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Early Retirement Decisions and Social Security Pension Fund in Thailand: A Monte Carlo Approach to Fiscal Implications

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Abstract: *This research paper employs the Monte Carlo experiments to assess the fiscal implications of early retirement decisions on the Social Security Pension Fund in Thailand. Most studies which have discussed this topic had employed a non-stochastic approach and emphasises the impacts of changing demographic structure of the workforce. This paper employs a stochastic approach and raises the more urgent issue of fiscal impacts and implications of the early exit from the workforce starting from 2014, the year in which the Fund started paying out regular monthly old-age benefits. The models simulate randomly distributed rates of early retirement among those aged between 50 and 54 with the mean around 5% and standard deviation of 1%. The simulations show that, on average, the Fund starts accruing net liability in 2020, and can potentially become depleted in 2058. This pinpoints to the important policy precautions that the currently high level of reserves does not imply fiscal security for the future retirees and, therefore, an urgent consideration of reform options is vital.*

Keywords: Stochastic Analysis, Early Retirement, Pension Funds
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1. Background Issues and Rationale

Since the economic crisis in 1997, the Thai government pursued fiscal deficit strategy until the present, except in 2005 and 2006 during which there was a temporary balanced budget. History shows that once welfare campaigns have been initiated, successive governments tend to continue to offer similar or larger provisions by changing the names of the schemes. Constrained by budgetary limitations and political pressure, off-budgetary expenditure and tapping off from large public-managed funds such as the Social Security Fund (SSF) tend to become novel tempting use of fiscal tools for all future

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governments. This is because of the country's relatively loose legal framework for monitoring and surveillance of the fund's usage.

Owing to the country's fiscal constraints, the SSF has often been subject to political decisions. Due to excessive government expenditure on other sectors, there have been subsidy cuts in addition to delay in contribution. By law, the government partially contributes to the funds. However, since 2010 until 2012, there was an overdue of over 63,200 million baht. Furthermore, the popular campaign of rate reduction implied long-term costs to the contributors due to the interrupted cash flows; for example, due to the flood in 2011, the government reduced the employers' and employees' contribution rate to 2% in the first six months, and then to 1% in the last six months of 2012 (Social Security Office, 2012). In fact, to truly "help" the victims in the long term, the government should subsidise for the loss in the cash flows. There was no attempt to fix the cash flow problems. The fund is also a tempting source of finance for the government's new projects. About 10,000 million baht was withdrawn from the funds, instead of using the government emergency expenditure, to provide loans through commercial banks for the insured persons to rebuild their homes and lives. Several attempts to withdraw from the funds were boosted by the view that the funds, particularly reserves for old-age benefit payment, are a huge amount and should not be left "unused". In 2011, for old-age benefits amounted to 595,304 million baht, approximately 7.4% of the gross domestic product (GDP).

Pension fund is often subject to political discretion and manipulation and hence, this paper assesses the fiscal impacts of the fund if some "shocks" were to happen. In this particular case, the shock relates to the early retirement decision of contributors aged between 50 and 54 years. For instance, the one-time, large lump-sum, old-age benefit can be an incentive for some contributors to opt for early retirement. Many companies are already providing early retirement incentives for high-salary executives. Most of these executives are within the considered age group between 50 and 54. This trend is consistent with Ebbinghaus' (2006) pathways to early exit to the workforce. The country's social security practitioners are increasingly concerned about the potentially large number of early retirees in the coming years. However, there is a dearth of quantitative studies in Thailand to concretely address such impacts. Phijaisanit and Myles (2014), analysed the fiscal tolerability of the Social Security Pension Fund and found that with an early retirement rate of 9% or higher per year, the tolerability of the system can be maintained for no longer than 25 years from now. The finding is the result of employing a non-stochastic approach. This paper contributes to literature by providing a stochastic analysis, which considers the dynamics of early retirement.

This paper consists of seven sections. The second section reviews relevant issues of social security pension funds, ageing and early retirement in the context of international experiences as potential lessons for Thailand.

The third section is an overview of the Thai social security system, bringing into focus the details of the pension fund within the SSF. The fourth section discusses relevant theoretical concepts and modelling. The fifth section details sources of data and assumptions while the sixth section analyses the Monte Carlo simulation analysis. The last section discusses policy implications.

2. International Experiences on State Pension Funds, Ageing and Early Retirement

2.1 Japan

Japan's total population as of 2012 was 127.6 million. The ageing population (aged 65 and over) represent 34% of the population (International Longevity Center, 2013). The radical transformation of the Japanese population structure over one century is very interesting. Japan went from being a young nation in 1950s, to a middle-aged nation in 2000, and to a remarkably old nation by 2050. Retirement income security in Japan is supported by a two-tier universal public pension system established in 1961 and restructured in 1985, along with additional optional corporate pensions as the third tier. The universal two-tier mandatory schemes are financed on a pay-as-you-go basis, consisting of: (1) The Basic Pension Contribution and (2) The Employee Pension Insurance (EPI) and Mutual Aid Association (MAA). The first tier requires "flat-amount" contributions from all residents aged 20-59. Contributions can be reduced for low-income individuals. Individuals with a minimum of 25 years of contributions are eligible for old-age benefits at the age of 65. The second tier, the EPI, for private-sector employees and the MAA for public-sector employees, comprises the employer-based schemes with "earnings-related" contributions and benefits. The entitlement age, currently being raised from 60 to 65, varies according to the beneficiaries' birthdays. The Basic Pension Contribution, the EPI and the MAA provide benefits for people with disabilities and surviving dependents. The self-employed can voluntarily participate in the tax-preferred "National Pension Fund Scheme" as the third tier.

