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# Analysis of Savings Behavior after a Pension Reform from a PAYG to a Fully-Funded System in Asian Emerging Economies

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#### Abstract.

Pension systems in Asian emerging economies are under great pressure to conduct important reforms in response to declining growth rates and population aging. Our analysis aims to investigate how a shift from a PAYG to a fully funded pension scheme would influence household savings. Our analysis is focused on China, Thailand and the Philippines. We use a standard two-period OLG model with heterogeneous labor productivity and contrast the results to a framework where agents behave altruistically towards their parents. The latter is typical for the rural population in Asian emerging economies where intra-family wealth transfers represent an important share of old-age income. The individual's response in terms of savings and gifts is highly correlated to the respective discount factor. In a stable political environment, we find that a fully funded scheme partially crowds out individual savings and gifts for both high and low skilled agents. Introducing strong disincentives to save does not change the trend with respect to high income earning individuals. Less productive agents, however, who gain access to formal old-age social security for the first time, tend to borrow against their expected pension benefits, and increase their gifts to the older generation.

Keywords: Household saving, saving determinants, labor heterogeneity, ascending altruism, Asian emerging economies, pension reform, PAYG, fully-funded

JEL: H55 (social security and public pensions), H31 (household), E21 (consumption, saving)

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# 1 Introduction

A generous basic state pension is the least a civilized society should offer those who have worked hard and saved through their whole lives.

- George Osborne

Current institutional pension systems can be assigned to two major categories. Most Western European retirement systems, for example Spain, France and Germany, rely on a tax financed Pay-As-You-Go system (hereafter PAYG). Taxes imposed on the current working generation are used to finance the retirement benefits paid out to the current old generation. A fully funded system, is a form of forced savings, and requires the individual to accumulate private wealth in order to finance his/her own retirement.

Population ageing and the upcoming retirement of the large cohorts of the 'baby boomers' generation have generated widespread concerns about the financial sustainability of PAYG systems. Some researchers (Feldstein, 1999) argue that a fully funded system has an absolute advantage over a PAYG system when dealing with the problem of an ageing population. Following the World Bank's Multipillar Model (refer to Appendix II for a detailed description), many Western European countries have added complementary, funded individual accounts to their established PAYG systems during the last decade (Fanti, 2009; for Spain see Sanchez V. et al., 2010).

Being exposed to similar threats with respect to population ageing and a general slowdown in economic growth rates, we expect similar reforms to take place in Asian emerging economies in the near future. China has already launched a reform in 2005, in order to extend coverage for the rural population and to switch from PAYG to individual accounts (see Appendix II for a detailed presentation of recent Chinese reform efforts). Pension reforms in emerging countries and their impact on private savings are much less subject of profound research than in developed economies. However, social security reforms in Western countries considerably differ from those in Asian emerging economics due to their timing. Western economies first experienced cultural rationalization, then economic modernization, accompanied by first social security benefits, and have only recently been confronted with demographic transition (Calvo & Williamson 2008). The population in Asian emerging markets, however, faces a profound demographic change while the economic transformation into an industrialized country is still ongoing. Thus, pension reforms in Asian emerging countries take place within a very different economic and institutional framework than well-established systems in Western European countries.

In this paper, we study the relationship between pension reforms and household savings behavior, and how the latter responds to a pension reform from a PAYG to a fully-funded system. We base our analysis on an OLG model (Overlapping Generations Model) specified for Asian emerging economies who share common characteristics, such as intra-family wealth transfers and inequality in terms of income as well as access to social security. We contrast the effects of a pension reform in a framework with altruistic behavior to a standard economy, while we keep the economy's interest rates constant. Prior to the reform, high skilled agents are assumed to benefit from a PAYG scheme whereas low skilled agents contribute to the system as they pay taxes on labor income, they are not able to claim future pension benefits. We then introduce fully-funded individual accounts for both types of agents which are assumed to replace the existing pension system. Since we do not consider any transitional dynamics, we can compute different steady state equilibria to compare household savings decisions and altruistic behavior. We find that a shift from a PAYG to a fully funded scheme partially crowds out individual savings and gifts, but the underlying causes differ conditional on the agents' skill level. High skilled agents generally respond to higher pension benefits by decreasing their savings. Low skilled agents, in contrast, may even decide to borrow when disincentives to save are sufficiently strong.

The paper proceeds as follows. Section two establishes the link between pension reforms and the households' savings behavior. Section three focuses mainly on household savings behavior and the relevant characteristics of pension systems in Asian emerging economies. We present our research focus and contribution to the literature in section four.

In section six and seven, we present two OLG models, a basic and an extended version, both representing Asian emerging economies. In section eight and nine, we compare both models, discuss some policy implications. We conclude this thesis with some final remarks in section ten.

# 2 Importance of understanding savings and the link to pension reforms

According to the IMF (2012), Asian emerging economies, in particular China, India, Indonesia, Malaysia, Thailand and the Philippines have experienced a fast economic growth in the past ten years, but lately have been growing at a slower pace, which is why experts highly recommend to conduct a sustainable pension reform. Moreover, the slowly declining economic growth rate results in important income changes for the households.

Differences in savings rates around the world are a fact that should not be neglected: East Asia saves more than 30 percent of Gross National Disposable Income (GNDI), whereas savings rates in Sub-Saharan Africa are below 15 percent (Loayza et al., 2000). The level of savings is an important indicator for policy decisions, since it is highly correlated to a host of externalities, such as market failures and policy induced distortions. The latter may eventually drive savings away from a socially acceptable or desirable level, and induces an unsustainable capital flow (Loayza et al., 2000). Moreover, national savings consist to a large extent of household savings, and represent an important element for the economic development of a country. The social value of savings can exceed its private value in many developing countries, in particular poorer countries. The social value of savings has a stabilizing effect on the society and fosters the country's development in a long term perspective. Too low savings result in inadequate capital flows for the development. Too high savings, on the other hand, cannot fully hedge against a weak or unsustainable financial system (Loayza et al., 2000).

Chile is the first nation that entirely transformed its pension system from PAYG to fully funded and privately managed individual accounts in the early 80s (Barr, 2006; Calvo, Williamson 2008). This pension reform had a major impact on private savings. Quintanilla (2011) points out that the Chilean transition from PAYG to a fully funded scheme results in a displacement rate of 30%, which means that for every additional dollar of pension wealth, it reduces accumulated financial assets at the time of retirement by 30 cents. The size of the displacement depends *inter alia* on the respective individual's age when the reform was introduced. Feldstein (1974) was among the first who studied substitution effects of social security on private wealth. He shows that social security can reduce personal savings by half.

Feng, He and Sato (2009) use an econometric approach to estimate the policy induced variation in pension wealth and its impact on individual savings in China. They obtain highly significant negative coefficients for pension wealth, while they distinguish between public and private employees. Their results suggest that additional pension wealth of 100 RMB reduces private savings by roughly 25 RMB.

Our research interest is to analyze the above mentioned relations between pension systems and household savings behavior. According to Gale (1998) the size of the tradeoff between pension wealth and private savings is influenced by numerous factors such as age, education, financial literacy. We therefore model a representative Asian emerging economy with workforce heterogeneity to address potential differences in their respective savings decisions. We distinguish the agents by their initial access to social security and their respective labor productivity to generate income inequality.

In addition, we take private intra-family wealth transfers into account which are deeply embedded in Asian traditions. Wu and Li (2014) show that such private transfers provide important subsidies to the elderly in rural areas, who are not eligible to benefit from a general pension system, but face high health expenditures in old age. Likewise Cong and Silverstein (2011) find that the adult children's monetary support to older parents enhances the parent's use of health care services when needed in rural regions in China. We argue that these transfers represent an important share of rural old-age income in Asian emerging economies, and one needs to consider the private intra-family support when analyzing savings behavior, in particular if the country is exposed to the high future aging of the population. Under the condition that the reformed system provides sufficient coverage and benefits, the elderly may be able to solely rely on their own resources, and need less additional sources of income. The latter would result in an increase of the children's income, and thereby affect household savings.

First, we start with a standard two-period model with heterogeneous labor productivity, where each period equals to 30 years in order to match reality. Second, we extend our basic model by introducing endogenous ascending altruism (typically in a way of kids giving gifts back to parents to support their parents' retirement life), and compare the respective savings decisions before and after a social security reform from a PAYG to a fully-funded system.

We are aware of some critics arguing that during the transition from a PAYG to a partially or fully funded pension system, there will always be at least one generation suffering from a double financial burden. In a two-period OLG model, however, it is difficult to attain a modification of the pension system while making both generations before and after the transition threshold better off. Since the transition phase during such a pension reform is not our research focus, we focus in our analysis on the two steady state equilibria before and after the pension reform.

In this regard, the next two sections present the determinants of savings and pension schemes in Asian emerging countries that are currently in place, and discuss their relevance for our model setting.

# 3 Review of Savings and Pension Reforms Literature

## 3.1 Savings Literature

3.1.1 Different Types of Savings

One cannot disregard the enormous differences in savings rate worldwide, which eventually results in various dissimilarities in a country's economic and political performance. Thus, it is important for researchers and economists to conduct analysis concerning savings behavior and the potential impact of social security reforms.

Generally, there are three measurements of savings analysis that are of researchers' main interest, namely household saving, public saving and corporate saving.

Household saving is defined by the OECD as the difference between income and expenses of the household, including the change in their net equity. The income consists of the payment from work or the revenue of their own company, revenue of interest rates and social service minus the accruing taxes and payments of interest rates. Expenses include mainly the payment for daily consumer goods and services. Furthermore, it consists of the imputed costs for properties, facilities, machines, commodities et cetera (OECD Library).

Corporate saving is defined by the *System of National Accounts* (SNA) as the revenue of the company minus the consumption of fixed capital.

Government saving or public saving is the balance between income, i.e. taxes and government expenditure and investment. We study the influence of a pension reform at an individual level, because the primary objective of social security reforms in Asian emerging countries is to increase coverage. Therefore, we expect individual savings behavior to change drastically, when they are eligible to benefit from social security for the first time.

## 3.1.2 Motives of Savings

Theoretical literature suggests that the motives of household savings can be categorized into five main parts. To provide resources for retirement and bequests; to finance expected large lifetime expenditures (including house purchase and education); to finance unexpected losses of income (precautionary saving); and to smooth the availability of financial resources over time to maintain a more stable consumption profile (Callen & Thimann, 1997) and to prevent any penury from not having any resources left.

## 3.1.3 Determinants of Savings

The existing literature offers abundant analysis regarding determinants of savings, especially on how economic variables and policy decisions would affect household savings behavior. In this section, we will review the above-mentioned motives and argue why we should/shouldn't include them in our representative model of Asian emerging economies.

## **Income inequality**

We make a distinction between workers' skill qualities in our models, namely high and low skilled workers, because the amount of household savings depends to a large extent on the income level. High-income households provide the majority of the aggregate household savings. An unequal economy with relatively more high-income households, who are capable to save a larger share of their income, normally has much higher savings rates compared to those who have less high-income households (Edwards, 1996).

This phenomenon is extremely common among Asian emerging countries. In general, the six Asian emerging countries that we have cited before, exhibit similar level of income inequality, particularly China and Indonesia. In China, one can observe very high income disparities that are rare to find in western European countries. The strict social, economic and political division of China in urban areas and rural provinces allows to roughly categorize the workforce into two groups, where private wealth determines the level of education and equality (Fang et al., 2008). In big Chinese cities such as Shanghai and Beijing, the access to education is more equally distributed than in rural provinces. However, in rural areas like the Shanxi Province, it is relatively more difficult to get admitted to a university in a big city (good universities are always located in international big cities in China) compared to local, urban students. The difference in access to higher level education leads consequently to a difference of skill levels. Holding a good university degree is generally the inevitable entrance condition for well-paid jobs in big cities in China (some firms do not recruit students from second or third tier universities at all). In order to take social inequality in Asian emerging economies into account, we introduce heterogeneous labor productivity in our model by income inequality caused by different working skills demonstrated in the labor market (OECD Economic Surveys 2000).

#### Ascending altruism

Change in social security can have no effect when generations are linked by a "chain of operative discretionary transfers" (Barro, 1974). These transfers refer to both, bequests and ascending altruism from children to parents.

Intra-family wealth transfer is a common phenomenon in Asian emerging economies. The great majority of the current literature hereby limits the analysis to bequests, only considering descending altruism, exchange motives or sudden death as most important motivation to bequeath Feldmann (2015). However, ascending altruism, the transfer from children in working age to their retired parents, is often disregarded when analyzing social security in Asian emerging economies. We argue that the reciprocal relationship between children and parents is deeply embedded in the Asian culture. Even nowadays, people still obey to old traditions and follow the principles that were established thousands of years ago by their ancestors. The young generation feels a strong responsibility for their parents, and elderly care represents a social obligation in numerous aspects. Therefore, most children contribute back to their parents as soon as they become financially independent (Cong & Silverstein, 2010; Feldman et al., 2015). Consequently, we will introduce ascending altruism in our model which, on one hand,

represents the special characteristics of Asian emerging economies. On the other hand, we expect that an efficient pension reform will not only directly affect an individual's savings behavior, but will also lead to a change in intra-family wealth transfers. On the condition that the reformed system provides sufficient coverage and benefits, the elderly may be able to solely rely on their own resources, and need less additional sources of income. The latter would result in an increase of the children's income, and thereby affect household savings.

Introducing ascending altruism implies that we will mostly disregard bequests, since a twoperiod OLG model is not a suitable framework to allow for simultaneous wealth transfers in both directions. Furthermore, Feldman (2015) finds a negative correlation between financial support by the children and the amount of bequest they receive. This suggests that the poorer the parents are, the more support they receive from their children, and the less they possess to bequeath. We will address this issue by introducing heterogeneous agents.

