Mandating public annuity purchase and banning gender-based pricing may unintentionally lead to advantageous selection

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Abstract

A well-known solution to adverse selection in insurance markets is to mandate that everyone buy insurance. This paper revisits this solution when gender-based pricing is banned in a mandatory public annuity program with partial waiver. In a simple model with these two policy features and the assumptions of positive health-wealth correlation and gender gaps in health and wealth, we introduce a measure of the severity of adverse selection and decompose this measure into the within-group and between-group effects when the gender-neutral pricing is adopted. A surprising result is that the severity of adverse selection may be zero and may even be negative (meaning that advantageous selection is present) if the between-group effect is stronger. Our analysis suggests that advantageous selection may arise from the interaction of gender-neutral pricing and the exemption clause of the mandatory public annuity program. This provides an alternative mechanism to the idea emphasized in models with multidimensional private information.

Motivation

An canonical solution to adverse selection:
Asymmetric information is present in many insurance markets. The high-risk customers purchase larger amount of the product, leading to adverse selection with a higher equilibrium price for all customers (Rothschild and Stiglitz, 1976). An canonical solution to adverse selection is to **mandate that every customer buy insurance** (Einav and Finkelstein, 2011, p. 120).

This paper revisits this canonical solution in an economy with two observed policy features of

(a) a mandatory public annuity program;

Under the trend of population aging, the traditional unfunded PAYGO pension systems become financially unsustainable. Several governments have undertaken reforms by building up the fully-funded defined-contribution system with Individual Accounts (IAs) during accumulation phase. Furthermore, some governments such as Lithuania, Singapore and Sweden require the pensioners to use the accumulated contributions in the IAs to buy public annuities as the compulsory decumulation option. The public annuity products transfer contributions in IA to a stream of steady income payable to retirees as long as they are alive.

(b) the trend of replacing gender-based pricing by gender-neutral pricing.

Gender-based pricing in the insurance sector was banned in the European Union in 2012, with gender equality regarded as the fundamental right. It is likely that gender equality will be increasingly emphasized in different societies in the coming years, leading to more use of gender-neutral pricing in the annuity market.

Research question: to examine implications of adopting gender-neutral pricing in the mandatory public annuity programs: whether the adverse selection will be eliminated?

A simple two-period model

- **Period 1:**

Retirees buy public annuities according to

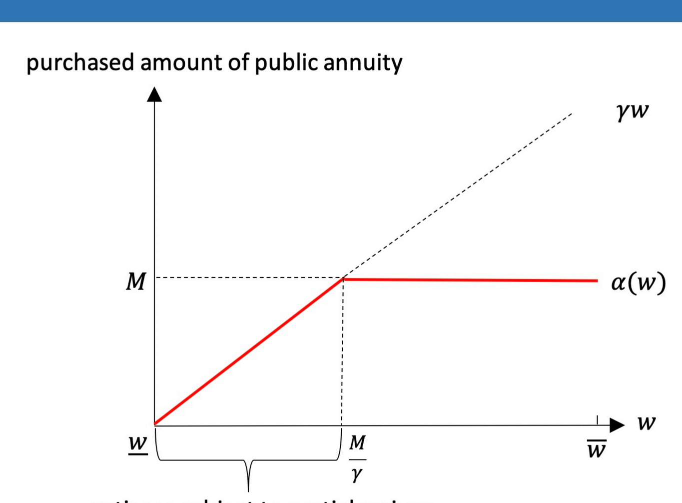
$$\alpha(w) = \begin{cases} \gamma w, & w < \frac{M}{\gamma}\ (partial\ waiver) \\ M, & w \geq \frac{M}{\gamma} \end{cases}$$

$\alpha(w)$: annuitization rates; w : $\underline{w} \leq w \leq \overline{w}$, accumulated contributions in IA (pension wealth); γw: $0 < \gamma \leq 1$ the required annuitization rates for low-income retirees; M: the required annuitization level for high-income retirees.

- **Period 2 (with uncertainty):**

Retirees receive the annuity payout if they survive to Period 2 with probability θ.

θ: $0 < \underline{\theta} \leq \theta \leq \overline{\theta} < 1$, the survival probability to Period 2



- **No choice element in $\alpha(w)$**: γ and M are required by the government.
- **Retirees subject to partial waiver:** such as Lithuanian retirees with pension wealth between 10,000 and 60,000 Euros, are allowed to buy annuities at the level of γw, (which is proportional to their pension wealth) instead of M.

Assumptions

Assumption 1 (Gender gaps in health):

$$E(\theta; f) = \int_{\underline{\theta}}^{\overline{\theta}} \theta g_\theta(\theta; f) d\theta > \int_{\underline{\theta}}^{\overline{\theta}} \theta g_\theta(\theta; m) d\theta = E(\theta; m)$$

Assumption 2 (Gender gaps in wealth):

$$G_w(w; f) - G_w(w; m) > 0, for\ w \in (\underline{w}, \overline{w})$$

- It ensures that gender gaps in wealth exists in any sub-interval of $(\underline{w}, \overline{w})$.

Assumption 3 (Positive health-wealth correlation):

It is assumed that θ and w satisfy the linear conditional mean specification,

$$E(\theta|w; i) = a^i + b^i w, b^i > 0$$

- It ensures that positive health-wealth correlation exists in any sub-group of pensioners. It incorporates commonly-used bivariate normal distribution, as well as bivariate uniform distribution, etc.

