

The costs of annuitizing

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Disclaimer

The opinions in this presentation are my own and do not necessarily represent those of Banco Central del Uruguay.

Motivation

- ▶ Retirees face two main risks at retirement:
 1. Longevity risk: the risk of living more years than expected and, hence, running out of savings.
 2. Market risk: the risk of market volatility and its effect on the accumulated funds.
- ▶ Solution: buy an annuity.
 - ▶ The retiree is promised to receive regular payments by an insurance company for the rest of her life in exchange for a one-time premium payment.
- ▶ What do insurance companies do to hedge against the longevity risk?
 - ▶ Pool resources of annuitants, bearing the costs associated with providing this product: administrative expenses, wages, commissions to agents, and adverse selection.

Motivation

- ▶ If the costs of providing annuities are significant, insurance companies may be tempted to charge more than what would be charged for an “actuarially fair” annuity.
- ▶ Two ways to look at how actuarially fair an annuity is:
 1. Money’s Worth Ratio (MWR): expected present discounted value (EPDV) of the income stream from an annuity over its purchase price.
 2. Annuity margin (m): reduction in yield associated with investing in an annuity rather than in alternative investments.
- ▶ Our approach:
 - ▶ We focus on insurance companies’ costs and estimate an “efficient margin” that includes the insurance company administrative costs but excludes adverse selection costs.

What we do

- ▶ We follow the stochastic frontier approach and estimate insurance companies translog cost function.
- ▶ We use data from the financial statements that insurance companies must file each quarter to the regulatory and supervisory authority.
 - ▶ The data covers financial statement information from 13 Uruguayan insurers during the period 2005-2015.
- ▶ With the estimated cost function we are able to recover the marginal cost of providing annuities.
- ▶ This allows us to estimate the “efficient margin”.

Money's Worth Ratio: MWR

- ▶ Assume a person retires at time $t = 0$ and has a maximum length of life of T .
- ▶ Let p_t be the probability of surviving until time t , A_t the payout at time t , and i the annual interest rate. Then:

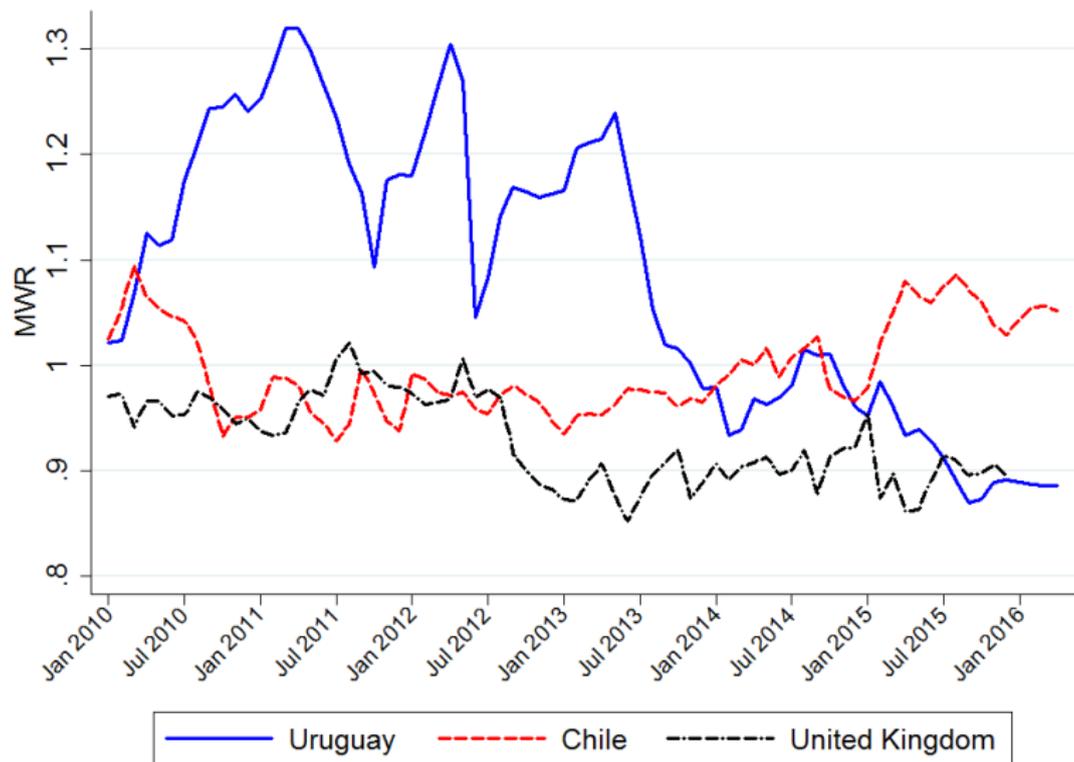
$$EPDV = \sum_{t=0}^T \frac{p_t A_t}{(1+i)^t}$$