#### Social security and welfare systems

Callen and Thimann (1997) have introduced the terminology of precautionary savings, which has a close connection to the social welfare system in a society. From OECD's Economic Surveys 2000, China, is expected to age fast due to low fertility rate and rising life expectancy. There exist different pension systems across the country, which leads to a difference in households' saving behavior from various districts. Generally speaking, one can relate rural areas to lower labor productivity due to a lack of education, and local job opportunities. Most of these rural residents come to bigger cities and look for better paid manual work. The difference in skills leads to income inequality, and to a fragmentation of a pension system. In general, the performance of rural area's pension schemes is very low in terms of coverage and benefits compared to that in urban areas, and requires an urgent reform (Ang, 2008).

Besides the regional differences in social security, unemployment rates and related policies also influence precautionary savings, which eventually impacts household savings rates. A well designed and appropriate welfare system is likely to reduce household savings, since individuals no longer need precautionary savings to make provisions for future negative income shocks and old-age consumption. (Feldstein, 1980, Koskela and Viren, 1983).

#### **Demographics**

A country's population structure has an important impact on household savings behavior. The age dependency ratio is equal the share of population that typically does not belong to the workforce (younger than 15 or older than 64) over the share of those in the workforce (those aged 15-64). It measures the potential productivity and the demographic pressure on a population. A high age dependency ratio therefore results in low aggregate household savings, since the share of the population who is either young or retired is relatively more important than the share of the workforce in the particular economy (cf. Appendix I). The opposite direction yields higher aggregate savings. Moreover, population growth and population size affects economies through changes in consumption and the savings rate (Yao et al, 2013).

Appendix I compares savings rates with the age dependency ratio in Asian emerging economies. The age dependency ratio is steadily increasing, whereas the graphs show a negative trend in savings rates. However, this trend is subject to fluctuations, which makes us conclude that there are more determinants influencing household savings behavior besides demographics. In general, all Asian emerging economies are facing a population ageing problem, which influences their households' savings behavior. We use the age dependency ratio in order to simulate declining PAYG benefits caused by demographic change.

#### **Economic growth**

Economic growth influences household savings, since savings depends to a large extent on the income that a household can earn. A high economic growth typically translates into higher income for the workforce, and vice versa. Consequently, economic growth increase household savings. The relationship between economic growth and human capital is well addressed by Lucas (1988). Attanasio et al. (2000) also discussed the relationship between human capital and productivity growth. In sum, increasing productivity has the effect that the savings of the young surpasses the dissaving of the old, thus it yields additional productivity growth.

Appendix I shows that Asian emerging economies experience a slowing down in their respective growth rates in recent years. China, as the leading economic power, and its declining growth rates pose a substantial risk to the whole region, but also to the global economy. This situation makes policy makers reflect about precautionary measures, and initiates some further financial reforms.

#### Other determinants

Besides the five main determinants for savings, there are evidently many other factors that could have certain influence on the household savings rate, such as financial deregulation and terms of trade, housing markets, taxes (Callen and Thimann, 1997) etc. Nevertheless, we chose not to present them as much in detail as the other five factors, because we focus on the most important aspects in Asian emerging economies instead of covering determinants of savings in a global scope.

#### 3.2 Pension Systems Review

This chapter shortly categorizes the main types of pension systems, and then focuses on the characteristics and special needs of pension systems in Asian emerging markets. We finally present our conclusions for the model's framework.

*Pay-as-you-go* (*PAYG*) pensions are financed by current government revenues (tax revenues). Partially-funded pensions are often referred to as PAYG (Barr & Diamond, 2009, pp. 7–8). PAYG pension systems, exactly as pure defined benefit pensions, cannot respond to demographic changes, and thus, transfers the risk of demographic transition from one generation to another.

*Fully-funded pensions* are financed by a member's lifetime contribution. Partially funded pensions pay benefits from both, accumulated assets and current contributions (Barr, 2006; Barr & Diamond 2009). The level of funding affects intergenerational distribution of resources, and hence, savings (Barr & Diamond, 2009, p. 13).

*Defined benefit pensions* represent a "*full service social insurance*" (Fanti, 2009, p. 1). The paid benefits are determined by either an individual's earnings history or final wage as well as the length of service (refer to Appendix II for more details).

*Defined contribution* schemes are based on the individuals' savings plan, and solely depend on the value of their lifetime contributions. Their primal objective is consumption smoothing (refer to Appendix II for more details).

## 3.2.1 Lessons from Western European Countries and Chile

Due to changing demographics during the last decade, Western European countries have added complementary individual accounts to their established system (Fanti, 2009). The increasing life expectancy after having reached the retirement age has not only raised the costs of the established systems (old-age spending as a share of GDP increased by two percentage points from 1980 to 2001), demographic transition also deteriorates the basis of contributions due to a shrinking number of young contributors (Barr, 2006). Across 23 OECD countries, the share of population aged 65+ increased from 19 percent in 1980 to 22 percent in 2001 (Whiteford & Whitehouse, 2006).

Chile was the first nation which transformed its pension system from PAYG to fully funded and privately managed individual accounts in the early 80s (Barr, 2006; Calvo & Williamson, 2008). The Chilean government introduced two main pillars. The first pillar consists of unconditional defined benefits, addressing the poorest 60 percent of the population. The second pillar is based on individual defined contributions with a contribution rate of 10% of wage income, not including administration fees and disability insurance. There is a ceiling on contributions which corresponds to eight times the minimum wage (OECD et al. 2014). According to Calvo and Williamson (2008), the key of success was efficient investment of the collected funds. However, they note that many were left without any coverage. While the contributors represented 64 percent of the economically active population before the reform in 1980, this share reduced to 58 percent in 2002 (Calvo & Williamson, 2008).

We address the differences in access to social security in our model as pointed out in the next section. We continue by summarizing common characteristics of pension systems in Asian emerging countries.

#### 3.2.2 Pension Systems in Asian Emerging Markets

Indonesia, Malaysia, the Philippines, Thailand and Vietnam rely mostly on defined benefits and PAYG schemes. Only Korea has a prefunded system. In contrast, pension systems in Singapore and Malaysia have no social risk pooling (e.g. a minimum pension). China is in transition to a multipillar model addressing both, rural and urban population. All countries have in common that their social security systems are relatively new compared to Western European countries. Calvo and Williamson (2008) argue that Western countries are "*rationalized cultures*" characterized by elderly supporting institutions, individual financial planning, legality and wealth. Asian emerging countries, in contrast, are low-income economies with strong traditional cultures that value family support. Family life is characterized by reciprocal relationships and loyalty (altruism) that we will encounter again, when describing typical problems of social security systems in these countries. As we pointed out in the introduction, pension reforms in Asia differ from those in developed countries due to their timing. Only recently, the decrease in family size and urbanization has created the need for formal pension systems or reforms of the existing, mostly unsustainable pension schemes (for projections of demographic trends in Asian emerging countries (cf. Appendix II).

#### Challenges for social security in Asian emerging markets

A substantial part of the population is employed in the informal sector, having no or little access to labor regulations, pension and other social security benefits. Felipe and Hasan (2006) estimate that in China and Thailand, the share of informal sector employment in nonagricultural/urban employment amounts to 25 percent and remarkable 60 percent, respectively. Consequently, contribution rates in these countries are very low. Contribution rates are typically expressed as a percentage of the contribution base that is needed to be paid into the pension fund (OECD Glossary). The IMF only reports total contribution rates greater than 20 percent for Korea and Malaysia (with respect to 2007). China roughly reaches a level of 20 percent, including the employer share. Contribution rates in Indonesia, the Philippines, Korea and Thailand do not exceed ten percent (for exact numbers refer to Appendix II; Park & Estrada, 2014). Contribution rates differ conditional on the pension scheme the individuals participate in (urban vs. rural).

Besides low contribution rates, the existing pension schemes do not cover a satisfying share of the labor force. The only countries where coverage rates exceed 50 percent are Korea and Singapore. The Philippines, Indonesia, Thailand and Vietnam are similar to China with roughly 20 percent (Park & Estrada, 2014). Public employees, in contrast, are typically well covered. Public employees in China benefit from coverage rates greater than 90 percent compared to 58 percent for urban workers. In Thailand, coverage rates are 70 percent versus 30 percent, respectively.

Since the poor rural population is not only very difficult to reach, but also suffers from compliance costs (e.g. bribes, receiving less benefits than promised), this group is unlikely to contribute. The latter results in hidden costs that have to be financed by taxes (Calvo & Williamson 2008), and to intra-family support as the main source of income for elderly.

According to OECD's economic survey in China (2010), the older a person becomes, the more she financially depends on family support, the so-called ascending altruism. Calvo and Williamson find that the poor in rural areas prefer to finance housing or their children's education instead of funding their individual pension accounts which is a rational behavior in cultures based on reciprocity. Thus, family support is likely to remain the main source of income for disadvantaged elderly in rural provinces (OECD 2010).

Very low replacement rates aggravate the need for additional sources of income, and reinforce the traditional system of family support. High coverage rates usually correlate with very low replacement rates for "ordinary" workers.

Finally, urbanization causes large parts of the rural population to migrate to the major cities. These so-called migrant workers have very little access to social security for two reasons. They are often employed in the informal sector where they are left without any access to social security. Fang and Zhao (2009) find evidence that the older a worker is, the more likely she is to return to her home province, where they would be left without any entitlements. The lack of portability impedes voluntary compliance by migrant workers.

To conclude, we want to capture the above-mentioned characteristics in our model by differentiating workers according to their home province in combination with level of income. We divide the workforce in low and high skilled agents. Low skilled agents represent formally employed individuals that are born in rural provinces. High skilled agents refer to urban citizens that are formally employed in private, non-state-owned companies. We explicitly exclude public employees as well as the very poor population and disadvantaged elderly in rural provinces from our analysis. Public employees in Asian emerging economies typically benefit from a very generous, particularly designed PAYG pension and thus, will not be affected by a general reform. The savings of the very poor - if they exist - are not likely to have a major impact on the economy's aggregate capital, since this part of the population typically has no access to financial markets. We furthermore assume that low skilled individuals from rural areas have no access to social security prior to the reform to take into account that the purpose of a general pension reform in rural provinces essentially is to increase coverage. Nevertheless, the taxes in Asian emerging economies are mostly paid by the employer, not the individual. Therefore, we collect taxes from both types of agents and use the collected funds to pay out pension benefits. This implies that high income earning individuals enjoy pension benefits that are cross-financed by the rural population which benefit from the system. We argue that introducing redistribution from low to high skilled agents is appropriate in order to model the relatively generous pension scheme for a very limited part of the population. After the reform, contributions that have been made to the fully funded scheme are exclusively linked to the individual's account. Thus, redistribution is not taking place, since we restrict our analysis to a balanced government budget.

Appendix II presents the Chinese, the Philippines' and Thailand's pension systems in detail. We have selected these three countries among Asian emerging economies to test our model's external validity, and decided to put the focus on recent efforts with respect to pension reforms in those countries. The reason why we do not include India, the second largest Asian economy, in our analysis is that India has no general pension system in place. Public officials were covered by a PAYG scheme until December 2003 (today 20 million participants). Public officials employed in January 2004 or thereafter (roughly 2 million) participate in a new fully-funded scheme, the National Pension System. Approximately 117 million employees are covered by the Employees Provident Fund, a fully funded system. The schemes are currently subject to minor reforms, which do not transform the entire system (Government of India, Ministry of Finance). Since there are also differences in pension schemes at a state level, the current oldage security system is highly fragmented, and does neither cover nor target a satisfying share of the population. We argue that a pension reform analysis would not allow to draw major conclusion for the Indian household savings rates, and therefore disregard India in our analysis.

# 4 Research focus

## 4.1 Research Question and Motivation

Facing a similar situation of population ageing and slower economies growth as some Western developed economies, Asian emerging economies have realized the insufficiency of their current PAYG pension system. Our research question reads as follows: Analysis of savings behavior after a pension reform from PAYG to fully funded system in Asian emerging economies. While declining growth rates and population ageing are the reasons why policy makers introduce pension reforms, we focus on the individual savings behavior in our analysis, and discuss how the prospect of old-age social security directly affects savings rates as well as intra-family wealth transfers.

We furthermore assume heterogeneous labor productivity to take into account that the rural population typically had no access to social security prior to the reform.

As stated in the introduction, we will not model the transition phase, but only compare the two steady state equilibria before and after such a pension reform. We argue that the recently introduced pension reforms essentially provide social security to an important share of population that never had access to such benefits before. Therefore, their savings behavior does not change in response to the transition from one pension scheme to another. Instead, they adapt their behavior to the fact that they are covered by social security for the first time in their life. Modelling the transition would also imply to put much emphasis on the financing of this transition and on the question whether both generations are eventually better off. Therefore, we decide to focus on the comparison of two steady state equilibria where we manipulate the parameters of the respective pension scheme through various sensitivity tests. Our main interest is whether the newly introduced pension schemes affect the households' savings behavior as well as traditional intra-family transfers, and whether the latter becomes obsolete.

