the prior changes with λ, this is not immediate. Notice first that

$$\lambda(\ell_\lambda - 1) = \lambda \left(\sqrt{\frac{6\sigma^2}{\pi^2 \lambda^2} + 1} - 1 \right) = \sqrt{\frac{6\sigma^2 \lambda^2}{\pi^2 \lambda^2} + \lambda^2} - \lambda = \sqrt{\frac{6\sigma^2}{\pi^2} + \lambda^2} - \lambda.$$

Taking derivatives, we find

$$\begin{aligned} \frac{\mathrm{d}\lambda(\ell_\lambda - 1)}{\mathrm{d}\lambda} &= \frac{2\lambda}{2\sqrt{\frac{6\sigma^2}{\pi^2} + \lambda^2}} - 1 = \frac{\sqrt{\lambda^2}}{\sqrt{\frac{6\sigma^2}{\pi^2} + \lambda^2}} - 1 \\ &= \sqrt{\frac{\lambda^2 \pi^2}{6\sigma^2 + \lambda^2 \pi^2}} - 1 = \sqrt{\frac{6\sigma^2}{\pi^2 \lambda^2} + 1}^{-1} - 1 \\ &= \frac{1}{\sqrt{\ell_\lambda}} - 1 < 0, \end{aligned}$$

since $\ell_\lambda > 1$.

Now compute the change in this expected value with λ. We have that

$$
\begin{aligned}
&\frac{\partial \lambda(\ell_\lambda - 1) \log \sum_{k=1}^N \exp\left(\frac{V_{ik}+\xi_{ik}^0}{\lambda(\ell_\lambda-1)}\right)}{\partial \lambda} \\
&= \frac{\partial \lambda(\ell_\lambda - 1)}{\partial \lambda} \log \sum_{k=1}^N \exp\left(\frac{V_{ik}+\xi_{ik}^0}{\lambda(\ell_\lambda-1)}\right) \\
&+ \lambda(\ell_\lambda - 1) \frac{1}{\sum_{k=1}^N \exp\left(\frac{V_{ik}+\xi_{ik}^0}{\lambda(\ell_\lambda-1)}\right)} \sum_{n=1}^N \exp\left(\frac{V_{in}+\xi_{in}^0}{\lambda(\ell_\lambda-1)}\right) \left(\frac{\partial \lambda(\ell_\lambda - 1)}{\partial \lambda}\right) \left(-\frac{V_{in}+\xi_{in}^0}{(\lambda(\ell_\lambda-1))^2}\right) \\
&= \frac{\partial \lambda(\ell_\lambda - 1)}{\partial \lambda} \left(\log \sum_{k=1}^N \exp\left(\frac{V_{ik}+\xi_{ik}^0}{\lambda(\ell_\lambda-1)}\right) - \frac{\sum_{n=1}^N \exp\left(\frac{V_{in}+\xi_{in}^0}{\lambda(\ell_\lambda-1)}\right)\left(\frac{V_{in}+\xi_{in}^0}{\lambda(\ell_\lambda-1)}\right)}{\sum_{k=1}^N \exp\left(\frac{V_{ik}+\xi_{ik}^0}{\lambda(\ell_\lambda-1)}\right)}\right) \\
&= \frac{\partial \lambda(\ell_\lambda - 1)}{\partial \lambda} \left(\log \sum_{k=1}^N \exp\left(\frac{V_{ik}+\xi_{ik}^0}{\lambda(\ell_\lambda-1)}\right) - \sum_{n=1}^N \frac{\exp\left(\frac{V_{in}+\xi_{in}^0}{\lambda(\ell_\lambda-1)}\right)}{\sum_{k=1}^N \exp\left(\frac{V_{ik}+\xi_{ik}^0}{\lambda(\ell_\lambda-1)}\right)} \left(\frac{V_{in}+\xi_{in}^0}{\lambda(\ell_\lambda-1)}\right)\right).
\end{aligned}
$$

We can interpret the first term in the bracket as the LogSumExp (or LSE, a smooth approximation to the maximum) of the terms, and the second one as a weighted average of them. Given that the LSE is always weakly larger than the maximum, the term in the brackets must be positive. Since the first term is negative, the entire derivative is negative. We have

$$
\frac{\partial \lambda(\ell_\lambda - 1) \log \sum_{k=1}^N \exp\left(\frac{V_{ik}+\xi_{ik}^0}{\lambda(\ell_\lambda-1)}\right)}{\partial \lambda} < 0.
$$

Comparative Static 2 *The expected value of a decision with an intermediary is weakly decreasing in the intermediary bias c^I.*

In RI model This follows directly from inducing a stronger misalignment of incentives. Given the value of the intermediary

$$
U_i^I = \mathbb{E}[U_{\text{Intermediary}}] = \sum_{k=1}^N \int_{\xi_i} \xi_{ik}^I \mathcal{P}^{*,I}(\boldsymbol{\xi}_i)\ G(\mathrm{d}\boldsymbol{\xi}_i),
$$

with

$$
\mathcal{P}_{ik}^{*,I}(\boldsymbol{\xi}_i) = \mathbb{1}\big(\arg\max_k \xi_{ik}^I + c^I \mathbb{1}(k \text{ is annuity})\big),
$$

we have that as c^I increases to c_2^I, the change in the value of the expression Δ is given by realizations of $\boldsymbol{\xi}_i$ that induce different choices,

$$\boldsymbol{\xi}_i : \quad \arg\max_k \xi_{ik} + c^I \neq \arg\max_k \xi_{ik} + c_2^I.$$

The consumer can only lose in this case, since they are induced to switch from buying a higher value (ξ_{ik}) to a lower value annuity.

Given prior assumption G_λ The argument above applies. Explicitly, we can compute

$$\frac{\partial U_i^I}{\partial c^I} = \frac{\partial \sqrt{\frac{6\sigma_i^2}{\pi^2}} \log \sum_{k=1}^N \exp\left(\frac{\xi_{ik}^{0,I} + c^I \mathbb{1}(k \text{ is annuity})}{\sqrt{6\sigma_i^2/\pi^2}}\right) - \sum_{k=1}^N \mathcal{P}^{0,*,I} c^I \mathbb{1}(k \text{ is annuity})}{\partial c^I},$$

where

$$\mathcal{P}^{0,*,I} = \frac{\exp\left(\frac{\xi_{ik}^{0,I} + c^I \mathbb{1}(k \text{ is annuity})}{\sqrt{6\sigma_i^2/\pi^2}}\right)}{\sum_{j=1}^N \exp\left(\frac{\xi_{ij}^{0,I} + c^I \mathbb{1}(j \text{ is annuity})}{\sqrt{6\sigma_i^2/\pi^2}}\right)}.$$

For the first term, the standard result for the log exp formula yields

$$\frac{\partial \sqrt{\frac{6\sigma_i^2}{\pi^2}} \log \sum_{k=1}^N \exp\left(\frac{\xi_{ik}^{0,I} + c^I \mathbb{1}(k \text{ is annuity})}{\sqrt{6\sigma_i^2/\pi^2}}\right)}{\partial c^I} = \sum_{k=1}^N \mathcal{P}^{0,*,I} \mathbb{1}(k \text{ is annuity}).$$

For the second term,

$$\frac{-\sum_{k=1}^N \mathcal{P}^{0,*,I} c^I \mathbb{1}(k \text{ is annuity})}{\partial c^I} = -\sum_{k=1}^N \frac{\partial \mathcal{P}^{0,*,I}}{\partial c^I} c^I \mathbb{1}(k \text{ is annuity}) - \sum_{k=1}^N \mathcal{P}^{0,*,I} \mathbb{1}(k \text{ is annuity}).$$

The sign of the derivative is therefore determined by the term

$$-\sum_{k=1}^N \mathbb{1}(k \text{ is annuity}) \frac{\partial \mathcal{P}^{0,*,I}}{\partial c^I} = -\sum_{k \text{ is annuity}} \frac{\pi^2}{6\sigma^2} \mathcal{P}_k^{0,*,I} \left(1 - \sum_{j \text{ is annuity}} \mathcal{P}_j^{0,*,I}\right) < 0.$$

Comparative Static 3 *The demand for intermediation can increase or decrease with the prior stakes* σ_i^2.

[in progress]

C.4 Unobservable taste shock

The goal is to add a shock to the utility of each product that can be used to rationalize whatever parts cannot be explained by the life-cycle model. This is relevant given there are patterns that are hard to rationalize with unobservables – at least with the limited ones we can feasibly add into estimation. Another reason to introduce this is that the source of identification comes from the assumption that the different types of intermediaries are both "perfect" in terms of observing the true value of utility. Given this and a model without some unobserved preference shock, estimation using MLE will be challenging: for any given realization of preferences, the intermediary problem would essentially imply 1s and 0s as choice probabilities, and the likelihood will severely punish any variation that is unexplained by the model we formulated.

