The Role of Private Pension Insurance in the Retirement Security System

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Abstract

The retirement security system is adversely affected by risk factors including population aging, inflation, and incentives for withdrawal, but neither the public pension plan nor the private insurance sector alone can cost-effectively respond to these factors. This study attempts to identify an optimal division of functions between public pension plans and private pension insurance by extending the separating Nash equilibrium model. The results reveal that the private-public pension system can promote public pension participation and preserve private pension availability. This is possible only when the public pension provides partial coverage of the pooled contributions base up to the point of junction between the fair-price line of the pooled contributions and the utility indifference curve for younger participants and the risk-differentiated private pension is offered in the exceeding area of the public pension plan.

Keywords: Retirement Security System, Population Aging, Public Pension Plan, Private Pension Insurance, Separating Nash Equilibrium

1. Introduction

This study develops a framework for private-public collaboration on the pension insurance system for sustainable retirement security. The study investigates how the coexistence of private and public pension insurance minimizes the adverse effect of risk factors including population aging, inflation, and incentives for pension participants.

Global society is experiencing rapid population aging, which is caused by the combined effect of increasing life expectancy and decreasing fertility rates in developed markets and many growing economies. Increasing longevity and decreasing fertility rates are associated with both economic growth and urbanization in developed and growing markets. Economic development typically increases personal incomes, which results in access to better healthcare and improved hygienic conditions. Urbanization may discourage people from having a number of children because their children are less likely to care for them in their retirement.

Public pension plans in many mature markets have responded to population aging by cutting benefits, raising contributions or taxes, and issuing government bonds, but these

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traditional approaches are reaching their limitations. Therefore, it is not rational to rely solely on the public sector. Policymakers may be forced to consider reducing public pension benefits and actively introducing private retirement insurance to fill the gap. The private insurance industry, however, cannot finance all retirement risk alone because it faces limited insurance capacity, high correlation between insurance losses and inflation and other macroeconomic factors, and high parameter uncertainty attributable to the rapid progression of healthcare technology. Additionally, the literature has not fully elucidated how such private-public collaborations should transpire. Attempting to address this gap in the literature, this research relies on the separating Nash equilibrium model to find an optimal domain of private and public pension insurance. The results provide managerial implications for the insurance industry to formulate a set of effective strategies for product development and pricing. The results also provide public implications for policymakers designing a resilient public pension plan.

2. Literature Motivating the Study

Some theoretical works have discussed the economic rationale of private-public insurance collaboration. Santerre and Neun (2007) focus on health insurance as part of the social security system and analyze the economic rationale of the combination of compulsory public insurance and voluntary personal insurance.[2] The authors find that the government produces insurance coverage only to the extent that consumers cannot resolve the information problem efficiently but simultaneously indicate that when the cost to operate public insurance forces an excessive burden on taxpayers, an alternative scheme including for-profit private insurance may be preferable.

An important study that attempts to theoretically analyze the double-layered structure of insurance is Zweifel (2000). This study focuses on health insurance and discusses efficiency reasons for the division of labor between private and social insurance. The author extends the Nash equilibrium model and demonstrates that partial mandatory insurance can alleviate adverse selection problems and enhance Pareto improvement for both low and high-risk individuals. Additionally, Zweifel (2000) illustrates that private insurers' inability to precisely estimate the probability of loss of individual exposure may constitute an efficiency reason for mandatory social insurance with partial coverage.

Suzawa and Scordis (2013) investigate whether a private-public insurance partnership can contribute to global societal sustainability by focusing on health insurance, natural disaster insurance, and liability insurance programs. The authors' analysis reveals that a double-layered insurance scheme consisting of private and public insurance can be cost-

[2] Santerre and Neun (2007), pp.229-292.

effective in minimizing moral hazard and adverse selection in the social security system. It can also be cost effective by preserving insurance availability when compulsory public insurance provides basic protections on the pooled premiums base, and voluntary private insurance is offered in the area exceeding the limitation of compulsory insurance on a risk-differentiated basis.