# 4.2 Research Analysis and Contributions to Current State of Art

Our research focus includes our contributions to current state of art. We specifically look into Asian emerging economies, which is a rare focus among existing literature which is related to social security. Besides, we include workforce heterogeneity in our model setting, a division of high and low skills among workers, which is also a rare method comparing to some other existing research which had similar research topics, such as Song Zheng (2014). Besides the heterogeneity, we also integrate endogenous ascending altruism, wealth transfers from the children to the parents, in the extended model, which is more realistic and representative for our targeted group, Asian emerging economies. For our research, we mainly study the effect of pension reforms on savings and intra-family wealth transfer in the way of ascending transfer of gifts to parents. Finally, we do not focus on the transition phase from PAYG to a fully-funded scheme, but we allow for different initial social security for each type of agent and compare the effect on household savings behavior.

# 4.3 Model Validity and Reliability

To summarize, we find that social security systems in Asian emerging countries are very similar. They are relatively new compared to well-established schemes in Western countries and face the challenge of demographic transition without having transformed into a fully developed economy.

In order to analyze the implications of pension system reforms, we will mainly consider intrafamily support from the children to their parents and divide workers in low and high income earners, mostly related to their productivity level and their status as urban or rural citizen. We thereby introduce the major disparities in terms of coverage, pension scheme and contribution between rural and urban households in our model.

External validity evaluates if our model could be representative for other economies beyond the scope of our analysis. Note that our study solely focuses on household savings behavior in Asian emerging economies, and does not claim to find general patterns that are valid beyond the above-mentioned context. Our models include ascending altruism and income differences based on heterogeneous labor productivity. As a benchmark, we parametrize the pension reform in order to match China, the Philippines and Thailand's data and should not be taken outside of this context. Besides, we only include income inequality, intergenerational transfer in the way as an ascending altruism and pension schemes in our model. Other determinants of household savings are not our main research focus, thus are not included in our model setup.

# 4.4 Model Specification and Stackelberg Approach

As previously stated, we neither model endogenous fertility nor bequests, but only ascending altruism which literature often refers to as "gift economy". In order to familiarize the reader with our model in the next section, we first discuss the most important concerns related to OLG models with an operative gift motive.

Asian emerging economies exhibit very diverse trends in fertility rates. The most extreme cases are unquestionably China and India. Endogenous fertility combined with endogenous ascending altruism would imply that the representative agent is left with a simple trade-off decision. Conditional on child-bearing costs and interest rates, it is either more profitable to raise children or to save in order to provide for expenses for old-age consumption. Therefore, we disregard endogenous fertility in our analysis. Veall (1986), Nishimura and Zhang (1992) and Lagerlöf (1997) discuss such corner solutions in more detail.

A two-period OLG model is not an appropriate framework to allow for simultaneous transfers in both directions, from the children to their parents and vice versa. We therefore limit our model to one-sided intra-family wealth transfers, i.e. an operative gift motive.

Carmichael (1982), Abel (1987) and Kimball (1987) are the first who studied the necessary assumptions in terms of parameterization to obtain an operative gift motive in Nash equilibrium. Carmichael and Abel show that the steady state Nash equilibrium is overcapitalized, if the weight on the parents' consumption in the utility function is smaller than one. Kimball finds a very particular combination of parameters for which the golden rule with operative gift or

bequest motive is respected. However, his solution is very sensitive to the choice of parameters, and would imply harsh constraints for our analysis. Therefore, we do not consider his approach in our framework.

The literature suggests two further options in order to obtain dynamic efficiency with an operative gift motive, i. e. endogenous growth or the so-called Stackelberg approach. Saint-Paul (1992) shows that over accumulation of capital no longer holds in a framework with endogenous growth. Since endogenous growth would interfere with our analysis of how a social security reform affects individual savings, we do not consider this approach in our framework either (cf. for example Wigger (2002) for a gift economy with a PAYG scheme and endogenous growth).

Finally, the Stackelberg approach assumes that the agents do not take the other generations' decisions as given as in Nash equilibrium, but decide subsequently. The Stackelberg approach is not very prominent in current research on pension reforms in Asian emerging economies. Veall (1986) is the first who used the Stackelberg approach in a model of a gift economy with social security. He compares a zero savings to a zero gifts economy and finds that social security is welfare improving compared to a pure gift economy. The reason is that the parents no longer need to solely rely on their children's' gift as old-age income, if they are covered by social security. O'Connell & Zeldes (1993) extends the framework in Veall (1986) to study dynamic efficiency in the gift economy with positive gifts and savings. They introduce a linear reaction function where gifts depend on the prior generation's savings. Since this model allows for numerous tweaks in terms of parameters and heterogeneity, we decided to apply their method in our framework such that the gifts in period t depend on the savings decisions from the old generation in period t-1 and the pension benefits that they currently receive. Our adapted linear function takes the form of

$$g_t(s_{t-1}, pension_t) = a - h \times s_{t-1} - d \times pension_t$$

where 'a', 'h', and 'd' are constant over time. A detailed explanation of our model's parametrization and framework are presented in the next sections.

# 5 Model parameterization

#### Share of Capital and Labor: α

We assume  $\alpha = 0.33$ .

## Weights on old-age consumption in period t+1 and the parents' consumption in period t: $\beta^l < \beta^h$ and $\theta$

 $\Theta$  represents the weight on the parents' consumption within the kid's utility function, on the other hand,  $\beta$  represents the weight on the kids' own consumption when old. We have carefully chosen  $\beta$  and  $\theta$  after conducting some sensitivity tests on savings rates in the gift economy in order to match the real households savings rate of those countries that we are testing in our models. Most importantly, the individual's weight on the parents' consumption must be larger than for his/her own consumption, in order to create strong incentives for the representative agent to provide financial support to the older generation.

We also set a different value for  $\beta$  for the high skilled workers than for low skilled workers.  $\beta$  for the less productive agents is sufficiently low in order to provide the low skilled agents with incentives to act altruistically instead of saving for their own consumption when old, due to the interest rate gain of their own savings.

#### **Contribution rate b**

For China, we set the contribution rates accordingly. In urban areas, employees contribute eight per cent of their salary to the fully funded scheme. Another twenty per cent of the salary is paid by the employer. Therefore, we set  $b^h = 28/120$ . In 2011, 241mn workers contributed to 41.5bn RMB to the New Rural Pension in China. Dividing the average per capita contribution by the average wage (in 2011) yields an average contribution rate of  $b^l = 0.12$  (Bureau of Statistics China).

With respect to the Philippine and Thai pension systems, we conduct a sensitivity test on b for both countries, as we find different contribution rates for urban and rural areas in different literature.

#### Labor productivity

According to Fleisher et.al. (2006), the average annual earnings for a high educated worker are equal to 96.3 thousand renminbi (RMB) and a low skilled worker 36.49 thousand RMB, respectively. Computing the labor productivity ratio yields a value for  $H^H = 2.6$  for  $H^L = 1$ . Similarly, we collect data for the average annual income of urban and rural households in order to calculate the productivity ratio in the Philippines (Bautista & Lamberte, 1990) and Thailand (Mazumdar, forthcoming).

#### Risk parameter **y**

We assume a logarithmic utility function where  $\gamma = 1$ , following Song et al. (2015) whose research focus is on Chinese pension reform efforts, and therefore closely related to our framework.

## Population growth rate n

We took data from the World Bank Database for the past year's population growth rate for each of those countries in Asian emerging economies. More specifically, we used the average of the annual population growth rate from 2000 to 2015 for each country. For instance, the average population growth rate for China would be 0.5%, however, for the Philippines, the figure would be 1.6%, which hits the higher bound for all those countries.

## High skilled agents' population ratio $\rho$

We calculate the high skilled agents' population ratio by World Bank Data's indicator of rural population ratio out of total population. Similarly to our calculation of the population growth rate in each country, we take the past 10 year's average in order to get a more representative  $\rho$  for each country. Nevertheless, we noticed the abnormally fast urbanization speed of China, thus, for China, we take  $\rho$ =0.25 as an average of the values from year 1995 to 2005 before the pension reform in China and we take  $\rho$ =0.4 after the pension reform. However, for the Philippines and Thailand, the ratio did not change as much as China's did before and after their pension reforms. We take one single value of  $\rho$  for these two countries for both before and after such a pension reform from PAYG to a fully funded system.

## 6 Standard economy with inelastic labor supply

We use a standard two-period OLG model in order to analyze the savings behavior after a pension reform from PAYG to a fully funded scheme. The young agents, denoted by y, work, save and consume, while the old, denoted by o, are retired and fully rely on their savings and some social security benefits. Furthermore, we assume worker heterogeneity representing urban and rural inequality. Low skilled agents do not have access to any social security before the reform. Their old-age income is fully determined by their savings decision made in period one. In contrast, we assume that agents with high labor productivity are typically covered by some PAYG scheme. The pension reform results in a fully funded scheme for both types of agents.

#### **Factor prices**

The efficient production function of the economy is given by

$$F(K,N) = K^{\alpha} \left[ \left( \mu^{h} H^{h} + \mu^{l} H^{l} \right) N \right]^{1-\alpha}$$

where *K* denotes capital, *h*,*l* represent high and low productive agents respectively.  $H^h, H^l$  represent an efficiency index for each type of worker. We normalize  $H^l$  to unity for convenience.  $H^H > 1$  is constant and determined by the relative difference in wages between urban and rural Chinese workers. We further assume an inelastic labor supply, which is denoted by N.  $\mu^h, \mu^l$  represent the proportion of each type of agents' population in this economy. For simplicity,  $\rho = \mu^h, 1 - \rho = \mu^l$ .

Furthermore, we assume an exogenously given interest rate  $r_t$  which matches the values in the gift economy. The latter ensures that we obtain comparable results for the effects on savings in both models, the standard and the gift economy. The wages are equal to the first derivative of the production function multiplied by the respective labor productivity.

$$w_t^h = (1-\alpha)k_t^{\alpha-1}(\rho H^h + 1-\rho)^{-\alpha} H^h$$
$$w_t^l = (1-\alpha)k_t^{\alpha-1}(\rho H^h + 1-\rho)^{-\alpha}$$

Here, the market clearing condition is satisfied since the total income equals the total production, and from the budget constraint condition, each agent's income equals to his expenditure.

#### Consumers

The agents solely derive utility from consumption in both, young and old age. The utility function follows a CRRA (constant relative risk aversion) form and is given by

$$U(c_t) = \frac{c_t^{1-\gamma}}{1-\gamma}$$

By assuming  $\gamma = 1$ , we follow Song et al. (2015) whose research focus is on China's pension reform, and therefore closely related to our framework.

(11.1) 
$$U_{t}^{l} = \ln c_{y,t}^{l} + \beta \ln c_{o,t}^{l}$$
$$U_{t}^{h} = \ln c_{y,t}^{h} + \beta \ln c_{o,t}^{h}$$

The pension benefits in a PAYG regime depend on the current young's generation wage income. In a fully funded system, the agents are forced to contribute a share b of their income to individual pension accounts when young. They earn interest rates on their deposits and receive  $pension_{t+1} = (1 + r)bw_t$  when old. In addition, the agents can have voluntary savings,  $s_t$ . Thus, the individual accumulated wealth in a fully funded system is equal to

$$wealth_t = \frac{s_t + bw_t}{(1+r)}$$

Consequently, the maximization problem is subject to the following budget constraints.

Before the reform	Low labor productivity	No access to social security
(11.2)	$c_{y,t}^{l} = (1 - b^{l}) w_{t}^{l} - \frac{s_{t}^{l}}{(1 + r)}$ $c_{o,t+1}^{l} = s_{t}^{l}$	
After the reform	Low labor productivity	Fully funded scheme
(11.3)	$c_{y,t}^{l} = w_{t}^{l} - \frac{s_{t}^{l}}{(1+r)} - \frac{b^{l}w_{t}^{l}}{(1+r)}$ $c_{o,t+1}^{l} = s_{t}^{l} + \frac{b^{l}w_{t}^{l}}{\text{FF pension}}$	
Before the reform	High labor productivity	PAYG scheme
(11.4)	$c_{y,t}^{h} = w_{t}^{h} - \frac{s_{t}^{h}}{(1+r)} - \frac{b^{h}w_{t}^{h}}{(1+n)}$	

$$c_{o,t+1}^{h} = s_{t}^{h} + \underbrace{b^{h}w_{t}^{h} + b^{l}w_{t}^{l}}_{\text{PAYG pension}}$$

$$c_{y,t}^{h} = w_{t}^{h} - \frac{s_{t}^{h}}{(1+r)} - \frac{b^{h}w_{t}^{h}}{(1+r)}$$

(11.5)

$$c_{o,t+1}^{h} = s_{t}^{h} + b^{h} w_{t}^{h}$$
  
FF pension

where *b* is a social security tax levied on labor income.

#### Defining the equilibrium

The equilibrium is attained by maximizing the agents' utility function (11.1) subject to the first order conditions with respect to  $s_t$ .

(11.6) 
$$(1+r)^{-1} (c_{y,t}^{h})^{-1} = \beta (c_{o,t+1}^{h})^{-1}$$

(11.7) 
$$(1+r)^{-1} (c_{y,t}^{l})^{-1} = \beta (c_{y,t+1}^{l})^{-1}$$

Substituting for consumption with the respective budget constraint yields

Before the reform  $(11.8) \qquad s_t^h + (1+n) \left( b^h w_t^h + b^l w_t^l \right) = \beta \left( 1+r \right) \left[ \left( 1-b^h \right) w_t^h - \frac{s_t^h}{(1+r)} \right]$   $(11.9) \qquad s_t^l = \beta \left( 1+r \right) \left[ \left( 1-b^l \right) w_t^l - \frac{s_t^l}{(1+r)} \right]$ 

After the reform	Both types of agents	Fully Funded Scheme
(11.10)	$s_t^h + b^h w_t^h = \beta (1+r) \bigg[ (1-b^h) w_t^h \bigg]$ FF pension	$-\frac{s_t^h}{(1+r)}$
(11 11)	-1 $-1$ $-1$ $-1$ $-1$ $-1$ $-1$ $-1$	$s_t^l$

(11.11) 
$$s_t^l + b^l w_t^l = \beta (1+r) \left[ (1-b^l) w_t^l - \frac{s_t^r}{(1+r)} \right]$$
  
FF pension

Dropping time subscripts yields the following expressions for savings in steady state.