Here is one potential way of resolving this. We will consider two objects separately: the *prior* that the individual has about the realizations of the vector $\boldsymbol{\xi}_i$, and the distribution of the (to the econometrician) unmodelled and unobservable additive shocks to utility ϵ_i. Throughout I will use ζ_k to describe the financial utility of product k from the life-cycle model.

Recall that the assumption on the prior reads

$$\xi_k \sim \lambda \log X(\rho_p),$$

where $X(\rho)$ is a positive (or one-sided) stable distribution with parameter

$$\rho_p = \sqrt{\frac{\pi^2\lambda^2}{6\sigma_p^2 + \pi^2\lambda^2}} \in (0,1).$$

We will continue to assume this about the prior. The optimal choices of the individual therefore continue to take the optimal form

$$P_{ik} = \frac{\exp\left(\frac{V_{ik}+\xi_{ik}^0}{\lambda(\ell-1)} + \frac{V_{ik}+\xi_{ik}}{\lambda}\right)}{\sum_j \exp\left(\frac{V_{ij}+\xi_{ij}^0}{\lambda(\ell-1)} + \frac{V_{ij}+\xi_{ij}}{\lambda}\right)}.$$

We write

$$\xi_k = \zeta_k + \epsilon_k,$$

where ζ_k is the life-cycle utility and

$$\epsilon_k \sim \lambda \log X(\rho_s),$$

with

$$\rho_s = \sqrt{\frac{\pi^2\lambda^2}{6\sigma_s^2 + \pi^2\lambda^2}} \in (0,1).$$

This assumption leads to two important results

- **Closed form expected utility formulas:** as before, given the assumption on the prior ζ_i, we have that we get a closed form expression for the expected utility from making a decision by oneself. This is

$$\lambda(\ell_p - 1)\log\sum_{k\in\mathcal{J}}\exp\left(\frac{V_k + \xi_k^0}{\lambda(\ell_p - 1)}\right),$$

  with $\ell_p = \frac{1}{\rho_p}$, a function of the variance of the prior σ_p^2 and the information cost λ.

- **Closed form choice probabilities including unobserved shock:** the rational inattention solution to the problem is given by the choice probabilities

$$P_{ik}(\boldsymbol{\epsilon}_i) = \frac{\exp\left(\frac{V_k+\xi_k^0}{\lambda(\ell_p-1)} + \frac{V_k+\zeta_k+\epsilon_k}{\lambda}\right)}{\sum_{j\in\mathcal{J}}\exp\left(\frac{V_k+\xi_k^0}{\lambda(\ell_p-1)} + \frac{V_k+\zeta_k+\epsilon_k}{\lambda}\right)}.$$

  Given we do not observe the realization of the shock $\boldsymbol{\epsilon}_i$, we would like to integrate it out. We do this as follows. Take F to be the cdf of a Gumbel(0,1) distribution, and define $\ell_s = \frac{1}{\rho_s} = \sqrt{\frac{6\sigma^2}{\pi^2\lambda^2} + 1}$. Then we have, by the same trick used to derive the formula for the expected utility, and setting the mean of $\boldsymbol{\epsilon}_i$ to be zero, we have

$$\begin{aligned} P_{ik} &= \int_{\boldsymbol{\epsilon}_i} P_{ik}(\boldsymbol{\epsilon}_i)\ \mathrm{d}G(\boldsymbol{\epsilon}_i) \\ &= \int_{\boldsymbol{\epsilon}_i} \frac{\exp\left(\frac{V_{ik}+\xi_{ik}^0}{\lambda(\ell_p-1)} + \frac{V_{ik}+\zeta_{ik}+\epsilon_{ik}}{\lambda}\right)}{\sum_{j\in\mathcal{J}}\exp\left(\frac{V_{ij}+\xi_{ij}^0}{\lambda(\ell_p-1)} + \frac{V_{ij}+\zeta_{ij}+\epsilon_{ij}}{\lambda}\right)}\ \mathrm{d}G(\boldsymbol{\epsilon}_i) \\ &= \int_{\boldsymbol{\epsilon}_i,\boldsymbol{e}_i} \mathbb{1}\left(\arg\max_{j\in\mathcal{J}}\frac{V_{ij}+\xi_{ij}^0}{\lambda(\ell_p-1)} + \frac{V_{ij}+\zeta_{ij}-\lambda(\ell_s-1)\gamma+\epsilon_{ij}^s}{\lambda} + e_{ij} = k\right)\ \mathrm{d}G(\boldsymbol{\epsilon}_i)\ \mathrm{d}F(\boldsymbol{e}_i), \end{aligned}$$

  where we define ϵ_{ij}^s to be the λ times the log of a positive stable distribution with parameter ρ_s (note the adjustment we need to do on the means, as this distribution needs to have mean $(\ell_s - 1)\gamma$, where γ is the mathematical constant). The distributional assumption then implies

$$\begin{aligned}
P_{ik} &= \int_{\mathbf{f}_i} \mathbb{1}\left(\arg\max_{j\in\mathcal{J}} \frac{V_{ij}+\xi^0_{ij}}{\lambda(\ell_p-1)} + \frac{V_{ij}+\zeta_{ij}-\lambda(\ell_s-1)\gamma}{\lambda} + \ell_s f_{ij} = k\right)\, \mathrm{d}F(\mathbf{f}_i) \\
&= \int_{\mathbf{f}_i} \mathbb{1}\left(\arg\max_{j\in\mathcal{J}} \frac{V_{ij}+\xi^0_{ij}}{\lambda(\ell_p-1)\ell_s} + \frac{V_{ij}+\zeta_{ij}-\lambda(\ell_s-1)\gamma}{\lambda\ell_s} + f_{ij} = k\right)\, \mathrm{d}F(\mathbf{f}_i) \\
&= \frac{\exp\left(\frac{V_{ik}+\xi^0_{ik}}{\lambda(\ell_p-1)\ell_s} + \frac{V_{ik}+\zeta_{ik}-\lambda(\ell_s-1)\gamma}{\lambda\ell_s}\right)}{\sum_{j\in\mathcal{J}} \exp\left(\frac{V_{ij}+\xi^0_{ij}}{\lambda(\ell_p-1)\ell_s} + \frac{V_{ij}+\zeta_{ij}-\lambda(\ell_s-1)\gamma}{\lambda\ell_s}\right)} \\
&= \frac{\exp\left(\frac{V_{ik}+\xi^0_{ik}}{\lambda(\ell_p-1)\ell_s} + \frac{V_{ik}+\zeta_{ik}}{\lambda\ell_s}\right)}{\sum_{j\in\mathcal{J}} \exp\left(\frac{V_{ij}+\xi^0_{ij}}{\lambda(\ell_p-1)\ell_s} + \frac{V_{ij}+\zeta_{ij}}{\lambda\ell_s}\right)}.
\end{aligned}$$

Discussion of assumption By the same arguments as outlined above, the assumption that allows for closed form probabilities for both intermediated and non-intermediated retirees requires that the shape of the distribution of the unobserved shocks to utilities ϵ_{ik} changes both *within* non-intermediated retirees and *across* intermediation channels. Indeed, what we require is

- For a non-intermediated retiree with information cost λ_i, ϵ_{ik} is drawn from

$$\lambda_i \log X(\rho_i), \qquad \sqrt{\frac{\pi^2\lambda_i^2}{6\sigma^2+\pi^2\lambda_i^2}}.$$

- For an intermediated retiree, ϵ_{ik} is drawn from a Gumbel distribution with variance σ^2.

The assumption therefore effectively introduces an arguably arbitrary mechanism through which retirees are differentiated, which may additionally affect their incentives for seeking out intermediation. Given the shocks are assumed to be welfare relevant, their introduction induces a difference in the average utility obtained from products when they are purchased through an intermediary.

In counterfactuals, I account for the potential change in consumer welfare due to the change in the shape of the distribution. For a given individual, I "transform" draws of the shock across product from the adequate log positive stable distribution to a Gumbel (or viceversa) using empirical quantiles of the distributions. This transformation allows me to retain the "relative size" of the shocks and preserve the optimal product choice across counterfactuals to the best extent. Indeed, only 3.5% of the simulated sample (8% of those intermediated) changes the optimal product in the counterfactual, including those for which this may optimally arise due to the commission structure of intermediaries. As seen in the main text (e.g. Table 7), the welfare effects from the shock adjustment are small across the considered counterfactuals.