- ▶ Define F as the purchase price or premium of the annuity, then:

$$MWR = \frac{EPDV}{F}$$

- ▶ An actuarially fair annuity would pay, on average, a dollar per each dollar premium and thus the MWR would be equal to 1.

MWR: Uruguay, Chile and the UK



Annuity margin: m

- ▶ The yield of the annuity, taking into account the annuitant expected mortality, can be compared to the rate of return of a benchmark asset in the market.
- ▶ Annuity costs are expressed in terms of the reduction in yields or differences in the rate of return of the annuity vis-a-vis what could be obtained in the market.
- ▶ Define m as the annuity margin that captures the insurance company administrative and adverse selection costs:

$$EPDV = \sum_{t=0}^T \frac{p_t A_t}{(1 + i - m)^t}$$

- ▶ The higher m , the higher the cost the insurance company is charging and the lower the annual payment.

Efficient annuity margin: m^*

- ▶ Without considering the insurance company costs, the annuity payment should be equal to the expected discounted purchase price:

$$A = \frac{F}{\sum_{t=0}^T \frac{p_t}{(1+i)^t}}$$

- ▶ Taking into account the costs, on average, the annuity payment, A^* , plus the annuity annual costs, AC , should be equal to the expected discounted purchase price:

$$A^* + AC = \frac{F}{\sum_{t=0}^T \frac{p_t}{(1+i)^t}}$$

Efficient annuity margin: m^*

- ▶ Let C be the total cost of providing the annuity. Then:

$$AC = \frac{C}{\sum_{t=0}^T \frac{p_t}{(1+i)^t}}$$

- ▶ Or:

$$A^* = \frac{F - C}{\sum_{t=0}^T \frac{p_t}{(1+i)^t}}$$

- ▶ As a function of the efficient annuity margin m^* :

$$A^* = \frac{F}{\sum_{t=0}^T \frac{p_t}{(1+i-m^*)^t}} \quad (1)$$

Cost function: stochastic frontier

- ▶ We estimate the following translog cost function:

$$\begin{aligned} \ln C_{it} = & \alpha_i + \sum_j \delta_j \ln Y_{j,it} + \\ & \frac{1}{2} \sum_j \sum_k \delta_{jk} \ln Y_{j,it} \ln Y_{k,it} + \sum_z \eta_z \ln W_{z,it} + \\ & \frac{1}{2} \sum_z \sum_s \eta_{zs} \ln W_{z,it} \ln W_{s,it} + \\ & \frac{1}{2} \sum_j \sum_z \rho_{jz} \ln Y_{j,it} \ln W_{z,it} + \\ & \sum_q \beta_q Q_{it} + \sum_y \gamma_y D_{it} + u_{it} + v_{it} \end{aligned}$$

Cost function

- ▶ C_{it} represents the total cost of firm i at time t ,
- ▶ $Y_{j,it}$ represents the output of each line of business j (life and annuities, car and fire insurance) for firm i at time t ,
- ▶ $W_{z,it}$ represents the prices of the inputs z (labor, financial capital, physical capital and materials) of firm i at time t ,
- ▶ Q_{it} and D_{it} are dummy variables capturing quarter and year effects respectively,
- ▶ u_{it} is the one-sided inefficiency term, and
- ▶ v_{it} is the idiosyncratic error.
- ▶ We estimate the model using Greene (2005) “true fixed effects” model assuming a half-normal distribution for the inefficiency component of the error term.

Marginal cost

- ▶ With the estimated cost function we compute the marginal cost associated with the life and annuities output for a median firm:

$$\begin{aligned}\frac{\partial \ln C}{\partial \ln Y_{VP}} = & \delta_{VP} + \delta_{VP,VP} \ln Y_{VP} + \\ & \delta_{VP,Ve} \ln Y_{Ve} + \delta_{VP,I} \ln Y_{In} + \\ & \rho_{VP,K} \ln W_K + \rho_{VP,F} \ln W_F\end{aligned}$$

- ▶ So the marginal cost is given by:

$$MC_{VP} = \frac{\partial C^*}{\partial Y_{VP}} = \frac{\partial \ln C^*}{\partial \ln Y_{VP}} \frac{C^*}{Y_{VP}}$$

- ▶ Where C^* is the efficient cost.