(11.12) 
$$s^{h} = w^{h} \frac{\beta(1+r)(1-b^{h}) - (1+n)b^{h}}{(1+\beta)} - \frac{(1+n)b^{l}w_{t}^{l}}{(1+\beta)}$$

(11.13) 
$$s^{l} = w^{l} \times \frac{\beta}{(1+\beta)} (1+r) (1-b^{l})$$

After the reform

Both types of agents

Fully Funded Scheme

(11.14) 
$$s^{h} = w^{h} \times \frac{(1+r)}{(1+\beta)} \Big[ -b^{h} + \beta \Big(1-b^{h}\Big) \Big]$$

(11.15) 
$$s^{l} = w^{l} \times \frac{(1+r)}{(1+\beta)} \Big[ -b^{l} + \beta \Big(1-b^{l}\Big) \Big]$$

# 6.1 Results for China

China	PAYG	FF	FF	
β (low)	0.70	0.70	0.70	
$\beta$ (high)	0.90	0.90	0.90	
α	0.33	0.33	0.33	
ρ	0.30	0.30	0.30	
Contribution rate b (low)	0.10	0.10	0.10	
Contribution rate b (high)	0.23	0.23	0.15	
Net replacement rate				
- low	0%	38%	38%	
- high	35%	101%	60%	
Official Household Savings Rate	22%			
Individual savings as a share of disposable income	42%	33%	36%	
(w/o contributions to fully funded scheme)				
- low	41%	35%	35%	
- high	42%	32%	38%	
Total individual savings as a Share of disposable	42%	53%	51%	
income (including contributions to fully funded				
scheme)				
- low	41%	46%	46%	
- high	42%	62%	56%	

 $\beta$  is the discount factor on old-age consumption,  $\alpha$  represents the relative share of capital, and  $\rho$  the relative share of high skilled individuals in the economy.

At first glance, the household savings rate (weighted average of both agents) increase by 10 percentage points to 52% after a pension reform from a PAYG to a fully-funded system. We compute savings as a share of disposable income with and without contributions to a fully funded scheme in order to identify trends. The results suggest that the higher savings rate is driven by the funded accounts of the high skilled. Since they were covered by PAYG before, their pension benefits are now converted into forced savings. The increase in savings for the low skilled agents is relatively small, since they had no access to social security before and used savings in order to smooth consumption.

The table does not show the effect on savings behavior when taking urbanization into account. Conducting the same analysis where the contribution rates b are kept constant, but the population share  $\rho$  increases by +0.1 from pre to post-reform phase, we find a slightly stronger increase in savings rates for high skilled agents (contribution does not increase). We conclude that the higher savings rates are mainly driven by the pension reform, but subject to minor fluctuation by changes in the population structure.

Our savings estimates are substantially higher than what the data would have suggested. We observe a considerably lower rise in the data from 22% (pre-reform average) to 26% (current in-transition average). These differences are mainly due to two reasons: first, we assume a relatively long period of 30 years – whereas we only have 10 years of post-reform data. Second, the stylized economy we are modelling is a very simplified version which cannot capture many aspects that determine savings. However, we get the same overall increasing trend. We expect to obtain results that are closer to the data when studying ascending altruism in the next section.

In order to test the robustness of our model, we conduct sensitivity tests for  $\beta$ , since the choice for computational method of this parameter may appear to be very arbitrary. We do not test for increases in the interest rate r, because it is exogenously given by the parameterization of the gift economy. We compute our standard economy by using the same interest rates in order to increase readability. In general, an increase in r would lead to lower savings rates, since less deposits are needed in order to achieve the same level of second-period income.

A sensitivity test on the relative importance of old-age consumption,  $\beta$ , does not reveal any surprises. As one would have expected, an increasing  $\beta$  yields stronger positive effects on savings rates. The highest increase in savings rates occurs when high skilled agents move from a PAYG to a fully funded scheme. We decided to take the same parameters in both models, the standard and gift economy. In general, lowering beta to roughly 0.20 would shift down the results and yield estimates that are closer to the data. However, it would not change the overall trend.

# 6.2 Simulation Exercise for the Philippines and Thailand

Thailand has recently undertaken first steps towards a fully funded system by offering a voluntary fully funded scheme to informally employed workers who otherwise would have no access to social security programs. Today's old-age insurance on the Philippines is only based on defined benefit schemes, determined by an individual's earnings history and prices. We test whether the results that we obtain for China would still hold with parametrization for these two

countries. Regarding Thailand, we assume a contribution rate that is equal to today's level of social security taxes. Social security on the Philippines is considerably underfunded, since labor income taxes for old-age insurance barely reaches 5 %. We therefore conduct a sensitivity test in order to analyze savings behavior for numerous levels of taxes. Since we observe a uniform trend when changing contribution for low and high skilled agents simultaneously, we assume for simplicity that  $b^h = b^l$ . The most important parameters are summarized in the following table.

	Pre	Post	Pre	Post
	Tha	iland	Philip	ppines
β (low)	0.70	0.70	0.70	0.70
$\beta$ (high)	0.90	0.90	0.90	0.90
α	0.33	0.33	0.33	0.33
ρ	0.30	0.30	0.40	0.40
Annual population Growth n	0.3%	0.3%	1.6%	1.6%
Labor Productivity High relative to Low)	2.5	2.5	1.8	1.8
Annual interest rate r	4.1%	4.1%	4.3%	4.3%

 $\beta$  is the discount factor on old-age consumption,  $\alpha$  represents the relative share of capital, and  $\rho$  the relative share of high skilled individuals in the economy.

#### Thailand



Figure 1: Household savings rate analysis by sensitivity test on contribution rates (graph produced by the authors)

#### The Philippines



Figure 2: Household savings rate analysis by sensitivity test on contribution rates (graph produced by the authors)

Despite the gross disparities in terms of population growth and labor productivity, both economies exhibit similar trends in savings rates before and after a reform from PAYG to a fully funded scheme. Without any further efforts towards a fully funded system (blue line), the model would predict that households in both economies save approximately 50% of their income. For a reasonable level of mandatory contribution rates, such as 15% - 20% for both high and low skilled agents, both countries would experience a significant increase in household savings rates to approximately 60%.

Our results are substantially higher than what we find in the data. Thailand's household savings rate is approximately 9 %. Filipinos save roughly 20 % of their disposable income. These enormous differences to the data are linked to the simple model setup. Since we decided to take the same parameters as in the gift economy, the model's predictions are inaccurate. Introducing ascending altruism will succeed to approach savings rates that are close to what we can observe in reality.

# 7 Gift economy with inelastic labor supply and endogenous altruism

The model is a two-period OLG model which builds upon the gift linear function of O'Connell and Zeldes (1993). Agents in the model live for two periods, denoted by young, y, and old, o. Agents work and pay taxes during the first period; when they are young. Old agents retire and receive pensions during the second period. Due to the fact that there is more social demand of gift altruism in rural region in Asian economies, we only introduce gift component in the low skilled agents' case.

To avoid repetition of the model explanation, we only illustrate those parts in detail which are different from the standard economy:

#### **Factor prices**

$$F(K,N) = K^{\alpha} \left[ \rho H^{h} N + (1-\rho) N \right]^{1-\alpha}$$
$$w^{h} = (1-\alpha) k^{\alpha-1} \left( \rho H^{h} + 1-\rho \right)^{-\alpha} H^{h}$$
$$w^{l} = (1-\alpha) k^{\alpha-1} \left( \rho H^{h} + 1-\rho \right)^{-\alpha}$$

#### Consumers

The utility form follows a CRRA form and is given by:

$$U(c) = \ln c, \gamma = 1$$

We utilize logarithmic function, followed by Song et al (2015), whose research is mainly about China's pension reform, which is closely related to our research topic.

Consequently, an agent's total utility is given by

$$V_{t}^{l}\left(g_{t}\left(s_{t+1}\right)\right) = \left[u\left(c_{y,t}^{l}\right) + \beta^{l}u\left(c_{o,t+1}^{l}\right)\right] + \theta V_{t-1}^{l}\left(g_{t}\right)$$
$$V_{t}^{h} = u\left(c_{y,t}^{h}\right) + \beta^{h}u\left(c_{o,t+1}^{h}\right)$$

The model describes two types of agents: those with high labor productivity and those with low labor productivity. Highly productive agents have no gifts in their utility function, however, the lowly productive agents care about their parents' wellbeing and thus give gifts. Therefore, we introduce a different  $\beta$ , the discount factor for old-age consumption. We assume  $\beta^l < \beta^h$  in order to imitate the low return that the low skilled agents earn on savings. Highly productive agents enjoy a PAYG pension while agents with a low productivity do not. However, after a pension reform from a PAYG to a fully funded scheme, both highly and lowly productive agents will be covered by a fully funded pension scheme. Besides, both highly and lowly productive agents have access to financial markets.

Consequently, the budget constraints when young and old are as follows for the high productive agents:

$$c_{y,t}^{h} = (1 - b^{h}) w_{t}^{h} - (1 + r)^{-1} s_{t}^{h}$$

$$c_{o,t}^{h} = s_{t}^{h} + b^{h} w_{t}^{h}$$
Fully funded pension
$$c_{y,t}^{l} = (1 - b^{l}) w_{t}^{l} - (1 + n)^{-1} g_{t}^{l} - (1 + r)^{-1} s_{t}^{l}$$

$$c_{o,t}^{l} = s_{t}^{l} + b^{l} w_{t}^{l} + \underbrace{g_{t+1}^{l}(s_{t}^{l})}_{\text{Fully funded pension}} + \underbrace{g_{t+1}^{l}(s_{t}^{l})}_{\text{Ascending altruism}}$$

The constraints for those agents with low labor productivity are different in the PAYG and the fully funded scheme due to the reason that the lowly productive agents started with no pension and are covered by the new fully funded system after the reform:

Before the reform	Low labor productivity	No access to social security
	$c_{y,t}^{l} = w_{t}^{l} - (1+n)^{-1} g_{t}^{l} - (1+r)^{-1}$ $c_{o,t}^{l} = s_{t}^{l} + g_{t+1}^{l} (s_{t}^{l})$	<i>S</i> <sup><i>l</i></sup>
After the reform	Low labor productivity	Fully funded scheme
	$c_{y,t}^{l} = (1-b) w_{t}^{l} - (1+n)^{-1} g_{t}^{l} - (1+c_{y,t}^{l}) + c_{o,t}^{l} = s_{t}^{l} + g_{t+1}^{l} (s_{t}^{l}) + pension_{t+1}^{l}$	$r)^{-1} s_t^{l}$
Before the reform	High labor productivity	PAYG
	$c_{y,t}^{h} = w_{t}^{h} - \frac{s_{t}^{h}}{(1+r)} - \frac{b^{h}w_{t}^{h}}{(1+n)}$	

$$c_{o,t+1}^{h} = s_{t}^{h} + \underbrace{b^{l}w_{t}^{l} + b^{h}w_{t}^{h}}_{\text{PAYG pension}}$$

$$c_{y,t}^{h} = w_{t}^{h} - \frac{s_{t}^{h}}{(1+r)} - \frac{b^{h}w_{t}^{h}}{(1+r)}$$
$$c_{o,t+1}^{h} = s_{t}^{h} + \frac{b^{h}w_{t}^{h}}{FF \text{ pension}}$$

where savings are modelled by  $s_t$ .  $w_t^l$  and  $w_t^h$  denote the wages earned by an agent with low labor productivity and high labor productivity, respectively. Social security tax is levied through an exogenously given rate, b.

#### **Defining the equilibrium**

The equilibrium for high skilled agents is exactly the same as the standard economy since they do not have altruism extension of their model. Thus, we only introduce the low skilled agents' case in detail.

Equilibrium in this model is attained by maximizing the low skilled agents' utility, taking parents' wellbeing into consideration. In other words, the basic recursion of the value function is:

$$V_{t}(g_{t+1}(s_{t})) = \max\left[u(c_{y,t}) + \beta u(c_{o,t})\right] + \theta\left[u(c_{y,t-1}) + \beta u(c_{o,t-2})\right] + \theta^{2}V_{t-2}(g_{t-1})$$
  
where  $u(c) = \ln(c)$ 

Maximizing the utility function, that is, taking the derivative with respect to  $s_t$  and  $g_t$  yields the following first order conditions:

$$\frac{u'(c_{y,t})}{(1+r)} = \beta (1+g'_{t+1}) \times u'(c_{2,t}) \qquad \Rightarrow c_{y,t}^{-1} = \beta (1+g'_{t+1})(1+r)c_{o,t}^{-1}$$
$$\frac{u'(c_{y,t})}{(1+n)} = \theta \beta u'(c_{o,t-1}) \qquad \Rightarrow c_{y,t}^{-1} = \beta \theta (1+n)c_{o,t-1}^{-1}$$

For  $(1+g'_{t+1})=(1-h)$ , it follows that in steady state  $r=\frac{\theta(1+n)}{1-h}-1$ .