Finding the right distribution for ξ_i One could want ensure that it is possible to assume that the distribution of ζ_i, ϵ_i and ξ_i are internally consistent. That is, that given the distributions on ξ_i and ϵ_i we assume in order to get the closed form solutions outlined above, we can find a distribution for the ζ_i that makes these two "fit". In other words, we want to find

$$\zeta_k + \varepsilon_k \sim \xi_k,$$

where $\varepsilon_k \sim \lambda \log X(\rho_s)$ shifted to have mean zero, $\xi_k \sim \lambda \log X(\rho_p)$ shifted to have mean ξ_k^0, and $X(p)$ is a positive (or one-sided) stable distribution with parameter $p \in (0,1)$. As before, we set these parameters to be

$$\rho_p = \sqrt{\frac{\pi^2\lambda^2}{6\sigma_p^2 + \pi^2\lambda^2}}, \qquad \rho_s = \sqrt{\frac{\pi^2\lambda^2}{6\sigma_s^2 + \pi^2\lambda^2}}.$$

By matching the means, we must have ζ_k have mean equal to ξ_k^0. Recognizing that we can nonetheless correct for the means by shifting the resulting distributions appropriately, assume ε_k and ξ_k are non-shifted (but scaled by λ) log positive stable distributions, which implies their variance is given precisely by σ_p^2 and σ_s^2, and the means by

$$\mu_p = \lambda \left(\frac{1}{\rho_p} - 1\right)\gamma, \qquad \mu_s = \lambda \left(\frac{1}{\rho_s} - 1\right)\gamma.$$

Consider now $\zeta_k' = \frac{\zeta_k}{\lambda}$. We are then looking for a random variable Z_F with distribution F such that

$$Z_F + \log X(\rho_s) \sim \log X(\rho_p).$$

To find this distribution, we use Lemma 2.2 in Cardell (1997) or Remark 2 in Galichon (2021), which state that

$$\rho_2\rho_1 \log X(\rho_1) + \rho_2 \log X(\rho_2) \sim \rho_2\rho_1 \log X(\rho_2\rho_1).$$

Multiplying by $\frac{1}{\rho_2\rho_1}$, we get

$$\log X(\rho_1) + \frac{1}{\rho_1}\log X(\rho_2) \sim \log X(\rho_2\rho_1).$$

Therefore, the distribution we are looking for is $\frac{1}{\rho_s}\log X(\frac{\rho_p}{\rho_s})$.

As an aside, it turns out the same distribution $\eta \log X(\rho)$ will be the conjugate – in the sense of Cardell (1997) – of both a Gumbel distribution $\mathcal{G}(0,\eta)$ and a log positive stable $\log X\left(\frac{1}{\eta}\right)$. That is, scaling a log positive stable yields the unique distribution that (in general) preserves *both* the Gumbel and the log positive stable families. That is, for $\eta > 1$ and $\rho \in (0,1)$,

$$\eta \log X(\rho) + \mathcal{G}(0,\eta) \sim \mathcal{G}\left(0, \frac{\eta}{\rho}\right), \quad \eta \log X(\rho) + \log X\left(\frac{1}{\eta}\right) \sim \log X\left(\frac{\rho}{\eta}\right).$$

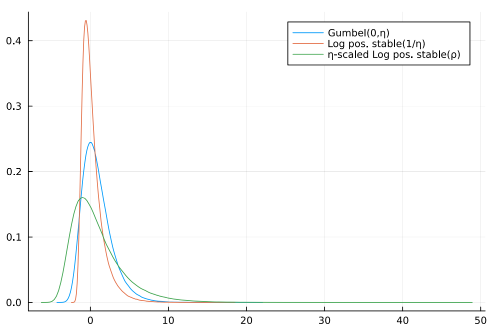
More generally, for $\kappa < \eta$, we get

$$\eta \log X(\rho) + \kappa \log X\left(\frac{\kappa}{\eta}\right) \sim \kappa \log\left(\frac{\kappa\rho}{\eta}\right),$$

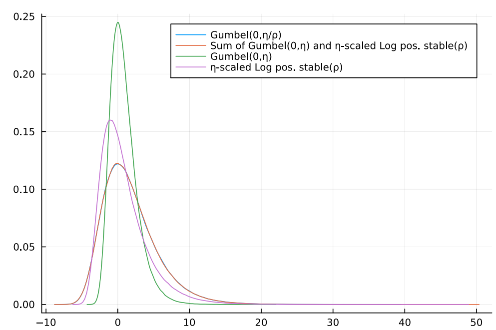
which links this again to Remark 2 in Galichon (2021) with $\eta = \rho_2$, $\rho = \rho_2$ and $\kappa = \rho_1\rho_2$.

For preserving the Gumbel distribution we see that $\eta \in (0, \infty)$ – in particular $0 < \eta < 1$ – is valid as well.

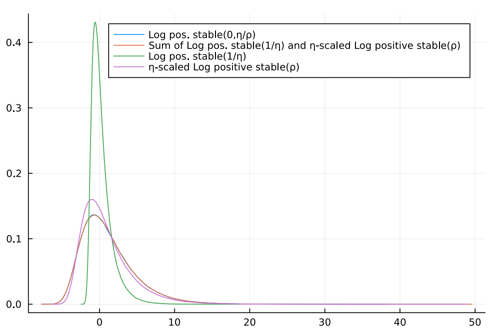
Figure C.38 shows the conjugate property of the scaled log positive stable distribution, sampled using the algorithm proposed in Kanter (1975) (see also section C.2). (a) shows an example for the two distributions that have the same conjugate – a Gumbel with scale η and a log positive stable with parameter $1/\eta$. The conjugate is an η-scaled log positive stable with parameter[80] ρ. Its distribution-preserving property can be seen in (b) for the Gumbel and in (c) for the log positive stable distribution. Finally, in (d) we see that this also applies to another scaled log positive stable distribution, where the scaling factor $k < \eta$.



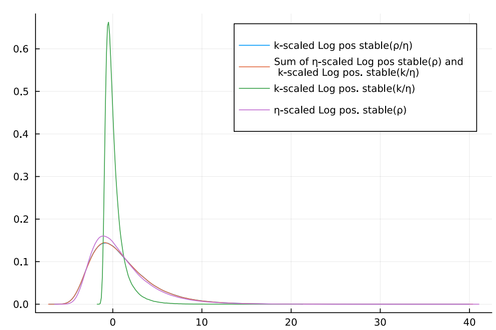
(a) Gumbel, log pos stable and conjugate



(b) Gumbel and conjugate



(c) Log pos stable and conjugate



(d) Scaled log pos stable and conjugate

Figure C.38: Conjugate property of the scaled log pos. stable distribution

[80]Note that one can choose $\rho \in (0, 1)$. One can find infinite ways of dividing a Gumbel as a sum of a scaled log pos stable and another Gumbel: this is what generates the nested logit. Similarly, one also repeat the same procedure for any log positive stable. Finally, it follows that one can also repeat the same procedure for a scaled log pos stable, which is self-conjugate.

C.5 Assumptions on prior for estimation

Benchmark The benchmark prior assumption is that retirees are ex-ante completely uninformed about which of the pension products is optimal/higher value for them. I assume that they are aware of the *stakes* in the decision captured through the prior variance σ^2, which reflects the true underlying variance in the pension product utilities (including the unobserved shock). I assume that the prior means are the same across prior dimensions

$$\xi_{ik}^0 = c_i = \frac{1}{N}\sum_{k=1}^{N} \xi_{ik}, \qquad \sigma_{ik}^2 = (1+\alpha_{\sigma_i^2})\frac{1}{N}\sum_{k=1}^{N}(\xi_{ik} - c_i)^2.$$

The disadvantage of this assumption is that it eliminates any selection based on pure taste for products into intermediaries. Preferences therefore only affect individuals' choice of intermediation through the "stakes" involved in the decision. An additional disadvantage comes from the independence of the realizations across the different dimensions of the prior. It could be reasonable to assume that retirees would have a notion of how values of similar pension products are correlated given preferences. For example, learning about a 10-year guarantee could be informative about the value of a 15- or 20-year guarantee.

Informed prior An alternative to the benchmark is to set the prior means to the life-cycle utility value of each pension product, and the variance to be given by that of the unobserved shock.

$$\xi_{ik}^0 = \zeta_{ik}, \qquad \sigma_{ik}^2 = \alpha_{\sigma^2}\frac{1}{N}\sum_{k=1}^{N}(\xi_{ik} - \xi_{ik}^0)^2.$$

This assumption induces the *maximum* level of prior information about each pension product that the model an accommodate in estimation, as the unobserved shock is necessary for the SMLE procedure to work. Note that this prior corresponds to a version of *rational expectations* with respect to the realizations in the population of individuals.

Estimation of this prior can be done in a very similar routine to the benchmark one, accounting for the impact on both choice probabilities and the expected utility of intermediation.

Hybrid prior A compromise between the "informed" and flat prior in the benchmark is a hybrid prior that allows for uncertainty beyond the shock. One natural way of introducing this is in terms of the unobserved preference parameters of the life-cycle model. Essentially, this accounts for assuming that the retiree's uncertainty about pension products is captured by their beliefs about the probability of each preference "type". This uncertainty can in turn reflect either not knowing their own type or how the product characteristics map into it. Once again, in order to allow for estimation using SMLE under the identifying assumption for intermediaries choosing without any costs of information, I allow for an unobserved shock to preferences.