The 2004 reform introduced a unique financial mechanism that automatically adjusts benefits to compensate for the changing demography by offsetting two factors, namely: (1) the decline in the number of active participants and (2) the increase in longevity. Under the new system, the replacement rate of about 60% currently can be reduced to its lower limit of 50%. There had also been a law promoting employment of older people introduced since 1971, with partial revisions made in April 2006. The revised law requires employers to adopt one of the following measures by 2013: (1) to gradually raise mandatory retirement age to 65; (2) to abolish mandatory retirement age; and (3) to introduce some system(s) to ensure continuous

employment by measures such as reemployment (International Longevity Center, 2013). This is in line with the conclusion drawn by Gruber and Wise (2005) using data from Japan and 11 other OECD countries. Gruber and Wise suggest a three-year-increase in programme eligibility would reduce government net benefit payments by 27% of the current programme cost or about 0.7% of the GDP, depending on the extent of actuarial adjustment to benefits under the current provisions. Additionally, to ensure sustainability, the 2004 reform also increased the subsidy rate from general revenue to Basic Pension from a third to a half by 2009. However, securing tax revenues for this subsidy increase will inevitably be another major political agenda for future Japanese government. This is in contrast to Thai policies whereby the government does not intend to contribute to the pension fund but, instead, is tempted to bring out the fund's cash.

2.2 Singapore

In Singapore, the Central Provident Fund (CPF) is the major source of low-cost multi-functional funds established by the government in 1955 to provide for the needs of the old age. More than 60% of the workforce who are employed by the same employer for more than one month participates in the CPF scheme (Asher and Nandy, 2008). CPF has grown both in size and scope, having enlarged its domain to include other aspects of social security. Generally, working Singaporeans and their employers make monthly contributions to the CPF and these contributions go into three accounts, namely: (1) Ordinary Account (OA) for housing, pay for CPF insurance, investment and education, (2) Special Account (SA) for old age and investment in retirement-related financial products, (3) Medisave Account (MA) for hospitalisation and approved medical insurance. The Retirement Account (RA) was created using the savings from OA and SA to be accessed by those have attained 55 years of age. The RA is set up to cover basic needs during old age (Ministry of Manpower, 2012). The CPF savings earn a minimum risk-free interest of 2.5% guaranteed by the Government.

A different model from that of Japan, the social security system of Singapore limits the contribution from the state while increases the role of family, community and employer. The most noticeable flaw in the system has been, in times of economic downturn, the weakest segment of society tends to become most vulnerable since CPF does not provide unemployment benefits and the purchasing power of the funds is lost with inflation. Moreover, as the economy of Singapore relies heavily on international trade, any currency depreciation will affect the wealth of the elderly. McCarthy et al (2000) assess the responsiveness of CPF returns to changes in contribution rates using the general the equilibrium approach. Simulating alternative scenarios, it is found that the replacement rate is always less than 30% since at higher wage level, the replacement rate declines. On the other hand, the returns on housing yield

high earnings. Thus, the elderly in Singapore are said to have low liquidity but rich in asset.

As indicated above, Singapore's pension system has a single dominant pillar, which relied on the state mandated and managed saving pillar. Owing to its multiple objectives, this has enabled the government to direct the contributors' disposable income towards politically-selected objectives. However, the average balances of the CPF members remain relatively low due to high early retirement withdrawals and low real rate of return credited to member's account. Despite calls towards a multi-pillar social security, the system has remained unchanged. Instead, additional schemes were introduced with the hope the new schemes would alleviate existing problems. Some of these schemes include CPF Minimum Sum (MS) Schemes, CPF Lifelong Income Scheme for the Elderly (CPF LIFE) and policies to convert assets in other retirement accounts into the retirement account. The CPF MS Scheme provides members with a monthly income to support a modest standard of living during retirement. For members who are unable to set aside the full MS in cash, their property bought with their CPF savings will be automatically used to make up half of their MS. The CPF LIFE is a scheme that provides a monthly pay out starting from the draw down age for lifetime. This is said to be an improvement of the MS Scheme where pay outs can last for only 20 years (Ministry of Manpower, 2013).

Despite the CPF Life annuities schemes and MS Scheme providing the means to stagger CPF withdrawals or pool longevity risks, they do not fundamentally solve the problem of re-investing the massive CPF savings to ensure low yields are able to provide substantial retirement savings for elderly citizens. There remain other risks in the system with low diversification since alternative investment options and consumption for the low and medium income households are limited. Somewhat similar to the case of Thailand, the key pillar that sustain any pension or provident fund system is the trust on the public sector and the future government's ability to pay old-age benefits upon retirement. The Argentinian case showed when financial crisis hits, governments tend to draw out pension funds to smoothen the shocks (Mofett, 2008).

2.3 Some Countries in the West: Germany, United Kingdom and Sweden

German pension system consists of five elements: health insurance, accident insurance, unemployment insurance, pension system and long-term care insurance. Germany has a generous retirement system and it faces a dramatic increase in ageing population. The first tier of German pension system is the universal public-defined benefit pay-as-you-go system, mandatory State Pension Insurance. It is mandatory for every worker except self-employed and labour with small income. The system covers over 80% of the working population and the participation depends on labour market activity. The

benefit is related to individual labour market status and average earning. Prior to the reforms, the eligible age was 60 and older. There are also survivor benefits for spouses and children. Around 80% of the public pension budget is financed via payroll tax known as "social security contribution" while the government revenue supports the rest. The contribution is divided equally between employer and employee. Civil servants in Germany do not pay any contributions but their salaries are lower than the private sector employees. However, recent changes to the system imply that from 2012 to 2023, the retirement age will be increased by one month per year reaching 66 years in 2023 (Meierkord, 2009). From 2023, the retirement age will be increased yearly by two months to reach 67 in 2029. Each missing year results in a 3.6% reduction in the pension entitlement. The second tier retirement scheme is the supplementary occupational pensions, which come in different forms. The third tier is voluntary savings, which accounts for only 3% of Germany's old age retirement income (Berkel & Borsch-Supan, 2004).