However, there are few existing works specific to private-public partnerships in the retirement security system that analyze the optimal division of functions between the insurance industry and the government.

3. Private and Public Pension Rationality for the Minimization of Risk Factors

Private-public insurance collaboration contributes to some sections of social security including health insurance, natural disaster insurance, and liability insurance by minimizing incentive issues and preserving insurance availability as reviewed in the previous section. For the retirement security system, we must consider other risk factors that impose additional costs on society and how private and public pension insurance would react, efficiently or inefficiently, to the adverse effects of such factors.

(1) Risk Factors of the Retirement Security System

The factors that undermine the sustainability of the retirement pension system include population aging, inflation, information asymmetry on solvency, and the bounded rationality of individuals.

Demographic Transformation. Increased longevity increases the relative number of older, retired beneficiaries, which also increases the burden on current workers. Decreasing the fertility rate reduces the population of the younger generation which, in turn, reduces the number of future workers and, thus, contributions to retirement plans.

Inflation. A critical macroeconomic factor is inflation. Retirement plans face a substantial long-term deficit in terms of high inflation because the expenditures for payments to retired beneficiaries may exceed the funds accumulated through their contributions.

Information Asymmetry. Current and potential participants in a pension plan are essentially information inferior to the insurer with respect to solvency. Recognizing such information asymmetry and when combined with unfavorable demographic and macroeconomic trends, a person is likely to question the commitment of the insurer to ensure future benefits. Consequently, current participants may have an incentive to withdraw from the pension plan, and potential applicants may also refrain from participation.

Bounded Rationality. People are not rational and often make shortsighted decisions. In cases where individuals are sufficiently visionary and able to prudently evaluate their financial needs in their future retirement, individuals could successfully retain retirement

risk and accumulate the necessary amount of financial resources in a planned and consistent way until their retirement. However, people tend to overestimate the financial needs of the moment while underestimating the financial needs of the future. Individual tend to prioritize short-term interests and procrastinate when preparing for their old age. This tendency is expected to be more distinct among the younger generation than older generations.

(2) Private and Public Pension Rationality

Both the private insurance sector and the public retirement security system respond to risk factors in different ways, but either of these systems alone cannot perfectly alleviate the negative effects of all risk factors simultaneously.

Demographic Transformation. Most private pension plans are operated under a fully-funded approach to minimize the unfavorable effects of demographic change. An insurer funds individual retirement benefits through upfront contributions made over the working period of the insured. Under the fully-funded pension system, the necessary funds are secured to pay for the accrued benefits of current participants. In contrast, public pension plans are typically operated under the pay-as-you-go system and, thus, the policymakers in many developed countries have traditionally cut retirement benefits, raised contributions or taxes, and issued government bonds to borrow retirement funds from the public. It is unlikely that these strategies will resolve the unfavorable effects of continued population aging because cutting benefits exposes the elderly to poverty risk. Moreover, tax rates are already high in most mature jurisdictions, and government deficits have reached their maximum in many mature countries.

Inflation. The public sector responds to unfavorable macroeconomic change by designing a public pension plan based on the pay-as-you-go approach. Almost all OECD countries employ this approach to their retirement income security plans as Skipper and Kwon (2007) discuss.[5] Under this system, benefits for current recipients are paid using upfront contributions from the working population. Meanwhile, the private pension market attempts to minimize the inflation problem by increasing the percentage of investment assets that are highly correlated with the price index. However, insurers must limit such investments to ensure investment safety to fulfill future obligations of insurance payments and, thus, the private insurance sector cannot perfectly resolve the possible fund deficits caused by inflation.

