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Three Essays on Early Retirement, Demographic Structure, and International Capital Flow

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Abstract

My dissertation consists of three chapters, which study the relationship between early retirement, demographic structure, and savings, international capital flows in developing countries, especially in China. The first chapter studies the role of early retirement and pension system as drivers of China's persistent high savings. The main findings are that the early retirement effect contributes to the majority of the growth and fluctuation in the saving rate while both early retirement effect and wealth substitution effect have a positive impact on the saving rate. The second chapter, accounting for the facts that the global current account balance must be equal to zero, re-examines the impact of demographic change on the current account balance. The main finding of this paper is that the young dependency ratio has a robust and significant negative impact on the current account but the old dependency ratio has an ambiguous and insignificant impact on the current account under the general equilibrium condition. The last chapter examines studies the role of early retirement and pension system reform as drivers of China's persistent high savings and current account surplus with the aid of an opened-economy model. The results show that, the dominant early retirement effect coupled with the wealth substitution effect can increase the household’s savings. The current account surplus is due to the high savings and the domestic firms have financial borrowing friction to access domestic investment. The earlier and earlier actual retirement age finally results in the growing saving rates and current account surplus under the restriction of domestic investment.
Three Essays on Early Retirement, Demographic Structure, and International Capital Flow

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Three Essays on Early Retirement, Demographic Structure, and International Capital Flow

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[2019]

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Early Retirement, Pension System and the High Saving Rate in China

Xin Liang

Abstract

Since the reform and opening policy, China has maintained remarkable high national saving rates for over 35 years. Especially from 2000 to 2008, the national saving rate in China rose by an unprecedented 40%. This paper is the first paper that studies the role of early retirement and pension system as drivers of China’s persistent high savings. The model in this paper is a closed economy life-cycle model. The model incorporates China’s fact of early retirement and the 1990s pension reform. The findings suggest that, qualitatively, the model is capable of generating changes in the national saving rate in China and the early retirement effect contributes to the majority of the growth and fluctuation in the saving rate while both early retirement effect and wealth substitution effect have a positive impact on the saving rate; quantitatively, the model can explain approximately 66% of the increase in the saving rate between 1995 and 2012.

JEL classification: E21, D91, H55, O10

Keywords: early retirement, saving rate, pension system, China

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1 Introduction

Since the “Reform and Opening” policy was launched in 1978, China’s economic and social development has achieved remarkable unprecedented changes, one of which is an equally remarkable high rate of saving. While the gross national saving as a share out of the gross domestic product (GDP) hovered around 35 percent in the 1980s, the average yearly rate climbed up to 42 percent in the early 1990s (Figure 1). Since the 21st century, when China entered the World Trade Organization (WTO), the aggregate saving rate started to accelerate, which is surging from 37 percent in 2000 to an unprecedented 52 percent in 2008. After 2000, China’s national saving rates have been one of the highest in the world, far outnumbering the average saving rates of the world, the high-income area, the middle-income area, OECD and other East Asian economies during the years of their miracle growth. To be specific, most of China’s national saving rates are about 1.5 times of the average saving rates of the middle-income area. And it is about twice of the average saving rates of the high-income area, OECD and world, respectively. Why are the national saving rates so high in China remains a question worths pondering.

Figure 1: Saving rates: China VS Different Areas of the World
Source: World Bank Indicator

In addition, China has undergone a dramatic economic transformation involving not only fast economic growth and sustained capital accumulation, but also major shifts in social systems. The gradually implemented pension system reform from 1995 to 1997 changed the pension system in China from a pure Pay-As-You-Go (PSYG) to a combination of both PSYG and Fully Funded (FF)\(^1\). This is almost the very time when China’s national saving rate started to soar. It is not coincident. With the reform of the pension system, which is highly related to the pension income, the behaviors of consumption, saving and

\(^1\)For the details about the pension system before and after the pension reform in 1997, see the appendix.
investment of households will change during both the working period and the retirement period, which contributes to the change of the saving rates.

China also sets up a much earlier mandatory retirement age\textsuperscript{2} than other countries with a similar life expectancy and allows for early retirement.\textsuperscript{3} Under this circumstance, what accompanies the process of the pension reform is a noteworthy phenomenon that Chinese people choose to retire earlier than the mandatory retirement age. In addition, the average retirement age is trending lower constantly. According to the China Health and Nutrition Survey (CHNS) and China Labor-force Dynamics Survey (CLDS), the average retirement age surged from 53 to 57 in the 1980s. Afterward, it has decreased from age 57 in 1992 persistently to about 54 in 2004. Finally, the average retirement age remained relatively stable at around 53 from 2005 to 2015 (Figure 2). These facts can offer potential channels of the early retirement and pension system to explain the high savings in China.

![Average retirement age in China](source: CHNS and China Labor-force Dynamic Survey(CLDS))

There are already some explanations for this high saving rates from different perspectives including consumption-smoothing theory, culture, demographic change, pension system and uncertainties. However, there are different shortcomings and the findings are inconclusive. The details of these imperfections in the existing literature are discussed in the next section.

In investigating the joint impact of the early retirement effect and the change of pension incomes brought by the pension reform on savings, the paper makes three main contributions: (i) a tractable

\textsuperscript{2}60 for male and 50 for female.
\textsuperscript{3}The retirement policy in China is that, according to the State Council Provisional Regulations on Retirement and Resignation of Workers, if they have worked for more than ten years, male employees should retire at age 60, female employees should retire at age 50 and female cadres should retire at age 55. In the heavy labor and high-risk industries, for example, the mining industry, male should retire at 55 and female should retire at 45. If employees lost the ability to work which is proven by hospitals, male should retire at 50 and female should retire at 45.
model linking average retirement age, the change of pension incomes and savings; (ii) its quantitative version calibrated to macro data; (iii) several decomposition tests to prove the mechanism in this paper.

The theoretical framework incorporates two new elements to the standard life-cycle theory of savings: early retirement effect and wealth substitution effect. Agents retire earlier than the mandatory retirement age. To cover the more extended periods of retirement over which accumulated assets will be spread, agents have to increase their saving rates (early retirement effect). Also, agents’ pension incomes change due to the pension reform. If the pension incomes increase, the increment of pension incomes can substitute for the savings for retirement. This will reduce saving rates (wealth substitution effect). This model thus sheds light on the impact of the interaction between early retirement effect and wealth substitution effect on savings decisions and saving rates. A stronger policy response of the positive effect of the early retirement compared to the weaker negative effect of wealth substitution between pension incomes and savings, encourages the savings response to a large extent. Also, the reduced pension replacement rate in the 1990s pension reform results in increased pension incomes, which increases saving rates.

The second contribution lies in the quantitative exploration of my mechanism. A quantitative version of the model is developed and is calibrated to macro-level Chinese data. We evaluate the quantitative performance of my model through three angles. First, combining both the early retirement effect and the wealth substitution effect, we find that the model imputes 66% of the rise in the national saving rates over 1995-2012. Second, regarding the effect of the change of pension incomes only, the saving rates fall substantially to a very low level. Third, considering the effect of early retirement only, the saving rates decrease slightly lower.

Third, this paper designs three decomposition experiments of savings to emphasize the mechanism. The first test is to force all agents to retire at the mandatory retirement age in China. This can exclude the early retirement effect and allow us to observe the wealth substitution effect only. The second experiment is to shut down the pension reform in the model. Since there are no changes in the pension incomes brought by the pension reform, this allows us to look at the impact of the early retirement effect only. The third trial is to remove both effects in order to examine their joint effect and the interaction between these two effects.

The model in this paper is not going to study why people retire early by endogenizing the retirement decision to match the data of average retirement ages and then try to examine what factors result in the early retirement. In this paper, given the fact of early retirement, we show that the early retirement effect contributes to the majority of the growth and fluctuation in the saving rate while both early retirement effect and wealth substitution effect have a positive impact on the saving rate. The model simplifies the reality by not distinguishing the difference between male and female, households savings and firms savings but captures the difference between urban and rural population.
The rest of the paper is organized as follows. Section 2 discusses the related literature. Section 3 presents the model. Section 4 shows the calibration of the model. Section 5 discusses the results of static and dynamic analysis. Finally, section 6 concludes.

2 Literature Review

This paper is mainly related to the body of the literature which tends to explain the remarkable high saving rates in China. Most of the paper in the literature investigate the interaction between different factors rather them the influence of only one element on saving rates. Therefore, various theories on the explanation can be roughly classified into the following different strands.