Variables definition: outputs, inputs and prices

- ▶ Outputs: deflated (CPI) gross premiums.
- ▶ Inputs: labor, financial capital, physical capital and materials.
- ▶ Prices:
 - ▶ Labor: total labor expenses over number of employees.
 - ▶ Financial capital: 3-years MA of ROE of the insurance industry.
 - ▶ Physical capital and materials: expenses associated to physical capital and materials over the value.

Data: cost function

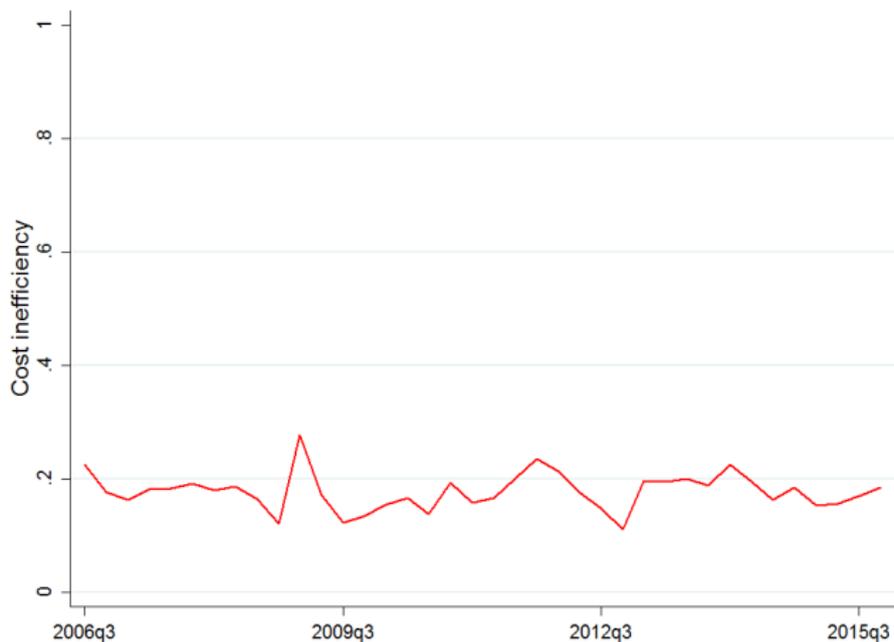
- ▶ We construct a dataset based on information from the regulatory quarterly statements filed by insurers to the SFS from December 2005 to December 2015.
- ▶ The initial sample consists of 467 firm-quarter observations.
- ▶ Focus on the insurance products that represent the largest portion of the market: life and annuities, car and fire insurance.
- ▶ We exclude from the sample the reinsurance and the accident lines of business.
- ▶ We also exclude firms for which the data displays negative direct premiums or positive expenses.
- ▶ The final sample consists of 13 firms and 420 observations.