Denote each combination of unobserved preference parameters as $d \in D$, each with probability p_d. Suppose then that the prior distribution of values can be described as – defining $\mathrm{LPS}(\xi_k^0, \sigma^2, \lambda)$ as the scaled log positive stable prior with mean ξ_k^0 and variance σ^2 that gives a closed form given an information cost λ–

$$G_\lambda(\xi_k) = \sum_{d\in D} p_d \mathrm{LPS}(\xi_{kd}^0, \sigma_d^2, \lambda),$$

essentially a linear combination of different priors, each of them for a realization of the preferences. The formulation is made to be flexible enough to represent one desirable case, which would be being able to set those prior means to the actual values ξ_{kd}, the variance tagged to the variance in that state of the world d. Note that the prior then captures a version of rational expectations.

We know from Corollary 1 in Matejka and McKay (2015) that we can write the RI problem as

$$\begin{aligned}
&\max_{\mathcal{P}_1^0,\dots,\mathcal{P}_N^0} \int_{\xi_k} \sum_{d\in D} p_d \lambda \log\left(\sum_{k=1}^N \mathcal{P}_k^0 \exp\left(\frac{\xi_k}{\lambda}\right)\right) \, d\mathrm{LPS}(\xi_{kd}, \sigma_d^2, \lambda),\\
&\text{s.t. } \forall k \quad \mathcal{P}_k^0 \geq 0, \qquad \sum_{k=1}^N \mathcal{P}_k^0 = 1.
\end{aligned}$$

We can solve for this either by maximizing this function directly using a non-linear solver, or using the iterative Blahut-Arimoto algorithm to get at the solution. If we have to discretize the shock distribution, this would be computationally costly.

Following similar arguments to those in section C.1.1, the optimal solution should be interior. Then we can repeat the steps of the proof of the closed form for the log positive stable prior following in Brown and Jeon (2023) or C.1.1 to get an equivalent formulation of the problem given by

$$\max_{\mathcal{P}_1^0,\dots,\mathcal{P}_N^0} \sum_{d\in D} p_d \lambda \ell_d \log\left(\sum_{k=1}^N \left(\mathcal{P}_k^0\right)^{\frac{1}{\ell}} \exp\left(\frac{\xi_{kd}}{\lambda \ell_d}\right)\right).$$

This expression accounts for the unobservable preference shocks, and it can be used in the Blahut-Arimoto algorithm. The iteration steps starting from a guess for the $\{\mathcal{P}_k^{0,G_1}\}$. Given a value ξ_{kd} in state d, the optimal choice probability reads

$$\mathcal{P}^{G_1}(\xi_{kd}) = \frac{\left(\mathcal{P}_k^{0,G_1}\right)^{\frac{1}{\ell_d}} \exp\left(\frac{\xi_{kd}}{\lambda \ell_d}\right)}{\sum_{j=1}^N \left(\mathcal{P}_j^{0,G_1}\right)^{\frac{1}{\ell_d}} \exp\left(\frac{\xi_{kd}}{\lambda \ell_d}\right)},$$

where we can verify that the integration works out by reproducing the argument made for the prior in section C.4. Then we can integrate these to get a new guess for the unconditional choice probabilities

$$\mathcal{P}_k^{0,G_2} = \sum_{d\in D} p_d \mathcal{P}^{G_1}(\xi_{kd}),$$

and iterate to convergence. In estimation, one approach is to make the beliefs about the probability p_d of each state $d \in D$ be the population one.

C.6 Introducing heterogeneity in risk aversion

The unobserved preferences in the life-cycle model – mortality shifter m, bequest motives δ_{beq} and wealth outside pension savings w_0 – can be generally understood as not shifting the scale of utility. Utility can be understood in terms of consumption units (and the equivalent valuation of bequests).[81] Allowing for risk aversion breaks this, since it changes the relative "units" in which utility is measured across different individuals. It therefore poses a challenge for the interpretation of the parameters of the model, information costs λ_i and stakes σ_i^2 that depend on the level of utility, as well as the bias of the intermediary c^I.

An alternative formulation that allows us to circumvent that problem is to write the utilities in terms of *wealth equivalents*. A wealth equivalent would be defined as the initial level of wealth w_k that provides exactly the same level of consumption and bequest utility as the consumption/bequest streams implied by a pension product. That is, denoting ζ_k as the utility derived from a product k, we have w_k defined implicitly by

$$
\begin{aligned}
\zeta_k \overset{!}{=} \max_{\{c_t, a_t\}_{t=0}^{T}} \; & \mathbb{E}_{d_t}\left[\sum_{t=0}^{T} \beta^t u(c_t, f_t | s_t, d_t)\right] \\
\text{s.t.} \quad & a_t = m_t - c_t, \qquad m_{t+1} = a_t R, \\
& f_{t+1} = a_t R, \qquad a_t \geq 0 \quad \forall t, \\
& m_0 = w_0 + \mathbf{w_k}.
\end{aligned}
$$

By writing the problem in these terms, we normalize the unit of utility to dollars, or *relative* dollars by fixing a product of reference, for example, the Phased Withdrawal. This then allows for comparisons across individuals that account for differences in risk aversion while still capturing an adequate notion of scale and "stakes".

[81] However, this formulation still differentiates marginal utilities, which impacts the "stakes" of the decision when expressed in terms of relative pension payments, as in the main text.

C.7 Insurance company choice

For an individual i who has chosen an annuity k as their pension product, I model the choice across different insurance companies $j \in J_k$. An annuity k offered by an insurance company j is characterized by its financial characteristics ξ_{ijk} – payments while alive, and bequest left at time of death – and their non-financial value v_{ijk}. The choice is given by

$$u_{ijk} = \xi_{ijk} + v_{ijk} + \varepsilon_{ijk}, \tag{7}$$

where ε_{ijk} is an unobserved, idiosyncratic EV(I) shock.

As argued before, the financial value of an annuity can be hard for an individual to readily understand. I therefore write the value of annuity k offered by insurance company j as

$$\xi_{ijk} = \bar{\xi}_{ik} + (\xi_{ijk} - \bar{\xi}_{ik}),$$

where $\bar{\xi}_{ik}$ denotes the average value of all annuities of type k. I assume that $\bar{\xi}_{ik}$ is *costly to observe*: consumers must exert mental "effort" – gathering information, studying alternatives, or simply dealing with stress – in order to "understand" its value. I also assume that $\xi_{ijk} - \bar{\xi}_{ik}$ is costlessly observable. The assumption is reasonable in the Chilean setting: the implication is that comparing the payouts of different insurance companies for the same annuity type is simple, while figuring out *the right annuity* is complex[82]

These assumptions on the structure of utility lead to two useful implications. Assuming the shock ε_{ijk} follows an EV(I) distribution, the probability of individual i choosing offer from company j is given by

$$p_{ijk} = \frac{\exp\left(v_{ijk} + \bar{\xi}_{ik} + (\xi_{ijk} - \bar{\xi}_{ik})\right)}{\sum_{n \in J_k} \exp\left(v_{ink} + \bar{\xi}_{ik} + (\xi_{ink} - \bar{\xi}_{ik})\right)} = \frac{\exp\left(v_{ijk} + \xi_{ink} - \bar{\xi}_{ik}\right)}{\sum_{n \in J_k} \exp\left(v_{ink} + \xi_{ink} - \bar{\xi}_{ik}\right)}, \tag{8}$$

since ξ_{ik} is common to all offers and we do not allow for an outside option[83]. This implies that the individuals' choices at this stage do not depend on ξ_{ik}, which means their choices are internally consistent and well defined even if – as will be the case in this framework – they *never learn the true value* of ξ_{ik}. It is also useful for empirical tractability.

Second, the ex-ante (before the realization of the EV(I) shock) utility of selecting pension product k is given by

$$\begin{aligned} \log \sum_{j \in J_k} \exp(v_{ijk} + \xi_{ijk}) &= \log \sum_{j \in J_k} \exp(\bar{\xi}_{ik}) \exp(v_{ijk} + \xi_{ijk} - \bar{\xi}_{ik}) \\ &= \bar{\xi}_{ik} + \log \sum_{j \in J_k} \exp(v_{ijk} + \xi_{ijk} - \bar{\xi}_{ik}) =: \xi_{ik} + V_{ik}. \end{aligned}$$

This allows me to write the utility for the pension product in an additive form and in terms of an observ-

[82]The assumption is in line with the intermediaries' description on their role (see footnote 41), as well as with the general design of the *Offer Certificate* (see Figure 2).

[83]Once individual i has chosen annuity k, they must choose one of the available $j \in J_k$.

able and unobservable component.