Many early studies applied Modigliani-Brumberg’s consumption smoothing theory to study the saving behavior in China. The theory argues that people desire to translate their consumption from periods of high income to periods of low income to obtain more stability and predictability. These studies including Chow (1985), Qin (2003) and Modigliani and Cao (2004) tested similar hypotheses but ended up with inconclusive findings for the saving behavior of the Chinese. One challenging fact that hardly reconciles with theories is that, Chinese households continued to save more in anticipation of higher future incomes instead of consuming more to smoothen lifetime consumption. Studies based on household data also could not find evidence showing that the current consumption growth is positively correlated with the past consumption growth in China (Chamon and Prasad (2010)).

Culture is an alternative candidate that can explain the rise in savings. Carroll et al. (1994) argue that the consumption inertia is related to a culture-based explanation to saving behavior. Since thrift has been one of Chinese tradition for thousands of years, their consumption growth could have lagged behind their income growth during the reform period, thus leading to higher household saving. Through the provincial-level empirical work, Horioka and Wan (2007) find that variations in household saving over time and space are influenced by the lagged saving rates, which is a result consistent with the existence of inertia or persistence. However, the empirical evidence is inconclusive. As Modigliani and Cao (2004) argue, the traditional and commonsensical explanation, for example, Chinese people’s thrift, counts little. Using the 1988–2003 China Health and Nutrition Surveys, Zhao (2007) finds that younger Chinese cohorts actually have a higher propensity to save than older cohorts after controlling for other saving determinants. Given that older cohorts usually carry more cultural tradition than younger cohorts, these findings show that thrift is not an important determinant of Chinese household saving.

Demographic changes induced by China’s one-child policy and the population aging can also affect the saving rate. Studies from this perspective are often accompanied by the incomplete pension system in China. The primary mechanisms are summarized as follows. First, since the non-working population consists of the young and the old who consumes without earning any income, a rise in their share in
the population tends to reduce national household saving. Second, in a developing country without a mature social security system, the older population have to rely on the support (long-term care) from their children. Thus children act as an effective substitute for life-cycle saving. (Choukhmane et al. (2014), He et al. (2016), Imrohoroglu and Zhao (2018b)). In addition, Modigliani and Cao (2004) use the share of the employed population out of the number of minors up to age 15 to approximate demographic change. They find that the decline in the young population dependency between 1953 and 2000 increased Chinese household saving through both effects of “fewer mouths to feed” and old-age security. However, this time series evidence is not confirmed by panel data studies. Neither aggregate dependency ratio (Kraay (2000)) nor separate accounts of the young and the old dependency ratios (Horioka and Wan (2007)) are found to have a significant effect on the household saving rates across Chinese provinces. Applying cohort analysis to data from the Urban Household Survey (UHS), Chamon and Prasad (2010) reach a similar conclusion that demographic structural shifts do not go very far in explaining saving behavior in China. Wei and Zhang (2011) consider the saving motive from the perspective of the sex ratio. They find that Chinese parents with a son competitively raise their savings to improve their son’s relative attractiveness for marriage and the pressure on savings spills over to other households. However, they may omit the saving motives in preparing for the education and life expenditure of children as the children grow up. Specifically, this refers to the difference in the expenditure of raising boys and girls which is originated from the traditional culture “Poor Boys, Rich Girls.”

Uncertainties including employment, education, health care, and housing services are another important motivation in studying the high saving rates in China. The uncertainty associated with the transition could trigger precautionary motives to save. For the employment, the aggressive reforms of privatization of State Own Enterprises (SOEs) led to mass layoffs in 1997. Given the earnings uncertainty and unemployment risk combined with liquidity constraints and incomplete unemployment insurance, Meng (2003) finds that Chinese urban households that experienced past income uncertainty appeared to have increased their propensity to save in the period of 1995–1999. Blanchard and Giavazzi (2016) have noted the importance of income uncertainty in explaining the high saving rate in China. However, reconciling the findings with the macroeconomic facts is difficult. For example, the employment uncertainty associated with state-sector restructuring continued to rise and reached its peak in the late 1990s. However, the national saving rates did not increase accordingly but rather fell to the bottom of the valley during the second half of the 1990s. In addition, there has been no large employment shock since 2000. Therefore, the precautionary saving motive stemming from employment uncertainty does not seem to explain well the surge in the national saving rate. For the uncertainties in education, health care and housing services, Chamon and Prasad (2010) argue that these rising private financial burdens could induce higher household saving, as younger families accumulate assets for future education spending, older families prepare for uncertain health expenditures, and most people save to prepare for mortgage
payments or housing upgrades. Although these are plausible factors, their quantitative effects on savings are difficult to assess. However, intuitively, most of the young adults have already finished their own education, there is no need to save for that purpose. Also, as individuals retire, fewer uncertainties are remaining in their life cycles, and the need for buffer-stock savings shrink. Gourinchas and Parker (2002) have demonstrated that buffer-stock saving occurs mostly at the beginning of the life cycle; therefore, it is unlikely to be a major explanation for the saving of the entire population. Similar compositional effects exist for housing expenditures, as higher costs in housing mortgage tend to reduce the disposable income that can be used in savings.

The last related and important strand of the literature is about the contribution of retirement on savings through the pension system. Sánchez Martín (2010) assesses the pension reform in the Spanish economy whose major policies include delaying legal retirement ages and reducing the generosity of pension benefits. They find that the pension reform extends the length of the averaging period in the pension formula, which reduces the size of pension benefits and finally leads to higher levels of personal savings and capital accumulation. Fehr et al. (2003) investigate five different reform proposals by means of an OLG model with endogenous retirement age for the Norwegian economy. This paper finds that even if the early retirement subsidy is substituted by an early retirement tax, only households in the middle-income class increase their retirement age. The majority of households retire early, resulting in that the pension benefits are reduced, and people increase their savings. Díaz-Giménez and Díaz-Saavedra (2017) study the 2011 and 2013 pension reforms in Spain and find that, through delaying the legal retirement ages, the reforms finally lead to the longer working time. And the lower retirement pensions increase savings, and this increases the stock of physical capital. However, the reforms studied in this strand of the literature manipulate the mandatory retirement age, while the pension reform in China from 1995 to 1997 did not. This difference means that the case of China provides a better opportunity to look at the association between the retirement age and the pension system by excluding the influence of the change of mandatory retirement age. In addition, the existing early retirement literature mainly focuses on the pension system in developed countries which penalizes early retirement by a much lower pension replacement rate. But there are very few studies about China, where there is no penalty for early retirement.

3 Model

In this section, we present a closed economy life-cycle model or our analysis of China’s saving rate. The outline of the model follows Conesa and Krueger (1999) and Song et al. (2015). We model the agents from born to death, which will be further discussed in section 4.1, but the representative agents
only have an impact on the economy when they enter the labor market at age 22\(^4\), work until age \(J_W\), and live up to age \(\bar{J}\). Many cohorts are included in the model. The economy in this model begins in 1995.\(^5\) Different cohorts enter in the year 1995 with different starting ages. Agents are assumed to be either workers or entrepreneurs. Workers earn labor income during their working years, make exogenous retirement decision before or at the mandatory retirement age and receive social security after they retire. There is no private insurance market and the annuity markets are closed as assumptions. There are no intergeneration transfers. Agents in this economy save because of concerns about the retirement period.

This model abstracts from some potentially important features. First, the model considers neither idiosyncratic nor intergenerational risk. Even though these two risks are important, it is difficult to insure in emerging economies. Second, the model ignores within-cohort inequality since public pensions can also provide some intragenerational redistribution. Last but not least important, this model does not consider altruism within families as in, e.g., İmrohoroğlu and Zhao (2018a).

### 3.1 Worker’s Problem

The life-time utility function of the representative agent at time \(t\) is as follows,

\[
U_t = \sum_{j=0}^{J} \beta^j s_j u(c_{t,j}, h_{t,j})
\]  

(1)

where \(\beta\) stands for a time discount factor, \(s_j\) is the unconditional probability of surviving till age \(j\) for an agent and \(s_j = \prod_{i=1}^{j} \psi_i\). \(\psi_i\) is the conditional survival probability from age \(j-1\) to age \(j\). \(c_{t,j}\) denotes the consumption and \(h_{t,j}\) denotes the labor supply.

The standard utility function including the consumption and the disutility of labor supply captures preferences as follows,

\[
u(c_{t,j}, h_{t,j}) = \log(c_{t,j}) - \frac{\zeta \theta^{1+\frac{1}{\theta}} h_{t,j}^{1+\frac{1}{\theta}}}{1 + \frac{1}{\theta}}
\]  

(2)

where \(\theta\) is the Frisch elasticity of labor supply and \(\zeta\) denotes the weight of leisure.