Data: MWR

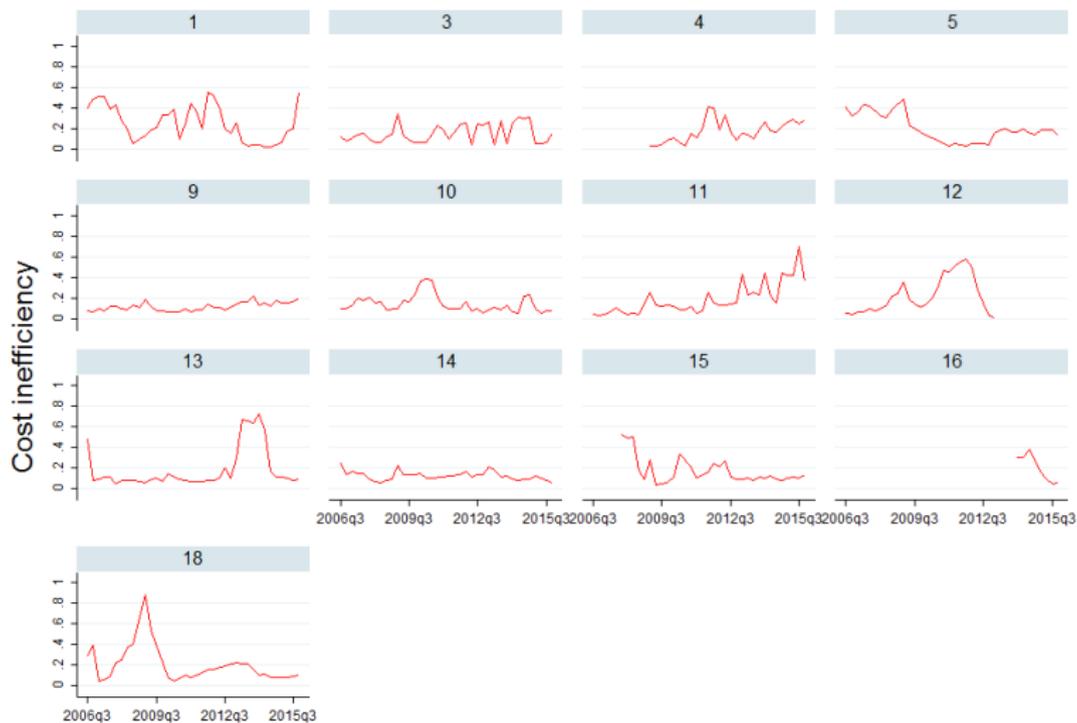
- ▶ Term structure of interest rates, the survival probabilities at different ages and the annuity premiums.
- ▶ Pension income in Uruguay is linked to earnings growth rates and thus both the interest rate and the annuity payments are going to be expressed in earnings growth terms.
- ▶ Given the lack of earnings-linked financial instruments, we use the term structure of inflation-linked securities and assume real earnings growth of 2.4%.
- ▶ We use new mortality tables.

Results: cost inefficiency

- ▶ Production costs could be reduced 17.8%, on average.



Results: cost inefficiency by firm



Graphs by i

Results: efficient annuity margin

- ▶ The estimated marginal cost is 0.011755, whilst the estimated marginal *efficient* cost is 0.010206.
- ▶ Then, an increase of 1,000 pesos in the individual funds - or annuity premium - implies an increase of 10.21 pesos in costs.
- ▶ If we think that the average annuity premium is currently 1 million pesos, the total administrative costs of the average annuity during the whole payment period is 10,210 pesos.

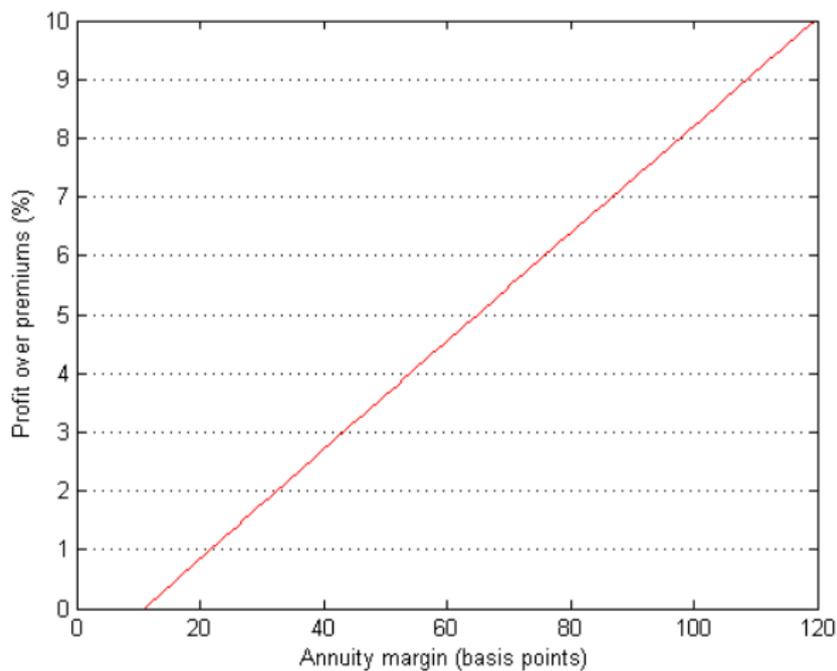
Results: efficient annuity margin

- ▶ From equation:

$$A^* = \frac{F}{\sum_{t=0}^T \frac{p_t}{(1+i-m^*)^t}}$$

- ▶ This is equivalent to an efficient annuity margin of 11 basis points over the market interest rate.
- ▶ If we also consider a 1% profit margin over premiums, the efficient annuity margin increases to 22 basis points.

