

# Voluntary versus mandatory public annuity plans: A unified framework to understand their pros and cons

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## Population aging and longevity risk

- Possible solutions : pension, support from family, private annuity, etc
- Alternative : Public annuity (PA) plans in recent years :  
Singapore and Hong Kong ;  
More plans : e.g., Lithuania since 2020.  
Lifelong annuity.

# The Lifelong Income for the Elderly program

## A brief history

- 1987, Minimum Sum Scheme ; receive payout for 20 years ;  
But, live longer than 20 years
- 2009, CPF LIFE program, voluntary
- 2013, mandatory

## Choice flexibility

- Be required to set aside Full Retirement Sum (FRS, 181 000 SGD (about 134 700 USD) in 2020) ;  
Or if have a property, Basic Retirement Sum = 0.5 FRS
- Can buy more : up to Enhanced Retirement Sum = 1.5 FRS

# The Hong Kong Mortgage Corporation Annuity

## A young program

- July 2018, launched by HKMC Annuity Limited
- Permanent citizens aged 60 and above
- Voluntary program

## Choice restriction

- July 2018, the maximum purchase of HK\$ 1 million
- Dec 2018, the maximum purchase of 2 million
- May 2019, the maximum purchase of 3 million

One major difference in those plans :

- Voluntary plan, but with a ceiling on the purchase amount
- Mandatory PA plan, but with some flexibility

A common problem in those plans :

- no health screening ; adverse selection

Research questions :

- The pros and cons of voluntary versus mandatory PA plans
- In what ways are the citizens affected by a particular plan ?

We aim to

- provide a unified framework to understand different plans
- offer some policy suggestions

(a) The growing literature of retirement financing

- The idea of government-provided annuity
- e.g., Diamond (2004), Fong et al. (2011), Lau and Zhang (2020)

(b) The annuity demand in the presence of adverse selection

- Yaari (1965), Davidoff et al. (2005)
- Non-exclusive contract with linear pricing (e.g., Abel, 1986 ; Brugiavini, 1993 ; Hosseini, 2015)
- Exclusive contracts specifying both prices and quantities (e.g., Eckstein et al., 1985 ; Eichenbaum and Peled, 1987).
- Our study : something in the between  
Specifying linear price but having quantity restriction.  
This allows us to examine the mandatory versus voluntary elements in a PA plan

Each individual lives for two periods at most :

- Period 1 (with certainty) : work
- Period 2 (with uncertainty) : retire
- Survival probability is privately known in Period 1 ;  
The problem of adverse selection ;
- Longevity risk in Period 2

To make the model simple without loss of insight

- no bequest preference
- no wealth heterogeneity (but a numerical extension)

Maximize lifetime utility by making annuity choices

- (a) Risk-free bonds
- (b) Insurance companies :
  - Offer private annuity in Period 1
  - Pay in Period 2 (to those who are alive)
  - Competitive market (leads to zero-profit condition)
- (c) Public annuity :
  - Similar to private annuity, but
  - Supplied solely by the government
  - No profit, no deficit
  - The capability of enforcing the maximum (ceiling) and minimum (floor) amounts of purchase



(a) Before the PA is introduced : Choose  $\hat{v}_\theta$  to maximize

$$\hat{U}_\theta = u(\hat{c}_{1\theta}) + \frac{\theta}{1+\rho} u(\hat{c}_{2\theta}) \quad (1)$$

subject to the budget constraints :

$$\hat{c}_{1\theta} = w - \hat{v}_\theta, \quad (2)$$

$$\hat{c}_{2\theta} = \hat{V}\hat{v}_\theta. \quad (3)$$

The equilibrium value of the payout term

$$\hat{V}^* = \frac{(1+r) \int_{\underline{\theta}}^{\bar{\theta}} \hat{v}_\theta^* dF_\theta(\theta)}{\int_{\underline{\theta}}^{\bar{\theta}} \theta \hat{v}_\theta^* dF_\theta(\theta)}. \quad (4)$$