Pension product choice With an observable part of utility, the problem of the consumer reads

$$\max_{\{\mathcal{P}_{ik}(\boldsymbol{\xi}_i)\}_{k=1}^N} \left(\sum_{k=1}^N \int_{\boldsymbol{\xi}_i} (V_{ik} + \xi_{ik}) \mathcal{P}_{ik}(\boldsymbol{\xi}_i) G(\mathrm{d}\boldsymbol{\xi}_i) \right) - \lambda_i \kappa(\mathcal{P}_i, G), \tag{9}$$

$$\text{s.t.} \quad \mathcal{P}_{ik}(\boldsymbol{\xi}_i) \geq 0 \; a.s., \qquad \sum_{k=1}^N \mathcal{P}_{ik}(\boldsymbol{\xi}_i) = 1 \; a.s.,$$

where as before $\kappa(\cdot)$ is the mutual information cost written in terms of the discrete actions,

$$\kappa(\mathcal{P}_i) = \left[-\sum_{k=1}^N \mathcal{P}_{ik}^0 \log \mathcal{P}_{ik}^0 + \int_{\boldsymbol{\xi}_i} \left(\sum_{k=1}^N \mathcal{P}_{ik}(\boldsymbol{\xi}_i) \log \mathcal{P}_{ik}(\boldsymbol{\xi}_i) \right) G(\mathrm{d}\boldsymbol{\xi}_i) \right], \tag{10}$$

and $\mathcal{P}_{ik}^0$ is the *unconditional* or ex-ante probability of choosing k,

$$\mathcal{P}_{ik}^0 = \int_{\boldsymbol{\xi}_i} \mathcal{P}_{ik}(\boldsymbol{\xi}_i) G(\mathrm{d}\boldsymbol{\xi}_i).$$

Under the prior assumption, we have that the choice probabilities read

$$\mathcal{P}_{ik}^*(\boldsymbol{\xi}_i) = \frac{\exp\left(\frac{V_{ik}+\xi_{ik}}{\lambda_i} + \frac{V_{ik}+\xi_{ik}^0}{\lambda_i(\ell_{\lambda_i,\sigma_i^2}-1)} \right)}{\sum_{n=1}^N \exp\left(\frac{V_{in}+\xi_{in}}{\lambda_i} + \frac{V_{in}+\xi_{in}^0}{\lambda_i(\ell_{\lambda_i,\sigma_i^2}-1)} \right)}, \quad \ell_{\lambda_i,\sigma_i^2} = \sqrt{\frac{6\sigma^2}{\lambda^2\pi^2} + 1}.$$

Choice under sales agent The choice under the sales agent is similar to the one under the pension advisor: they eliminate information costs, but charge a commission which is discounted from certain products and therefore potentially leads the retiree to choose suboptimally. One change distinguishes the sales agent from the pension advisor: the sales agent is not only biased towards certain products, but towards an insurance company in particular.

When choosing an insurance company, a retiree intermediated by an agent of insurance company h will choose according to the indirect utility

$$u_{ijk}^{SA} = \xi_{ijk}^{SA} + \Delta \mathbb{1}_{j=h} + v_{ijk} + \varepsilon_{ijk},$$

where ξ_{ijk}^{SA} accounts for the commission payments, and Δ is the bias introduced by the agent towards their company[84]. Defining p_{ihk} as the probability of choosing insurance company h, the *ex-ante* utility from product k reads

$$V_{ik}^{SA} + \bar{\xi}_{ik}^{SA} + p_{ihk}\Delta.$$

[84]The bias might come from the sales agent overselling certain aspects of their insurance company, as well as from a perceived cost by the individual to refuse to follow the agent's advice.

The problem solved with the agent is then

$$\max_{\{\mathcal{P}_{ik}(\boldsymbol{\xi}_i)\}_{k=1}^N} \left(\sum_{k=1}^{N} \int_{\boldsymbol{\xi}_i} (V_{ik}^{SA} + \bar{\xi}_{ik}^{SA} + p_{ihk}\Delta + c_k^{SA}) \mathcal{P}_{ik}(\boldsymbol{\xi}_i) G(\mathrm{d}\boldsymbol{\xi}_i) \right)$$
$$\text{s.t.} \quad \mathcal{P}_{ik}(\boldsymbol{\xi}_i) \geq 0 \; a.s., \qquad \sum_{k=1}^{N} \mathcal{P}_{ik}(\boldsymbol{\xi}_i) = 1 \; a.s.,$$

with solution

$$\mathcal{P}_{ik}^{*,SA}(\boldsymbol{\xi}_i) = \mathbb{1}(\arg\max_k V_{ik}^{SA} + \bar{\xi}_{ik}^{SA} + p_{ihk}\Delta + c_k^{SA}).$$

Note once again that the utility from the choice derived by the retiree is $V_{ik}^{SA} + \bar{\xi}_{ik}^{SA}$, highlighting the potential distortions from misaligned incentives.

Estimation For estimation, I group insurance companies into three categories $g \in \{0, 1, 2\}$ based on their risk rating[85]. I then model their non-financial utility v_{ijk} as a multiplicative factor on the financial value $p_g \cdot \xi_{ijk}$.

[85] Anecdotally, the risk rating groupings are also a good approximation for the type of firms: AA+ or AA rated companies are larger and spread more widely.

D Life-cycle model

D.1 Solution concept

This section generally follows Illanes and Padi (2021), with some notational changes.

Recall the problem of the consumer is given by

$$\max_{\{c_t,a_t\}_{t=0}^{T}} \mathbb{E}_{d_t}\left[\sum_{t=0}^{T}\beta^t u(c_t, f_t|s_t, d_t)\right] \tag{11}$$
$$\text{s.t.} \quad a_t = m_t - c_t, \qquad m_{t+1} = a_t R + p_{ijk}^{t+1},$$
$$f_{t+1} = a_t R + b_{ijk}^{t+1}, \qquad a_t \geq 0 \quad \forall t,$$
$$m_0 = w_0,$$

where c_t denotes consumption, f_t implied bequests, a_t savings, m_t money in the bank, p^t the pension products' payment and b^t the incidental bequests if the individual dies in period t. Recall also

$$u(c_t, f_t|s_t, d_t) = \begin{cases} \frac{c_t^{1-\gamma}}{1-\gamma} & \text{if } s_t = 1, \\ \delta_{\text{beq}}\left(\frac{f_t^{1-\gamma}}{1-\gamma}\right) & \text{if } d_t = 1, \\ 0 & \text{otherwise.} \end{cases}$$

The mortality process is governed by d_t,

$$d_t = \begin{cases} 1 & \text{w/ prob. } \mu_t \\ 0 & \text{otherwise,} \end{cases}$$

where $\{\mu_t\}_{t=0}^{T}$ is the vector of death probabilities at every t.

Let $s_t \in \{0, 1\}$ describe whether the retiree is alive or dead at period t. The variable evolves according to d_t

$$s_t = \begin{cases} 1 & \text{if } s_{t-1} = 1 \text{ and } d_t = 0, \\ 0 & \text{otherwise.} \end{cases}$$

We solve the problem by backwards induction. By assumption, the probability of death at period T is 1. Utility is therefore given by

$$V_T(f_T) = \delta_{\text{beq}}\frac{f_T^{1-\gamma}}{1-\gamma}.$$

In the next to last period, if the individual is alive, we have

$$
\begin{aligned}
V_{T-1}(m_{T-1}, b^T) = &\max_{c_{T-1}} \frac{c_{T-1}^{1-\gamma}}{1-\gamma} + \beta\delta_{\text{beq}} \frac{\left((m_{T-1} - c_{T-1}) \cdot R + b_T\right)^{1-\gamma}}{1-\gamma}, \\
&\text{s.t.} \quad c_{T-1} \leq m_{T-1}.
\end{aligned}
\tag{12}
$$

Solving for the optimal policy yields,

$$
c_{T-1}^{-\gamma} \geq \beta\delta_{\text{beq}} R \cdot \left((m_{T-1} - c_{T-1}) \cdot R + b^T\right)^{-\gamma},
$$

$$
c_{T-1}(m_{T-1}, b_T) = \min \left\{ m_{T-1}, \frac{m_{T-1}R + b^T}{(\beta\delta_{\text{beq}}R)^{\frac{1}{\gamma}} + R} \right\}.
$$

We can then plug this into (12) to obtain $V_{T-1}(m_{T-1}, b^T)$. Note the optimal policy is *kinked*: for a low enough value of m_{T-1}, the retiree consumes all their current wealth. Solving for this cutoff yields

$$
\underline{m}_{T-1} = \frac{b_T}{\left(\beta\delta_{\text{beq}} R\right)^{\frac{1}{\gamma}}}.
$$

Note also that by the Envelope Theorem, we have that for $m \geq \underline{m}_{T-1}$, the marginal utility of additional wealth is given by

$$
V'_{T-1}(m, b^T) = c_{T-1}(m, b_T)^{-\gamma},
$$

since the FOC holds with equality. Notice that this is also true for $m < \underline{m}_{T-1}$: the consumer is not saving, so the marginal utility of additional wealth is the marginal utility of consumption. Hence,

$$
V'_{T-1}(m_{T-1}, b^T) = c_{T-1}(m_{T-1}, b_T)^{-\gamma}
$$

is a continuous function.