The budget constraint for a representative worker \((j \leq J_W)\), who works until age \(J_W\), is as follows,

\[
c_{t,j} + a_{t+1,j+1} = (1 + r_t)a_{t,j} + (1 - \tau_{t,j})w_t \epsilon_j \eta_j h_{t,j}
\]  

(3)

where \(a_{t+1,j+1}\) is the asset holding for the next period, and \(r_t\) is the domestic saving interest rate. \(\tau_t\) is the labor income tax and \(w_t\) is the wage rate. \(\epsilon_j\) is the deterministic age-dependent productivity at age \(j\). \(\eta_j\) represents the human capital at age \(j\).

---

\(^4\)Chinese teenagers generally enter college at 18 and graduate at age 22.

\(^5\)There are two reasons to choose 1995 as the beginning year of this model. First, China’s pension system reform started to implement between 1995-1997. Second, China’s saving rates started to increase in 1995.
In addition, since there is no private insurance market, each individual has to self-insure the risks she faces through asset accumulation. In any period $t$, a retired individual of age $j$ ($J_W + 1 \leq j \leq J$) faces the following budget constraint,

$$c_{t,j} + a_{t+1,j+1} = (1 + r_t)a_{t,j} + p_{t,j}$$

(4)

Following Song et al. (2015), $p_{t,j}$, the pension received at period $t + j$ by an agent who worked until period $t + J_W$ (and who became “adult” in period $t$) is computed as follows:

$$p_{t,j} = \sigma_t \nu \bar{y}_t + \nu \bar{y}_t + (1 - \nu)\bar{y}_t$$

(5)

where $j > J_W$; $\nu$ measures the importance of indexed average wage in the determination of social security benefits; and $\sigma_t$ denotes the replacement rate in period $t$ and $\bar{y}_t$ is the average pre-tax labor earnings for workers in period $t$:

$$\bar{y}_t \equiv \sum_{j=0}^{J_W} \mu_{t-j}s_j(\bar{y}_{t-j}h_{t-j} + \bar{y}_{t-j+1})$$

(6)

where $\mu_{t-j}s_j$ is the number of agents of cohort $t-j$ (i.e., who became economically active in period $t-j$) who have survived until period $t$. In particular, $\mu_t$ is the population of age $j$ at year $t$. $j$ is the survival probability from age $j$ to age $j+1$. The numerator in equation (7) is the total pension contribution from the working population at year $t$. And the denominator in equation (7) is the total working population. This fraction represents the "Average Indexed Monthly Earnings" (AIME) of average wage at time $t$, which is consistent with the pension reform regulation.

### 3.2 The life-time problem

The life-time maximizing problem of workers is as follows,

$$\max_{c_t} U_t = \sum_{j=0}^{J} \beta^j s_j \left( \log(c_{t,j}) - \chi \frac{h_{t,j}}{1 - \theta_t} \right)$$

s.t. $$\sum_{j=0}^{J} s_j c_{t,j} = \sum_{j=0}^{J} s_j \left( (1 - \tau_{t,j})w_t \epsilon_j \eta_j h_{t,j} + \sum_{j = J_W+1}^{J} \frac{s_j}{R} p_{t,j} \right)$$

(7)

Standard analysis yields the first-order conditions:

$$c_{t,0} = \lambda^{-1}$$

(8)
\[ c_{t,j} = \lambda^{-1} \beta^j R^j = (\beta R)^j c_{t,0}, \text{ for } j \in \{0, 1, ..., J\}, \]  
(9)

\[ h_{t,j} = (\frac{w_t}{c_{t,j}})^{\theta}, \text{ for } j \in \{1, 2, ..., J_W\}, \]  
(10)

where \( \lambda \) is the Lagrange multiplier associated with the resource constraint.

### 3.3 Firms

Goods market is competitive. The representative firm is constant returns to scale with no adjustment costs. The total technological changes at period \( t \) is denoted by \( A_t \). The firm chooses labor, capital to maximize a Cobb-Douglas production function \( Y_t = A_t K_t^\alpha L_t^{1-\alpha} \). Where \( \alpha \) is the capital-labor elasticity, \( K_t \) and \( L_t \) are the effective capital and labor input at time \( t \), and \( A_t = A_0 (1 + g_t)^t \). \( g_t \) is the exogenous growth rate of the TFP. This model assumes that this technology is own by a large number of profit-maximizing, competitive firms.

The capital \( K \) follows the law of motion

\[ K_{t+1} = (1 - \delta) K_t + I_t \]  
(11)

where \( I_t \) denotes capital investment. \( \delta \) is the constant depreciation rate. The first order conditions that determine net real return to capital and real wage are as follows,

\[ r_t = \alpha A_t K_t^{\alpha-1} L_t^{1-\alpha} - \delta \]  
(12)

\[ w_t = (1 - \alpha) A_t K_t^\alpha L_t^{-\alpha} \]  
(13)

### 3.4 Public Sector

The main role played by the public sector is to run a social security system in the spirit of PSYG before 1995-1997 and a mixed pension system with both PSYG and Fully Funded after 1995-1997 in China. The government receives taxes from labor income to finance the pension system. Given an initial pension trust fund, \( P_0 \), the government intertemporal budget constraint is as follows,

\[ P_0 + \sum_{t=0}^{\infty} \frac{1}{R^t} (\tau t \sum_{j=0}^{J_W} \mu_{t-j} s_{t-j} c_{t-j} h_{t-j,t}) \geq \sum_{t=0}^{\infty} \frac{1}{R^t} (\sum_{j=J_W+1}^{J} \mu_{t-j} s_{t-j,t}) \]  
(14)

where the left hand side of the constraint is the pension contribution from the working population; the right hand side of the constraint is the pension payment to the retired population.
3.5 The Competitive Equilibrium

**Definition:** In a closed economy, a Stationary Equilibrium for given the policy arrangements \( \{ \tau_t, \sigma_t, \nu \} \) and age structure \( \{ \{ \mu_t,j \}_{j=1}^{J} \}_{t=1}^{T} \) consists of a sequence of an individual’s consumption, asset holding and working hours, \( \{ \{ c_{t,j}, a_{t,j}, h_{t,j} \}_{j=1}^{J} \}_{t=1}^{T} \); a sequence of prices, \( \{ r_t, w_t \}_{t=1}^{T} \); a sequence of pension benefits, \( \{ p_t \}_{t=1}^{T} \); a sequence of factors of production, \( \{ K_t, L_t \}_{t=1}^{T} \); and a sequence of time-variant age-dependent distribution of individuals \( \{ \{ \text{dist}_{t,j}(X) \}_{j=1}^{T} \}_{t=1}^{T} \) with the set of state variables \( X = (a, l) \) when \( 1 \leq j \leq J_W \) and \( X = (a) \) when \( J_W + 1 \leq j \leq J \) such that:

1. Given the prices \( \{ (r_t, w_t)_{t=1}^{\infty} \} \), the individual’s decision rule \( (c_t, a_t, h_t) \) solves the individual’s dynamic problems (7).
2. The factor prices are determined by equation (12) and (13).
3. The time-variant age-dependent distribution of individuals follows the law of motion,

\[
\text{dist}_{j+1,t+1}(X') = \begin{cases} 
\sum_{\{a,l'a'\}} \text{dist}_{t,j}(X) & 1 \leq j \leq J_W \\
\sum_{\{a,a'\}} \text{dist}_{t,j}(X) & J_W + 1 \leq j \leq J
\end{cases}
\]  
(15)

where \( a' \) is the optimal assets in the next period.
4. The capital market clears:

\[
K_t = \sum_{j=1}^{J} \mu_{t,j} \text{dist}_{t,j}(X) a_{t,j}
\]  
(16)

5. The labor market clears:

\[
L_t = \sum_{j=1}^{J_W} \mu_{t,j} h_{t,j} \text{dist}_{t,j}(X) \epsilon_{t,j}
\]  
(17)

6. The social security system is self-financing and determined by equation (14).

4 Calibration

4.1 Demographics

This section describes and parametrizes the demographic model similar to Song et al. (2015) in this paper. China faces a major demographic transition not only in the form of the population growth but also the internal rural-urban migration. This demographic transition interacts with the function and sustainability of the pension system and saving-investment behaviors. Therefore, we construct in this section a detailed demographic model. We model both the exogenous population growth and rural-urban migration by: first, a model without internal rural-urban migration; second, an extended model of migration with fixed age-gender-specific emigration rates over time.
We first start with a model without rural-urban migration. The initial population is classified according to their birthplaces, ages, and genders. Under the no-rural-urban migration framework, we take advantage of the initial population size and distribution from the adjusted 1995 census data, to project the population in 2000. And the projected 2000 population is targeted to the adjusted 2000 census data. Regardless of the mentioned time span issue, another reason for this is that, there is a consensus among economists\textsuperscript{6} that birth rates have been underreported in Chinese census data, causing a downward bias of the census data. Take the 2000 census as an example, Zhai and Chen (2007) use the primary school enrollment rate to adjust the census data and find that there is a deficit of 29.67 to 37.83 million age 0 to 9 children in the 2000 census. To heed this concern, for the 1995 census, we take the rural-urban population and age-gender distribution from the 1995 census and adjust the data with the subsequent National Bureau of Statistics (NBS) revisions. For the 2000 census, we not only take the same variables from the 2000 census with the same revisions but also adjust this according to the linear estimates in Zhai and Chen (2007), which is to calculate the missing number of children of each age group and add them to the data.

