Chapter 2   Literature Survey on Aging and Its Impact on Pension Reforms

2.1 Introduction

The objective of this chapter lies in presenting literature survey on aging and pension reforms using overlapping generations model. Overlapping generations (OLG) model which sets up aggregate consumption and saving decisions by multiple generations living in one period was first developed by Samuelson (1958) and sophisticated by Diamond (1965). In the 1970 and 80's, many of the simulation analysis on aging pension related studies were conducted by econometric models with elaborated public finance sector. However, since Auerbach and Kotlikoff (1987) who introduced OLG consumers into a general equilibrium framework, it is the OLG model that has replaced econometric models and been widely used in pension reform analysis.

First, we will present literature survey on how aging affects the economy on theoretical as well as empirical grounds. We also discuss the impact of aging on savings and investment and therefore current account balance. Then, we turn to the life cycle hypothesis, on which many simulation and studies are based. The life cycle hypothesis argues that people save when young and dis-save when retired. Is this hypothesis really valid? We will present there are so many arguments pros and cons on this hypothesis. Then, we will survey how aging affects public finance and financial market.

Through understanding the impact of aging on the economies, we will see how unsynchronized timing of aging in different countries affects other countries and how policies undertaken against aging in one country affect other countries and therefore are affected by its repercussion on other countries. These findings lead us to recognizing that it is crucial to analyze aging related issues such as pension in one country within a multi-region framework incorporating the rebound of the policy in one country on other countries.

Subsequently, we will look at available options for pension reforms and their impacts on savings and economic growth. We will argue that reform plans have to be

tailored by combining options to suit to each individual country's need and simulated to find the best mix of options.

Finally, we turn to looking into empirical as well as simulation researches on pension reform using OLG. There are many existing researches on aging and pension reforms using OLG model in general equilibrium framework. However, there are not many works conducted in a way using a forward-looking model, not a recursive one, in a multi-regional framework (multiple regions OLG/GE model). Later on this chapter, we focus on existing researches on pension reform using multiple regions OLG/GE models.

2.2 The Impact of Aging on Growth: Pros and Cons

In this section, we will look into critical issues in analyzing the impact of aging from the impact of aging on savings to that on pension systems. While some of the issues such as its impact on capital accumulation are already mentioned in previous chapters, we focus more on empirical findings than on theoretical ground on those topics mentioned before. This section also presents not only those researches which support conventional discussions on the impact of aging but also those which are against.

The prime question throughout this section is "does aging affect the economy and if so, how". Aging is defined as a shrinking share of working-age population caused by a lower fertility rate and a rising share of the elderly due to a falling mortality rate, which implies an extension of life expectancy. Many studies have been conducted to investigate the relationship between aging and economic growth and found statistically significant positive relationship that per capital GDP growth is positively associated with the share of working-age population and negatively with that of the youth and the elderly (IMF 2005; Kelly and Schmidt 2001;Bloom and Sevilla 2001).

This is because of the direct impact of smaller labor force as a consequence of a slowing population growth. Aging weakens the growth potential of the economy due to smaller labor force on the supply side and lower investment demand in the economy on the demand side due to slow-down of the market growth.

2.2.1 Impact on Savings

41

Moreover, one of the reasons for positive statistical relationship between aging and per capita GDP growth is attributable to the impact of aging on savings. People have stable incomes during their working-age while they have no labor income after retired. The life cycle hypothesis (LCH) points out that people smooth down their consumption by intertemporaly transfer of savings. Namely, households save during working-age and dis-save after retirement. As the share of working-age population expands, savings increase, which accelerates capital accumulation and leads to a higher growth. On the other hand, as the share of the elderly rises, savings of the economy fall. As a consequence, capital accumulation decelerates and therefore economic growth slows down[1].

The impacts of aging on the economies chiefly stem from its adverse impact on savings, based on the life cycle hypothesis (LCH). Many econometric studies including Graham (1987), Koskela and Viren (1992), Mason (1998); and Miles *et al*. (1999) using cross-section data of OECD countries finds statistically significant correlation between saving rates and aging.

However, regarding the relationship between old dependency rates and saving rates, the research by Loayza (2000) also using cross-country OECD data indicates that the sign between them is minus but the relation is not statistically significant. Attanatio (2000), Gregory, Mokhtari and Schrettl (1999) and Weil (1997) based on the dataset including developing countries detected no statistically significant correlation between aging and saving rates and did not observe decline in saving rates. In addition, most of the researches using individual developing country data find no statistically significant relation between aging and saving rates.