For a general period $t < T - 1$, the consumer solves

$$
\begin{aligned}
V_t(m_t, \{p^t, b^t\}_{t+1}^T) = &\max_{c_t, a_t} \frac{c_t^{1-\gamma}}{1-\gamma} + \beta \left(\mu_{t+1}\delta_{\text{beq}} \frac{(f_{t+1})^{1-\gamma}}{1-\gamma} + (1-\mu_{t+1}) V_{t+1}\left(m_{t+1}, \{p^t, b^t\}_{t+2}^T\right) \right). \\
&\text{s.t.} \quad a_t \geq 0, \\
&m_{t+1} = a_t \cdot R + p^{t+1}, \\
&f_{t+1} = a_t \cdot R + b^{t+1}.
\end{aligned}
$$

Following Jappelli and Pistaferri (2017), Chapter 5, we can show that this problem can be solved using the same recursion as one without the liquidity constraint. Omitting function arguments for ease of notation, we have

$$c_t^{-\gamma} - \beta R\Big(\mu_{t+1}\,\delta_{\text{beq}}\,f_{t+1}^{-\gamma} + (1-\mu_{t+1})V_{t+1}'(m_{t+1},\cdot)\Big) \geq 0. \tag{13}$$

We can write the derivative of the value function as

$$\begin{aligned}V_t(m_t,\cdot)' = c_t'(m_t,\cdot)\bigg(c_t(m_t,\cdot)^{-\gamma} - \beta R\Big[\mu_{t+1}\,\delta_{\text{beq}}\,f_{t+1}^{-\gamma} + (1-\mu_{t+1})V_{t+1}'(m_{t+1},\cdot)\Big]\bigg)\\ + \beta R\Big(\mu_{t+1}\,\delta_{\text{beq}}\,f_{t+1}^{-\gamma} + (1-\mu_{t+1})V_{t+1}'(m_{t+1},\cdot)\Big).\end{aligned}$$

Note that if the constraint $a_t = 0$ does not bind, the Envelope Theorem holds: the FOC binds with equality, and therefore

$$\begin{aligned}V_t(m_t,\cdot)' &= \beta R\Big(\mu_{t+1}\,\delta_{\text{beq}}\,f_{t+1}^{-\gamma} + (1-\mu_{t+1})V_{t+1}'(m_{t+1},\cdot)\Big)\\ &= c_t(m_t,\cdot)^{-\gamma}.\end{aligned}$$

If the constraint binds, then it must be that every unit of additional wealth is consumed, we therefore still have

$$V_t(m_t,\cdot)' = c_t(m_t,\cdot)^{-\gamma}.$$

Recursively, this implies that the solution to the problem can be written as a cutoff decision based on a $\bar{m}_t$ for which the FOC in (13) holds with equality at $c_t = \bar{m}_t$,

$$\bar{m}_t^{-\gamma} = \beta R\Big(\mu_{t+1}\,\delta_{\text{beq}}\,\Big(b^{t+1}\Big)^{-\gamma} + (1-\mu_{t+1})V_{t+1}'(p^{t+1},\cdot)\Big).$$

We then have

$$c_t(m_t,\cdot) = \begin{cases} m_t & \text{if } m_t < \bar{m}_t,\\ c_t^*(m_t,\cdot) & \text{otherwise,}\end{cases}$$

where $c_t^*(m_t,\cdot)$ solves (13) with equality. We can then recursively verify that the value function is continuously differentiable with respect to m, and therefore the solution based on the FOC valid.

D.2 Solution with binding constraints

In practice, to solve this, I use the Endogenous Gridpoint Method (Carroll, 2006). Intuitively, rather than spanning a grid of current assets m_t and finding the optimal consumption decision c_t to it – which involves a costly root finding to solve (13) – one can instead find a grid of possible *savings* decisions a_t and find the wealth level m_t for which this savings decision is optimal by using the FOC.

For a given a_t, we have

$$\begin{aligned} m_{t+1} &= a_t \cdot R + p^{t+1}, \\ f_{t+1} &= a_t \cdot R + b^{t+1}, \\ c_t &= \left(\mu_{t+1}\, \delta_{\text{beq}}\, f_{t+1}^{-\gamma} + (1-\mu_{t+1}) V'_{t+1}(m_{t+1}, \cdot)\right)^{-\frac{1}{\gamma}}, \\ m_t &= c_t + a_t. \end{aligned}$$

We can use this to obtain the value function and its derivative at a wealth level m_t,

$$\begin{aligned} V'_t(m_t, \cdot) &= c_t(m_t, \cdot)' = c_t^{-\gamma}, \\ V_t(m_t, \cdot) &= \frac{c_t^{1-\gamma}}{1-\gamma} + \beta R \left(\mu_{t+1}\delta_{\text{beq}} \frac{(f_{t+1})^{1-\gamma}}{1-\gamma} + (1-\mu_{t+1}) V_{t+1}(m_{t+1}, \cdot)\right). \end{aligned}$$

By setting $a_t = 0$, we can find the cutoff level $\bar{m}_t$ at which the constraint binds, but the FOC holds with equality. For any $m_t < \bar{m}_t$, we therefore have

$$\begin{aligned} a_t &= 0, \\ m_{t+1} &= p^{t+1}, \\ f_{t+1} &= b^{t+1}, \\ c_t &= m_t, \\ V'_t(m_t, \cdot) &= c_t^{-\gamma}, \\ V_t(m_t, \cdot) &= \frac{m_t^{1-\gamma}}{1-\gamma} + \beta R \left(\mu_{t+1}\delta_{\text{beq}} \frac{(f_{t+1})^{1-\gamma}}{1-\gamma} + (1-\mu_{t+1}) V_{t+1}(m_{t+1}, \cdot)\right). \end{aligned}$$

This allows us to construct an approximation to both V'_t and V_t that accounts for the constraint binding. By interpolating these functions across m_t we can therefore repeat this step for period $t-1$, and recursively derive the life-cycle value of the product

$$\zeta_{ik} = V_0(w_0; \{\mu_t\}_{t=1}^{T}, \delta_{\text{beq}})$$

Algorithm

1. Solve for V_{T-1} and V'_{T-1} explicitly as seen for (12) above.

2. Using V_{T-1} and V'_{T-1}, solve for V_{T-2} and V'_{T-2} on a grid for a_{T-2} given by $[0, \bar{a}_{T-2}]$, where $\bar{a}_{T-2}$ denotes the maximum level of wealth attainable by the consumer at period $T-2$

$$\bar{a}_{T-2} = R^{T-2} w_0 + \sum_{t=0}^{T-2} R^{T-2-t} p^t.$$

   This implies a grid for m_t, with its lowest point corresponding to $\bar{m}_{T-2}$.

3. Solve for V_{T-2} and V'_{T-2} on a grid for m_{T-2} given by $[p^{t-2}, \bar{m}_{T-2}]$
4. Interpolate V_{T-2} and V'_{T-2} across the implied grid for m_{T-2}.
5. Repeat steps 2-4 until period 0, using the interpolated values for V_{t+1} and V'_{t+1} at every step.

D.3 Solution in unconstrained case

The EGM is efficient and quick when accounting for the borrowing constraint is necessary in the optimization (i.e. when the retiree would otherwise optimally choose to borrow). Intuitively, retirees without taste for bequests (δ_{beq}), or those with low survival expectations and products that guarantee incidental bequests – such as the Phased Withdrawal or guaranteed annuities – could find it optimal to borrow in an unconstrained problem.

If the FOCs hold with equality throughout, we can use an alternative algorithm following Einav, Finkelstein, and Schrimpf (2010). Instead of solving the full backwards induction, we can write the problem as a maximization in terms of the initial consumption value c_0, using the FOC to derive the implied consumption and incidental bequest path.

Formally, define φ_t as the Lagrange multiplier when the first order conditions hold with equality

$$\beta^t(1-\mu_t)c_t^{-\gamma} = \varphi_t \quad \forall t \in \{0, 1, \ldots, T\}, \tag{R1}$$

$$\beta^t \mu_t \delta_{\text{beq}} f_t = -\varphi_t + \frac{1}{R}\varphi_{t-1} \quad \forall t \in \{1, 2, \ldots, T\}, \tag{R2}$$

$$a_t = m_t + p^t - c_t, \quad \forall t \in \{0, \ldots, T\}, \tag{R3}$$

$$m_{t+1} = a_t \cdot R + p^{t+1} \quad \forall t \in \{0, 1 \ldots, T-1\}, \tag{R4}$$

$$f_{t+1} = a_t \cdot R + b^{t+1} \quad \forall t \in \{0, 1 \ldots, T-1\}. \tag{R5}$$

One can solve for an implied path of consumption given a guess for initial consumption c_0.