For the mortality rates in the population projection, the general idea is that, we first take the initial group-specific mortality rates from data, and then set the mortality rates to match some specific years in the future. Finally, in the long run, the mortality rate is fixed. In particular, the initial group-specific mortality rates are derived from the 1995 census. The life expectancy at birth in the initial year is 70.8 years, which is close to the World Development Indicator figure in the same year (70.2). The three specific years are chosen to be 2020, 2050, and 2080. The mortality rates chosen for these three future years can match the demographic projection until 2080 by Yi (2007). We use linear interpolation over the intermediate periods. After 2080, the mortality rate is assumed to be fixed. This can imply a long-run life expectancy of 81.9 years.

For the choice of fertility rates, we follow the same logic as the choice of mortality rates. The initial group-specific (urban and rural) fertility rates for 1995 and 2000 are taken from the 1995 one-percent population survey and the 2000 census, respectively. We interpolate linearly the years 1996-1999. Between 2000 and 2012\textsuperscript{7}, we assume age-specific fertility rates (urban and rural) to be the same as the 2000 level. The average urban and rural total fertility rates (TFR) are 1.2 and 1.98\textsuperscript{8} in the projection, respectively. Between 2013 and 2050, to be consistent with the claim of the Chinese authorities, as outlined by the National Health and Family Planning Commission\textsuperscript{9} and the estimation in Yi (2007)\textsuperscript{10},

\textsuperscript{6}Mi (2004). Zhang (2005), Zhai and Chen (2007), etc.

\textsuperscript{7}The reason to cut off this time span is that, in 2013, the third plenum of the Chinese Communist Party’s 18th Party Congress announced the plan allowing couples to have two children if one of them is an only child, which was rapidly implemented by provinces.

\textsuperscript{8}The estimated value from the 2000 census and earlier surveys are between 1.5 and 1.8 (see, e.g., Zhang and Zhao, 2006).

\textsuperscript{9}Source: Xinhuanet November 15, 2013

\textsuperscript{10}Yi (2007) estimates that the second-child policy would increase the urban TFR from 1.2 to 1.8 (the second scenario in
we assume age-specific fertility rates in the rural area to remain constant, i.e., 1.98 and age-specific fertility rates in the urban area to be 1.8\textsuperscript{11}. After 2050, the long-run TFR is assumed to be 2.0766 following the United Nations population forecasts. In particular, we linearly interpolate the TFRs for the years 2051-2099 from 1.98 to 2.08 in the rural area and from 1.8 to 2.08 in the urban area to smooth the demographic change.

4.1.2 Rural-urban migration

In the rapid process of industrialization and urbanization in China, a large scale of the rural population migrates to the city, which will have a profound impact on both the rural and urban population structure. If we use the place of permanent registered residence (i.e., Hukou) as a classification standard, there are mainly two categories of rural-urban migrants\textsuperscript{12}. The first category consists of people who physically move from rural to urban areas but retain a rural Hukou. We call it the Floating Population. The second category comprises people who change their Hukou from rural to urban even they do not physically move to cities. We call it the Permanent Population. The sum of the two categories is called the net migration flow (NMF).

Generally, it is difficult to estimate and predict the rural-urban migration, even for developed countries. The pervasive legal and administrative regulations in China compound this problem. Although emigration rates are likely correlated with a series of factors including the urban-rural wage gap, pension and health care entitlements for migrants, the rural old-age dependency ratio, and so on, we have to and can only abstract from these factors and assume that the demographic migration only depends on the age distribution of rural workers. Accordingly, in this simple model of migration, we assume that the age-gender specific emigration rates that are estimated from the 1995-2000 population projection are fixed over time. To incorporate rural-urban migration in our population projection, we make two assumptions. First, the age-gender-specific migration rates remain constant after 2000 at the level of our estimates for the period 1995-2000. Second, once the migrants have moved to an urban area, their fertility and mortality rates are assumed to be the same as those of urban residents.

The general idea to estimate the NMF and the age- and gender-specific distribution and use these as the backbone of the projection of migration. We first use the 1995 census to construct a projection of the rural and urban population without migration until 2000 based on the method described in section 4.1.1. We then estimate the age- and gender-specific distribution by taking the difference between the 2000 projection of the population without migration and the actual population in the data according to the 2000 survey.

\textsuperscript{11} Yi (2007).
\textsuperscript{12} The difference is significant since most non-resident workers are currently not covered by any form of urban social insurance including pensions.
4.1.3 Results for the population projection

According to our estimates, the overall NMF between 1995 and 2000 was 91.3 million, corresponding to 10.2% of the rural population in 2000. Our estimate implies an annual flow of 18.3 million migrants between 1996 to 2000, (equal to an annual 2.3% of the rural population). This index is in line with estimates of earlier studies. For instance, Ying (2003) estimates an annual flow between 17.5 and 19.5 million in the period 1996-2000.

The estimated age-gender-specific migration rates are shown in Figure 3. Both the female and male migration rates peak at age twenty-five, with 7% for both females and males. The migration rate falls gradually at later ages, remaining above 1% until age forty-five for males and until age forty-eight for females. Migration becomes negligible which is less than 0.5% after age fifty.

![Figure 3: Emigration Rates from Rural Areas by Age and Gender as a Share of Each Cohort](image)

Table 1: Age Structure of migration (%)

<table>
<thead>
<tr>
<th>Age</th>
<th>&lt;15</th>
<th>15-29</th>
<th>30-44</th>
<th>45-59</th>
<th>60+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ave. of 1995-2000 Census data</td>
<td>9.03</td>
<td>60.53</td>
<td>22.14</td>
<td>5.81</td>
<td>2.49</td>
</tr>
<tr>
<td>Simulation in this paper</td>
<td>15.48</td>
<td>51.51</td>
<td>27.07</td>
<td>7.33</td>
<td>-0.57</td>
</tr>
<tr>
<td>Simulation in Song et al. (2015)</td>
<td>25.8</td>
<td>64.8</td>
<td>26.5</td>
<td>-8.6</td>
<td>-8.6</td>
</tr>
</tbody>
</table>

Table 1 compares the actual migration structure with our estimates. We also include the estimation in Song et al. (2015) to provide more information. Even though Song et al. (2015) can match the data better between age 15 and 44, there exist two points in their paper worth doubting. First, they use the data in 2000 to project the population and migration in 2005 and then target the age distribution...
of migration between 1995-2000 with their 2000-2005 projection. In fact, the distribution should be
different in these two different time intervals. Second, the two distributions in Song et al. (2015) after
age 45 are relatively large and negative. This may be due to their overestimation of "<15" group which
is 16.77% greater than the data. In fact, due to the culture in China that "people prefer to die at where
they were born", the rural-urban migrants could go back to rural when they become old, for example,
−0.57% of the 60+ group in this paper’s estimation. But the rural-urban migrants aged 45+ account for
a 17.2% reversal rural-urban migrants is less possible. Accordingly, the estimation in this paper is more
reasonable.

Figure 4 shows the projected population dynamics (solid lines). We also compare the population
model without migration (dash lines, counterfactual) with the population model with migration (bench-
mark). There are mainly three findings for the benchmark: first, the rural population declines over the
whole period; second, the urban population as a share out of the total population increases from 51% in
2010 to 83% in 2050 and to over 95% in 2100; third, between 2050 and 2100 there are two opposite forces
that tend to make the urban population stable: on the one hand, fertility becomes very low in urban
areas from 2050 to 2100\(^{13}\); on the other hand, there decreasing rural population (red solid line), i.e., the
immigration to urban areas is still increasing and sizable, which offsets the negative urban population
growth.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{population_dynamics.png}
\caption{The figure shows the projected population dynamics for 1995-2100 (solid lines) broken down by rural and urban population. The dashed lines show the corresponding natural population dynamics (i.e., the counterfactual projection under a zero urban-rural migration scenario).}
\end{figure}

Figure 5 plots the old-age dependency ratio \(^{14}\) for rural and urban areas (solid lines). We also plot the

\(^{13}\)The urban benchmark (black solid line) line become flat and even starts to decline after 2050

\(^{14}\)the number of population aged 60+ as percentage of population in working age (15-60)
old-age dependency ratio in the no migration counterfactual (dashed lines). The projected urban old-age dependency ratio is 63% in 2050, but it would be as high as 90% in the no migration counterfactual. The Chinese pension system only covers urban workers. Accordingly, its sustainability hinges on the urban old-age dependency ratio. If we ignore the rural-urban migration, the population projection and the calculation that is associated with the pension system are bias.