Demography is a main threat to the German public pension system. It is expected that the share of the elderly would increase from 21% in 1995 to 36% in 2035. The old-age dependency ratio will be 49.2 in 2030 (Borsch-Supan & Schnabel, 1998). Berkel and Borsch-Supan (1998) employ the analysis of option value as central incentive variable using German Socio-Economic Panel data to observe the retirement behaviour of the elderly workers in Germany. The result implies that the introduction of actuarial adjustment factor changes the retirement decision. According to Borsch-Supan (2010), early retirement in Germany is very costly and increases the burden of the German public pension system as a result of an ageing population. Benefits paid to individuals aged 64 or younger are about one quarter of total benefits paid. The current contribution rate is 5%. Borsch-Supan and Schnabel (1998) show that an important reason for the large and costly early retirement in Germany is due to early retirement incentives built into the German public pension system. The attractive provisions driving workers into early retirement are not accidental side effects of the pension system design, but are explicit motivations to "make room for the young". However, in reality, this is not the case as new jobs and old jobs are different, and by allowing the old to work, would create more demands and different jobs for the young. Thus, it can be observed that the policy factor has a significant impact on putting the system back on a sustainable track. Important lesson to be learnt is for policymakers to take precautions in introducing early retirement incentives.

There are three types of pension schemes in the United Kingdom: State Pensions, Occupational Pensions and Individual/Personal Pensions. Personal accounts, automatic enrolment and the minimum employer contributions were introduced in 2012 to complement the pre-existing schemes. The state provides basic pension provision to prevent poverty in old age. Until 2010, men over the age of 65 and women over the age of 60 were entitled to claim

state pension; in April 2010, the age for women was harmonised to match that of the men. Currently, the highest rate one can get is GBP 110.15 per week. The basic state pension increases every year based on whichever of the following is the highest: (1) earnings-the average percentage growth in wages in Great Britain, (2) prices-the percentage growth in prices in the UK as measured by Consumer Prices Index (CPI) or (3) a constant 2.5% rate(Department for Work and Pensions, 2013).

Blundell et al. (2002) studied the mixed state and private pension incentive and the pattern of early retirement in the United Kingdom using a sample of individuals from the UK Retirement Survey. Relative to other counties in Europe, the UK has the highest level of private pension coverage of. Blundell et al claim the state pension scheme, the State Earnings Related Pension Schemes (SERPS), in the United Kingdom tends to have a smaller incentive effect on retirement behaviour than other countries. The state provides a flat rate contributory benefit for men over 65 and women over 60. The result shows that incentive and wealth on retirement through the pension system has significant impacts on retirement decision. The private occupational pension incentive encourages early retirement. Thus, in longer term, the retirement age for both men and women is expected rise to 68 by no later than 2046 and possibly much earlier. This is pending approval by the parliament (Department for Work and Pensions, UK, 2013).

In Sweden, the mandatory public pension systems constitute a large and important public commitment to the aged. Before the pension reforms in 1990s, they were typically constructed on the pay-as-you-go principle and are designed to provide a defined benefit from a specific pension age in countries in the Organisation for Economic Cooperation and Development (OECD). The eligible age is typically 65. In many developed countries, including Sweden, the actual retirement age is much lower due to older workers' high take-up of disability and occupational benefits. In many cases, mandatory public or occupational benefits provide little opportunity to combine work with a benefit; and as a result, older workers must choose between being in or out of the workforce (Palmer, 2002). At the same time, similar to the situation in Thailand's former pension system for government officials, the pay-as-you-go systems were threatened by increasing costs due to increasing dependency ratios. The financial instability of pay-as-you-go systems in Sweden had been resolved by changing the system design to encourage higher ratio of years of work and contributions to benefit years. More generally, pension systems should be actuarially neutral in individual choices between work and leisure. The pension reform in 1990s had converted the system from defined benefit to defined contribution along with the introduction of wage indexation linked to the price base amount calculated by Statistics Sweden. As a result of the reform, the current pension systems in Sweden are based on lifetime earnings. They are linked to the country's economic growth and have become more tolerable

to demographic changes than in the past. The pension system is financially autonomous and completely separated from the central government budget. The retirement age is also flexible. Both income-based and premium pensions can be drawn from the age of 61. They can be drawn wholly or partially. One can continue to work while drawing a pension. Anyone who has not earned an adequate pension is guaranteed a top-up guarantee pension (Ministry of Health and Social Affairs, 2012).

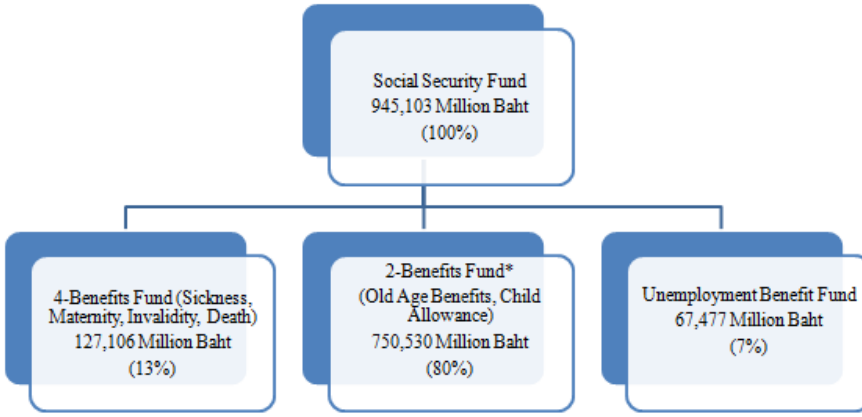
3. Overview of Thailand's Social Security System

Thailand's Social Security Office (2008) addresses the importance of the principles of social security for the citizens throughout their lifetime. The major characteristics of the Thai social security system include the following elements: (1) solidaristic approach, averaging out net costs and benefits, beginning with the formal sector with the intention of extending the scheme to the informal sector, (2) contributors contribute and are guaranteed the benefits at the expense of the cumulative reserves in the fund, (3) the contribution is considered a special tax levied on the persons identified by the law. The long-term objective of the social security system is to extend the latter to becoming a universal coverage scheme in the future.