Algorithm: Consumption path given c_0

1. Find a_0 from R3
2. Find m_1 from R4 and f_1 from R5
3. Find ϕ_0 from R1
4. Find ϕ_1 from R2
5. Finc c_1 from inverting R1
6. Repeat steps for $t \in \{1, \ldots, T\}$

This allows for writing and solving for the value function (and consumption/bequest path) by numerically maximizing with respect to c_0. Given this implementation is relatively fast – and more precise than the backward interpolation – I can use it to implement the transformations into wealth equivalents as outlined in section C.6.

D.4 Approximation via interpolation

In estimation, I approximate the financial value of an annuity product for a consumer with bequest parameter δ_{beq} by solving for the life-cycle model on a grid of values, and interpolating across it in the SMLE routine.

The interpolation is justified if the value of the product $V_0(w_0; \delta_{\text{beq}})$ is continuous with respect to the parameter δ_{beq}. This is an application of Berge's Theorem of the Maximum.

E Search model for intermediaries

E.1 Search model

Take U_{NI}, U_{SA} and U_{IA} – the expected utility of using no intermediary, a sales agent or an independent advisor – as given. This section develops a sequential search model for intermediaries following Hortaçsu and Syverson (2004).

Suppose that finding one requires "search". A consumer can always choose no intermediation U_{NI}. Depending on their savings s and their location l, the probability of sampling or encountering each intermediary is given by p_{SA} and p_{IA}. If search is sequential and with recall – can revisit an intermediary already found –, we can write down the cutoffs for when a consumer stops searching. If no intermediation U_{NI} yields the highest expected utility, no search is ever needed and the consumer always chooses this. As in Hortaçsu and Syverson (2004), we assume that the retiree can search once costlessly.

If one or both intermediation types yield higher utility than none, can find cutoffs in the search distribution that determine when consumer stops searching. Wlog $U_{NI} < U_{SA} < UIA$, we have

$$\begin{aligned} c_{NI} &= p_{SA}(U_{SA} - U_{NI}) + p_{IA}(U_{IA} - U_{NI}), \\ c_{SA} &= p_{IA}(U_{IA} - U_{SA}), \end{aligned}$$

and can link points the CDF of the search cost distribution to "shares" of intermediaries (Hortaçsu and Syverson, 2004)

$$\begin{aligned} s_{NI} &= p_{NI}(1 - G(c_{NI})), \\ s_{SA} &= p_{SA}\left(1 + \frac{p_{NI}}{1 - p_{NI}} G(c_{NI}) - \frac{G(c_{SA})}{1 - p_{NI}}\right), \\ s_{IA} &= p_{IA}\left(1 + \frac{p_{NI}}{1 - p_{NI}} G(c_{NI}) + \frac{p_{SA} G(c_{SA})}{(1 - p_{NI})(1 - p_{NI} - p_{SA})}\right). \end{aligned}$$

If on the other hand we have $U_{SA} < U_{NI} < U_{IA}$, the consumer never accepts an offer from the sales agent and instead the market shares read

$$\begin{aligned} c_{NI} &= p_{IA}(U_{IA} - U_{NI}), \\ s_{NI} &= (1 - p_{IA})(1 - G(c_{NI})), \\ s_{IA} &= p_{IA} + (1 - p_{IA}) G(c_{NI}). \end{aligned}$$

Assuming a particular distribution for the search cost e.g. exponential with parameter κ, we have that

$$G(c) = 1 - e^{-\kappa c}.$$

E.2 Adding noise

The model above has discontinuities whenever the values of the intermediary options cross the one of no-intermediation (which is assumed to be the outside option or also the "always available without search option"). One can see that as the value of using an intermediary crosses that threshold they gain (or lose) a positive market share immediately. This discontinuity makes estimation challenging, as a gradient cannot be used to optimize the objective function.

We can try to get around this problem by introducing some (small) noise around the value of no-intermediation[86]. Suppose we introduce a shock $\varepsilon \sim \mathcal{N}(0, \sigma^2)$. Further suppose wlog that $U_{I1} < U_{I2}$. Then we can distinguish three cases as a function of the realization of ε,

$$
\begin{aligned}
U_{NI} + \varepsilon < U_{I1} < U_{I2} \quad &\Longrightarrow \quad \varepsilon \in (-\infty, U_{I1} - U_{NI}), \\
U_{I1} \leq U_{NI} + \varepsilon < U_{I2} \quad &\Longrightarrow \quad \varepsilon \in [U_{I1} - U_{NI}, U_{I2} - U_{NI}), \\
U_{I1} < U_{I2} < U_{NI} + \varepsilon \quad &\Longrightarrow \quad \varepsilon \in [U_{I2} - U_{NI}, +\infty).
\end{aligned}
$$

To get the probabilities of each intermediation channel, we need to integrate over the possible realizations of ε. The functional form assumptions allow for this. Notice that ε will enter the probabilities through $G(c_{I1})$ or $G(c_{I2})$. Notice that for the case $U_{NI} + \varepsilon < U_{I1} < U_{I2}$, we have

$$
\begin{aligned}
G(c_{I1}(U_{NI}, U_{I1}, U_{I2}, \varepsilon)) &= 1 - e^{-\kappa(p_{I2}(U_{I2} - U_{NI} - \varepsilon) + p_{I1}(U_{I1} - U_{NI} - \varepsilon))} \\
&= 1 - e^{-\kappa(p_{I2}(U_{I2} - U_{NI}) + p_{I1}(U_{I1} - U_{NI}))} e^{\kappa(p_{I2} + p_{I1})\varepsilon} \\
&=: 1 - H(c_{I1}) e^{\kappa(p_{I2} + p_{I1})\varepsilon},
\end{aligned}
$$

defining the last function for convenience as (without the shock)

$$
H(c_{I1}) = e^{-\kappa c_{I1}}.
$$

Armed with this, define the cutoff points for the intervals

$$
k_1 = U_{I1} - U_{NI}, \qquad k_2 = U_{I2} - U_{NI}.
$$

and can write

$$
\begin{aligned}
s_{NI} = &\int_{-\infty}^{k_1} p_{NI}(1 - (1 - H(c_{I1}) e^{\kappa(p_{I1} + p_{I2})\varepsilon})) f(\varepsilon) \, \mathrm{d}\varepsilon \\
&+ \int_{k_1}^{k_2} (1 - p_{I2})(1 - (1 - H(c_{I2}) e^{\kappa(p_{I2}\varepsilon)})) f(\varepsilon) \, \mathrm{d}\varepsilon \\
&+ \int_{k_2}^{\infty} f(x) \, \mathrm{d}\varepsilon.
\end{aligned}
$$

[86] Note that it is not necessary to add noise around every object here, since the probabilities of choosing an intermediary when their expected utilities cross each other do not evolve discontinuously.

From WolframAlpha I get that the first term is equal to

$$p_{NI}H(c_{I1})\frac{1}{2}e^{(\kappa(p_{I1}+p_{I2}))^2\sigma^2/2}\left(1+\operatorname{erf}\left(\frac{k_1-\kappa(p_{I1}+p_{I2})\sigma^2}{\sqrt{2\sigma^2}}\right)\right),$$

and similarly the second yields

$$(1-p_{I2})H(c_{I2})\frac{1}{2}e^{(\kappa p_{I2})^2\sigma^2/2}\left(\operatorname{erf}\left(\frac{k_2-\kappa p_{I2}\sigma^2}{\sqrt{2\sigma^2}}\right)-\operatorname{erf}\left(\frac{k_1-\kappa p_{I2}\sigma^2}{\sqrt{2\sigma^2}}\right)\right).$$

The third one yields

$$\frac{1}{2}\operatorname{erfc}\left(\frac{k_2}{\sqrt{2\sigma^2}}\right)=\frac{1}{2}\left(1-\operatorname{erf}\left(\frac{k_2}{\sqrt{2\sigma^2}}\right)\right).$$

Putting it all together, we have the unconditional probability of choosing NI given by

$$\begin{aligned}s_{NI}=&\frac{1}{2}p_{NI}H(c_{I1})e^{(\kappa(p_{I1}+p_{I2}))^2\sigma^2/2}\left(1+\operatorname{erf}\left(\frac{k_1-\kappa(p_{I1}+p_{I2})\sigma^2}{\sqrt{2\sigma^2}}\right)\right)\\&+\frac{1}{2}(1-p_{I2})H(c_{I2})e^{(\kappa p_{I2})^2\sigma^2/2}\left(\operatorname{erf}\left(\frac{k_2-\kappa p_{I2}\sigma^2}{\sqrt{2\sigma^2}}\right)-\operatorname{erf}\left(\frac{k_1-\kappa p_{I2}\sigma^2}{\sqrt{2\sigma^2}}\right)\right)\\&+\frac{1}{2}\operatorname{erfc}\left(\frac{k_2}{\sqrt{2\sigma^2}}\right).\end{aligned}$$