Finally, Figure 6 plots the dynamics of China’s total population from 1995 to 2100. The simulated population in the model of this paper is in solid line. The dashed line shows the population projection by United Nation population forecasts. The population projection in this paper rises from 1.20 billion to 1.38 billion until 2030 and then declines to 1.15 billion in 2100. The United Nation projection rises from 1.22 billion to 1.41 billion until 2030 and then declines to 1.0 billion in 2100. Both the simulation and the United Nation projection peak at around 2030 and start to decline. The comparison shows that this demographic model can project a valid population prediction.

4.2 Preferences

A period in the model stands for one year of real-time. The representative agent only has an impact on the economy when she enters the labor market at age $22$, works until age $J_W$, which is the retirement age in data in China as described in Section 1, and lives up to age $J = 100$. To focus on the period (1995-2010) studied in this paper, the retirement age before 1995 is set to be 60. In particular, according to the data, the retirement age from 1995 to 1998 is 55, from 1999 to 2004 it is 54 and the retirement age
Figure 6: The figure shows the comparison between the simulated population and the forecast of United Nation prospect.

is set to be 53 after 2005. Hence, workers retire after ($J_W = 22$) years of work. The discount factor is set to $\beta = 1.01286$ to match the average aggregate savings rate in China between 1995-2010 (i.e., 42.8%). The Frisch elasticity of labor supply $\theta$ is set to equal to 0.5, in line with the classical estimation in labor economics (Keane (2011)).

4.3 Labor income

To consistent with the estimated wages of workers with high school education in Ge and Yang (2014), which is the median level of labor income, urban hourly wages are assumed to grow at the rate of 5.7% between 1995 and 2013. From 2013 to 2031, the annual growth for this time interval is set to 4.9%. From 2031 to 2040, the annual growth is set to 3.6%. After 2040, to be in line with wage growth in the United States over the last century, the annual wages grow at 2% per year.

For the human capital variable $\eta_j$, it is matched to the average years of education by cohort according to Barro and Lee (2013) before 1990. We linearly extrapolate $\eta_j$ for cohorts born after 1990 and assume that when the average years of schooling reach the current level for the US (i.e., 12), the growth ceases in the year 2000. Per year of education is assumed to have an annual return of 10%.

We estimate the age-specific productivity $\{\epsilon_j\}_{j=22}$ it using the China Health and Nutrition Survey (CHNS) data and the method in Song and Yang (2010) to make it be consistent with the empirical evidence on gross labor earnings for Chinese urban workers. This implies a 0.5% average annual return to the age-specific experience.
For the initial distribution of workers and retirees’ wealth in 1995, due to the missing survey in 1990 in the China Household Income Project (CHIP) and the limitation of CHIP (1988), we have to and can only set the initial distribution of agents’ wealth in 1990 to be the same as the empirical distribution of financial wealth in 1995 in the CHIP. We simulate the model throughout the 1990-1995 period given the initial wealth distribution in 1990 to endogenously obtain the distribution of private wealth in 1995. To exclude human capital growth, we discount it using an annual wage growth of 5.7%. The distribution of that entrepreneurial wealth is obtained by assuming that all entrepreneurs are endowed with the same initial wealth in 1990.

4.4 Technology

The capital share of output $\alpha$ is set to 0.5, which is in line with the estimate in Bai et al. (2006). The depreciation rate $\delta$ is set to 0.1 such that the annual depreciation rate of capital is 10%.

We set the initial level of productivity $A_0$ to 9.6% of US’s GDP per capita in 1995. This yields a GDP per capita equal to 20% of the US level in 2010, which is consistent with the data. Between 2000-2013, we set the growth rate of productivity $g_t$ so that the model generates an average labor income growth of 7.5%. After 2013, productivity growth is forecasted by Song et al. (2011) to slow down. Accordingly, from 2013 to 2040 we linearly interpolate $g_t$ to fall to zero. In particular, between 2013 and 2040, China is expected to grow at a rate of 6.5%. In this case, the GDP per capita in China will be 68% of the US level by 2040 and remain stable while growing at the long-run world rate thereafter.

For the rural area, we set $\alpha_r = 0.3$ to match the investment rate in the rural area in 1995 data. The rural wage grows at the rate that can generate the rural-urban wage gap to increase from 1.84 in 2000 to 3.48 in 2040 and stays constant thereafter.

4.5 Pension System

In line with the 1995-1997 pension reform in Sin (2005), we assume that pensioners retiring before 1997 continued to earn a $\sigma_1 = 78\%$ replacement rate throughout their retirement. Moreover, those retiring after 1997 are entitled to a $\sigma_2 = 60\%$ replacement rate. In the long-run, i.e., 2030, to balance the pension fund, we set $\sigma_3 = 0.3913$ as documented in Song et al. (2015). The reason is as follows. According to Figure 7, both the UN projection and this paper’s simulation predict a peak of the population at around 2030. Afterward, the population will decline. This will reduce the population who contribute to the pension system and finally ruin the sustainability of the pension system unless the government lowers the pension replacement rate. We assume a constant social security tax equal to 20%, in line with the empirical evidence. The indexation of the average wage is $\nu = 0.6$ according to the pension rule in China.

This paper also takes into account the fact that the current pension system of China only covers a fraction of the urban workers. The coverage rate has grown from 45% in 2001 to 60% in 2011 according
to China Statistical Yearbook 2012. Therefore, the pension coverage rate is assumed to be constant at 60%. Those non-covered workers neither pay the social security tax nor do they receive pension incomes.

The initial wealth of government \( P_0 \) is set to 0.7% of GDP, matching the 43 billion RMB that is the cumulative balance of pension fund for urban workers in 1995 according to the National Statistics Bureau of China.

Table 2 summarizes all parameter values mentioned.

Table 2: Parameters values in the benchmark model

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Value</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \beta )</td>
<td>Subjective time discount factor</td>
<td>1.0075</td>
<td>Target average savings rate 1995-2010</td>
</tr>
<tr>
<td>( \theta )</td>
<td>Frisch elasticity of labor supply</td>
<td>0.5</td>
<td>Keane (2011)</td>
</tr>
<tr>
<td>( \zeta )</td>
<td>Weight of leisure</td>
<td>1</td>
<td>Galindev (2009)</td>
</tr>
<tr>
<td>( \alpha )</td>
<td>Capital labor elasticity</td>
<td>0.5</td>
<td>Bai et al. (2006)</td>
</tr>
<tr>
<td>( \alpha_r )</td>
<td>Capital labor elasticity (rural)</td>
<td>0.3</td>
<td>Target investment rate (rural) in 1995</td>
</tr>
<tr>
<td>( \delta )</td>
<td>Depreciation rate</td>
<td>0.1</td>
<td>Bai et al. (2006)</td>
</tr>
<tr>
<td>( \tau )</td>
<td>Social Security Tax</td>
<td>0.20</td>
<td>Pension Rule in China</td>
</tr>
<tr>
<td>( \sigma_1 )</td>
<td>Pension Replacement Rate (&lt;1997)</td>
<td>0.78</td>
<td>Sin (2005)</td>
</tr>
<tr>
<td>( \sigma_2 )</td>
<td>Pension Replacement Rate (1997-2030)</td>
<td>0.60</td>
<td>Pension Rule in China</td>
</tr>
<tr>
<td>( \sigma_3 )</td>
<td>Pension Replacement Rate (&gt;2030)</td>
<td>0.3913</td>
<td>Song et al. (2015)</td>
</tr>
<tr>
<td>( \nu )</td>
<td>Indexation of average wage</td>
<td>0.6</td>
<td>Pension Rule in China</td>
</tr>
</tbody>
</table>

5 Quantitative Result

In this section, we first construct a benchmark scenario with workers’ early retirement and pension reform between 1995-1997 to show the validity of this model. Then we consider a set of alternative scenarios to one-by-one analyze the two major mechanisms (i.e., early retirement effect and wealth substitution effect) that cause the high saving rates in China.

5.1 The benchmark result

This section shows the benchmark results including mainly the saving rate along the transition path. Before the initial steady state, a pre-transition simulation has been run to derive the initial steady state under the two major following assumptions. First, we assume that before 1990 workers supply 1 unit of labor and consume all the income. Second, before 1980, the wage growth rate was 0; from 1980 to 1995, the wage growth rate is constant and equal to the wage growth rate in 1980.