Homothetic utility

(b) PA is introduced : Choose PA ( $\gamma_\theta$ ) and private annuity ( $\nu_\theta$ )

$$\max_{\gamma_\theta, \nu_\theta} U_\theta = u(c_{1\theta}) + \frac{\theta}{1 + \rho} u(c_{2\theta})$$

subject to the new budget constraints :

$$c_{1\theta} = W - \gamma_\theta - \nu_\theta \quad (5)$$

$$c_{2\theta} = G\gamma_\theta + V\nu_\theta \quad (6)$$

$$f \leq \gamma_\theta \leq m \quad (7)$$

The equilibrium values of the payout terms

$$G^* = \frac{(1 + r) \int_{\underline{\theta}}^{\bar{\theta}} \gamma_\theta^* dF_\theta(\theta)}{\int_{\underline{\theta}}^{\bar{\theta}} \theta \gamma_\theta^* dF_\theta(\theta)} \quad (8)$$

$$V^* = \frac{(1 + r) \int_{\underline{\theta}}^{\bar{\theta}} \nu_\theta^* dF_\theta(\theta)}{\int_{\underline{\theta}}^{\bar{\theta}} \theta \nu_\theta^* dF_\theta(\theta)} \quad (9)$$

$m$  = maximum amount of purchase (ceiling)

$f$  = minimum amount of purchase (floor)

Three plans in one framework :

- Voluntary public annuity with ceiling (VPAc) :  $0 = f < m$
- Mandatory public annuity with flexibility (MPAf) :  $0 < f < m$
- Pure mandatory public annuity (pure MPA) :  $0 < f = m$

## Annuity payouts in the two-tier market

**Proposition 1.** *When either the voluntary public annuity with ceiling or mandatory public annuity with flexibility plan is introduced, the equilibrium payouts of the public and private annuities have the following properties :*

$$V^* < G^*. \quad (10)$$

**Implication :** a two-tier market

- (a) All people purchase the PAs first, subject to the ceiling
- (b) Healthier people (with excess demand) also purchase private annuities

**Intuition :** See Proposition 2

**Proposition 2.** *Consider the introduction of either the voluntary public annuity with ceiling or mandatory public annuity with flexibility plan in the two-period model. Compared with  $\widehat{V}^*$  (the equilibrium payout of the private annuity before the introduction of the PA plan),*

*(a) the equilibrium payout of the PA is higher :*

$$G^* > \widehat{V}^*; \quad (11)$$

*and (b) the equilibrium payout of the private annuity is lower :*

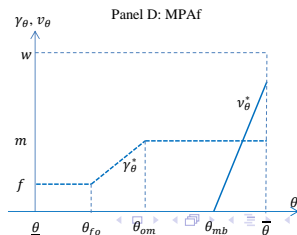
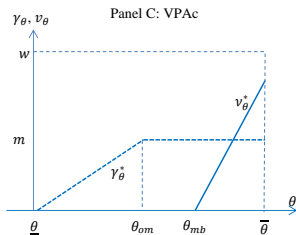
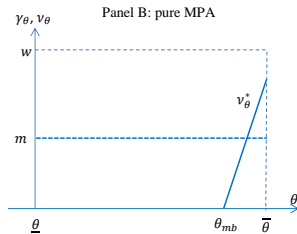
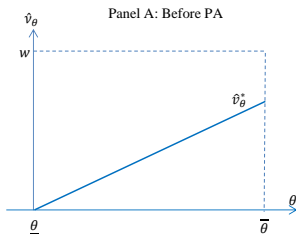
$$V^* < \widehat{V}^*. \quad (12)$$

**Intuition :** (See Figure 1)

(a) Healthier buyers (high risk) are constrained by the ceiling from over-purchase (i.e., severity reduction effect) ;

(b) Less healthy (low risk) buyers are dropped out from the private market (i.e., private market distortion effect).

# Figure 1 : Annuity choices under different plans



**Proposition 3.** *Comparing a voluntary public annuity with ceiling (VPAC) plan, a mandatory public annuity with flexibility (MPAf) plan and a pure mandatory public annuity (MPA) plan such that each plan has the same level of  $m$ , the equilibrium payouts of the PA and private annuity in the three plans are ranked as follows :*

$$V_{MPA}^* < V_{MPAf}^* < V_{VPAC}^* < \hat{V}^* < G_{VPAC}^* < G_{MPAf}^* < G_{MPA}^*. \quad (13)$$

**Intuition :** the floor going from 0 to the level of ceiling, less healthy (low risk) buyers are forced to buy more. Thus,  
(a) the severity reduction effect becomes stronger ;  
(b) so is the private market distortion effect.