Finally, provided the savings in the model and the assumption of full depreciation of capital over one period, the motion of capital is given by:

$$k_{t+1} = \frac{\rho s^{h} + \tau b^{h} \rho w_{t}^{h} + (1-\rho) s^{l} + (1-\rho) \tau b^{l} w_{t}^{l}}{(1+n)(1+r)}$$

where  $\rho$  represents the share of high skilled agents in the economy,  $\tau$  represents the pension scheme by changing from 0 to 1, which means that when  $\tau$  equals 0, it is a PAYG pension scheme and when  $\tau$  equals 1, it is a fully-funded pension scheme.

We substitute for consumption with the budget constraints, and solve the second FOC for savings. We plug this expression back into the first FOC. Straightforward algebra yields an expression for gifts as a function of a, h and d:

$$g_{t+1} = a - h \times s_t - d \times pension_{t+1}$$

where *a*, *h* and *d* are constants.

We further use the four budget constraints and respective FOCs as well as the combined capital equation, and apply *fsolve*, a built-in Matlab function for solving system of nonlinear equations (MathWorks<sup>®</sup> Matlab Documentation Version R2015b) in order to solve for old-age consumption  $c_o$  and young-age consumption  $c_y$  for both high and low skilled agents. With this equation system, we can also solve for  $s^l$  and  $s^h$ .

## 7.1 Model parameterization

# Weights on old-age consumption in period t+1 and the parents' consumption in period t: $\beta$ and $\theta$

We have carefully chosen  $\beta$  and  $\theta$  in order to balance the household's expenditure for gifts and savings. Our major criterion is that the weights yield results for our stylized model economy that are close to the available data. Most importantly, the low skilled individual's weight on the parents' consumption must be greater than for his/her own consumption, to generate sufficient incentives for the representative agent such that she provides financial support to the older generation.

We also set a different  $\beta$  value for high skilled workers than for low skilled workers, since they have a different value function of utility maximization equations.  $\beta$  for the less productive agents is sufficiently low such that it offsets the potential interest rate gain of savings, and provides a sufficiently strong incentive to give altruism.

#### Income taxes *b* to finance the social security system

The social security system is financed by some income tax b, where  $b^l \neq b^h$ . Since taxation in Asian emerging economies does not necessarily depend on individual income threshold levels, but is often related to the employer, we use average pension replacement rates as well as average contributions relative to average income in order to determine the level of taxes levied on income. We find that, on average, low skilled agents contribute ten percent to social security in both pre and post reform systems whereas contribution made by high skilled agents vary. We start our analysis by assuming a tax level of 23 percent which is in line with current contributions rates in the transition phase. Prior to the reform, the government collects taxes from high and low skilled agents and transfers the collected funds as PAYG benefits to the high skilled agents. We obtain pension benefits that are equal to approximately 35 percent of their pre-retirement net wage which is in line with data. Since we only consider formally employed individuals in rural areas, we argue that redistribution to urban employees is reasonable as employers in rural areas pay taxes, while rural workers do not have access to social security. In a fully-funded system, however, individual contributions are transferred to individual accounts where workers earn interest rates on their accumulated funds. For reasons of comparability, we also compute fully-funded contributions made by high skilled agents by assuming 23 percent of income taxes. However, the latter yields too high replacement rates and we contrast the results with a second fully-funded scenario where we re-compute contributions such that we match the official replacement rate target of 60% for urban workers.

# 7.2 Dynamic Programming

Our value function is solved numerically in Matlab, making use of the built-in function *fsolve* to solve for optimal consumption for both agents in both young and old times respectively and their savings given the current state. Utility is calculated through a standard constant-relative-risk-aversion function, assuming risk aversion parameter is equal to 1.

Due to the fact that we only have a two-period OLG model and we are comparing the two steady state equilibria before and after such a pension reform from PAYG to fully funded systems, we run a number of simulations for both of our standard and altruism model in the way of changing some parameters, such as the subjective discount factor  $\beta$  of low skilled agents, and also their subjective weights on parents' utility  $\theta$ .

We mainly utilize Newton's method, which solves our functions iteratively. The method requires an initial solution guess,  $x_0$ , and then evaluates f(x) at this initial value. We use *fsolve* to find the optimal decisions that solve the system of equations where we assume that  $s^l$  responds to  $s^h$ . This whole process is repeated until an optimal path is created for every combination of consumption when old and consumption when young for both agents, savings for both agents respectively.

# 7.3 Results of Modeling

## Two steady state equilibria before and after the pension reform

We choose the value of  $\theta$ ,  $\beta^l$  and  $\beta^h$  in order to approximate China's households' savings rate as an average of ten years' savings rate before the pension reform in 2005 (cf. Appendix I).

China	PAYG	FF1	FF2

θ	0.90	0.90	0.90
β (low)	0.70	0.70	0.70
β (high)	0.90	0.90	0.90
α	0.33	0.33	0.33
ρ	0.30	0.30	0.30
Contribution rate b (low)	0.10	0.10	0.10
Contribution rate b (high)	0.23	0.23	0.15
Redistribution	Yes	No	No
Net replacement rate			
- low	0%	38%	38%
- high	35%	101%	60%
Gift as a share of disposable income	16%	-2%	15%
Official Savings Rate	22%		
Individual savings as a share of	25%	19%	20%
disposable income (w/o contributions			
to fully funded scheme)			
- low	9%	7%	1%
- high	42%	32%	38%
Total individual savings as a Share of	-	40%	34%
disposable income (including			
contributions to fully funded scheme)			
- low	-	19%	12%
- high	-	62%	56%

 $\theta$  is the individual's weight on the parents' consumption in period t, whereas  $\beta$  is the weight on the individual's own old-age consumption in period t+1,  $\alpha$  represents the relative share of capital, and  $\rho$  the relative share of high skilled individuals in the economy.

Our model predicts a higher savings rate after the reform comparing to current Chinese household savings rate due to the fact that our two-period OLG model represents 30 years for each period. Both levels of individual savings for high and low skilled agents decrease after a pension reform from PAYG to FF. However, if we calculate savings by including the forced saving from fully funded pension benefits, the total individual savings increase after such a pension reform.

Low skilled agents reduce gifts to their parents after a pension reform, which is in line with our expectation, since they are now covered by the fully funded pension scheme, and therefore have less incentive to be altruistic. Furthermore, we observe a negative correlation of the net replacement rate for high skilled agents and gifts made by low skilled agents to their parents. This correlation seems paradox at first glance, but it is driven by the exogenous interest rate which determines steady state capital, and hence, the aggregate level of savings. As the high

skilled agents increase their savings in response to a reduction in their relative pension benefits, low skilled agents decrease their individual savings such that their gifts increase. The former is based on the relatively low discount on old-age consumption that high skilled agents are facing. We conclude that further research is needed in order to evaluate how savings would react in a closed economy with endogenously determined interest rates.

#### **Sensitivity Tests**



Figure 3: Aggregate savings pre/post reform comparison by sensitivity test on contribution rates when  $b^h = b^l$  (graph produced by the authors)



Figure 3: Pre-/post-reform comparison of gifts made by low skilled agents for various contribution rates when  $b^h = b^l$ (graph produced by the authors)

#### **Contribution rate b**

We conduct sensitivity test on the contribution rate of the pension benefits in both pension schemes to analyze how gifts respond to increasing pension benefits. The first graph shows that as b increases, household savings rate increase both, before and after the reform. The marginal increase of savings rate is smaller in the PAYG system compared to the fully funded scheme, because only high skilled agents benefit from higher contribution rates as their retirement income increases. Low skilled agents are required to contribute without having access to benefits. Hence, they reduce their savings. In a fully funded scheme, individuals with low income also benefit from the accumulated funds on their individual accounts. Thus, the increase in aggregate savings (including contribution to the funded system) is more important than under a PAYG with restricted access to social security.

As expected, gifts are negatively correlated with savings. In a PAYG system, altruistic transfers are relatively constant when taxes levied on labor income increases, since the low skilled agents are not covered in a PAYG system, and hence, do not benefit from increasing pension wealth. However, they need to adjust their gifts in response to the declining disposable income. Under a fully funded scheme, gifts as a share of income turn even negative. The threshold is at  $b^{l} = b^{h} = 12\%$  where replacement rates exceed 50 percent for both agents, since they earn interest rates on their funded accounts.

## Sensitivity test of $\theta \& \beta^l$ (only analysis for low skilled agents' savings and gifts)

All other parameters are held fixed as in the steady state analysis (details see parameterization). Contribution rates in PAYG  $b^{l} = 0.1$  and  $b^{h} = 0.23$ , in a fully-funded system  $b^{l} = 0.1$  and  $b^{h} = 0.15$ .



Figure 4: Savings rate analysis by sensitivity test on  $\vartheta$  (the individual's weight on the parents' consumption in period t) and  $\beta$  (the weight on the individual's own old-age consumption in period t+1) (graph produced by the authors)



Figure 5: Sensitivity test on  $\vartheta$  (the individual's weight on the parents' consumption in period t) and  $\theta$  (the weight on the individual's own old-age consumption in period t+1) (graph produced by the authors)



Figure 6: Sensitivity test on  $\vartheta$  (the individual's weight on the parents' consumption in period t) and  $\theta$  (the weight on the individual's own old-age consumption in period t+1) (graph produced by the authors)





Figure 7: Sensitivity test on  $\vartheta$  (the individual's weight on the parents' consumption in period t) and  $\theta$  (the weight on the individual's own old-age consumption in period t+1) (graph produced by the authors)

Due to the fact that we only change the low skilled agents' weights ( $\theta$  and  $\beta^l$ ) we restrict our analysis to their decisions with respect to savings and gifts.

First of all, we notice that regardless how  $\theta$  and  $\beta$  change, the savings of low skilled agents in both pension schemes are positive. In general, the individual savings of the low skilled agents decrease after a pension reform due to the fact that they will be covered in a fully funded social security scheme compared to no benefits at all in a PAYG system. They decrease savings in response to an increase in social benefits due to the gift functions' linear form. However, if we include the forced savings from the fully funded pension system, the aggregate savings would increase. The gifts to parents also decrease after they are covered by a fully funded pension system because with social benefits, the need for being altruistic towards parents declines.

When  $\theta$  increases, the savings of low skilled agents are decreasing because they care more about their parents' wellbeing, thus they choose to give more gifts to their parents instead of saving for their consumption in old. Decreasing  $\beta$  implies that their losses in savings for old-age consumption are so high that the agents prefer to consume more when young or to increase their support to their parents.



Figure 8: Sensitivity test on  $\vartheta$  (the individual's weight on the parents' consumption in period t) and  $\theta$  (the weight on the individual's own old-age consumption in period t+1) (graph produced by the authors)



Figure 9: Sensitivity test on  $\vartheta$  (the individual's weight on the parents' consumption in period t) and  $\theta$  (the weight on the individual's own old-age consumption in period t+1) (graph produced by the authors)

In contrast to savings, low skilled agents decide to be more altruistic towards their parents as  $\theta$  increases and  $\beta$  decreases. When  $\theta$  increases, the young care more about the elderly's wellbeing, their gifts certainly increase. Similarly, as  $\beta$  decreases, low skilled agents prefer to be altruistic instead of accumulating savings. However, we notice that when  $\theta$  is set too low and  $\beta$  is too high, the gifts of low skilled agents become negative, especially in a fully funded system. One could interpret these negative gifts as a bequest from the parents to the children, who would use it as additional savings on which they earn extra interest rates. The agents technically earn a return equal to the population growth rate n on their expected gifts. If the discount is too high

(when theta is very low), agents would experience a utility loss if they continued to give altruism to their parents instead of accumulating additional savings.

Our limited framework does not rule out negative gifts by forcing them to be equal to zero, which requires further research. We conclude that theta should not be set too low and the beta for low skilled agents should not be set too high in order to imitate ascending altruism in rural areas of Asian emerging economies.

With regard to aggregate savings rate before and after such a pension reform, we can see how it simultaneously responds to the change in parameters  $\theta$  and  $\beta$ . As  $\theta$  increases, aggregate savings rate decline due to the fact that low skilled agents choose to give more altruism and save less when they care more about their parents' wellbeing. When  $\beta$  decreases, savings rate decreases in response to a lower weight on their consumption when old. We observe the same trend for the aggregate household savings rate both before and after the pension reform. Besides, savings rates appear to be higher in a fully funded system than a PAYG scheme, however, we calculate the savings rate by adding the forced to the individual savings.

We conclude that heterogeneity and the functional form that we use to solve for gifts impose certain restrictions on beta and theta. Nevertheless, with judicious setting of the values of  $\beta$  and  $\theta$ , we obtain reasonable results matching our expectations of the household savings rate in China, which spurred the value and specialty of our gift model analysis. Hence, our model limitations are open to future research and discussions.

## 7.4 Extension of altruism model to other Asian emerging economies

We compute taxes levied on income such that the replacement rates are in line with what the current official scheme would predict. Since there is no evidence suggesting that low and high income earners contribute to a different extent, we assume that  $b^{l} = b^{h}$ .

## Thailand

Thailand has a general, formalized social security system based on a two-tier defined benefit scheme. As stated before, we do not consider public officials and their respective pension (first tier). Thus, the following analysis is limited to workers in the private sector who are covered by the Old-Age Pension System (second tier). The system is performing poorly in terms of coverage and is not able to provide sufficient benefits. The target replacement rate is 30 percent, and only 30 percent of the formally employed labor force participates in the defined-benefits scheme. In addition, the government offers employees to pay into voluntary, provident funds whose contributions must be matched by the employer. Voluntary compliance is still very low, and according to the Asian Development Bank, the fund is expected to be depleted within the next 30 years (Park, 2014).