In 1995, we shock the initial steady state by both imposing the pension reform and the fact that workers choose to retire earlier than the mandatory retirement age. In specific, for the early retirement, being consistent with the data shown in Section 1, the retirement age from 1995 to 1998 is 55, from 1999
to 2004 it is 54 and the retirement age is set to be 53 after 2005 until the end of dynamic. As for the pension reform, the pension replacement rate decreases from 0.78 to 0.60 following the pension rule in China. We use the actual data on the TFP growth rate along the transition path and assume perfect foresight for all these components.

Since this model does not capture the 2008 financial crisis, to avoid the impact of that crisis, we only focus and compare the saving rates along the transition path generated by the model to the Chinese data between 1995 to 2010 to evaluate whether the model is capable of accounting for the rise and the fall in China’s saving rates. The model that captures the 2008 financial crisis for a longer comparing period will be further developed.

The results in Table 3 show that the simulated model can match the key variables of China within the period of concern (1995-2010). The average aggregate saving rate is 42.8% in the data, while in my model it is exactly the same. The average consumption ratio is 57.1% in the data, while in my model it is 57.2%. The average aggregate investment rate is 39.2% in my model while the data is 41.2%. The average capital-output ratio in the data is 1.58 while in my model it is 1.54. It is fair to claim that the results are consistent with the data.

**Table 3:** Comparison between the model and data

<table>
<thead>
<tr>
<th>Variable</th>
<th>Average Value</th>
<th>Data</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregate Saving Rate (S/Y)</td>
<td>42.8%</td>
<td>42.8%</td>
<td></td>
</tr>
<tr>
<td>Consumption Ratio (C/Y)</td>
<td>57.1%</td>
<td>57.2%</td>
<td></td>
</tr>
<tr>
<td>Aggregate Investment Rate (I/Y)</td>
<td>41.2%</td>
<td>39.2%</td>
<td></td>
</tr>
<tr>
<td>Capital-Output Ratio (K/Y)</td>
<td>1.58</td>
<td>1.54</td>
<td></td>
</tr>
</tbody>
</table>

1The data sources for S/Y, C/Y and I/Y are the World Bank and Chinese Statistics Yearbooks. And the average time span is from 1995 to 2010. For Capital Output Ratio (K/Y), the data is from Table 1 in Bai et al. (2006). Since Bai et al. (2006) only estimate up to 2005, the average time span is from 1995 to 2005 for K/Y in Table for both data and model simulated result.

Figure 7 displays the saving rate generated by the benchmark economy versus the data for the first 18 years along the transition path starting in 1995. Overall, the time series path of the saving rate generated by the model tracks the data remarkably well. The model not only accounts for the decrease in the saving rate from 1995 to 2000 but also captures the major increase in the saving rate in the first ten years in the 21st century. In particular, in the data, as displayed in Table 4, the saving rate gradually decreased in the first five years in the 1990s, and then increased substantially from 35.8% of GDP in 2000 to 52.3% in 2008 and finally up to 49.6% in 2012. In the benchmark economy, the saving rate was also decreasing in the first five years in the 1990s and then increased from 37.3% in 2000 to 47.7% in 2008 and finally up to 49.5% in 2012.
Figure 7: The Chinese Saving Rate: Model vs. Data

Table 4: The Saving Rates Along the Transition Path

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td>39.6%</td>
<td>35.8%</td>
<td>45.8%</td>
<td>52.3%</td>
<td>49.6%</td>
</tr>
<tr>
<td>Benchmark model</td>
<td>42.4%</td>
<td>37.3%</td>
<td>44.0%</td>
<td>47.7%</td>
<td>49.5%</td>
</tr>
<tr>
<td>Decomposition experiment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Early+No Reform</td>
<td>40.9%</td>
<td>35.3%</td>
<td>42.1%</td>
<td>45.9%</td>
<td>47.8%</td>
</tr>
<tr>
<td>2. No Early+ Reform</td>
<td>23.0%</td>
<td>25.3%</td>
<td>30.0%</td>
<td>36.1%</td>
<td>41.8%</td>
</tr>
<tr>
<td>3. No Early+ No Reform</td>
<td>20.5%</td>
<td>22.6%</td>
<td>27.4%</td>
<td>33.7%</td>
<td>39.7%</td>
</tr>
</tbody>
</table>

5.2 Saving Rate Decomposition Experiments

This section explores the main reasons that drive the saving rates up in China. The findings support that, the rise in the aggregate saving rates is jointly driven by the early retirement and pension reform in China in the 1990s. In particular, the younger actual retirement age than the mandatory retirement age and the reduced pension income due to the pension reform jointly led to the increase in the household saving rate especially after 2000 as the actual retirement age become younger and younger.\(^{15}\)

5.2.1 Counterfactual 1: Early Retirement + No Pension Reform

To examine the impact of the 1990s pension reform on the saving rates, we simulate a counterfactual scenario in which the 1990s pension reform is never implemented. In particular, this means that the

\(^{15}\)Recalling that we follow the actual data of retirement age and set the retirement age in the model to be 55 from 1995-1998, 54 from 1999-2004 and 53 since 2005.
pension replacement rate is 0.78 from the beginning to 2030. Figure 8 shows the results of this experiment. Consistent with our "wealth substitution effect" mechanism, i.e., the pension income can substitute for the savings that are prepared for the retirement period, the saving rates are slightly lower during the entire period in this counterfactual economy. This is largely due to the increased pension income that is caused by the increased pension replacement rate from 0.60 to 0.78 between 1997-2030 compared with the case in the benchmark model. The 3rd row in Table 4 shows the value of saving rates along the transition path in this scenario.

Figure 8: The decomposition test of Chinese Saving Rate (Early + No Reform)

5.2.2 Counterfactual 2: No Early Retirement+ Pension Reform

To examine the impact of the early retirement on the saving rates, we simulate a counterfactual scenario in which the early retirement never happens. In particular, this means that the actual average retirement age is just exactly the same as the male mandatory retirement age, i.e., 60. Figure 9 shows the results of this experiment. Consistent with our "early retirement effect" mechanism, i.e., people will save more in order to cover a longer period over which the accumulated asset will be spread if they retire earlier, the saving rates are substantially lower during the entire period in this counterfactual economy. This is largely due to the decline in the saving rate as a result of no need to save more to cover the longer retirement periods in the benchmark scenario with early retirement (the blue dash line). Furthermore, comparing this counterfactual scenario (the green dash line) and the benchmark scenario (the blue dash line) we can observe that, without the early retirement, there is only a smooth and continuous growth
of the saving rates. Our second finding is that, the early retirement not only contribute to the growth of the saving rates from 1995 to 2012, but also result in the fluctuation of the saving rates during the growth. Last but not the least important, when we compare the saving rate in this scenario with the case of "Early + No Reform" (the green dash line in Figure 8), the “No Early+Reform Model” case drives down more saving rate than the “Early+No Reform” case. In Figure 8, the lowest point of saving rate is equal to 35.3% in 2000 as shown in Table 4. However, in Figure 9, the lowest point of saving rate is equal to 25.3% in 2000 as shown in Table 4. And the saving rates in counterfactual 2 along the transition path are obviously smaller in the saving rates in counterfactual 1. This means that the "early retirement effect" has a stronger positive effect on saving rate than the "wealth substitution effect" has. The 4th row in Table 4 shows the value of saving rates along the transition path in this scenario.

Figure 9: The decomposition test of Chinese Saving Rate (No Early + Reform)

5.2.3 Counterfactual 3: No Early Retirement+ No Pension Reform

To examine the joint impact of the 1990s pension reform on the saving rates, we simulate a counterfactual scenario in which the early retirement never happens and the pension reform is never implemented. In particular, this means that the pension replacement rate is 0.78 from the beginning to 2030 and the actual average retirement age is just exactly the same as the male mandatory retirement age, i.e., 60. Figure 10 shows the results of this experiment. Consistent with our "wealth substitution effect" and "wealth substitution effect" mechanisms, the saving rates are the lowest in all scenarios during the entire period and the fluctuation disappears in this counterfactual economy. This is largely due to the decline in the saving rate as a result of the shorter retirement periods and the increased pension income compared
to the benchmark case. The 5th row in Table 4 shows the value of saving rates along the transition path in this scenario.

![Graph showing Savings/GDP (%) over years](image)

**Figure 10:** The decomposition test of Chinese Saving Rate (No Early + No Reform)

For the explanatory power of this model, the change of the saving rate in data from 1995 (39.6%) to 2012 (49.6%) is 25.3% while the change of the saving rate in the benchmark model from 1995 (42.4%) to 2012 (49.5%) is 16.7%. Therefore, the joint effects brought by the early retirement effect and the wealth substitution effect in China, this model can explain 66.0% (16.7%/25.3%) of the change of the saving rate in China between 1995-2012.