Information Asymmetry. The public sector responds to this incentive issue by mandating participation in the pension plan in addition to complementing the possible deficit with tax income, but the policymaker possibly has to incur additional costs to screen uninsured

[5] Skipper and Kwon (2007), p.204.

individuals and enforce them to participate in the plan. On the other hand, private pension products are voluntarily purchased by individuals but are typically designed on a fully-funded basis, which allows insurers to alleviate the incentive problem.

Bounded Rationality. Because mandatory participation also addresses the issue of individuals' short-sightedness, the public pension system partly resolves this problem although there may be additional costs necessary to force all persons who reach a certain age to participate in the plan. Additionally, individuals voluntarily purchase private pension products for their own risk management. Risk-averse individuals may willingly sign the policy of pension insurance, but less risk-averse individuals may perceive pension insurance as too expensive and be reluctant to purchase pension insurance.

Neither the private nor public pension system alone can efficiently respond to population aging, inflation, information asymmetry and bounded rationality; thus, the private-public pension combination would provide a possible solution. In many countries, the retirement security system includes multiple sources: government pension systems such as social security, employer-sponsored pension or profit-sharing plans to supplement the benefits paid by social security, and personal pension insurance provided by private insurers, but the literature lags behind the reality that multi-layered retirement plans are conducted worldwide. The following section discusses an analytical model to demonstrate the optimal division of roles between the private and public sectors in a retirement security system.

4. Analytical Approach

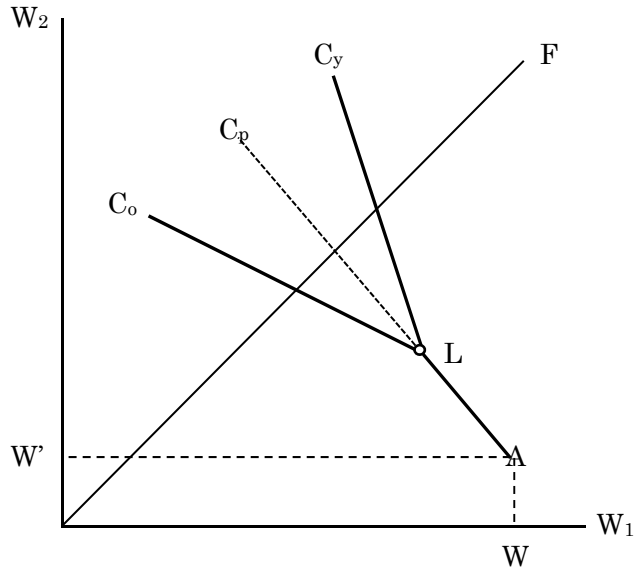
The analysis of this study is based on an assumption that a retirement security system consists of two different components: a compulsory public pension plan and voluntary private pension insurance. A public pension plan provides basic coverage up to a certain limitation while private pension insurance provides excess coverage in addition to the public plan. Similar to other social insurance sectors including public healthcare insurance, the upfront contributions of a public pension plan are collected based on individual participant's income regardless of any risk factors such as age. On the other hand, the premium rates of private pension insurance are risk-differentiated, that is, a younger new applicant is charged lower premiums while an older applicant is charged higher premium rates.

(1) Fair Contribution Lines of Pension Insurance

Zweifel (2000) analyzes the roles of private and social insurance based on the equilibrium model for health insurance referred to in Section 2. The author demonstrates

equilibrium points for both low and high-risk persons avoiding adverse selection.[6] This study expands the discussions of Zweifel (2000) to pension insurance and attempts to articulate an optimal domain of private pension insurance that avoids excessive risk differentiation and cream skimming as well as the appropriate scope of coverage for public pension plans, which efficiently induce individuals to participate. Figure 1 illustrates the analytical model of the division of coverage between the two sectors. The axes in the W_1-W_2 space show the wealth of a pension participant under two different circumstances, that is, W on W_1 denotes the wealth before the retirement age, for example, age 65, and the wealth after the retirement is donated by W' on W_2. For simplification, the analysis assumes that an equal number of only two types of individual exist; a younger group with a relatively longer period until retirement, and the older group that is relatively closer to retirement. All individuals have the same endowment level at Point A where both groups are uninsured. Line F traces equal values on both axes indicating a state of full pension coverage where W_1=W_2.