One of the reasons why statistically significant relation is not detected using developing country data is attributed to a lack of social safety net such as welfare institutions and insurance. That is why people still are very cautious about spending even during the retired period. Moreover, in developing countries, income inequality and income growth affects saving rates. In fact, Jorgensen (2010) finds that saving behaviors are differentiated by income levels. According to his study on Brazil, the poor defined by income per day less US$ 2 save less than the non-poor and different saving behavior intensifies during the retired period. He therefore implied that amelioration of income

---

[1] There are many statistically significant studies on this aging- saving relation., including Bosworth and Chodorow-Reich (2007) which find a statistical correlation between aging and national savings based on panel data for 85 countries during 1960-2005.

inequality and rapid rise of income levels could dominate the adverse impact of aging on saving in case of Brazil.

Generally, statistical evidences out of cross section and panel macro data using advanced counties support that savings increase in tandem with the share of working-age population while microeconomic data based on households and individual country data do not support that savings decrease as the share of the elderly rise (Poterba 2004).

2.2.2 Is LCH valid?

What factor functions against the LCH? Here are some theoretical implications. First and broadly recognized reason for the failure of LCH in explaining why the elderly do not reduce savings is bequest. Assuming inter-generational altruism, the elderly leave their wealth and incomes including pension benefits to the younger generations. As a consequence, savings accumulated during working age period are not run down by the elderly even after retired. This type of inter-generational transfer is often practiced in developing countries where multiple generations usually cohabit. Jorgensen (2010) argued based on his study in Brazil that older generations of the family transfer their wealth in the form of in-house transfer, which is mostly derived from pension benefits. He also finds that in-house transfer can be observed in many other countries in Latin American region, which have a generous pension benefits[2].

Another reason which calls LCH into a question is pre-cautionary savings. As population age, life expectancy and uncertainty about the timing of death increase. In response to longer retired period and higher uncertainty, people save more when they are young and do not run down their savings in preparation for possible medical and health related expense even when old. There are some empirical evidences at micro levels (Hurd, 1990) and macro levels (Bloom el al., 2003) that the higher life expectancy increases saving rates.

Another reason lies in the negative relationship between a fertility rate and women's participation to labor force. Women allocate their time between raising children and works. As a fertility rate falls, women would allocate more time in work, which would have been spent on raising children, otherwise. As a result, falling fertility rate

---

[2] This is another form of Ricardian equivalence proposition. Parents who care about their children save their pension benefits and leave them to their children, allowing children to pay pension contributions without changing parents' consumption level. This off-set and nullify inter-generational fiscal policy.

pushes up women's labor participation and contributes production, leading to higher growth. As a consequence of higher growth and income, saving rates even rise in transition of aging. Moreover, in response to a longer period of the retired life, it is possible that the households increase savings, which contradict the insight of LCH.

Questions on LCH also come from statistical relation between aging and savings. That is while many empirical studies suggest statistically significant relationship between aging and savings, many of them do not indicate causality between them in a way theory traditionally suggests. In fact, some of the empirical researches on individual counties do not support causal relationship that aging leads to lower savings while many cross country studies support (Jorgensen 2010).

2.2.3 Impact of Saving on Investment

So far, we have seen the impact of aging on the economy implicitly assuming that rising saving rates fuel domestic investment. Does saving prop up investment? Feldstein and Horika (1980) find that domestic savings and investment are highly correlated based on their researches on OECD countries where capital mobility is close to perfect. Attanasio (2000) and Orazio (2000) also analyzed causal relation between saving and investment and both find statistically significant and robust causal relationship among saving, investment and economic growth.

However, it is also argued that most of the researches supporting the statistical correlation among aging, saving, investment and growth are based on the data before 2000. In those days, international financial markets were not as developed and integrated as now. Capital accounts were already liberalized in OECD countries with virtually no restriction on international capital mobility. Therefore, as Feldstein and Horika (1980) and Attanasio (2000) and Orazio (2000) assumed, there was no regulatory friction in capital mobility. However, that does not guarantee that capital were perfectly mobile in those days since integration of international financial markets was helped by globalization of financial institutions such as banks and development of IT technology, which was missing before 2000.