6 Conclusion

The persistent long-run current high saving rates in China have attracted the attention of scholars for the past 20 years. However, very few pay attention to the prospect of the fact that workers are actually retiring earlier than the mandatory retirement age and its interaction with the pension system. In this paper, we analyze the positive and dominant effects of early retirement and its interaction with the pension system with the aid of a dynamic model calibrated to China.

A number of existing studies more or less explore the relationship between the pension system reform and saving rates, saving rates in China (see, e.g., He et al. (2019), İmrohoroğlu and Zhao (2018a)). Our analysis concurs with their view that the pension reform in the 1990s does have an impact on the saving rates and even saving rates in China. We took a further step to explore a new channel that is the early retirement effect: it would increase the saving rates due to people save more to cover the longer periods
over which the accumulated asset will be spread. Furthermore, the fact reflected in the data that people are retiring earlier for the past 20 years drives the saving rates increasing. That could be one of the necessary reason that China government is gradually postponing the female mandatory retirement age from 50 to 55 and finally to 60 as the same as the male’s.

The results are subject to some caveats. First, the fact that early retirement has a positive impact on the saving rates in China. The earlier and earlier average retirement age is one of the major reason that causes the growing saving rates and fluctuation for the past 20 years. Nevertheless, we do not allow the agent to retire endogenously while we just use the average retirement age in the data. On the contrary to the restriction of integer retirement age in this model, the average retirement age is non-integer in the data. The difference would cause estimation bias. In the future version of this paper, the model will be extended into a model with endogenous retirement decision. Second, the 1990s pension reform has a positive impact on the saving rates. However, we don’t follow the pension rule in China before and after the reform with 100% accuracy. We just follow Song et al. (2015) and İmrohoroglu and Zhao (2018a). We do not model the subsequent series of pension reform (e.g., the 2005 pension reform) in this paper. In the future version of this paper, these two points will be considered into the model. Finally, we compare the two channels in this paper and find that the early retirement effect has a larger impact on the saving rates than the 1990s pension reform has. Similar to Song et al. (2015), we abstract from the crowding out effect of public pensions on within-family old-age care, consider neither idiosyncratic nor inter-generational risk. We believe that extending the analysis in these directions would not overturn our main insights.
Appendix

China’s Pension Reform

Since 1995, China has successively carried out reforms of the social security system in various provinces. The core content is the implementation of the integration of social pooling and personal accounts in social security for enterprise employees. At the end of 1997, the State Council promulgated the “The State Council Document No. 26: Decisions of the State Council on Establishing a Unified Basic Pension Insurance System for Enterprise Employees” (“Decision 1997”). This reform sets the goal that the new social security system implements the partial accumulation system through implementation of the “the integration of social pooling and personal accounts in the pension insurance system.” Besides, it unifies the conditions for the calculation and payment of pensions.

The specific provisions are as follows: the employees who retired before the implementation of the “Decision 1997” (the Old) still receive pensions according to the old regulations before the reform, that is, according to the seniority, they receive 60% to 90% of their standard wages at the time they retire. And the pension adjustment method is implemented at the same time. For the employees who participated in the work after the implementation of the “Decision 1997” (the New), if the individual payment period has accumulated for 15 years, the pension will be paid monthly after retirement. The pension incomes consist of basic pensions and individual account pension. The monthly standard of the basic pension is 20% of the average monthly wages of local employees in the previous year. The monthly standard of individual account pension is the amount of personal savings divided by 120. For the employees who participated in the work before the implementation of the “Decision 1997” and retired after the “Decision 1997” (the Middle), if the individual payment period has accumulated for 15 years or can be considered as that the individual payment period has accumulated for 15 years, their pension incomes consist of three parts: basic pensions, individual account pensions, and transitional pensions. Therefore, under the new system, according to the individual’s employment status when the Decision 1997 implemented (retired, employed, unemployed), the calculation and payment methods of pensions for enterprise employees are different, so do the pension benefits. On the other hand, the pension benefits of employees of government agencies and institutions still follow the previous system regulations without adjustment. Table 5 concludes the main contents of the pension calculation and payment regulations of the enterprise employees before and after the reform according to the “Decision 1997”.

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Table 5: The pension calculation and payment regulations before and after the 1997 reform

<table>
<thead>
<tr>
<th></th>
<th>Pension Benefits</th>
<th>Pension Tax Rate</th>
</tr>
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<tbody>
<tr>
<td>Before reform</td>
<td>60% to 90% of their standard government wages at the time they retire</td>
<td>According to total wages and local regulation (Firm); Gradually implemented, less than 3% of wages (Individual)</td>
</tr>
<tr>
<td>After reform</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The New</td>
<td>Basic pensions (Target to 35% of the average monthly wages of local employees in the previous year) + Individual account pensions (balance in the account divided by 120; target to 24.2%)</td>
<td>Firm: 20% of employees’ total wages Individual: 4% of personal wages (1997), 8% of personal wages after 1997; 11% of personal wages goes to individual account</td>
</tr>
<tr>
<td>The Middle</td>
<td>Basic pensions (same as the New) + Individual account pensions (same as the New) + Transitional pensions (Indexation of monthly average wages × Coefficient × Number of years without individual account)</td>
<td>Same as the New</td>
</tr>
<tr>
<td>The Old</td>
<td>Same as “Before reform” Pension adjustment method is implemented</td>
<td>None</td>
</tr>
</tbody>
</table>

After 1997, there are several other pension reforms. But these reforms are a merely slight improvement which is based on the reform in 1997. The primary concerns of these reforms are to widen the coverage of the pension system and adjust the pension tax rate for the individual account. For example, in “The State Council Document No. 38: Decisions of the State Council on Improving the Basic Pension Insurance System for Enterprise Employees” (“Decision 2005”), the pension system includes industrial and commercial individual and flexible employment personnel. Besides, it reduces the tax rate that goes to individual account from 11% to 8%. Taxes paid by firm’s do not enter the individual account any further.
References


The Impact of Rapid Aging and Pension Reform on Savings and the Labor Supply: International Monetary Fund.


Demography Change and Current Account Balance in Emerging Economics: a Re-examination under the General Equilibrium Condition

Xin Liang

Abstract

This paper, accounting for the facts that the global current account balance must be equal to zero, re-examines the impact of demographic change on the current account balance. The method is to design a new empirical specification to introduce the general equilibrium effect of global current account balance into the framework and use a panel data of the sample of emerging economies to estimate the relationship between demographic structure and current account balance under this new framework. The main finding of this paper is that the young dependency ratio has a robust and significant negative impact on the current account but the old dependency ratio has an ambiguous and insignificant impact on the current account under the general equilibrium condition, the latter of which is at loggerheads over with the traditional literature that finds a negative impact of both young and old population on the current account balance.

JEL classification: F32,J10,D50,O16

Keywords:demographic change, current account balance, general equilibrium
1 Introduction

Motivated by the observations that emerging economies are in the grips of a rapidly aging process, which embodies in fewer young population and more old population, the interest in the macroeconomic effects of demography change has been growing. The demographic change due to the aging process can have a large influence on many aspects including saving behaviors, labor markets, and investment, consequently leading to a change in the current account balance. Traditionally, following the life-cycle hypothesis of consumption, young population borrow against their future income, middle-age population save for relinquishing debts and retirement, and old population dissaves. From the lens of the current account balance, it is equal to excess saving over investment. Accordingly, when people become aging, the increased population that dissaves are more likely to help this country to run current account deficits, which puts pressure on export and the foreign-exchange earning opportunity. Stemming from Higgins and Williamson (1997) and Higgins (1998), they find that countries with relatively young populations are capital importers, whereas the aging population will deteriorate the current account. Following research support this finding; e.g., Obstfeld and Rogoff (2000), Brooks et al. (2003), Lührmann (2003), Callen et al. (2006), Gudmundsson and Zoega (2014). However, the existing empirical literature ignores the general equilibrium condition of the global current account balance, i.e., the current accounts for all countries sum up to zero\footnote{Formally speaking, let $CA_j$ denotes the current account of country $j$ at time $t$. The general equilibrium condition means that, $\sum_{j=1}^{N} CA_j = 0$, where $j$ denotes the country $j$ and $N$ denotes the total number of countries in the world.}. Given the fact that the current account of each country interacts with each other in the real world which is following this general equilibrium condition, the neglect of it will lead to biased estimation coefficients in exploring the impact of demographic change on the current account balance.