$g_\theta(\theta; i) = \int_{\underline{w}}^{\overline{w}} g(\theta, w; i) dw$ is the marginal probability density function of health of gender i;

$G_w(w; i) = \int_{\underline{w}}^{w} g_w(w, i) dw$ is cumulative distribution function of wealth of gender i;

$E(\theta|w; i) = \int_{\underline{\theta}}^{\overline{\theta}} \theta g_{\theta|w}(\theta|w; i) d\theta$ is the conditional mean of health on wealth and $g_{\theta|w}(\theta|w; i)$ is the probability density function of gender i's health level conditional on wealth level.

The severity of adverse selection

Taking gender-based pricing as an example. Under the assumption of **0-profit condition** (revenue equals to expected payments), the measure λ^i is defined by

$$\lambda^i = \frac{1+r}{A_{zp}^i} - E(\theta; i) = \int_{\underline{\theta}}^{\overline{\theta}} \theta \left[\frac{\int_{\underline{w}}^{\overline{w}} \alpha(w) g(\theta, w; i) dw}{\int_{\underline{\theta}}^{\overline{\theta}} \alpha(w) g_w(w; i) d\theta dw} \right] d\theta - \int_{\underline{\theta}}^{\overline{\theta}} \theta g_\theta(\theta; i) d\theta .$$

where $A_{zp}^i = \frac{(1+r) \int_{\underline{w}}^{\overline{w}} \int_{\underline{\theta}}^{\overline{\theta}} \alpha(w) g(\theta, w; i) d\theta dw}{\int_{\underline{w}}^{\overline{w}} \int_{\underline{\theta}}^{\overline{\theta}} \theta \alpha(w) g(\theta, w; i) d\theta dw}$ is the annuity payout for one unit of annuity purchase with $i = f$ for females and $i = m$ for males, $g(\theta, w; i)$ is the joint probability density function of w and θ, and $g_w(w; i) = \int_{\underline{\theta}}^{\overline{\theta}} g(\theta, w; i) d\theta$ is the marginal probability density function of wealth of gender i.

- λ^i is defined as the differences between "annuitization-weighted" survival probability and unweighted survival probability.
- $\lambda^i > 0$: healthier retirees (high-risk type) buy more annuities leading to **adverse selection**; $\lambda^i = 0$ indicates the market is **actuarial fair**; $\lambda^i < 0$: less healthy retirees (low-risk type) buy more annuities leading to **advantageous selection**

Results

Proposition 1: When gender-based pricing with zero-profit condition is adopted in a mandatory public annuity program with partial waiver, **adverse selection** is present:

$$\lambda^i = \rho^i \frac{\sigma_\theta^i}{\sigma_w^i} \frac{cov(w, \alpha(w); i)}{E(\alpha(w); i)} > 0,$$

where $\rho^i > 0$ is health-wealth correlation coefficient, $\sigma_\theta^i > 0$ and $\sigma_w^i > 0$ are standard deviations of health and wealth.

Intuition: The combined effect of the partial waiver component ($cov(w, \alpha(w); i) > 0$) and the health-wealth correlation ($\rho^i > 0$) leads to adverse selection.

Implication: Conventional wisdom suggests that mandating purchase eliminates adverse selection in insurance markets under information asymmetry. However, we find a counter-example in mandatory public annuity markets when considering positive health-wealth correlation.

Proposition 2: When gender-neutral pricing with zero-profit condition is adopted in a mandatory public annuity program with partial waiver, (a) the severity of adverse selection in the annuity market is given by

$$\lambda = \lambda^{wg} + \lambda^{bg}$$

where

$$\lambda^{wg} = \beta^f \lambda^f + (1 - \beta^f) \lambda^m > 0,$$

with $0 < \beta^f = \frac{E(\alpha(w); f)}{E(\alpha(w); f) + E(\alpha(w); m)} < 1$ and

$$\lambda^{bg} = \frac{[E(\theta; f) - E(\theta; m)][E(\alpha(w); f) - E(\alpha(w); m]}{2\,[E(\alpha(w); f) + E(\alpha(w); m]} < 0;$$

(b) a sufficient condition for **advantageous selection ($\lambda < 0$)** to appear is

$$\rho^f \sigma_\theta^f \sigma_w^f + \rho^m \sigma_\theta^m \sigma_w^m < \frac{1}{2}[E(\theta; f) - E(\theta; m)] \int_{\underline{w}}^{\frac{M}{\gamma}} [G_w(w, f) - G_w(w, m)] dw \ (1)$$

Intuition: (a) There are two opposite effects: λ^{wg}(the within group term) captures the effect that *healthier individuals within each gender group* purchase more annuities leading to **adverse selection**; λ^{bg} (the between group term) captures the effect that *less healthy group (male group)* purchase more annuities leading to **advantageous selection**. (b) Weaker correlation between health and wealth of either gender (the left-hand side of (1)), and/or larger gender gaps in health and/or wealth (the right-hand side of (1)), the advantageous selection is more likely to appear.

Implication: Proposition 2 contributes the literatures that explain advantageous selection in insurance market with asymmetric information (Hemenway, 1990; Fang et al., 2008).

Corollary 1: When gender-based pricing with the actuarially fair output level is adopted (annuity payout for one unit of annuity purchase for gender i is $\frac{1+r}{E(\theta; i)}$), the budget of the public annuity provider is in **deficit**.

Corollary 2: When gender-neutral pricing with the actuarially fair output level is adopted (annuity payout for one unit of annuity purchase for either gender is $\frac{1+r}{0.5[E(\theta; f) + E(\theta; m)]}$), the budget of the public annuity provider is in **surplus if (1) holds**.

Conclusion

Examines the effects of mandatory public annuity purchase on the possibility of eliminating adverse selection:

- under gender-based pricing, **adverse selection is still present** when health and wealth are positively correlated;
- under gender-neutral pricing, **advantageous selection is present** when between-group effect is strong enough.

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