In addition, there are many restrictions on capital account especially in developing countries. In fact, it was after the year 2000 that developing countries have started liberalizing capital account transaction of the BoP. Now, the world is globalizing and capital move instantly from one country to another beyond boundary. Hence, it is

possible that domestic savings no longer play as critical a role in promoting investment and therefore growth as before. Therefore, there still remains a question about the validity on one to one relationship between domestic savings and investment even through it was statistically supported in the past.

Even if domestic savings are still important for investment, growth is highly complex phenomena and not uniquely stemmed from capital accumulation. In fact, regarding the relationship between working-age population and growth, which are not very controversial, many studies have pointed out that demographic changes have to be supported by institutional development and appropriate policies in order to fully materialize its impact on the economy. Some researches (Lee, Masonand Miller 1997;Williamson 2001) found that open and competitive market, basic education, fiscal discipline and financial market development are behind successful absorption of demographic dividends by East Asian countries where savings rose in proportion to the share of working age population. Conversely speaking, it is not straightforward that aging necessarily reduce saving and investment.

2.2.4 Impact on Investment

Turning to the impact of aging on investment, empirical studies support that investment is positively related to the share of the young in the population (Higgins 1998). Countries with demographic structure relatively young have a higher demand for investment for development of human capital and infrastructure investment. As the population ages, however, the labor force grows more slowly and the level and composition of investment shift in line with the demands of the elderly such as demand for medical facilities. On the other hand, there is a counter argument that longer life expectancy incentivizes investment in human and physical capital, accelerating economic growth. This is because returns from investment improve if people live longer.

As we have seen above, there are many arguments regarding the impact of aging on the economy. Understanding how demographic change affects the economy such as saving and investment is far from complete. In fact, aggregate saving and investment will also be significantly influenced by other factors[3], including policies and business-cycle conditions. However, while there are uncertainties about the reactions of saving and

---

[3] For example, the rich save more than the poor. The larger the size of the rich cohort, the lager the savings. Empirical studies support that inequality is positively related to precautionary savings. Improvement in income inequality increase savings.

investment as the demographic transitions unfolds, it is fair to conclude that households are expected at least at an aggregate level to respond according to the broad predictions of the life-cycle model as a number of empirical and theoretical researches suggest.

2.2.5 Impact on Public Finance

Apart from the impact of aging on economic growth, the issue of aging also warns its negative effect on public finance. Firstly, as the population ages, medical and health related expenditures of the governments increase while its revenues decline due to slower GDP growth. Secondly, under Pay-As-You-Go (PAYG) pension system, the number of pensioner rises as the population ages while that of the contributor falls. As a consequence, aging is expected to deteriorate fiscal balance unless appropriate policies are undertaken.

Adverse correlation between aging and fiscal balance is broadly recognized and warned by many studies (Heller 2003 and Casey and others 2003) as well as policy makers including international institutions such as IMF and OECD. However, the impact of aging on fiscal balance does not stop within public finance but go far beyond through how the deficit of the fiscal balance is financed. If the deficit is financed by raising tax or contribution, then, it would discourage labor supply and be detrimental to growth. Financing by cutting government expenditure will lose fiscal space available for pro-growth public investment or fiscal policy undertaken during the downturn of the business cycle. Bond financing for deficits will boost up interest rates and bring down the economy on top of aggravating inter-generational equality as a consequence of bond financing.

2.2.6 Impact on Financial Market

Academic literature has recently and increasingly paid attentions to the impact of demographic changes on financial market. It has been pointed out that the stock market boom in the 1980's of the US coincides with a shift of the baby boomer into their prime saving years, i.e., age 40 to 64. This argument implies downward pressure on the equity prices when the US baby boomer retires and starts to liquidate their financial assets. This is called "Financial Market Meltdown." Empirical literature supports statistically significant correlation between the proportion of high saving population cohort and asset

prices implying that aging could cause real asset price down (Bergantino 1998; Davis and Li 2003; and Geanakoplos, Magill, and Quinzii 2003).

However, Poterba (2004) argues that statistical tests used in these researches are based on the few effective degrees of freedom in the historical record of age structure and asset returns have limited power to detect such effects. There seems a correlation between asset levels and the population age structure. Once again, however, the results from these researches are sensitive to choices regarding econometric specification. It seems that these empirical findings offer weak supports, if so, for the view that asset prices could fall as the share of the elderly rises. On the whole, empirical and theoretical works provide that a correlation between asset prices and aging is not very clear and there could be many other factors operating behind the correlation. The issue of Financial Market Meltdown also has significant ramifications on the economy including savings and growth, however.