Figure 1. Partial Public Pension Coverage and Excess Private Pension Coverage



W_1: Initial Wealth Before Retirement

W_2: Wealth After Retirement

A: Uninsured State

C_p: Pooled Fair Contributions Charged for All Participants

C_y: Separated Fair Contributions for the Younger Group

C_o: Separated Fair Contributions for the Older Group

L: Coverage Limit of Public Pension

The public pension insurer offers coverage at a pooled price providing only partial coverage at Point L on a mandatory basis. Because the risk classification is not allowed for the public plan, a risk neutral pension insurer charges the pooled fair contributions from all participants along with Line $C_p = p/(1-p)$ where p denotes the average probability that a participant reaches the retirement age. Exceeding areas over the limitation of public pension coverage, a private insurance company provides excess coverage with age-

[6] Zweifel (2000), pp.933-966.

separating contributions along with Line C_y for the younger group and Line C_o for the older group on a voluntary basis. The risk classification is assumed to be allowed for private insurance, and the insurance company charges upfront contributions along Line C_y: $p_y/(1-p_y)$ for the younger group and contributions on Line C_o: $p_o/(1-p_o)$ for the older group. Since the average period toward the retirement of the older group is shorter than that of the younger group, Line C_y is steeper than Line C_o characterized by $p_y < p_o$. Assuming that both the younger and older groups are composed of exactly the same number of individuals, Line C_y and Line C_o become symmetrical centering Line C_p.

(2) Indifference Curve of Participants' Utility

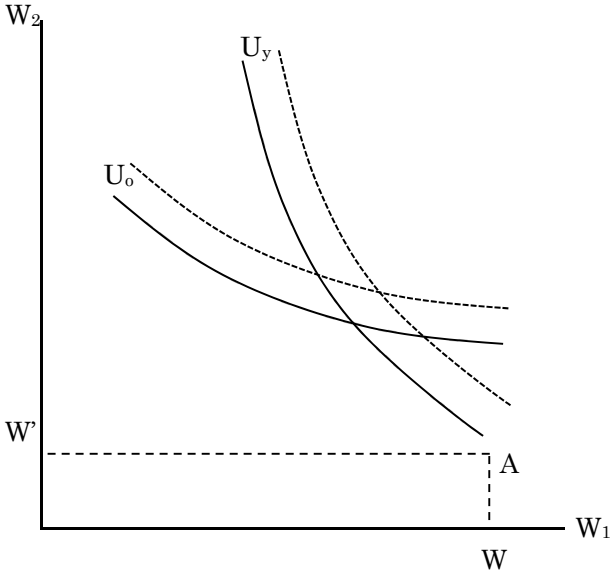
We can also illustrate the indifference curve of pension participants' expected utility on the same W_1-W_2 diagram. People are not sufficiently visionary and often underestimate their financial needs for the future, which implies that younger participants have a lower tendency to appraise pension coverage highly than older individuals. The indifference curve of expected utility is, thus, steeper for the younger group than the older group. The slope of the indifference curves for the younger group and the older group are given by the ratio of probability-weighted marginal utilities, respectively, as:

U_y: $\partial W_1/\partial W_2 = -(p_y \partial U/\partial W_1)/[(1-p_y)\partial U/\partial W_2]$

U_o: $\partial W_1/\partial W_2 = -(p_o \partial U/\partial W_1)/[(1-p_o)\partial U/\partial W_2]$,

and both indifference curves are also described on the W_1-W_2 diagram in Figure 2.