We simulate the Thai pension system by assuming that only high-income earners are likely to receive benefits from the existing defined-benefits scheme, since compliance is limited. As

recommended by the Asian Development Bank, we further introduce mandatory, fully-funded individual accounts which are accessible to both, low and high skilled agents. The structure of the analysis is similar to the Chinese system. In addition to a scenario where we use the standard parameters that we have identified before, we also compute a case that better succeeds to match the extremely low official household savings rate of approximately 10%. The following table reports our results.

Thailand	and Standard Parameters		Very low hous	ehold savings
	PAYG1	FF1	PAYG2	FF2
θ	0.90	0.90	0.90	0.90
β (low)	0.70	0.70	0.50	0.50
β (high)	0.90	0.90	0.70	0.70
α	0.33	0.33	0.25	0.25
ρ	0.30	0.30	0.30	0.30
Contribution rate b (low)	0.18	0.09	0.18	0.09
Contribution rate b (high)	0.18	0.09	0.18	0.09
Redistribution	Yes	No	Yes	No
Net replacement rate				
- low	0%	33%	0%	39%
- high	31%	33%	31%	39%
Gift as a share of disposable income	20%	27%	62%	56%
Official Household Savings Rate		1	0%	
Individual savings as a share of	26%	20%	14%	10%
disposable income (w/o contributions				
to fully funded scheme)				
- low	8%	-3%	-10%	-17%
- high	43%	42%	37%	35%
Total individual savings as a Share of		30%	0%	20%
disposable income (including				
contributions to fully funded scheme)				
- low		7%	0%	-7%
- high		52%	0%	45%

 $\theta$  is the individual's weight on the parents' consumption in period t, whereas  $\beta$  is the weight on the individual's own old-age consumption in period t+1,  $\alpha$  represents the relative share of capital, and  $\rho$  the relative share of high skilled individuals in the economy.

Taking standard parameters, we find that, similar to the Chinese reform, mandatory, a fully funded pension scheme would partially crowed out individual savings, low skilled agents even borrow against their future expected benefits. Total individual savings, including individual accumulated funds, increase as the previous analysis would suggest. Surprisingly, gifts transferred to parents increase when the agents gain access to social security. We argue that this effect is due to the functional form of gifts where negative savings result in higher gifts, and it is too strong to be offset by the downward pressure of pension benefits. The latter might

represent a limitation of the model's capacity to explain altruistic behavior in response to varying return on capital.

The second scenario on the right-hand side is characterized by strong disincentives to save in order to achieve an extremely low household savings rate of approximately 10% that is reported by real data. There has been research arguing that the low savings rates are caused by the unstable, political environment that Thailand has been facing for several years. The results suggest that low skilled agents tend to borrow even more compared to the standard parameter set up, and heavily rely on intra-family wealth transfers for old-age consumption. In contrast to the standard parameters, the share of gifts of disposable income now declines, which implies that the new social security benefits offset the upward pressure of negative savings on gifts.

## **The Philippines**

Similar to Thailand, the Philippines have a mandatory defined benefits scheme in place. The Philippine pension system suffers from huge discrepancies between the contributions and the benefits that are paid out. The Asian Development Bank estimates that the system's long-run sustainability is limited to 2013, and suggests to move to a defined contribution scheme. We conduct a similar analysis as before, where a substantial share of the population is not covered. Even though, at 75%, official coverage rates are relatively high, compliance is very low. Therefore, we argue that the Philippine system faces the same problems as the Thai and Chinese system. An important share of the population finances a system which provides benefits to a limited group.

One major difference of the Philippine economy in comparison to China and Thailand is the high annual population growth of two percent (versus 0.5% in China and 0.3% in Thailand).

The Philippines	Standard Parameters			
	PAYG	FF2	FF3	
θ	0.90	0.90	0.90	
β (low)	0.70	0.70	0.70	
β (high)	0.90	0.90	0.90	
α	0.33	0.33	0.33	
ρ	0.40	0.40	0.40	
Contribution rate b (low)	0.20	0.11	0.20	
Contribution rate b (high)	0.20	0.11	0.20	
Redistribution	Yes	No	No	
Net replacement rate				
- low	0%	43%	87%	
- high	41%	43%	87%	
Gift as a share of disposable				
income	21%	28%	-14%	
Official Household Savings Rate		20%		
Individual savings as a share of disposable income (w/o contributions to fully funded	26%	20%	19%	
scheme)				
- low	8%	-6%	0%	
- high	41%	41%	34%	
Total individual savings as a		32%		
Share of disposable income				
(including contributions to fully				
funded scheme)			44%	
- low		7%	25%	
- high		53%	59%	

 $\theta$  is the individual's weight on the parents ' consumption in period t, whereas  $\beta$  is the weight on the individual's own old-age consumption in period t+1,  $\alpha$  represents the relative share of capital, and  $\rho$  the relative share of high skilled individuals in the economy.

The official target replacement rate is 40%. Similar to Thailand, we compute the respective level of income taxes for low and high skilled agents such that their benefits achieve this target level. We find similar effects of a pension reform on household savings and gifts as in Thailand. The population growth does not seem to have a major impact on altruistic behavior. Individual savings decline, whereas total savings including contributions to the funded accounts increase. Keeping the replacement rate constant by reducing the tax burden levied on income results in negative savings for low skilled agents. The reason is that high skilled agents are inclined to smooth consumption to the second period (and thereby earning interest rates) instead of immediately consuming the additional income when young. Since interest rates, and hence,

capital, are fixed, low skilled agents tend to borrow against their future pension benefits, as they suffer from much higher discount rates than high skilled individuals. Due to the given functional form of gifts, we observe an increase in altruistic transfer as savings turn negative while the tax burden on labor income diminishes. The column on the right hand side reports negative gifts, i.e. bequests, when contribution is kept constant whereas pension benefits are scaled up by earning interest rates on the funded accounts. Low skilled agents rather decide not to save, as their utility from old-age consumption is now strongly discounted.

# 8 Model comparison

Both models, the standard as well as the gift economy, capture the same trend: individual savings drop in response to a higher old-age income. Aggregate household savings, however, increase after a pension reform from PAYG to FF, since PAYG pension benefits are converted into forced savings and become part of the economy's capital stock. Keeping contribution constant, the reform yields higher future benefits, since the agents now earn interest rates on their accumulated funds. Population growth directly affects the size of ascending altruism and yield some "return" of investment in children. Since contribution is enforced by levying taxes on the individual's income, we find that the government could either lower future tax rates, to finance similar levels of net replacement rates, or use the surplus for other purposes such as financing the transition. This finding is conditional on our assumption of full coverage and compliance, since we restrict the analysis to groups that either already had access to social security prior to the reform or would typically gain access as part of the target group.

Heterogeneity is crucial in order to model the important income disparities among Asian emerging economies which determine the individual's access to social security. Since Asian social security systems typically suffer from either low coverage or compliance accompanied with high future remuneration for a small group of beneficiaries, we assume that the existing PAYG systems implicitly rely on redistribution. Agents that earn relatively low wages are forced to contribute to the system by paying taxes, whereas they cannot claim future pension benefits. The latter leads to important intra-family wealth transfers that we take into account by introducing ascending altruism. We hereby follow O'Connell and Zeldes (1992) and assume that gifts are negatively correlated to savings and future pension benefits.

We use the same parameters in both models, the standard and gift economy, in order to increase comparability. The major drawback is that savings rates in the standard economy are too high compared to what we find in the data. One could better match real figures by adjusting the discount factor  $\beta$ . However, the standard model that we use is a very stylized version of Asian emerging economies and not fully equipped to provide a quantitative in-depth analysis of the economies that we study. As long as it captures the same overall trend, we prefer to put more emphasis on comparability. Since the gift economy is more sensitive to our choice of parameters, we calibrate the latter first and apply the same set of parameters to the standard economy.

Numerically, both models report similar increases in aggregate individual savings by +10%. The estimates are even identical for high skilled agents, but differ considerably with respect to low skilled agents. In the standard economy, their savings as a share of disposable income is relatively close to what we predict high skilled agents to save. Introducing ascending altruism dramatically reduces their initial level of savings prior to the reform and continues to exert a strong downward pressure on savings after moving to a fully funded system. We obtain estimates which are close to or even below zero. The standard economy does not reveal any diverging trends for China, Thailand or the Philippines, whereas we find very different savings decisions in the gift economy conditional on the respective disincentives.

Gifts as a share of disposable income exhibit very different trends for China, Thailand and the Philippines, and yields some feedback loops on savings due to the interlinkage between both of them. Overall, gifts drop in response to higher replacement rates for low skilled agents. Moreover, we observe a negative correlation of the net replacement rate for high skilled agents and gifts made by low skilled agents to their parents. This correlation seems paradox at first glance, but it is driven by the exogenous interest rate which determines steady state capital, and hence, the aggregate level of savings. High skilled agents are more inclined to adjust their savings correspondingly than low skilled agents due to their higher discount factor beta. Therefore, as the high skilled agents increase their savings in response to a reduction in their relative pension benefits, low skilled agents decrease their individual savings such that their gifts increase.

With respect to Thailand, total individual savings, including individual accumulated funds, increase, as the previous analysis would suggest, whereas low skilled agents tend to borrow against their future pension claims. Surprisingly, gifts transferred to parents increase when the agents gain access to social security. We argue that this effect is due to the functional form of gifts where negative savings result in higher gifts, and it is too strong to be offset by the downward pressure of pension benefits.

The Philippines experience the highest population growth among all Asian emerging economies. Our analysis suggests that population growth does not have a major impact on altruistic behavior. Individual savings decline, whereas total savings including contributions to the funded accounts increase. Keeping the replacement rate constant by reducing the tax burden levied on income results in negative savings for low skilled agents. The reason is that high skilled agents are more inclined to smooth consumption to the second period (and thereby earning interest rates) instead of immediately consuming the additional income when young. Since interest rates, and hence, capital are fixed, low skilled agents tend to borrow against their future pension benefits, since they suffer from much higher discount rates than high skilled individuals. Due to the given functional form of gifts, we observe an increase in altruistic transfer as savings turn negative while the tax burden on labor income diminishes.

## 8.1 Limitations

Chinese savings data from 2005 to today suggests that aggregate rates have slightly increased by approximately four percent. Ang (2008) conducts empirical research on household savings behavior in order to identify causal relationships. The author uses an extended life cycle model and finds a negative effect of pension benefits on savings in China. The results are in line with our results and confirm the hypothesis that household savings rates are negatively correlated with the expected benefits from pension schemes at the point of retirement. Research by Munnell (1976) and Edwards (1996) yields similar results for cross-country estimates. Ang (2008) concludes that the development of pension systems in Asian emerging economies tend to discourage the household savings in Asia in the long run. Theoretical literature, however, suggests very different effects of pensions on savings. One prominent example is Feldstein (1974) who uses time series aggregate data to verify the relationship between personal savings

and social security wealth in the U.S. His results show that social security wealth depresses personal saving by 30-50 percent. In contrast, Kotlikoff (1979) and Venti and Wise (1990) argue that pensions do not necessarily offset private savings.

Limiting the comparison to literature on China, we find that research by Curtis, Lugauer and Mark (2011) as well as Coeurdacier, Guibaud and Jin (2014) is closest to our framework. They study household savings in China with exogenous altruism. Their focus, however, is on endogenous fertility. They find that high savings rates are driven by restricted fertility policy, and further identify labor income growth as major factor that depresses individual savings. The analysis suggests that we succeed to explain some recent trend in Chinese savings rates and give some hint on how savings behavior in other Asian emerging economies would respond to such a reform. We argue that introducing ascending altruism is an important characteristic of Asian culture and needs to be taken into account when studying private wealth accumulation. However, the models that we use are accompanied by a number of limitations that need to be considered.

First, the general assumption that there is no intergenerational transfers among high skilled agents might neglect the effect of bequests decisions. Having endogenous two-sided transfers is technically difficult to achieve, in particular, if the analysis intends to shed light on endogenous fertility decisions like Curtis, Lugauer and Mark (2011) and Coeurdacier, Guibaud and Jin (2014). We limit our analysis to ascending altruism, since the pension reform most importantly intends to increase coverage in rural areas. Introducing a bequest motive may exert a negative pressure on saving decisions made by young individuals conditional on the period when they receive the bequest. Since we use a two-period OLG model, this is beyond our framework.

Second, we do not consider government debt and thereby extra transfers in a form of subsidies to the rural area. China's social security system, for example, is mostly underfunded and accumulated wealth on individual accounts is largely notional. The government officially incentivizes compliance to the New Rural Pension by subsidizing contributions made to the individual accounts. However, it is not clear to what extent these notional subsidies will be funded in future. Intuitively, if the government's subsidy to low skilled agents was taken into consideration, one could expect that individual savings by low skilled agents decrease by the respective discounted amount. The effect on high income earners is difficult to predict when these subsidies are financed by additional government debt, and the budget is not required to be balanced. Since this is beyond the scope of our analysis and model framework, we leave interlinkages between debt-financed subsidies and ascending altruism open for further research.

Third, our model does not include economic growth. We would expect that introducing economic growth leads to a growth in both agents' wage income. Given that pension benefits are indexed on wage or benefit from additional remuneration by higher interest rates, expected old-age income would increase. Even if the ability to save rises with increasing income, the overall effect on savings and intergenerational transfers is difficult to predict, since the increase in wage would boost the return on traditional old-age support, and thereby depresses savings and most likely compliance to institutionalized pension schemes.

Furthermore, we do not include borrowing constraints, population aging and endogenous interest rates in our framework. Population aging is undoubtedly one of the major reasons why the current PAYG schemes lack sustainability in the long run. Our analysis provides the prereform steady state estimates when population aging is still an upcoming issue, but has not caused the system to fail at this point in time. We would expect that savings respond stronger if pension benefits are considerably lower than the amount that the agents have paid in.