Sensitivity of the annuity margin to profit margin



Annuity margin in other countries

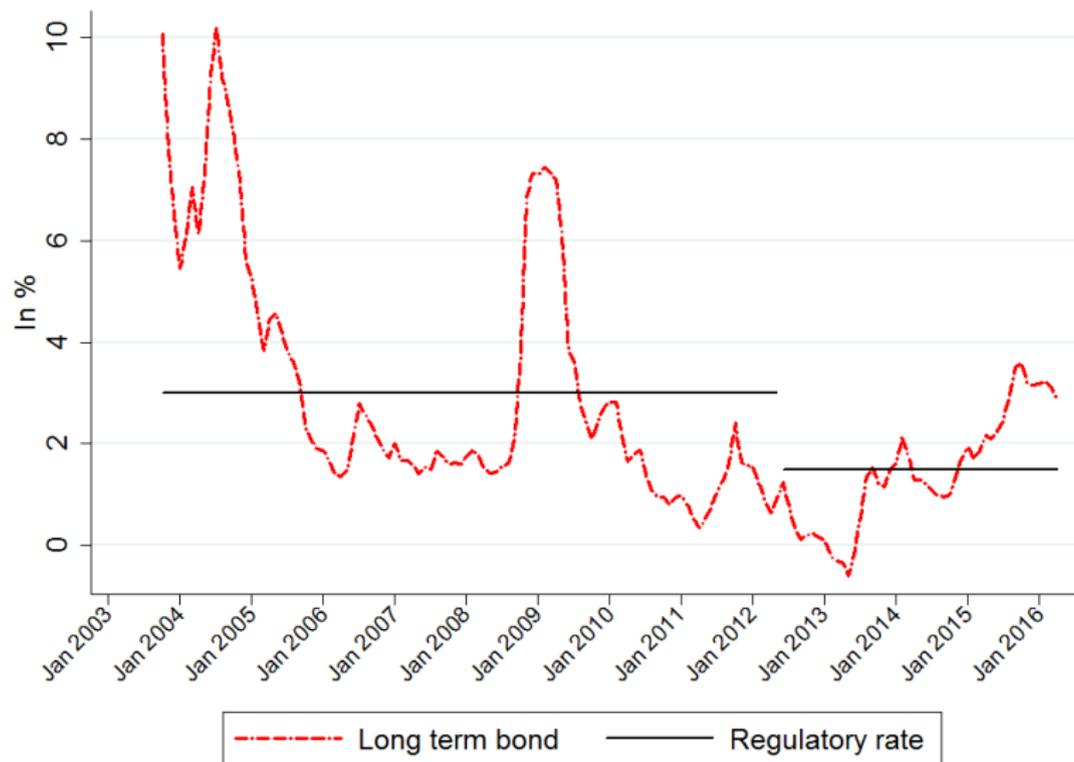
- ▶ We estimate an efficient annuity margin of 11 basis points in Uruguay:
 - ▶ United Kingdom: between 50 and 150 basis points.
 - ▶ Canada: 111 basis points.
 - ▶ United States: 197 basis points.
 - ▶ Australia: 113 basis points.
 - ▶ Switzerland: 97 basis points.
 - ▶ Chile: 50 basis points (negative in the last years).
- ▶ Explanations:
 - ▶ Adverse selection costs.
 - ▶ Production efficiency.
 - ▶ Profit margin.

Conclusion

- ▶ We propose a new approach to study annuitization costs.
- ▶ We estimate a translog cost function and find that the average cost inefficiency in the Uruguayan insurance sector during the period 2006-2015 has been stable and close to 18%.
- ▶ There is substantial heterogeneity in cost inefficiency across firms: some working close the production frontier and others showing cost inefficiency of almost 90%.
- ▶ The efficient marginal cost is 0.010206.
- ▶ Without considering profits, this is consistent with an efficient annuity margin of 11 basis points over the market interest rate.