Figure 2. Indifference Curve of Participants' Utility



U_y: Indifference Curve of Expected Utility for the Younger Group

U_o: Indifference Curve of Expected Utility for the Older Group

A potential buyer of private pension insurance and an insurance company may determine insurance coverage that they purchase or sell through a trial and error process

considering the fair contribution lines in Figure 1 superimposed by the utility indifference curves of pension participants in Figure 2. The younger group is expected to opt for a policy featuring partial coverage but at a lower premium. At the same time, the older group will prefer more sufficient protection although they must be charged higher contribution amounts. Through repetition of such a trial-and-error process, a certain point of a separating equilibrium will be determined.

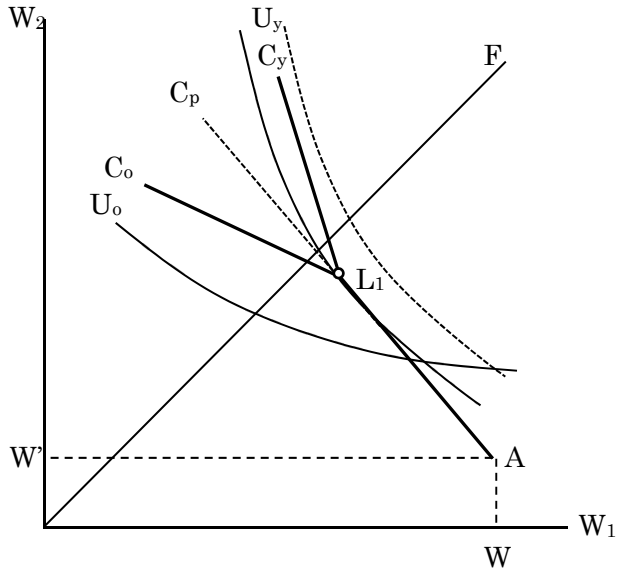
5. Analytical Results

By moving the coverage limit of the public pension plan, that is, Point L upward or downward on the pooled fair contributions line: C_p, we can observe how a participant and an insurer make decisions on participating in and providing pension insurance. By comparing a possible outcome in a case where a public pension plan provides a generous protection with an outcome in another case where only limited public protection is given, we can specify an optimal point dividing the coverage scope of the private and public pension plans. This point will cost-efficiently ensure participation in the public pension and avoid cream-skimming, preserving pension availability in the voluntary private pension market.

(1) Excessive Coverage of the Public Pension Plan

First, consider a case where the compulsory public pension plan provides partial but excessively generous coverage at a pooled-contributions base regardless of participants' age. The coverage limit of the public pension is identified at Point L_1 in Figure 3. The exceeding cost of L_1 is covered by risk-differentiated voluntary private pension insurance. The fair-contributions lines for the younger and older participants are illustrated as Line C_y and Line C_o, respectively. In this case, Point L_1 is located over Line U_o and, thus, induces older people to participate in the public pension plan because they regard the pension coverage as a good deal. However, L_1 is not always located above the utility indifference curve of the younger group. If the public pension provides a protection below U_y, younger individuals assume that the upfront contributions are unreasonably expensive and have an incentive to withdraw from the compulsory pension system. Thus, the pension organizer must possibly incur additional costs to screen uninsured individuals and enforce them to participate in the plan.

Figure 3. Excessive Public Pension Coverage



C_p: Pooled Fair Contributions of the Public Pension

C_y, C_o: Separated Fair Contributions of Private Pensions for Younger and Older Groups

U_y, U_o : Indifference Curves of Expected Utility for the Younger and Older Groups