2.2.7 Impact on Current Account

Aging has considerable impact on both investment and savings, which proposes that the current account balance is also affected by aging and varies during the different stages of a demographic transition. Theoretical literature suggests that countries with population relatively young should face current account deficits, as investment demand outstrips domestic saving. As children age, fertility rates decline, and life expectancy rises, the ratio of active workers to the total population increases, which in turn results in saving increasing faster than investment. Therefore, as economies go through a demographic transition, current accounts of those countries should be in surpluses. Eventually, as population ages and savings fall, the net impact on current account becomes negative, (Higgins1998 and Bosworth and Keys 2004). On this account, aging in one country affects international capital flows and therefore current accounts of other countries[4].

The impact of aging on international capital flows poses interesting discussion. Namely, demographic change in one country will have impacts on other countries. On the globe, while rapid aging is under way in some countries such as EU, Japan and China, working-age population is still growing in another set of countries such as India and African countries. Unsynchronized timing of aging creates saving surplus in the former

[4] According to Higgins (1998) and Helliwell (2004), about half of the demographic effects on national saving are matched by changes in domestic investment with the remainder altering the saving-investment balance.

set of countries on one hand and saving shortage in the latter set of countries. This non-synchronization of aging in different countries may help countries in different stage of aging help each other if capital move from those countries in surplus to those countries in shortage.

McKibbin and Nguyen (2004) argue that as populations in fast-aging regions pass through their high-saving years, they may invest part of their additional saving in regions where labor forces are larger and the rates of return on capital higher. As these populations then move into retirement, this capital should then be repatriated to finance retirement. These capital flows play an important part in the global adjustment process by allowing residents of regions that are aging at different speeds to borrow and lend to each other. These capital flows cushion the impact of demographic change relative to the case of a closed economy. Or, at least, under the world rapidly globalizing, it is essential to pay attention to capital movement caused by non-synchronization of aging in different countries.

2.2.8 Aging and pension reforms?

How does pension system come into the aging picture above? Pension system has considerable ramifications on the impact of aging on the economy. Firstly, the statutory retirement age, which is usually the age of receiving pension benefit, affects saving rates of the economy. When population ages, life expectancy improves. If working life increases in proportion to life expectancy, there is no effect that aging has on saving rates.

However, the pensionable age does not usually keep up with longevity of life expectancy. This is because firstly frequent adjustment of pensionable age is politically as well as operationally almost impossible once the retirement age is set[5]. Secondly, it takes time for the corporate sector to adjust retirement age of their employee to the changes in pensionable age[6]. This means that no matter how long life expectancy becomes, the pensionable age remains the same. As a consequence, people stop working at pensionable age. This generates a sudden drop in incomes of the worker as well as their savings. In case of the countries which have no public pension system, people stay longer in the labor market as life expectancy improves. Therefore, aging has only modest impact on saving rates and labor supply.

---

[5]In some countries, autonomous adjustment of pensionable age to life expectancy is already designed in the public pension system.

[6]Another reason is that labor unions are usually against postponing retirement age.

The level of pension benefits also encourages workers to retire at pensionable age even though they are still healthy and able to work and therefore affects savings as well as labor supply. If the pension benefit is high, this is dis-incentive for workers to stay in the labor market and incentive to retire. The level of pension contribution also has impacts on savings and labor market in a similar manner as tax, discouraging workers to stay in the labor market. In fact, some economist argues that it is pension system that creates distortion in saving behavior and labor market.

2.3 Pension Reform

2.3.1 Types of pension system

Before moving to survey, we briefly review pension system in this section. There are five types of pension system, each of which is not mutually exclusive.

(A) Fully Funded (FF)

This system is financially backed up against liability of the future pension claims with contribution payments of plan participants. The amount of benefits is determined on the total sum of the collected contribution by the participant and earning from the accumulated contribution invested in financial markets. Therefore, the system is always in balance and financially resilient to external shocks. The financial sustainability is very high on the other hand[7].

This is another form of saving. The system has virtually no impact on the economy as long as the ratio of contribution to income is lower than saving rates. If it is higher, then, the system can contribute to raise saving rates and accelerate capital accumulation and growth.