The social security system of Thailand refers to the principles stated in Convention No. 102, which was adopted by the International Conference of the ILO on 28 June 1952. The Convention sets a framework of common and important basic social security principles on which any social security system should be based on to encourage the widest development of social security schemes. The Convention defines nine classical branches of social security and sets minimum standards for each. These social security branches include medical care, sickness benefit, unemployment benefit, old-age benefit, employment injury benefit, family benefit, maternity benefit, invalidity benefit and survivors' benefit (ILO, 2012). In Thailand, social security is organised into two major funds: Workmen's Compensation Fund and Social Security Fund.

The Workmen's Compensation Fund (WCF) provides security for employees who are injured or sick from work-related causes. The employers contribute to the fund according to the risk of such category of business at the rates ranging between 0.2%-2.0%. The Social Security Fund (SSF) is the major focus of this paper. The SSF was established in 1990 under the supervision of the SSO. The SSF initially covered four types of benefits including injury or sickness, maternity, invalidity and death. It extended the benefits to include child allowance and old age pension in 1998 and unemployment in 2004. In 2011, the number of insured persons registered with SSF was 10,499,993, covering 27.3% of the workforce and 16.4% of the population. Of these figures, there were 9,054,535 compulsory insured persons (Article 33).

Figure 1: Composition of social security fund



Source: Statistics from SSO Annual Report 2011.
* The reserve fund for old-age benefit payment amounted to 595,304 million baht

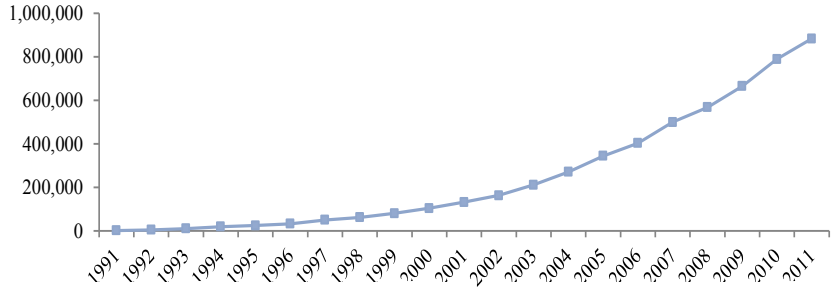
Table 1: Contribution rates for insured person under Article 30 of the Social Security Act

Type	**Benefits**	**Contribution Rate**			**Percentage Share of Government's Contribution**
		Employee	Employer	Government	
Four-Benefit Fund	Sickness, Maternity, Invalidity, Death	1.5%	1.5%	1.5%	33.33%
Two-Benefit Fund	Old Age Benefit, Child Allowance	3%	3%	1%*	14.29%*
Unemployment Fund	Unemployment Benefits	0.5%	0.5%	0.25%	20.00%
	Total	5%	5%	2.75%	21.57%

Source: Phijaisanit and Myles, 2014.
*Government's contribution only goes to child allowance, implying its contribution to the old-age benefit is 0%.

The paper focuses on the insurance cases under Article 33, covering the majority of the insured persons. Future research may consider voluntary contributors under Articles 39 and 40 (the voluntary contributors) as the SSF coverage expands. The SSF consists of three sub-funds illustrated in Figure 1. These sub-funds include the Four-Benefit Fund (sickness, maternity, invalidity and death), the Two-Benefit Fund (child allowance and old age benefits), and the Unemployment Insurance Fund. Under the normal circumstances, employers and the insured persons under Article 33 pay contributions equally at the rate of 5% of wages of which 1.5% goes to the Four-Benefit Fund, 3% goes to Two-Benefit Fund and 0.5% to the Unemployment Insurance Fund. The government pays contribution at the total rate of 2.75% of wages; 1.5% goes to the Four-Benefit, 1% to Two-Benefits Fund and 0.25% to the Unemployment Benefit Fund. The government's contribution only goes to child allowance in the Two-Benefit Fund.

Figure 2: Accumulated Contributions and Investment Return 1991-2011 (Million Baht)



Source: Investment Bureau, Social Security Office

In terms of returns-generating performance, as at 31 December 2011, the total investment amount of the SSF was 883,423.92 million baht. Of these, 755,544.91 million baht was the Two-Benefit Fund; 67,394.36 million baht was the Four-Benefit Fund and 67,394.36 million baht was the Unemployment Insurance Fund. The rest amounting to 262.24 million baht is the fund for voluntary insured persons under Article 40. In 2011, the SSF received investment returns amounting 36,062 million baht. This was generated by the interest income from bank deposits, bonds and debentures amounting 29,295 million baht; and the dividends and profits from the sale of common stocks amounting 6,767 million baht. The average investment returns during the past five years is approximately 5%. Due to the large amount of pension reserves, political institutions often consider it a possible source of finance for other public expenditures.