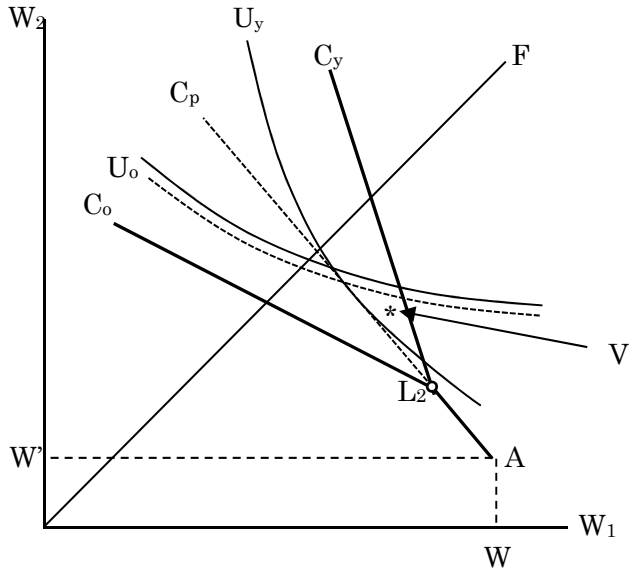
L_1: Excessive Coverage Limit of Public Pensions

(2) Under-provision of Public Pension Coverage

What will happen if the public pension plan provides only a limited amount of coverage? Assume that the public pension organizer makes an offer of coverage at Point L_2, and private insurers sell voluntary pension insurance over the limit of the public plan as illustrated in Figure 4. The private insurer can profitably underwrite pension insurance policies if prices are below Line C_y for younger people and below Line C_o for older individuals.

Considering that all private insurers are facing competitive pressure in the voluntary pension market, one insurer may decide to offer pension coverage at Point V, which is well below Line P_y where the price of contributions is profitable only for younger people. Point V is located above the indifference curve for the younger group, that is, U_y, and young people are willing to purchase a private pension product. In contrast, Point V is beyond the affordable area for the older group because it can be located below the utility indifference curve of the older group, that is, U_o. Consequently, this private insurer can draw younger people into its policy portfolio and exclude older individuals in a costless manner through a self-selection process resulting in impairment of the availability and affordability of private pension coverage and an increase in the number of under-protected people. Moreover, another insurer may provide a voluntary pension product slightly above Point V to attract younger individuals. The cream-skimming strategy taken by one insurer may induce other insurers under competitive pressure to do the same, exposing many retired elderlies to a significant base risk.

Figure 4. Under-provided Public Pension Coverage



C_p: Pooled Fair Contributions of the Public Pension

C_y, C_o: Separated Fair Contributions of the Private Pension for Younger and Older Groups

U_y, U_o : Indifference Curves of the Expected Utility for Younger and Older Groups

L_2: Insufficient Coverage Limit of Public Pension

V: Private Pension Insurance Aimed at Cream-skimming

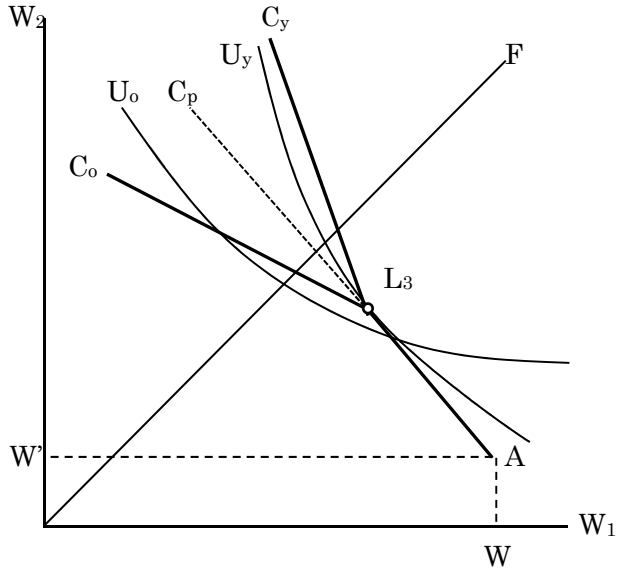
(3) Optimal Division of Roles between Public and Private Pensions