However, in many cases, the pooled funds are invested in financial markets and therefore sometimes subject to investment risk, which implies that benefit level varies and is not predictable in advance. Moreover, institutionalizing this FF requires fairly developed financial markets and is operationally difficult to apply the system to all the

---

[7]Holzman and Palmer (2006) points out that the FF also contributes to development of financial market.

countries. Since the level of benefit depends on the state of financial market, the FF does not always offer adequate level of retired income nor is its benefit level predictable for the participants. Unless he or she pays the contribution, he or she will not be able to receive the benefits. Therefore, the system is not very appropriate as a social protection for immediate use.

(B) Pay-As-You-Go (PAYG)

This is the pension system widely adopted in many countries, in which the benefits to pensioners are financed by the contribution collected by working-age population. No reserve fund is accumulated, as is the case with an employer provided defined-benefit plan Therefore, it is basically inter-generational transfers administered by the government. The amount of the pension is determined by the number of years worked and the wage or salary received in the last years of work and therefore the predictability of the system is high[8]. In addition, the system is progressive to the income level of the contributor and has income redistribution function. Moreover, the system is applicable for immediate use as a social wide protection.

On the other hand, financial sustainability is coherently sensitive to the demographic structure, namely aging since the liability and assets depend on elderly and working-age population, respectively. Furthermore, since the deficit of the system is fiscally financed by tax or government bonds, the fiscal burden of the system is also very high. Therefore, the impact of the system on the economy is high.

(C) Defined Contribution (DC)

The level of the pension contribution in DC is set in terms of fixed proportion to salaries. The collected contributions are pooled as fund and invested in the financial market. Meanwhile, the system does not promise the level of benefits, which depends on the total sum of the collected contribution by the participant and earning from investment. The system is financially sustainable and robust to external shock. Therefore, the system is resilient to aging. However, the system does not necessarily function as an old age income security.

---

[8]Predictability of the system is critical for pensioners since pension benefits is part of their income during old age.

(D) Defined Benefits (DB)

This system is the form of pension provision widely adopted in many countries together with PAYG. The level of the pension benefit is fixed in terms of amount or in proportion to their wage when they are active in labor market while its contribution level varies depending on the financial state of the pension system account. Since the benefit level is fixed, predictability for the pensioners as an old age income security is very high. However, the system is not financially very sustainable or resilient to external shocks such as aging.

(E) Non-financially Defined Contribution (NDC)

This system is basically the same as PAYG. The difference lies in the individual account created in the system and benefit levels are determined in proportion to the level of the collected contribution by the pensioner. In the PAYG system, no matter how much contributions she pays, the benefit level is the same as others, which discourage participants to pay. As a consequence, the collection rate is low. The NDC system incentivizes participants to pay contributions by linking the contribution and benefits and improve the collection rates, which is a shortfall for PAYG system.

There are mainly five types of pension systems as above. However, most public pension systems are combinations of defined-benefit (DB) and Pay-As-You-Go (PAYG) plans under which the amount of the pension is determined by the number of years worked and the wage or salary received in the last years of work. The PAYG/DB is considered as extremely sensitive to demographic shock, namely, aging.

Aging has a direct financial impact on PAYG/DB plan. The pension bill in PAYG/DB plan has to be equal to the contribution paid by the employed. Aging increases the ratio of pensioners to employed and makes the pension account into deficit unless the benefit level is adjusted accordingly[9]. In fact, pension expenditures rose by 3½ percentage points of GDP over 1970–2010in advanced economies and by 1½ percentage

---

[9]The benefit level is fixed in PAYG/DB.

points of GDP over1990–2010 in emerging economies, pension spending now accounts for about one-fifth of primary total spending in both advanced and emerging economies.

The deficit is usually financed by the government out of an increase in the payroll tax or the issuance of bonds. In many industrial countries, payroll tax rates have already been raised substantially over the past 40 years[10].In addition, a rise in payroll tax to keep pension plans financially viable have brought about labor market distortions, especially in Europe and have compounded the aging problem by deteriorating labor force participation rates. Average age of withdrawal from labor markets substantially dropped in European countries from 1960 to 2000 (IMF 2004).

Against upcoming rapid aging, pension bill in industrial countries are projected to increase by more than 10 percentage points of GDP unless pension reforms are undertaken (Catalán, Guajardo; and Hoffmaister 2007). With the already large size of public debt, financing pension deficit by issuing government bonds is not advisable in considering its adverse impact on financial markets and inter-generational equality. Therefore, pension reforms are imminent needs not only in terms of fiscal consolidation purpose but also for pensioners. Pension reforms can also avoid the need for even deeper cuts in pro-growth spending, such as public investment. Pension reforms can also boost potential growth if appropriately designed.