Finally, limited data resources imply that our models' external validity is restricted to only those three countries that we have tested with our models, namely China, the Philippines and Thailand.

# 9 Policy implications

In order to mitigate the effects of a decreasing population growth in the short run and enhance welfare in the long run as well, this section evaluates three policies that the government in Asian emerging economies could think about for future implementations.

First, in our framework, boosting human capital, modeled by an increase of the share of high productivity agents in the total population, would raise the aggregate savings rate, because high skilled agents are less inclined to transfer wealth to their old parents, but are more likely inject additional capital in the economy. Combined with potential bequest motives, it might yield major positive effects on the level of household savings.

Second, we assume full coverage within our framework, since we restrict our analysis to groups that either already had access to social security prior to the reform or gain access by introducing a general fully funded scheme. We argue that it is important for the government to increase the coverage of their pension scheme, which should be prioritized. Steps are needed to provide incentives for agents to increase their contribution to the pension system (Ebbers et al., 2008) which relates back to the discussion of debt-financed subsidies in the previous section. An increase in old-age security benefits crowds out private transfers, which is more efficient in terms of capital stock.

Third, pension funds' return on investment is usually low, with approximately three to four percent in the case of China according to NSSF. Given that labor income growth was relatively high in the past decades, too low return on funds might create disincentives for compliance (Ebbers et al., 2008) and reinforces the traditional intra-family wealth transfers as main source of income for elderly. In order to attract more contributions, it is further important to diversify the investment portfolio and reconsider funds management by local public authorities.

# 10 Conclusion

Our investigation is based on the fact that Asian emerging economies' pension systems are experiencing or are expected to be subject to major reforms in near future due to population aging and lower rates of economic growth. There has been first reform efforts to switch from a PAYG system with limited coverage to funded individual accounts that also address the rural population. The latter is typically excluded from any type of old-age social security, and relies on intrafamily wealth transfers from children to parents when old. Our investigation aims to analyze household savings behavior in response to a pension reform from PAYG to fully funded individual accounts including typical characteristics of Asian emerging economies: income inequality, intergenerational transfers and differences in access to social security prior to the reform. We use a two-period OLG model, and contrast the effects of a pension reform in a framework with altruistic behavior to standard economy. High skilled agents are assumed to have access to PAYG pension benefits. Although low skilled agents contribute to the system as they pay taxes on labor income, they are not able to claim future pension benefits prior to the reform.

Since we do not consider any transitional dynamics, we could compute different steady state equilibria to compare household savings decisions and altruistic behavior. We find that a shift from a PAYG to a fully funded scheme partially crowds out individual savings and gifts, but the underlying causes differ conditional on the agents' skill level. High skilled agents generally respond to higher pension benefits by decreasing their savings. Low skilled agents, in contrast, may even decide to borrow when disincentives to save are sufficiently strong. We assume gifts to follow a linear function where it depends on some intercept and savings as well as pension benefits. The function's coefficients are constant, but solved in equilibrium to model endogenous altruistic behavior. The depressing effect of pension wealth exerts more pressure on savings than on gifts. In a politically unstable environment such as in Thailand where very high discount rates discourage the agents to save, we find that low skilled agents rather borrow against their future pension benefits. They prefer to rely on traditional old-age intrafamily support instead of institutionalized pension schemes, and increase the transfers made to their parents when young.

The presented results are subject to a number of limitations that one needs to consider. Most importantly, we do not consider economic growth which would not only yield intergenerational income inequality in addition to intragenerational income heterogeneity as in our framework, but would boost wages from one period to the next. The aggregate effect is difficult to predict, since higher income typically leads to higher savings. However, growth in labor income would also yield higher return for traditional old-age support. Furthermore, we do not include intergenerational transfers among high skilled agents, e.g. bequests, because endogenous two-sided altruism is technically difficult to achieve in a two-period framework. Our results indicate that we succeed to explain some recent trend in Chinese savings rates and give some hint on how savings behavior in other Asian emerging economies would respond to such a reform. Interlinkages between savings, ascending altruism and other aspects such as growth, two-sided transfers or government subsidies are beyond the scope of our analysis, but certainly valuable to look into for future research when analyzing private wealth accumulation in Asian emerging economies.

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# 12 Appendix

# 12.1 Appendix I: Data







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## 12.2 Appendix II: Pension Systems

12.2.1 Overview of Pension Schemes

(Taken from Park & Estrada, 2014, p. 279.)

**Defined benefit pensions** represent a "*full service social insurance*" (Fanti, 2009, p. 1). The paid benefits are determined by either an individual's earnings history or final wage as well as the length of service (Barr, 2006). The pension may be (partially) funded or unfunded. In a pure DB pension system, the risk of low portfolio performance falls on the financing party, often the employer, who needs to set aside financial assets in order to make provisions for future liabilities (Bohn, 2011; Fanti, 2009). Pure defined benefit pensions cannot respond to demographic changes, and thus, transfers the risk to the following generations (Barr & Diamond 2009).

*Defined contribution* schemes are based on the individuals' savings plan, and solely depend on the value of their lifetime contributions. Their primal objective is consumption smoothing. The scheme has the advantage that it is relatively robust against government failure. However, the individual pension fund heavily relies on stock market performance and provides no insurance against low income periods. Since it does not include risk sharing among several individuals, pure DC schemes are inadequate to address the risk of old-age poverty. Moreover, they might not be the right pension system in countries where the savings rates are already high such as China (Barr, 2006; Barr, 2014; Barr & Diamond, 2009; Calvo & Williamson 2008).

*Notional defined contribution* schemes simulate individual accounts, but are financed by a Pay-As-You-Go system. The benefits depend on an individual's former wage and lifetime contribution as well as the retirement age and lifetime expectancy (Barr, 2006). The pension authority keeps record of individual contributions and adds annual interests. When the individual retires, the accumulated accounts are converted into an annuity (Barr, 2014). Partial funding permits to enhance welfare (Barr & Diamond, 2009) by dividing economic risks among several individuals (see also Dutta et al., 2000; Devolder & Melis, 2013) - on the condition that administrative costs remain at reasonable levels and do not offset potential gains (Feldstein 1999). This implies that a NDC system is more robust against economic crisis, but heavily exposed to the risk of government failure and misuse of funds. Moreover, it usually causes less administrative costs than privately managed individual funds (Barr, 2014).

*A noncontributory basic pension* is usually offered to the poorest part of the population which is not or only partially eligible for other pension benefits.

#### 12.2.2 Demographic Transition in Selected Asian Countries

Demograp	hic Indica	itors of Se	lected As	ian Count	ries			
Country	Total Population (million)		Average Annual Rate of Change of Population (percent)		Total Fertility Rate		Median Age	
Year	2010	2050	2005–10	2045-50	2005–10	2045-50	2010	2050
World	6,895.9	9,306.1	1.2	0.4	2.5	2.2	29.2	37.9
China	1,341.3	1,295.6	0.5	-0.6	1.6	1.8	34.5	48.7
Indonesia	239.9	293.5	1.1	0.1	2.2	1.7	27.8	41.6
Korea	48.2	47.1	0.5	-0.5	1.3	1.8	37.9	51.8
Malaysia	28.4	43.5	1.7	0.6	2.7	2.0	26.0	36.9
Philippines	93.3	154.9	1.7	0.8	3.3	2.1	22.2	32.5
Singapore	5.1	6.1	3.5	-0.1	1.3	1.8	37.6	51.4
Thailand	69.1	71.0	0.7	-0.3	1.6	1.7	34.2	46.8
Vietnam	87.8	104.0	1.1	-0.1	1.9	1.7	28.2	45.8
Country	Life Expe Bi	ectancy at Life Expectancy at rth Birth (2005–10)		Percentage of Population Ages 60 and Older		Population Ages 60 and Older (million)		
Year	2005–10	2045-50	Men	Women	2005	2050	2005	2050
World	67.9	75.6	65.7	70.1	11.0	21.8	759.8	2,031.3
China	72.8	79.2	71.1	74.5	12.3	33.9	165.2	439.2
Indonesia	67.9	77.6	66.3	69.4	8.2	25.5	19.6	74.7

83.3

75.7

71.3

82.7

77.1

76.2

15.7

7.7

5.7

14.0

12.9

8.4

38.9

20.4

15.3

37.8

31.8

30.8

7.6

2.2

5.4

0.7

8.9

7.4

18.3

8.9

23.6

2.3

22.6

32.0

TABL	E 1	4.	1

Source: United Nations (2011). Note: Total fertility rate is in births per woman.

79.9

73.4

67.9

80.6

73.6

74.3

84.6

79.7

76.3

85.2

79.5

80.4

76.5

71.2

64.5

78.5

70.2

72.3

#### **TABLE 14.2**

Korea

Malaysia

Philippines

Singapore

Thailand

Vietnam

Pension Age and Basic Structure of Pension Systems, 2010						
Country Pension Age (Years)		Difference Between Life Expectancy and Pension Age (Years)	Defined Benefit or Defined Contribution	Element of Income Redistribution		
China	60 (55)	13 (18)	Defined Benefit, Defined Contribution, and Notional Defined Contribution	Yes		
Indonesia	55.0	15.7	Defined Contribution	No		
Korea	65.0	13.6	Defined Benefit	Yes		
Malaysia	55.0	19.2	Defined Contribution	No		
Philippines	65.0	6.7	Defined Benefit	Yes		
Singapore	65.0	15.0	Defined Contribution	No		
Thailand	55.0	15.6	Defined Benefit	No		
Vietnam	60 (55)	14.2 (19.2)	Defined Benefit	No		

Sources: Park (2011, 2012).

Note: The pension age in parentheses refers to the pension age for women if different from that for men. Life expectancy refers to life expectancy at birth. The pension age applies to private sector workers in Indonesia, Malaysia, Singapore, and Thailand, and to both public and private sector workers in China, Korea, the Philippines, and Vietnam. In Singapore, the retirement age of 65 refers to 2012.

(Source: Park & Estrada, 2014, p. 276)

## 12.2.3 Share of Urban Population in Selected Asian Countries



Figure 14.3 Urban Population as Share of Total Population, 1950–2050 (Percent)

(Source: Park & Estrada, 2014, p. 276)

Source: United Nations (2012). Note: Singapore, as a city-state, is excluded.

## 12.2.4 Total Contribution Rates of Pensions Systems in Selected Asian Countries



**Figure 14.5** Employee, Employer, and Total Contribution Rates of Pension Systems, 2007 (*Percent*)

Source: Asian Development Bank (2008). Note: DB = defined benefit; DC = defined contribution.

(Source: Park & Estrada, 2014, p. 280)

#### 12.2.5 The World Bank's Multipillar Model

According to the World Bank (1994), a pension system should have three main purposes. At first, it permits to smooth savings and consumption over lifetime. Secondly, it involves the redistribution assets to low-income workers whose wage history did not allow them to accumulate enough funds they could solely rely on as retirees. Moreover, it should provide insurance against major risks, such as an economic crisis and other market turbulences.

Holzmann (1994) points out that macroeconomic risks such as negative output shocks, unemployment, low wage growth or low portfolio performance may lead to lower revenues in an unfunded scheme. However, the effects at an individual level could be mitigated through risk sharing, while in a fully funded scheme, the individual solely bears the risk of negative effects on her accumulated funds. The pitfalls of an unfunded DB scheme are closely related to demographic risks such as a higher old dependency ratio. The latter would shrink the contributing labor force, and results in large public deficits. In contrast, individuals with a purely funded pension schemes would not be affected. However, Barr (2002) refutes the conclusion that individually funded schemes are immune to demographic risks. They show that without an increase in productivity, the aggregate output falls and leads to "[...] a mismatch between demand and supply in either the goods market or the assets market" (Barr 2002, p. 8). The major drawback of unfunded schemes is their volatility in response to short and long term budget constraints.

Being in accord with Holzmann, the World Bank argues that solely relying on one pure scheme is not enough to address the above-mentioned challenges. A pure public PAYG system is neither adequate to respond to recent demographic trends nor robust against political failure. PAYG schemes are often poorly designed which translates in higher expenditure than initially expected. These deficits are mostly caused by political leaders promising too high future benefits. In addition to this, early a retirement age requires either further tax subsidies or higher contribution rates. Moreover, the value of benefits in a PAYG system may deteriorate if they are not price indexed. High PAYG schemes may also discourage individual savings, and thereby reduce aggregate capital accumulation. In addition to Holzmann's critics on purely fully funded schemes, the World Bank names inefficient investment as one of the major problems with this pension design which is particularly true for low income and emerging markets.

Therefore, the World Bank suggests a three pillar model presented in the following figure:



(Source: The World Bank, 1994, p. 17)

The first pillar is ideally publicly managed, but modest in size. It provides insurance against old-age poverty, and major economic risks, e.g. an economic crisis, low investment return and inflation. The second pillar is fully funded and privately managed. Its aim is to smooth consumption and to simultaneously increase savings. The World Bank argues that the latter encourages growth that facilitates the financing of the first pillar. However, Barr points out that an automatic relationship does not exist:

"In any switch from PAYG to funded accounts a central question is what happens to the pensions of the older generation. If they are reduced, consumption will fall, and hence, ceteris paribus, savings will increase. If pensions are not reduced, they will have to be paid from taxes or debt. Extra taxation will exert downward pressure on saving; extra debt will be an offset, at least partially, to additional private capital formation. Such macroeconomic effects could swamp the behavior of individuals whose pension contributions are moved from a PAYG contribution to an individual funded account." (Barr 2002, p. 12)

The third pillar involves voluntary saving plans, primarily addressing high-income earners. Barr and Diamond (2009) criticize that relying primarily on funding causes problems due to complexity of such schemes. Even in developed countries, a great majority of participants does not understand the options of such pension funds and therefore does not deviate from the default investment option, even though it may not be the optimal choice.