Onto $I1$, we have

$$\begin{aligned}s_{I1}=&\int_{-\infty}^{k_1}\left(p_{I1}+\frac{p_{I1}p_{NI}}{1-p_{NI}}-\frac{p_{I1}p_{NI}}{1-p_{NI}}H(c_{I1})e^{\kappa(p_{I1}+p_{I2})\varepsilon}-\frac{p_{I1}}{1-p_{NI}}\left(1-H(c_{I2})\right)\right)f(\varepsilon)\,\mathrm{d}\varepsilon\\=&\frac{1}{2}\left(p_{I1}+\frac{p_{I1}p_{NI}}{1-p_{NI}}-\frac{p_{I1}}{1-p_{NI}}\left(1-H(c_{I2})\right)\right)\left(\operatorname{erf}\left(\frac{k_1}{\sqrt{2\sigma^2}}\right)+1\right)\\&-\frac{1}{2}\frac{p_{I1}p_{NI}}{1-p_{NI}}H(c_{I1})e^{(\kappa(p_{I1}+p_{I2}))^2\sigma^2/2}\left(1+\operatorname{erf}\left(\frac{k_1-\kappa(p_{I1}+p_{I2})\sigma^2}{\sqrt{2\sigma^2}}\right)\right).\end{aligned}$$

Finally, we have $I2$, which should just be the complement of the two above. For the sake of completenes,,

$$\begin{aligned}s_{I2}=&\int_{-\infty}^{k_1}\left(p_{I2}+\frac{p_{I2}p_{NI}}{1-p_{NI}}+\frac{p_{I2}p_{I1}}{(1-p_{NI})(1-p_{NI}-p_{I1})}(1-H(c_{I2}))\right)f(\varepsilon)\,\mathrm{d}\varepsilon\\&+\int_{-\infty}^{k_1}\frac{p_{I2}p_{NI}}{1-p_{NI}}H(c_{I1})e^{\kappa(p_{I2}+p_{I1})\varepsilon}f(\varepsilon)\,\mathrm{d}\varepsilon\\&+\int_{k1}^{k2}\left(p_{I2}+(1-p_{I2})(1-H(c_{I2})e^{\kappa p_{I2}\varepsilon})\right)f(\varepsilon)\,\mathrm{d}\varepsilon.\end{aligned}$$

We solve this to be

$$
\begin{aligned}
s_{I2} = &\left(p_{I2} + \frac{p_{I2}p_{NI}}{1-p_{NI}} + \frac{p_{I2}p_{I1}}{(1-p_{NI})(1-p_{NI}-p_{I1})}H(c_{I2})\right)\frac{1}{2}\left(\operatorname{erf}\left(\frac{k_1}{\sqrt{2\sigma^2}}\right)+1\right) \\
&- \frac{p_{I2}p_{NI}}{1-p_{NI}}H(c_{I1})e^{(\kappa(p_{I1}+p_{I2}))^2\sigma^2/2}\frac{1}{2}\left(1+\operatorname{erf}\left(\frac{k_1-\kappa(p_{I1}+p_{I2})\sigma^2}{\sqrt{2\sigma^2}}\right)\right) \\
&+ \frac{1}{2}\left(\operatorname{erf}\left(\frac{k_2}{\sqrt{2\sigma^2}}\right)-\operatorname{erf}\left(\frac{k_1}{\sqrt{2\sigma^2}}\right)\right) \\
&- (1-p_{I2})H(c_{I2})\frac{1}{2}e^{(\kappa p_{I2})^2\sigma^2/2}\left(\operatorname{erf}\left(\frac{k_2-\kappa p_{I2}\sigma^2}{\sqrt{2\sigma^2}}\right)-\operatorname{erf}\left(\frac{k_1-\kappa p_{I2}\sigma^2}{\sqrt{2\sigma^2}}\right)\right).
\end{aligned}
$$

E.3 Estimation

For simplicity, in estimation I assume the cost distribution is degenerate and infitely large. The model then depends completely on the relative magnitudes of the expected utilities $\mathcal{U}_{NI}, \mathcal{U}_{SA}, \mathcal{U}_{IA}$ and the sampling probabilities of each intermediary type. Keeping the same small ε shock from above, we distinguish the following cases and obtain formulas (again assume wlog $U_{I1} < U_{I2}$). Remember that the probabilities of the three cases distinguished above under the normality assumption are

$$
\begin{aligned}
&U_{NI}+\varepsilon < U_{I1} < U_{I2} &&\implies \varepsilon \in (-\infty, U_{I1}-U_{NI}) \quad \text{w/ prob. } \frac{1}{2}\left(1+\operatorname{erf}\left(\frac{U_{I1}-U_{NI}}{\sqrt{2\sigma^2}}\right)\right), \\
&U_{I1} \leq U_{NI}+\varepsilon < U_{I2} &&\implies \varepsilon \in [U_{I1}-U_{NI}, U_{I2}-U_{NI}) \quad \text{w/ prob. } \frac{1}{2}\left(\operatorname{erf}\left(\frac{U_{I2}-U_{NI}}{\sqrt{2\sigma^2}}\right)-\operatorname{erf}\left(\frac{U_{I1}-U_{NI}}{\sqrt{2\sigma^2}}\right)\right), \\
&U_{I1} < U_{I2} < U_{NI}+\varepsilon &&\implies \varepsilon \in [U_{I2}-U_{NI}, +\infty) \quad \text{w/ prob. } 1-\frac{1}{2}\left(1+\operatorname{erf}\left(\frac{U_{I2}-U_{NI}}{\sqrt{2\sigma^2}}\right)\right).
\end{aligned}
$$

Three cases are then possible. The retiree will choose no intermediary with certainty if the shock is such that the utility from no intermediation is highest. They will also choose that if only one of the intermediaries is preferred to no intermediation, but the individual does not encounter that type in their one (and only, since search costs are infinite) search. If we assume that the individual has a chance of not finding any intermediary in their search, we have

$$
\begin{aligned}
s_{NI} = &\frac{1}{2}\left(1-\operatorname{erf}\left(\frac{U_{I2}-U_{NI}}{\sqrt{2\sigma^2}}\right)\right)+ \\
&+\frac{1}{2}\left(\operatorname{erf}\left(\frac{U_{I2}-U_{NI}}{\sqrt{2\sigma^2}}\right)-\operatorname{erf}\left(\frac{U_{I1}-U_{NI}}{\sqrt{2\sigma^2}}\right)\right)(1-p_{I2}) \\
&+\frac{1}{2}\left(1+\operatorname{erf}\left(\frac{U_{I1}-U_{NI}}{\sqrt{2\sigma^2}}\right)\right)(1-p_{I1}-p_{I2}).
\end{aligned}
$$

The retiree chooses intermediary 1 only if it is better than no intermediation *and* it is sampled, which means

$$
s_{I1} = \frac{1}{2}\left(1+\operatorname{erf}\left(\frac{U_{I1}-U_{NI}}{\sqrt{2\sigma^2}}\right)\right)p_{I1}.
$$

Finally, intermediary 2 is similarly only chosen if it is better than no intermediation *and* it is sampled, yielding

$$s_{I2} = \frac{1}{2}\left(1 + \text{erf}\left(\frac{U_{I2} - U_{NI}}{\sqrt{2\sigma^2}}\right)\right) p_{I2}$$

For the estimation, I parameterize the sampling probabilities of each intermediary (and the probability of not encountering any) to depend on the individual's savings s and their geographic location (province p). In particular, the probability depends on the share of intermediated retirees 12 months prior k, and the probability of running into either sales agent or an independent advisor depends on the relative numbers of both advisors in that province h.

The sampling probabilities then read

$$\begin{aligned}
p_{NI} &= \frac{1}{1 + \exp\left(\phi k_{p,t-12} + \eta s_i + \eta_2 s_i^2 + \zeta(1 - h_{pt})\right) + \exp\left(\phi k_{p,t-12} + \eta s_i + \eta_2 s_i^2 + \zeta h_{pt}\right)}, \\
p_{SA} &= \frac{\exp\left(\phi k_{p,t-12} + \eta s_i + \eta_2 s_i^2 + \zeta(1 - h_{pt})\right)}{1 + \exp\left(\phi k_{p,t-12} + \eta s_i + \eta_2 s_i^2 + \zeta(1 - h_{pt})\right) + \exp\left(\phi k_{p,t-12} + \eta s_i + \eta_2 s_i^2 + \zeta h_{pt}\right)}, \\
p_{IA} &= \frac{\exp\left(\phi k_{p,t-12} + \eta s_i + \eta_2 s_i^2 + \zeta h_{pt}\right)}{1 + \exp\left(\phi k_{p,t-12} + \eta s_i + \eta_2 s_i^2 + \zeta(1 - h_{pt})\right) + \exp\left(\phi k_{p,t-12} + \eta s_i + \eta_2 s_i^2 + \zeta h_{pt}\right)}.
\end{aligned}$$