2.3.2 Types of pension reforms

As we have seen above, aging in industrial countries is seriously affecting their PAYG/DB pension plan up to the point that there is no way to raise tax rate further higher. In response to the pension system rapidly losing its viability, not only industrial countries such as EU and Japan but also developing countries in anticipation for future crisis in their pension system are looking for reforms of their pension systems.

On-going pension reforms are mainly divided into two kinds. One widely enacted in many industrial countries is parametric reforms, under which the existing system remains in place but its parameters such as the pensionable age, benefit levels and contribution level are changed. Another one is structural reforms, where a new kind of arrangement, such as an individual account system, is introduced.

---

[10] These increases were necessary due in part to what is known as the maturation effect, whereby the average contributory period of new retiree increases as the plan ages. However, much of the tax increase can be attributed to the rise in the ratio of pensioners to employed, i.e., aging.

Regarding options in parametric reforms, the payroll tax in many countries is already high, and raising tax rates further is expected to distort the labor market. This leaves pension reductions, which can be achieved in various ways. One way is postponing the pensionable age, an option that can be justified on the grounds that people live healthier and longer. This option, however, requires that people around the retirement age to be able to work. This option also requires both changes in employer attitudes and practices and labor market reform. A second option is to index the pension benefits to consumer prices rather than wages, as is done in the United Kingdom.

In either case, parametric reforms reduce the implicit rate of return of the public pension system. Therefore, reforms may result in lower saving rates. On the other hand, structural reforms may succeed in increasing saving rates. Structural reforms shift pension systems from PAYG/DB to fully funded (FF) or defined contribution (DC), which is synonymous with privatization of the pension. Privatization establishes an individual account for each participant in the public pension system. Part of the participant's current contribution is diverted to this account and are invested in financial markets in a way that the reform establishes. Upon retirement, these funds and their accumulated earnings can be withdrawn on monthly or annual basis[11]. Individual accounts, i.e., FF/DC, can replace the old public pension system, i.e., PAYG/DB, in its entirety.

The purpose of the pension lies not in promoting saving, investment and economic growth but in social protection while minimizing the detrimental impact of aging on public finance. Hence, the question is how the pension system is designed to be at least neutral over aging if not pro-growth. From this point of view, available reform options have to be combined to see which mix of options works best to individual country's need for pension reform stemming from aging. Achieving this goal, the reform plans have to be tailored in order to suit to each individual country and also simulated incorporating all the aspects of aging and pension reforms to see how the reform plan work.

2.4 Survey on Pension Reform using OLG Model

---

[11]This fund and earnings can be used to finance the purchase of an annuity if annuity markets are available.

One of few researches conducted by multi regions OLG/AGE models on pension reforms is the work by Philippe Karam, Dirk Muir, Joana Pereira, and Anita Tuladhar (2010), hereafter, KMPT (2010). KMPT (2010) used a large scale world macro model with stochastic elements, GIMF, developed by International Monetary Fund, hereafter IMF. It is a multi-region general equilibrium model with stochastic terms in some variables including technological progress. The model basically consists of 6 regions and countries, i.e., USA, EU, Japan, emerging Asian countries and the rest of the world. There are two sectors in production, i.e., intermediate goods and final goods. The OLG consumers live 20 periods with 95% of annual survival rate.

The model is a forward looking type but not perfect foresight. The agents can foresee only ten years ahead for their decision making in optimization, which makes real interest rates less sensitive to the shocks, adjusting slowly. Labor productivity declines by 5% every year, which makes consumption patterns in a way of life-cycle type.

There is a link between fiscal balance and real interest rate in a way that deterioration in fiscal position leads to a rise in real interest rates and therefore, adversely affects economy growth. The model has a Taylor rule type reaction function and capital adjustment cost so that it functions the impact of monetary policy in a short-term and that of fiscal policy in a long-term can be analyzed. Furthermore, liquidity-constraint households account for 20% of households in industrial countries and 50% in Asia, which enhances the impact of fiscal policy. Steady state pension balance in each region is given based on the state of the economy, fiscal balance and demographic structure of the region.