The compulsory component of retirement security is such that the public pension plan provides identical coverage for participants at pooled contributions regardless of their risk characteristics. However, the pension plan must attract all individuals to participate in the plan to avoid additional cost to enforce them to participate. This implies that the compulsory coverage denoted by Point L_n in the previous figures must pass beyond the utility indifference curves for both older and younger individuals: U_o and U_y. Then, younger people are expected to consider the upfront contributions of the public pension as rational although they are pooled with older people and are willing to participate in the pension. The exceeding cost over the limit of public pension is covered by the voluntary private pension insurance for which contributions are set separately based on the applicant's age. To ensure that for-profit private insurers willingly underwrite pension policies, the contributions should be priced at a sufficient level to avoid underwriting losses. Thus, the voluntary pension insurance must be provided below the fair contribution lines, that is, Line C_y or Line C_o.

Consider Point L_3 which is the interface between the pooled fair contribution line: C_p and the utility indifference curve of the younger group: U_y as described in Figure 5. If the compulsory coverage is provided at Point L_3 on the pooled contributions base, older and younger individuals recognize the coverage as reasonable and willingly participate in the pooled pension plan. For the exceeding area from Point L_3, risk-differentiated voluntary pension coverage should be offered. In the voluntary market, younger individuals can purchase low-cost pension coverage considering the length of time until retirement while older individuals can be insured by sufficient but relatively expensive pension coverage that

they consider necessary. Thus, the availability of the voluntary pension insurance market will be preserved, cost-effectively avoiding excessive competition and cream-skimming among insurance companies.

Figure 5. Optimal Domain of Public and Private Pensions



C_p: Pooled Fair Contributions of Public Pensions

C_y, C_o: Separated Fair Contributions of Private Pension for Younger and Older Groups

U_y, U_o : Indifference Curves of Expected Utility for Younger and Older Groups

L_3: Optimal Coverage Limit of Public Pensions

7. Summary and Implications

The retirement security system is exposed to some risk factors that impose additional costs on both a pension participant and an insurer. These factors include population aging, inflation, asymmetric information, and the bounded rationality of individuals. Considering the difficulties inherent in the public pension system and the private insurance sector alleviating the adverse effects of those risk factors individually, a private-public pension combination seems to be the best option.

This study extended the Nash equilibrium model to the retirement security system and attempted to describe how the public pension plan and private pension insurance should mutually collaborate and divide their functions. The analyses imply that in cases where the public pension plan provides excessive benefits to the retirees, younger participants will have an incentive to withdraw and newly eligible individuals will also consider participation in the plan worthless, resulting in additional cost to screen uninsured persons and mandate them to participate in the plan. On the other hand, under-provision of public pension coverage will possibly induce excessive risk classification in the private pension insurance market and impair the availability of pension insurance, particularly for the older generation who are close to retirement age.

What is an optimal domain of a public pension plan to minimize the incentive for individuals to withdraw and to avoid a cost increase for compulsion? How should the private

insurance sector provide pension products to preserve the availability of pension coverage and avoid excessive risk classification? This analysis identified the point dividing the domains of the public pension plan and private pension insurance as being located at the point of junction between the fair price line of the pooled contributions and the indifference curve of expected utility for younger participants. The result implies that the public pension plan should provide standardized partial coverage at that point on the pooled contribution basis so that both older and younger individuals will willingly participate in the compulsory public plan. Thus, the cost of screening uninsured persons and ensuring compulsion can be minimized. At the same time, private insurers should offer voluntary pension insurance exceeding the area of the dividing point on the risk-differentiated base so that individuals can purchase coverage suitable for their risk characteristics through a self-selection mechanism. Excessive risk classification and cream-skimming can be avoided, and a sufficient supply of private pension coverage will be maintained in the voluntary market. Public policymakers should consider the implications drawn from the results when designing a public pension plan including its contributions and setting benefits, and private insurance managers should do the same when formulating and executing a set of managerial strategies including product development, rate setting, and marketing.

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