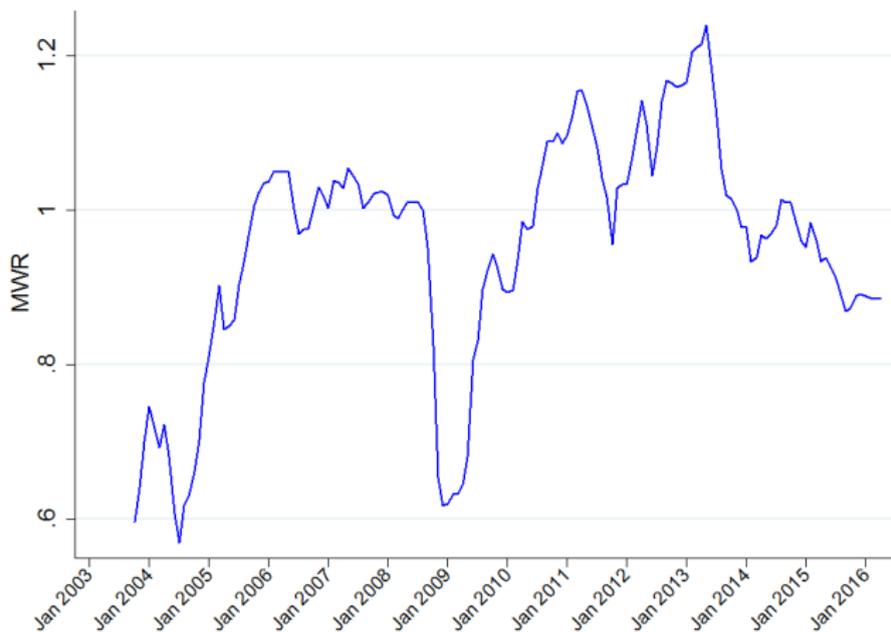
EXTRA SLIDES

Long term interest rate and regulatory rate



Results: MWR

- ▶ The value per-premium peso ranges from 0.65 in July 2004 to 1.32 in March 2011.



Literature review

- ▶ Money Worth Ratio and costs
- ▶ Stochastic frontier

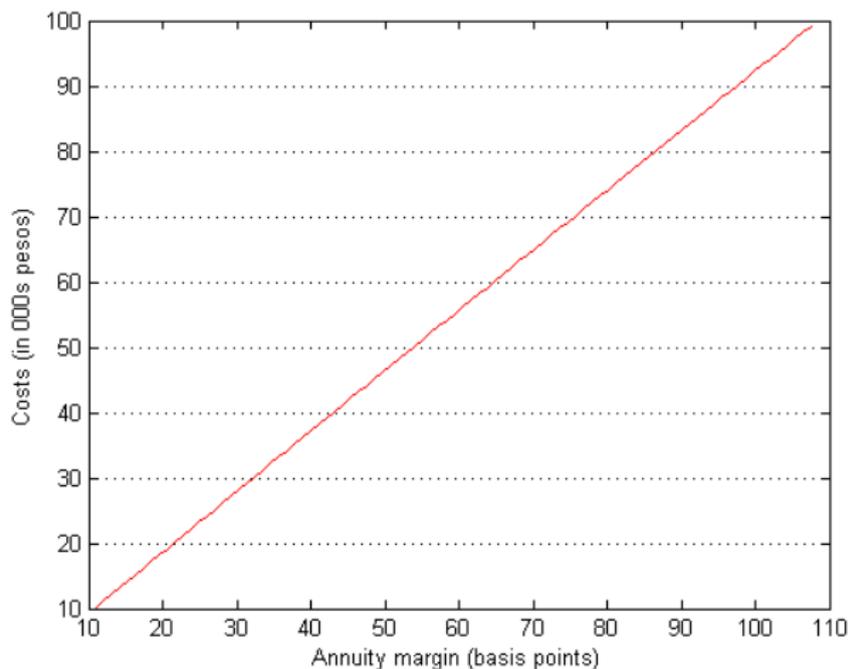
Economies of scale

- ▶ In a multi-product firm, economies of scale (ϕ) can be estimated from the following equation:

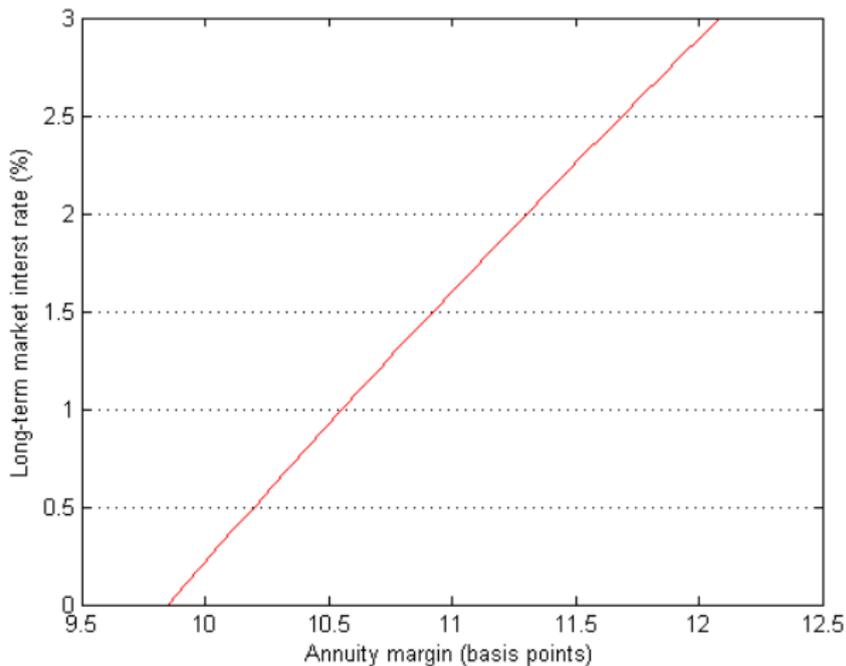
$$\phi = \frac{1}{\sum_j \frac{\partial \ln C}{\partial \ln Y_j}}$$

- ▶ Economies of scale allows us to infer whether insurance companies suffer cost savings or dis-savings as its output increases.
- ▶ We estimate ϕ at the mean, median, 25th and 75th percentiles of outputs obtaining economies of scale equal to 1.18, 1.23, 1.29 and 1.22 respectively.

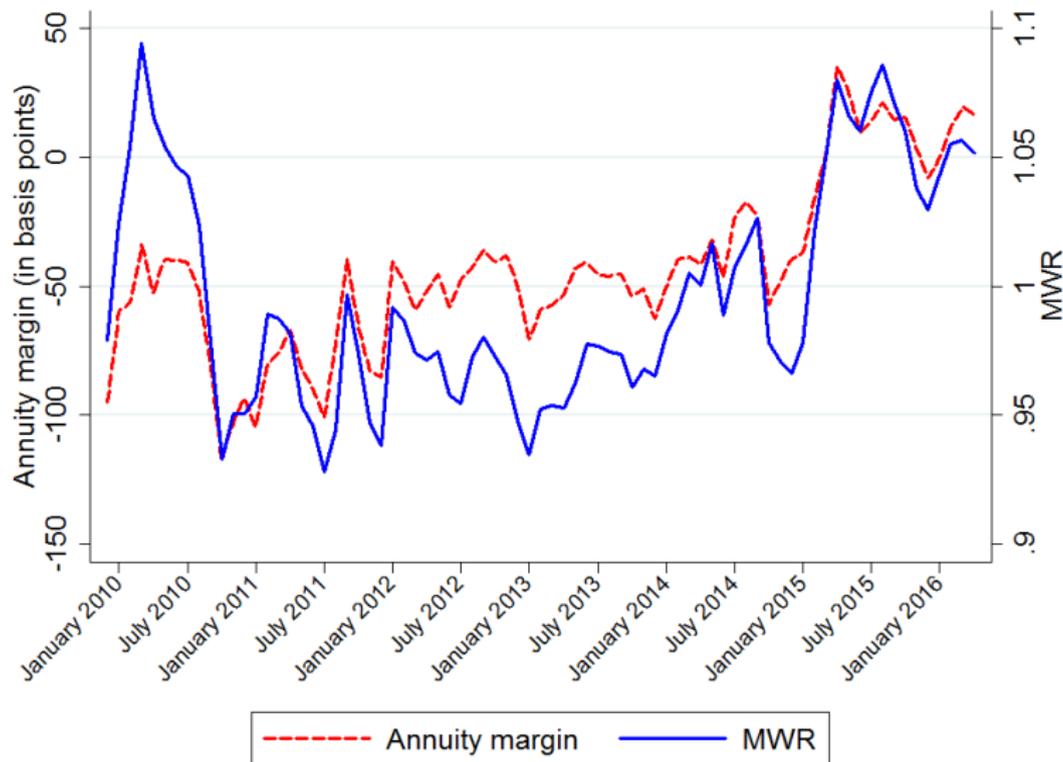
Sensitivity of the annuity margin to costs



Sensitivity of the annuity margin to market long-term interest rate



MWR and Annuity margin: Chile



MWR and Annuity margin: United Kingdom