Using GIMF, KMPT (2010) analyzed three cases of pension reforms, i.e., raising contribution rates, decreasing benefit levels and extending retirement age, applied to individual region as well as the case that pension reforms are implemented in an internationally concerted way. Raising contribution rates led to a fall in disposable incomes of working-age population, a contraction in labor supply and a decrease in production on supply side. Consumptions decreased due to a fall in disposable incomes, which resulted in a weaker demand on demand side. In case of cutting benefits, household increased savings during working periods in anticipation for a fall in post-retirement incomes. Saving increase together with lower real interest rate due to improved fiscal balance accelerated capital accumulation and stimulated growth.

Extending retirement age in USA, EU and Japan had a direct effect on fiscal position, i.e., more contribution and less benefit. Apart from that, a longer life after

retirement induced labor to stay in the labor market. As a consequence, an increase of labor supply in a short term pushed up life time labor income and therefore consumption, leading to a surge in economic growth. Despite of a positive impact of improved fiscal position on real interest rates, an expansion of consumption will push up inflationary pressure, which ends up with tightening monetary policy. Therefore, real interest rates will even rise, inducing capital inflows and aggravating current account.

Based on those findings above, KMPT (2010) concluded that among three pension reforms, extending a retirement age among three reform options is the most effective in view of its impact on growth while minimizing adverse and distortional impacts of reforms such as that on labor market. Its impact on debt reduction was limited compared with the other two options. KMPT (2010) also found that a synchronized reform among multi regions was more effective than individual reforms. These observations are consistent to the outcomes of econometric researches such as Andersen (2008).

This model assumes that all the regions and countries have PAYG pension system. Structural pension reform such as shifting to FF/DC is not designed in the model. Moreover, an improvement in life expectation and pension coverage, which are expected to be observed in large developing countries such as China and India are not incorporated in the model.

Another work on pension reform by a large scale world model is conducted by INGENUE model built and managed by CEPII (2001). The INGENUE covers EU, North American block, Japan, Asia (China, Korea and Russia) and the rest of the world (India and Latin America) with 15 generations (5 years for one generation). Technological progresses and labor supply is exogenously given. The economy produces one goods and one financial asset. The model used UN population projections up to 2050 and computed population in a way that population growth will be zero as of 2100. The life cycle hypothesis is incorporated into the model so that rapidly aging countries like Japan initially export capitals but import them in the later period of projection.

The model was applied to analyze the impact of three reform options and obtained almost the same outcomes. Firstly, reducing benefits raise savings during working age period and increases capital accumulation as observed in KMPT (2010). Raising contributions discouraged savings and led to slow-down of growth in comparison with base case scenario.

55

In case of extending a retirement age, savings fell in a short-term due to shorter post-retirement period while life time income increased due to longer working life. Relative share of the working age population gradually increased and pushed up demand for capital and increased capital accumulation. A fall in savings and rise in investment resulted in deterioration in current account. As a consequence, as aging advances, these countries tend to import capita from slowing aging countries and region, which mitigates the adverse impact of pension reform in rapidly aging countries and regions.

There are some researches on pension reform by a small open economy model. Nickel, Rother and Theophilolou (2008), hereafter NRT (2008), used two-country OLG/AGE model to analyze pension reform in EU area. Since this is an open model, interest rate is exogenously given. The fixed survival rate is incorporated in the model. Productivity is assumed to decline gradually. The findings by NRT (2008) are almost the same as KMPT (2010) and CEPII (2001). They concluded that while they address advantages of extending a retirement age, their policy recommendation is a combination of three reforms in accordance to the character of the economy. Particularly, they also found that reducing tax on investment could be offset the adverse effect on growth by saving falls.

Shimazawa and Koguro (2011) also analyzed pension reform with special emphasis on the difference in speed of aging using a small open OLG/AGE model. They found that the difference of aging between two countries affected direction and speed of the capital flows among two countries, which could mitigate the adverse impact of pension reform. They also found that the positive impact of pension reform is more significant in case of an open economic model than a closed economic model stemming from more efficient allocation of capital in an open economic model than a closed economic model. Similar findings are observed elsewhere. Luhrman (2001) showed that it is the difference in speed of aging among countries rather than aging itself that accelerates capital flows among countries.

Heer and Irmen (2008) investigated the impact of pension reform in the USA with endogenous growth for the period from 1950 to 2400. The agents start dying at a constant rate and everyone in one generation die at 75. The model produces two goods with endogenous labor-saving technology. In this model, due to aging, capital-labor ratio (K/L) improves and relative factor price (w/r) falls. This increases investment to induce technological progresses in a way to save labor which is expensive, raises productivity

and improves growth. Therefore, as aging advances, savings increases rather than decreases as widely observed in non-endogenous growth type model.