#### Economic theory

Samuelson (1958) demonstrated that a totally unfunded PAYG scheme is sustainable in an economy without capital stock where the wage growth is equal to the sum of population and productivity growth. Feldstein (1999), however, argues that the marginal product of capital can exceed wage growth (e.g. in China). Hence, it is more efficient to finance pension benefits by

funded schemes. He shows that the government could even reduce the resources needed to finance the promised benefits, if a pension reform results in a scheme consisting of the optimal mix between funding and PAYG. Barr and Diamond (2009) object that a reform is not automatically welfare improving, since one has to consider transition costs which primarily impose additional costs on the young generation who not only contribute to the new system, but also finance current benefits by their taxes. Moreover, a reform may cause an increase in implicit debts as it is the case in China (Sin, 2005). They discuss notional defined contribution pensions as medium term solution, since they allow postponing the increase in funding. Moreover, NDC can reduce transition costs, if they are based on the existing institutional infrastructure and avoid additional administrative costs as for privately managed accounts.

Following this reasoning, the World Bank proposes five main pension reforms, which primarily focus on diversification of pension schemes to combine the presented advantages of unfunded and funded schemes:

- i. "[...] parametric reforms that keep the benefit structure, public administration, and unfunded nature of the scheme and merely change the system's parameters;
- ii. a notional defined-contribution reform that changes the structure of benefits but keeps public administration and the unfunded nature;
- iii. a market-based approach that provides fully funded defined-contribution or definedbenefit arrangements under primarily private management (especially the investment of assets);
- iv. public prefunding that provides defined benefits or defined contributions that are publicly administered;
- v. multipillar reforms that diversify the structure of benefits, administration, and funding of the pension system." (Holzmann et al., 2005)

Following the World Bank approach of pension reforms to a large extent, China has implemented a three pillar system, including a PAYG DB basic pension, funded DC schemes and NDC schemes (Park & Estrada, 2014).

#### 12.2.6 China in Detail

In China, pension benefits are organized through three different public pension programs. The Pension for Urban Workers and Staff (PUWS) as well as Pension for Urban Residents (PUR) are supposed to cover all non-working urban residents. The New Rural Pension (NRP) was initially introduced in 1992, but subject to major reforms in 2009 in order to better address the needs of the rural population (Zuo, 2014). All three programs require a minimum of 15 years of contributions. The benefits are indexed with a mix of wage and prices (OECD, 2013).

#### The New Rural Pension (NRP)

Before 1992, rural households had no access to formal pension schemes. Elderly mainly relied on intrafamily support, largely financed by their sons. Elderly without any support were eligible to receive "five guarantees" which included food, clothing, housing, medical care and burial. In 1992, the government introduced a rural pension scheme managed at the county level and financed by the rural households' contribution. Due to the poor design of the scheme, very low benefits, and high financial risks, the program was not successful and needed major reforms in terms of financing and administration. As of 2009, the local and central government covers the expenses to a large extent. In addition to this, a two-pillar system was initiated in all 31 provinces. The first pillar consists of a basic, unconditional pension funded by public authorities. The second pillar is based on voluntary, individual accounts. The individuals' contributions are subsidized and at the age of retirement, the monthly benefits are determined by the total amount of accumulated funds and by using a government-determined annuity factor that depends on retirement age and life time expectancy.

The defined contributions in individual accounts are notional to a large extent. Only the Northeastern provinces Liaoning, Jilin and Heilongjiang as well as further eight provinces have partially funded accounts (Zuo, 2014).

#### Pension for Urban Workers and Residents (PUWS and PUR)

The PUWS and PUR have a similar two-pillar structure as the NRP. However, the saving increments are higher due to higher living expenses in urban areas (Zuo, 2014).

#### Other Pension Schemes

The government fully subsidizes pension benefits for public employees who do not pay contributions, but nevertheless receive relatively high benefits.

Finally, companies and employees can pay voluntary enterprise annuities at a maximum of 1/12 of the total payroll and wage, respectively. The pension benefits are tax exempt (Zuo, 2014).

## Major Challenges

A great majority of the pension funds are in deficit, and greatly rely on government subsidy. Without financial transfer from the central government, many local authorities would be unable to pay the monthly benefits.

Overview of China's Pension System, 2012							
Program	PUWS	NRP	PUR	Enterprise Annuities			
Targeted participants	Urban enterprise employees and self-employed	Rural residents 16 and older	Urban nonworking residents	Urban enterprise employees (voluntary)			
Total coverage (million)	283.91	326.43	5.39	15.77			
Recipients (million)	68.26	85.25	2.35				
Revenues (Y billion)	1,689.5	107.0	4.0				
Contributions (Y billion)	1,395.6	41.5	0.6				
Government subsidies (Y billion)	227.2	65.5	3.4				
Expenditures (Y billion)	1,276.5	58.8	1.1				
Accumulated surplus (Y billion)	1,949.7	119.9	3.2	0.36			

Source: Ministry of Human Resources and Social Security (2012).

Note: NRP = New Rural Pension; PUR = Pension for Urban Residents; PUWS = Pension for Urban Workers and Staff.

#### (Source: Zuo 2014, p. 301)

However, there are important disparities across provinces whether pension funds generate considerable surpluses and deficits. This inequality partially originates in the lack of portability when migrants move from their rural province of residence to large municipalities. They often contribute to the municipal pension system, but lose their entitlement when they either move or return to their rural provinces when old. These empty individual accounts pose an important burden on future generations, facing huge liabilities. Additionally, they hamper the development of a more sustainable capital market, since funds cannot act as major investors.

The system is highly fragmented. Each prefecture manages all three pillars which causes not only high administrative costs, but also impedes the pooling of financial risks involving wealthier municipalities. In order to reduce misuse at local level, the central government requires that pension funds must be invested either in state commercial banks or government bonds. These often generate very low (or even negative) rates of return and create additional financial stress (Asher et al., 2005).

Disparities in pension benefits don't foster compliance in rural provinces. In terms of average per capita expenditure in the respective regions, the average replacement rate in NRP is 21 percent, 29 percent in PUR, 193 percent in PUWS and 242 percent for public employees (Zuo, 2014, pp. 293-311).

#### Recent Reform Efforts

The Chinese government intends to expand the coverage of the three programs, but the participation of migrant workers remains at very low levels. The loss of entitlement fosters low compliance. Moreover, the government refilled the individual accounts with five percent of their respective wage. This reform failed because local authorities returned to the practice of using the individuals' accounts to finance current benefits. Centralization is being discussed in order to increase risk pooling, but due to concerns of flourishing municipalities, it has not been translated into practice yet.

The IMF suggests to lower contribution increments in PUWS to attract more migrant workers. In addition to this, the IMF favors the introduction of two additional pillars. One "zero pillar" involves an additional non-contributory central PAYG pension addressing the poorest households in rural areas. The fourth pillar should promote intra-family support as it is likely to remain the main source of income for elderly living in rural areas. We will take the above-presented characteristics and the IMF's recommendations into account when we establish the framework for our model (Zuo, 2014).

#### 12.2.7 Philippines in Detail

The Philippines pension system mainly constitutes of a defined-benefits part. This definedbenefits system is composed of Social Security Systems (SSS) for private sector workers and the Government Service Insurance System (GSIS) for public sector workers, and also the Armed Forces system for military. In total, they cover about 79% of the labor force. The monthly basic pension is dependent on earnings. The earnings basis is the greater of average earnings for the five years before pension claim or average earnings for the period during which contributions were made. Benefits are periodically adjusted for price inflation and wage growth on an ad hoc basis. With our model analysis, we are mostly referring to the defined benefits part of the private sector workers, which is the SSS part of their pension system (Park, 2014).

#### 12.2.8 Thailand in Detail

The first pension system was initiated already in 1902 by one of Thailand's kings in order to give benefits to all government officials after their retirements. It started as PAYG pension scheme for almost a century. However, in late 1990s, Thailand's pension system was completely restructured. Currently, Thailand's pension scheme is composed of 3 main pillars. The first pillar is the state pension, named as Old Civil Service Scheme and Social Security Fund, which is designed for basic needs. The 2nd pillar consists of the Government Pension Fund and the National Saving Fund. The Government Pension Fund (GPF) is a defined contribution pension system for civil servants. The 3rd pillar is a privately-financed personal provision and is voluntary. Similarly as China, in 2012, the Thailand government introduced the National Saving Fund (NSF), a new voluntary retirement savings program, which was designed in or der to cover more informally employed residents who were completely not covered by the pension systems before. Similarly to China, we are mainly referring to the National Saving Fund in the second pillar and also the third pillar of Thailand's pension system (Park, 2014).

# 12.3 Appendix III: Gift economy

12.3.1 Urban and Rural Inequality



(Source: Flow of Funds data and Urban and Rural Household Survey, National Bureau of Statistics, China)

## 12.3.2 Algebra

With respect to the low skilled agents.

## Utility function:

$$U(c) = \ln c, \gamma = 1$$

FOCs:

(12.1) 
$$c_{y,t}^{-1} = \beta (1 + g'_{t+1}) (1 + r) c_{o,t}^{-1}$$

(12.2) 
$$c_{y,t}^{-1} = \beta \theta (1+n) c_{o,t-1}^{-1}$$

**Budget constraints:** 

(12.3) 
$$c_{y,t} = (1-b) w_t - (1+n)^{-1} g_t - (1+r)^{-1} s_t$$

(12.4) 
$$c_{o,t} = s_t + g_{t+1}(s_t) + pension_{t+1}$$

Substituting consumption in the FOCs with the budget constraints yields two equilibrium conditions:

$$(12.5) s_{t} \left[ 1 + \beta \left( 1 + g'_{t+1} \right) \right] = \left[ \left( 1 - b \right) w_{t} - \frac{g_{t}}{1 + n} \right] \beta \left( 1 + g'_{t+1} \right) \left( 1 + r \right) - g_{t+1} \left( s_{t} \right) - pension_{t+1} \left( s_{t} \right) \right]$$

(12.6) 
$$(1-b)w_t(1+n)(1+r)-(1+r)g_t-\frac{s_{t-1}+g_t+pension_t}{\theta\beta}(1+r)=s_t(1+n)$$

We assume gifts to have the following functional form.

$$g_{t+1} = a_{t+1} - h_{t+1}s_t - d_{t+1}pension_{t+1}$$
$$g_t = a_t - h_t s_{t-1} - d_t pension_t$$

where 
$$a = a_t = a_{t+1}$$
,  $h = h_t = h_{t+1}$  and  $d = d_{t+1} = d_t$ .

We solve (12.6) for savings, and plug it into (12.5). Using the fact that

$$(1+g'_{t+1})=(1-h_{t+1})$$

yields

$$\underbrace{\left[\left(1+n\right)^{-1}\beta(1-h_{t+1})\left(1+r_{t+1}\right)-Q_{2}\left[1+\beta(1-h_{t+1})\right]+h_{t+1}Q_{2}\right]}_{\dot{Q}_{4}}g_{t}$$

(12.7) 
$$= -\left[1 + \beta (1 - h_{t+1})\right] Q_1 + \beta (1 - h_{t+1}) Q_1 - a_{t+1} + Q_1 h_{t+1} - pension_{t+1} + d_{t+1} pension_t - Q_3 h_{t+1} (s_{t-1} + pension_t) + \left[1 + \beta (1 - h_{t+1})\right] Q_3 s_{t-1} + \left[1 + \beta (1 - h_{t+1})\right] Q_3 pension_t$$

where

$$Q_{1} = (1-b) w_{t} (1+r)$$

$$Q_{2} = (1+r)(1+n)^{-1} (1+\beta^{-1}\theta^{-1})$$

$$Q_{3} = \theta^{-1}\beta^{-1} (1+n)^{-1} (1+r)$$

$$Q_{4} = \left[ (1+n)^{-1} \beta (1-h_{t+1})(1+r) - Q_{2} \left[ 1+\beta (1-h_{t+1}) \right] + h_{t+1}Q_{2} \right]$$

From (12.7) follows that we can solve for the constants a, h and d.

$$\Rightarrow \frac{Q_3 \left(-h_{t+1} + 1 + \beta \left(1 - h_{t+1}\right)\right)}{Q_4} = -h_{t+1} \qquad \text{and} \qquad \frac{-1 + d_{t+1} - Q_3 h_{t+1} + Q_3 \left[1 + \beta \left(1 - h_{t+1}\right)\right]}{Q_4} = -d_{t+1}$$

In steady state, we obtain

(12.8) 
$$h = \frac{\left(-2 - 2\beta - \theta\beta\right)}{-2\left(\beta + 1 + \theta\beta\right)} - \sqrt{\left(\frac{\left(-2 - 2\beta - \theta\beta\right)}{2\left(\beta + 1 + \theta\beta\right)}\right)^2} - \frac{\beta + 1}{\left(\beta + 1 + \theta\beta\right)}$$

(12.9) 
$$d = \frac{-1 - Q_3 h + Q_3 \left[1 + \beta \left(1 - h\right)\right]}{\left[-Q_4 - 1\right]}$$

(12.10) 
$$a = \frac{-\left[1 + \beta(1-h)\right]Q_1 + \beta(1-h)Q_1 + Q_1h}{Q_4 + 1}$$