## Two groups of buyers under VPAC

**Proposition 4.** *When the government introduces a voluntary public annuity with ceiling (VPAC) plan such that parameter  $m$  is set not too high, the VPAC plan systematically separates annuity buyers in two categories according to the change in utility level :*

- (a) an increase in a buyer's utility level for the poor health group ; and*
- (b) a decrease in a buyer's utility level for the good health group.*

**Intuition :**

- (a) The PA is cheap due to the severity reduction effect ;
- (b) The private annuity is expensive due to the private market distortion effect.

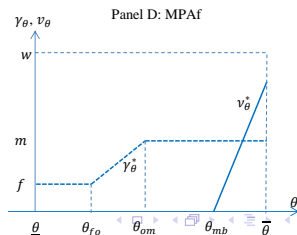
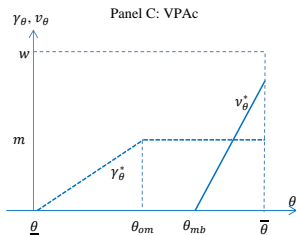
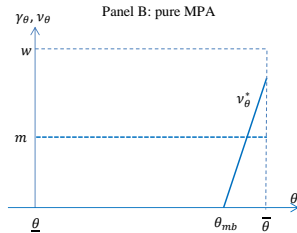
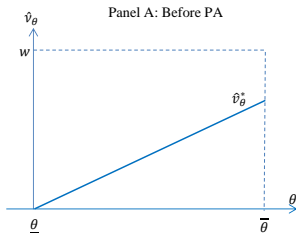


## Two or three groups of buyers under MPAf

Similar to the case under VPAC plan except for the distortion due to the mandatory force on the poor health buyers.

**Proposition 5(a).** *If  $m$  is set not too high and  $f$  is set too low, the MPAf plan systematically separates annuity buyers in two categories according to the change in utility level : an increase in a buyer's utility level for the group with poor or average health, and a decrease in a buyer's utility level for the good health group.*

# Figure 1 : Annuity choices under different plans

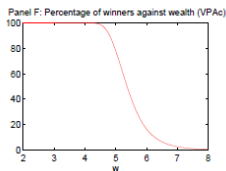
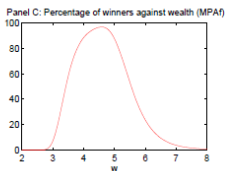
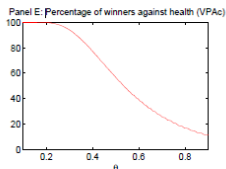
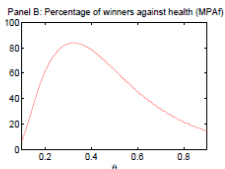
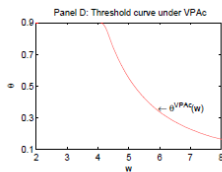
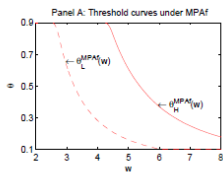


## Two or three groups of buyers under MPAf

**Proposition 5(b).** *When the government introduces a mandatory public annuity with flexibility (MPAf) plan such that parameter  $m$  is set not too high and parameter  $f$  is set not too low), the MPAf plan systematically separates annuity buyers in three categories according to the change in utility level : (a) a decrease in a buyer's utility level for the poor health group ; (b) an increase in a buyer's utility level for the group with average health ; and (c) a decrease in a buyer's utility level for the good health group.*

Wealth heterogeneity with a positive correlation with health.

- MPAf plan : Two threshold curves (See Figure 2)
- The pattern of different groups holds (along both wealth and health dimensions)



Motivated by two major types of PA plans : voluntary plan with restriction versus mandatory plan with flexibility.

- Develop a unified framework.
- A positive effect that mitigates the severity of adverse selection in the PA market.
- But, a negative effect that amplifies the distortion in the private market.
- PA intervention = a compromise of its positive effect and its negative effect.

Our study suggests

- A PA plan, either voluntary or mandatory, leads to a two-tier annuity market.
- A PA plan, either mandatory or voluntary, divides the population into different groups.
- Consider seriously the different effects on people who eventually benefit or get hurt.

Future research :

- Quantitative assessment : overall effect is small or large ?