By 2014, the fund started paying pension benefits to insured persons who worked and contributed to the SSF for at least 180 months, completing the

requirement to be eligible for monthly old-age pensions. The analysis in the next section illustrates the expenditure and cash flows will be sensitive to the decisions on early retirement. Moreover, due to several unexpected changes of contribution rates by the government, cash flows have consistently been adversely affected. The following sections explain the theoretical framework, data and assumptions of the model while Section 6 presents the optimistic baseline scenario of how sensitive the system is to unexpected shocks, one possibility of which is the high rate of early retirement in any particular year.

4. Theoretical Foundation

The analytical framework employs Phijaisanit and Myles' (2014) application of the basics of social security actuarial mathematics in Iyer (1999, p. 15) which has its foundation from Zelenka (1958). The major theoretical assumption asserts that the number of contributors to the national pension fund will increase until an indefinite time in the future. Therefore, the social security pension scheme in this hypothetical framework is open-ended. This is analogous to the assumption that the first generation of contributors will be identical to the future generation of contributors.

One of the crucial indicators for analysing the fiscal implications of a pension system is to consider the fiscal sustainability. The variables for the analysis at time t consists of the expenditure function (in the view of the pension fund management), $E(t)$, which comprises payments of benefits to contributors, the insured salary function, $S(t)$, the contribution rate function, $C(t)$, implying the type of fund, the reserves function, $R(t)$, which is the difference between cash inflows and cash outflows subject to the discount rate, . The relationship between each function can be represented by the differential equation in Equation (1).

$$dR(t) = R(t)\rho dt + C(t)S(t)dt - E(t)dt \tag{1}$$

Equation 1 implies the change in reserves during time t equals revenue from cumulative contribution and the excess of current contributions received after deduction of the benefits paid out in the same period.

Integrating Equation (1) during interval (n,m), gives the relationship between reserves at $t=n$ and $t=m$ as shown in Equation (2).

$$R(m)e^{-\rho m} = R(n)e^{-\rho n} + \int_n^m [C(t)S(t) - E(t)]e^{-\rho t}dt \tag{2}$$

From Equation (2), $R(m)$ can be rewritten as in Equation (3)

$$R(m) = R(n)e^{\rho(m-n)} + \int_n^m [C(t)S(t) - E(t)]\, e^{\rho(m-t)}dt \tag{3}$$

If $n = 0$ and assuming $R(0) = 0$ the retrospective equation for $R(m)$ can be represented in Equation (4).

$$R(m) = e^{\rho m} \int_0^m [C(t)S(t) - E(t)]\, e^{-\rho t} dt \quad (4)$$

The equilibrium for the entire period of the pension scheme can be represented by the equivalence between the present values of revenue and expenditure. The equation can be written by assuming present value of future contribution equals the present value of future expenditure as in Equation (5).

$$\int_0^\infty C(t)S(t)e^{-\rho t} dt = \int_0^\infty E(t)e^{-\rho t} dt \quad (5)$$

Equation (5) assumes the left-hand-side and the right-hand-side of the equation will converge under the condition that, during the beginning stage the ratio $E'(t)/S'(t)$ increases from zero until a certain period of time, say $t = t^*$, the ratio becomes constant. At $t = t^*$, the scheme will have reached its financial maturity. In most cases, population maturity will be reached before financial maturity. However, if the earlier generation had been paid relatively higher benefits, financial maturity will be reached earlier. At financial maturity, $E'(t)/E(t) = S'(t)/S(t) = \sigma + \gamma$ at time $t \geq t^*$, where σ is the rate of increase in contributors and γ is the growth rate of insured salary.

Equation (5) constitutes the basic equation for considering pension schemes which will be implemented by a government, implying Equation (6).

$$\int_0^m [C(t)S(t) - E(t)]e^{-\rho t} dt = \int_m^\infty [E(t) - C(t)S(t)]e^{-\rho t} dt \quad (6)$$

Substituting Equation (4) into Equation (6) leads to Equation (7), which is a prospective equation.

$$R(m) = e^{-\rho m} \int_m^\infty [E(t) - C(t)S(t)]e^{-\rho t} dt \quad (7)$$

Theoretically, from the beginning of the scheme, it can be observed that the contribution function, $C(t)$, in any form that solves for the equilibrium function in Equation (5) and having reserves derived from Equations (4) or (7) will be the scheme that is considered sustainable in the long-run.

However, in practice, it is necessary to introduce the conditions for $C(t)$ and $R(t)$ since, if $C(t)$ is negative, it implies that the scheme is, on the net effect, paying back to the contributors. Alternatively, if $R(t)$ is negative, it means that the scheme is accumulating liabilities in paying benefits to contributors. Hence, in practice, it is necessary to set the conditions that $C(t) \geq 0$ and/or $R(t) \geq 0$ at all time period t. By imposing such conditions, and other conditions will lead to the determination of various national pension schemes in different countries.