Heer and Irmen (2008) analyzed three pension reform options and found quite different outcomes in case of extending a retirement age while the outcomes were the same for the other two reforms. In case of raising contribution rates, labor supply fell and therefore life time income declined. As a consequence, savings decreased which decelerated capital accumulation and therefore slowed down growth. Lower benefit level induced a rise in savings and therefore accelerated growth. Extending a retirement age dis-incentivize savings because of shorter post-retirement period. However, longer working life increased life time incomes and savings, which dominated overall impact of extending a retirement age on savings. An increase in savings on the top of higher level of labor supply accelerated economic growth. Among three reform options, cutting benefits is the most desirable according to their conclusion.

Another interesting study by Attanasio, Kitao and Violante (2007) compares pension reform with respect to demographic changes in a closed model with an open model. Their model consists of the South and North regions. The South has a lower old dependency ratio, less than the half of the North, and is slowly aging while the North has a higher old dependency ratio and is rapidly aging. However, old dependency rations are to converge in 2100. The North has PAYG system while the South does not. The Fully Funded pension plan is incorporated into the North. The PAYG is dismantled and taken over by the FF in 2015. The so called "recognition bonds" are granted up on retirement to those PAYG participants who retire after 2015. This recognition bonds are to be paid by the government through wage tax, consumption tax and debt.

Parametric reforms, raising contribution rates, issuing debts, cutting benefits and increasing retirement ages are simulated using both a closed and an open economy model. The study find that thanks to the capital flows from the South, the North accumulates capital faster in the open economy model than the closed economy model. Accordingly, interest rates decreases and wage increase due to larger GDP than the closed economy model. From fiscal view-point, all the reforms result in higher labor income tax revenues and lower capital income tax revenues. Therefore, the path of fiscal variables stays almost the same between the closed and open economy models.

Structural reform in the North shifting from PAYG to FF gives different pictures from the parametric reform cases. In response to pension reforms, households in the North accumulate savings more in the open economy model than the closed

economy model as the PAYG is slowly phased out. This accumulation in savings and capital flows from the South generate a substantial decline in interest rates in both regions. As a result, the path of interest rates and wages turns out to be quite similar in both closed and open economy models while the absolute levels of impacts are different between closed and open economy models. The impact of the reform is smaller in closed economy model than open economy model. This difference stems from capital flows from the South into the North when domestic savings are low, which helps the North accumulate capital and grow faster.

2.5 Conclusion

We have conduced literature surveys on the impact of aging and pension reform with emphasis on OLG/AGE framework. We have learned that the conventional relationships among aging, growth and savings are broadly recognized. However, its causal relation is not robustly established. The pension system complicates the impact of aging on the economy further. When retirement age keeps pace with life expectancy, aging reduces savings. However, if the retirement age remains the same, longer life expectancy is likely to increase savings. The impact of extending retirement age is also complex. Extending retirement age is expected to reduce saving needs on one hand. However, the impact of increased life time incomes and labor supply may help savings increase. Therefore, we need to incorporate those contrasting effects in order to conclude the impact of aging in one countries on others, which is possible only in general equilibrium framework

In the latter half of this chapter, we have looked into the pension reform studies using OLG/AGE. Most of the studies on the impact of pension reform have similar outcomes. However, observing researches previously conducted, there are some areas not well discussed or exploited and left for further study. Firstly, the assumption for fixed coverage of the pension system in the total labor force is reasonable in industrial countries where the system is mature. However, it is not in developing countries where the coverage of the pension system is still very low and most likely in future to rise in developing countries. This may affect savings directly and indirectly through its impact on consumption. It will also have influences on public finance in developing countries. Secondly, the impact of longer life expectancy is not incorporated in most of the models.

Life expectance in developing countries are rapidly increasing and expected to continue to increase further, which has a complex impact on savings, labor supply, public finance and therefore current account. Thirdly, not many models are equipped with bequest. Savings affects savings and more importantly the mechanism of the Life Cycle Hypothesis. So, incorporating bequests is believed to have significant influences on all the outcomes. Lastly, there are not many empirical studies in the areas of the impact of structural reform despite the fact that many of the emerging countries now introduce FF/DC pension plans. Shifting pension system from one to another is extremely difficult operations in model building. However, it is most discussed political decisions. If it is possible, its outcomes will have sizable political implications.