In Thailand, the social security pension fund has the characteristic of General Average Premium System (GAPS) in which all members of the fund pay single contribution rate of 5% of their salary. The minimum salary is 1,650 Baht and the maximum limit is 15,000 Baht. In GAPS, at time $t=m$, and let $C(t) = C$ (a constant) in Equation (7) leads to Equation (8) during period (m,∞).

$$C = \frac{\int_m^\infty E(t)e^{-\rho t}dt - R(m)e^{\rho m}}{\int_m^\infty S(t)e^{-\rho t}dt} \tag{8}$$

In other words, the contribution rate equals the present value of benefits after deduction of reserves divided by insured salary during the period. To attain equilibrium in the system from the beginning of the scheme, Equation (8) can be re-written as general average premium in Equation (9).

$$GAP = \frac{\int_0^\infty E(t)e^{\rho t}dt}{\int_0^\infty S(t)e^{-\rho t}dt} \tag{9}$$

For simplification, the contribution rate in Equation (9) can be viewed as the average contribution between two groups of the population. The first group represents the first generation of contributors. The second group can be hypothesised as the future generation of contributors. Assume that $E(t) = E1(t) + E2(t)$ and $S(t) = S1(t) + S2(t)$, where $B1(t)$ and $S1(t)$ are benefits and insured salary for the first group; and $E2(t)$ and $E2(t)$ are the benefits and insured salary for the second group. Calculating the Average Premium (AP) equation for the two groups yields Equations (10) and (11) respectively.

$$AP1 = \frac{\int_0^\infty E1(t)e^{\rho t}dt}{\int_0^\infty S1(t)e^{-\rho t}dt} \tag{10}$$

$$AP2 = \frac{\int_0^\infty E2(t)e^{-\rho t}dt}{\int_0^\infty S2(t)e^{-\rho t}dt} \tag{11}$$

Hence, in this system of pension scheme, GAP can be rewritten as in Equation (12). Conceptually, GAP may be viewed as the weighted average between *AP1* and *AP2*.

$$GAP = \frac{AP1\int_0^\infty S1(t)e^{-\rho t}dt + AP2\int_0^\infty S2(t)e^{-\rho t}dt}{\int_0^\infty S(t)e^{-\rho t}dt} \tag{12}$$

With lower number of contributors relative to benefit receivers in the first stage, Equations (10) and (11) imply that the contribution rate for the first group must be higher than the second group. Hence, the relationship in (13) must hold.

$$AP1 > GAP > AP2 \tag{13}$$

The above equations show that in a pension scheme with single rate during period *t*, it is important the first group of population pay higher contribution rates in order to make the fund sustainable. Then, later on, when the second group of the population joins the scheme, the rate can subsequently be reduced and equilibrium can be attained. Hence, theoretically, such system will be able to accumulate sufficient reserves. However, such system can never be politically popular in most developing countries or many developed countries. Practical implication is that, in GAPS, despite the ease of management, the setback is that if the contribution and ceiling salary are inappropriate, the accumulation of cash inflows will be lower than pension benefit payment at the time of population maturity. In the beginning, there seems to be net inflows to the fund. This is because the full benefit payment had not yet been realised. Thailand's social security pension fund started paying regular monthly pensions in 2014. Once the regular pension payments started, along with early retirement lump-sum payment obligations, the simulation in the next section illustrates the reserves has the potential to become depleted when some unexpected events happen. In relation to this, an interesting case study in developing Asian country conducted by Giang (2008) considered the case of Vietnam pension fund. The study forecasts the ratio of liabilities of the funds for the pensioner and contributors in the pay-as-you-go system from 2005 to 2050. The result shows that the system will cause inequality across generations since the future generation tends to have to contribute AP at a rate which consecutively gets higher. Under the situation where discount rate is 3%, the GAP should increase to 17.4% of the insured salary. This rate is more than three times higher than the current rate in Thailand. However, the calculation of appropriate contribution rate for Thailand is beyond the scope of this study.

5. Description of Data and Assumptions

The forecast of the population pattern of insured persons in the Social Security System for the period 2012-2060 relies on the latest Office of National Economic and Social Development Board's 2010 forecast of the Thai population by age and sex under three major sets of assumptions. The first set of assumptions relates to fertility. The forecast assumes that in 2010, which is the base year, the total fertility rate is 1.62%. Then, from 2010 onwards, the rate remains constant at 1.62% during the first five years and gradually projected to decline to 1.30% in 2050. During the period of the forecast, the fertility pattern follows that of during 2005-2010. The female to male ratio is 105:100 during the whole period of the forecast. The second set of assumptions refers to mortality situation. The forecast assumes the average age for men increased from 70.34 years in 2010 to 75.25 years in 2050. The average age for women increased from 77.47 years in 2010 to 81.86 years in

2050. The survival rate is calculated using data from the Life Table built upon by Relational logit model using mortality pattern by age during 1999-2010, the period during which the relative ratio complies with the average age. The third set of assumptions specifies the migration situation. The forecast assumes no legal migration, or even if there is, the effect should be minimal and, thus, do not produce significant impact on the age and sex structure of the population.

Using ratios, discrepancies that may occur should be insignificant. Moreover, the statistics of unemployment rate during the past 10 years did not vary significantly around 1.6%. The increase in population during the same period is approximately 0.6% (World Development Indicator, 2010). In addition, the increase in the workforce is relatively constant remaining at around 2% and the number of increase in SSF insured persons varies around 2.6% per year. The analysis relies on the probability and risks such as the risk of not surviving until the end of the period, the risk of disability and the risk of stop working during the period and the risk of early retirement each year among others. Iyer (1999, p. 66) says the forecast can depend on a matrix which comprises chain multiplication: $n_t = n_{t-1} Q_{t-1}$ where n_t is the row vector comprising of insured persons (eg., workers, pensioners, disability beneficiaries, among others) at time *t* and Q_{t-1} is the square matrix comprising risks of changes in status of the insured person during period *(t-1, t)*.

The forecast of SSF population employed in the analysis of this paper follows the pattern conducted by NESDB, which has already integrated the risks from the Life Table using relational logit model for ages of different cohort. However, an alternative source of Life Table can be obtained from WHO Life Table 2010 and the results can vary slightly (see Phijaisanit, 2011). Other risks can certainly be considered in the future models. However, this awaits a more detailed life table for Thailand. Aside from the major statistics from the SSO and NESDB's population forecast, other macroeconomic statistics are obtained from Mahidol University Institute for Population and Social Research, World Development Indicators, Fiscal Policy Office and the Bank of Thailand.

The focus of the simulation is on the Two-Benefit Fund, which has the highest amount of fund among the three sub-funds within the SSF as indicated in the third section of this paper. Within the Two-Benefit Fund, the amount can be channelled into the two purposes, namely the old-age pension and the child allowance. It has to be reiterated the government's contribution only goes to child allowance and does not contribute to the old-age benefit. Thus, the pension fund comprises contributions of the employers and employees. The Four-Benefit Fund also has problems but will not be discussed as these are ~~but~~ not within the scope of this paper. Other sub-funds within the Social Security System provide year-on-year benefits only during work life and the excess will not be accumulated in the insured persons' accounts but goes

to the reserves for SSF expenditures. In contrast to the other sub-funds, the pension fund is cumulative and therefore, has long-run impacts on the insured persons post retirement.

In the baseline scenario analysis using Monte Carlo Simulation, the model assumes the average working age starts from 22 years (that is, the average age of receiving the bachelor's degree). For simplicity, it is assumed that no insured person will encounter disability throughout his or her work life. There will not be migration across the formal and the informal sectors as well as across jurisdictional borders. The ceiling insured salary is 15,000 Baht and increases at the rate of 1.2% per year in line with the past average inflation. There is no inflation adjustment in benefit and contribution rates throughout the period. This is another realistic assumption since, yet, there has been no attempt for inflation adjustment. The benefit and contribution rates are based on those of Table 1. To avoid complexity, there will be no benefit payment after death. This, of course, leads to an under-estimation of the benefit payments, but the model still serves its major purposes. The discount rate is 2.6% through the period. This is based on the past average. Based on the average returns in the past, the model assumes the returns from investment of SSF are 5% and the administrative costs are 10% of the total costs. There are only two risks in the model. The first is death during the beginning and the end of the year each year. As mentioned earlier, this has already been integrated in the demographic forecast. The second risk is early retirement, parameterised as "shocks" to the model. Following the SSF requirements, insured persons must be aged 55 and have contributed to the SSF for at least 180 months to be entitled to monthly pension benefits after retirement. The monthly pension rate is 20% of the average salary during the last 60 months of contribution. Each additional working year is topped up by 1.5% per year. Each year throughout the period, 60% of the insured persons retiring at the age of 55 are eligible for monthly pension benefits.

6. Monte Carlo Simulation

The function employed in conducting the Monte Carlo Simulation is derived from Equation (4) which attempts to calculate the cumulative liability of the fund reserves during the period t_0 to t_1. This can be reflected by the ratio, Φ(t), which is the net present value of cumulative reserve after deduction of benefits paid over the net present value of total cumulative reserves. Ratio calculation gives a relatively unbiased estimation of the direction than unit calculation.

$$\Phi\left(t_{t_1}\right) = \frac{e^{\rho t_1}\int_{t_0}^{t_1}[C(t)_{\sigma\alpha}\cdot S(t)_{\sigma\alpha} - E(t)]e^{-\rho t}dt}{\int_{t_0}^{t_1} 2C(t)_{\sigma\alpha}S(t)_{\sigma\alpha}e^{-\rho t}dt} \qquad (14)$$

Since the SSF employs GAPS, the contribution rate to the old-age benefit fund is 3% for all employers and employees (see Table 2). Hence, $C(t)_{\sigma\alpha} = C_p = 0.03$. The denominator in Equation (14) is multiplied by 2 because the contributions come from both the employers and employees. Equation (14) can be rewritten as Equation (15).

$$\Phi(t_1) = \frac{e^{\rho t_1} \int_{t_0}^{t_1} [C_p \cdot S(t) - E(t)] e^{-\rho t} dt}{\int_{t_0}^{t_1} 2C_p \cdot S(t) e^{-\rho t} dt} \quad (15)$$

Where:

$$S(t) = \sum\sum (1 - \mu(t)_{\sigma\alpha}) \cdot n(t)_{\sigma\alpha} \cdot S(t)_{\sigma\alpha}$$

$n(t)_{\sigma\alpha}$ = number of active contributors, sex σ, age group α at time
$S(t)_{\sigma\alpha}$ = insured salary in sex σ, age group α at time t
$(t)_{\sigma\alpha}$ = mortality risk in sex σ, age group α at time t until end of period t

Let t_p=2014 (the first year that monthly pension payment begins)

If $t < t_p$

$$E(t) = \bar{E}_p(t) \cdot \sum\sum q(t)_{\sigma\alpha} \cdot (1 - \mu(t)_{\sigma\alpha}) \quad (16)$$

If $t \geq t_p$:

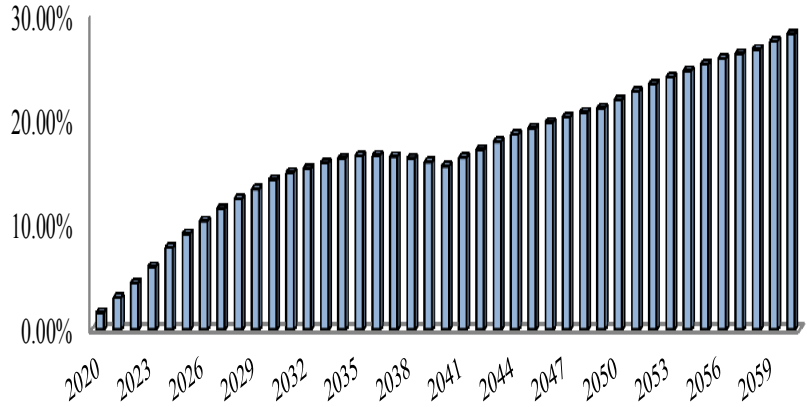
$$E(t) = E_{\sigma\alpha}(t) \cdot \sum\sum q(t)_{\sigma\alpha m} \cdot (1 - \mu(t)_{\sigma\alpha}) + \bar{E}_m(t) \cdot \rho(t)_m \quad (17)$$

Where:

$q(t)_{\alpha\sigma}$ = number of retiree sex σ age group α at time t
$(t)_m$ = number early retiree who have worked for m months at time t, where $m \geq 180$ months
$\bar{E}_p(t)$ = Average old-age benefit at time $t<t_p$

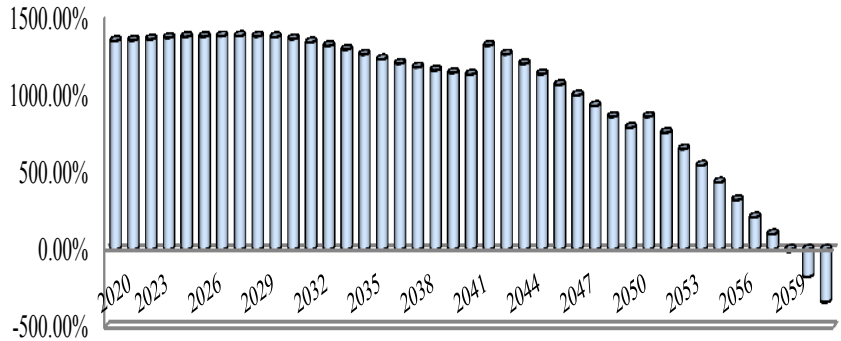
$E_m(t)$ = Monthly pension benefit at $t \geq t_p$ for pensioners having worked for m months, where $m<180$ months
$E_m(t)$ = lump-sum old-age benefit for early retirees at $t \geq t_p$ who have worked for m months, where $m<180$ months

Figure 3: Net present values of liabilities over contributions



Source: Author's calculation.

Figure 4: Cumulative reserves of the social security pension fund



Source: Author's calculation

More than 5,000 simulations conducted in this study employ the recent average early retirement rate of 5% and a standard deviation of 1%. This is within the range of the relative exit rates for men aged 55-59 during 1978-2004 in Sweden, Denmark and UK, which ranges between 5% and 20% (Ebbinghaus, 2006). Given the random changes of the percentages of early retirement of the potential early retirees (aged 50-54) in the Thai Social Security System, Figure 3 shows that liabilities will be borne approximately in the year 2020 and the fund will begin to use its reserves. Referring to Figure 4, under the baseline scenario, the reserves fund will be depleted in 2058,

about 40 years from now.

The results of the analysis show that given the current system of defined pension benefit in Thailand, the later generations face the risk of not receiving old-age benefits in full upon retirement. There is also asymmetric information of, for example, the changes in contribution rates or the SSO's long-term plan. In such open-ended fund managed by the government, it is important the initial rates should be higher to attain long-run equilibrium. However, imposing such policy can be politically unpopular. In Section 2, international experiences reveal common solutions include increasing retirement age, reducing benefit rates, increasing contribution rates or changing the system, for example, to become defined contribution system. This is another sensitive policy issue requiring a much wider public discussion on how the Thai social security pension should be restructured.

7. Policy Implications

The Monte Carlo simulation provides a stochastic analysis of how vulnerable the Social Security Pension in Thailand is to a certain "shock" parameterised by early retirement decision among the insured persons aged between 50 and 54. In congruent with the early findings, the results of the simulations emphasises the calls for a reconsideration of a more appropriate contribution and benefit rates. The Social Security Pension in Thailand employs the General Average Premium System. Theoretically, this system requires contribution rates be adjusted accordingly. Corresponding issue regarding the rate adjustments is the release of news and information. That is, contributors must be explicitly informed of their contribution pattern throughout their working life. That is, the authority should make sure that changes in the rates should not constitute as another unexpected "shock" to the insured persons and to the model. As with other countries, there had been some debates, discussion and reviews on measures to sustain the pension funds, such as the extension of retirement age in many countries (Thailand Development Research Institute, 2008). Nevertheless, no consensus has yet been achieved. Up to the present, the retirement for the SSF remains at 55 years. It is important to note, however, the retirement age extension may be able to solve the problem in the short-term by prolonging the life of the fund. However, just the retirement age extension alone does not solve the core problem of non-sustainability.

International experiences show the inflexible defined benefit system seems unsustainable, especially in times of shocks and recession. Along with the option of rates adjustment, a reconsidering of the type of pension scheme in Thailand in the midst of increasing age dependency ratio and various political constraints should be seriously considered. There are several alternatives that can be considered. One option is the defined contribution system while others suggest the notionally defined contribution system which can calculate returns by net present value of contributions plus returns on investment.

The most important factor, however, is the transparency in policy-making, the disciplines in the fund management and the use of funds are also serious issues of concern for the Thai working population in the formal sector. This also raises the question of who should manage the fund. Currently, the social security pension fund is managed by the public authority, who is not the direct stakeholder.

In terms of fiscal constraints faced by the government, the social security pension fund is one of the targeted sources for financing government's new projects. This is due to widespread belief there is more than ample supply of funds in the system, neglecting the possible shocks along the process. Through Monte Carlo simulation, this paper further asserts there is definitely no ample space for other-purpose extractions. Given the possibility of the depletion of the funds within 40 years from now or earlier if the degree of early retirement gets higher, there may not be any remaining fund for future retirees. Statistics showed a high level of current reserves in the pension funds. However, the paper illustrates that withdrawal from reserves would incur widespread loss among the households of the insured persons than the short-term gains by certain groups of the population.

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