This paper, accounting for the facts that the global current account balance must be equal to zero, re-examines the impact of demographic change on the current account balance. To achieve this goal, this paper: first, constructs a simple model to derive the regression model that links the current account and demography structure variables; second, designs a new empirical specification to introduce the general equilibrium effect of global current account balance into the framework; and third, uses a panel data of the sample of emerging economies to estimate the relationship between demographic structure and current account balance under this new framework. This paper also investigates whether controlling for the potential endogeneity of demographic changes has a significant impact on the estimated impact of demographic change on national saving, investment, and current account. The main finding of this paper is that the young dependency ratio has a robust and significant negative impact on the current account but the old dependency ratio has an ambiguous and insignificant impact on the current account under the general equilibrium condition.
The latter finding is at loggerheads over with the traditional literature that finds a negative impact of both young and old population on the current account balance.

The remainder of this paper is organized as follows. Section 2 reviews the related literature. Section 3 justifies the roles of demographic variables in the determination of aggregate savings, investment, and current account balance in a simple growth model with overlapping generations. Section 4 describes the derivation of the new modeling framework to introduce the general equilibrium condition. Section 5 illustrates the data and variables selection. Section 6 reports the regression results. The final section concludes.

2 Literature Review

This paper is closely related to the strand of the empirical literature on the macroeconomic impact of demographic change on the current account. Within this literature, Obstfeld and Rogoff (2000) empirically studied the impact of changes in the age structure on balances of global savings-investment balance and found that an aging population deteriorates a country’s current account. Brooks et al. (2003) found that when baby boomers enter old age, wealth consumption will cause the Europe Union and the United States to maintain a huge current account deficit. Börsch-Supan et al. (2004) applied an overlapping generation model based on long-term population forecasts of seven countries and regions to find that capital initially flows to other countries in the world from those rapidly aging countries, but when the families begin to use their savings, this trend will reverse. Callen et al. (2006) used a dynamic intertemporal general equilibrium model and found that if the elderly reduce assets during retirement it will worsen the current account and slow down economic growth in developed countries. Kim and Lee (2008) adopted the method of panel VAR model to show that an increase in dependency rate significantly lowers saving rates, especially public saving rates, resulting in deteriorating current account balances in the G-7 countries. Graff et al. (2012) used a new framework that adjusts the demographic variables by the difference between the home country and the rest of world, openness measure, and country size to find that population aging does not appear to have discernible impacts on the current account balance.

While these studies differ vastly concerning sample coverage, econometric approaches, and macroeconomic methods, in general, it is fair to summarize that they find that the population that dissavestend to have a negative impact on the current account. However, the existing findings as mentioned above do not consider the condition that the global current account balance has to sum up to zero. Also, the majority of existing works dwell on the developed countries or the mixed sample of both developed countries and emerging economies while the works that only dwells on emerging economies are rare. Through focusing on the sample of emerging economies and taking
into account the general equilibrium condition, it is expected to frown upon the existing findings in the literature.

Another common neglect in these empirical works is that they do not consider the reverse causality between demographic change and current account surplus. On the one hand, demographic changes have an impact on the current account through the channel of aggregate saving and aggregative investment. On the other hand, if there exists a current account surplus in the emerging economies, the country will have more foreign exchange reserves to purchase advanced medical equipment, which may lower the mortality rate of the aging population and the neonatal\(^2\). Accordingly, the dependency ratio of this country rises.

Although the aggregate investment is in tandem with the aggregate saving in determining the current account balance, in contrast to the rich works on the impact of demographic changes on aggregate saving rates and then on current account balance, the existing works have paid little attention to the relationship between demographic changes and investment. Only Cooper (2008) theoretically discusses that the aging population decreases the capital needed to equip labor. However, no empirical work has been done in testing this argument. Another missing piece is the increase in capital needed to maintain the same output when the labor supply declines. Theoretically, in the long term, this will drive up the capital-labor ratio which results in a decline in the rate of return to capital and finally a capital outflow to chase for a higher rate of return to capital. Nevertheless, an empirical test on this argument is needed. One of the few studies that try to involve in this discussion is Acemoglu and Restrepo (2017). One of their empirical findings is that, rapid aging countries are more likely to adopt robots which can neutralize the negative effect of labor scarcity. However, the Internation Federation of Robotics (IFR) dataset that is used in their work only includes 49 countries and most of them are developed countries, which may not apply in the case in emerging economies and cannot explain the change of capital-labor ratio due to the aging population.

The last issue merits consideration and, to my knowledge, has not been discussed in the empirical literature on this topic is the endogeneity of labor and demographic changes. The increased capital-labor ratio not only decreases the rate of return to capital but also increases the wage rate. The higher wage rate will increase the labor participation rate, which neutralizes the negative effect mentioned by Cooper (2008). As for the demographic changes, the higher wage rate will drive up the opportunity cost of having children, prompting residents to delay their childbearing decisions. This would lead to a declined fertility rate and further exacerbate the problem of population aging.

\(^2\)Take China as an example, from 1994 to 2017, China has run a current account surplus for 23 consecutive years. The highest current account as a share of GDP reached 10% in 2007. In the meantime, China’s old dependency rate (ODEP) increased persistently from 9.1% to 14.8%. According to the WTO’s report, from 1990 to 2011, the natal mortality rate has decreased by 62%. According to the World Bank Indicator, the life expectancy has increased from age 69.293 to age 76.252.
3 The Simple Model

In this section, a simple life-cycle model is constructed to link old dependency ratio (ODEP), young dependency ratio (YDEP) to national savings, investment and current account balance and derive the econometric model for regression. In this simple overlapping generation model, agents experience three periods in their lives: the childhood period, the working period and the retirement period. The exogenous fertility rate is set to be $n_t$. The working population is $P_t$. Accordingly, the childhood population $P_{t+1} = P_t n_t$, $n_t \in (0, 1)$. The childhood population can survive to working age with certainty, while the working population can survive to retirement age with probability $\Phi_t$. Accordingly, the total population at time $t$ is the summation of all three types of population: $P_t + P_t n_t + P_{t-1} \Phi_{t-1}$.

A middle-aged agent inelastically supplies one unit of labor endowment to work and earns a wage income of $W_t$. A retired agent consumes savings $S_t$ and government transfer $T_t$. The government transfer refers to a defined-benefit from a Pay As You Go pension system. Given the above assumption, the representative agent’s utility maximization problem is as follows,

$$\max U_t = \log M_t + \beta \Phi_t \log O_t$$

s.t.

$$M_t + s_t = W_t (1 - \tau)$$

$$O_t = R_t s_t + T_t$$

$$T_t = \frac{\tau W_t P_t}{\Phi_{t-1} P_{t-1}}$$

(1)

Where $M_t$ and $O_t$ denote the agent’s consumption in the working-aged and the retirement period. $\tau$ is the social security contribution rate. $R_t$ is the aggregate interest rate. $\beta$ is the time discount factor.

The first order condition gives the solution of this simple model as follows,

$$s_t = W_t \Omega_{s,t}, \quad \Omega_{s,t} = \frac{\Phi_t \beta R_t (1 - \tau) - \tau N_t}{R_t (1 + \Phi_t \beta)}$$

(2)

$$M_t = W_t \Omega_{m,t}, \quad \Omega_{m,t} = 1 - \tau - \Omega_{s,t}$$

(3)

$$O_t = R_t \Phi_t \beta M_t$$

(4)

The production function is $Y_t = A_t K_t^\alpha L_t^{-\alpha}$. For simplicity, I assume a 100% depreciation of capital within one period in production. If $y_t = Y_t / L_t$ denotes the output per worker and $k_t = K_t / L_t$ denotes the capital per worker, the two factor prices are $W_t = (1 - \alpha) y_t$ and $R_t = \alpha A(y_t / A)^{\frac{1}{1-\alpha}}$. 


The aggregate savings $S_t = Y_t - C_t - G_t - \delta K_t$. Since there is a 100% depreciation, i.e., $\delta = 1$ and government expenditure is assumed to be 0, i.e., $G_t = 0$, the aggregate savings $S_t = Y_t - C_t$.

The aggregate savings as a ratio out of aggregate output is as follows,

$$\frac{S_t}{Y_t} = \frac{P_t y_t - P_t M_t - P_{t-1} \Phi_{t-1} O_t}{P_t y_t} = 1 - (1 - \alpha) \Omega_{m,t} - \frac{P_{t-1} \Phi_{t-1} O_t}{P_t y_t} \quad (5)$$

Where $\beta_0 = 1 - \frac{(1 - \alpha)(1 - \tau + \Phi_{t,\beta})}{1 + \Phi_{t,\beta}}$, $\beta_1 = -\frac{(1 - \tau)(1 - \alpha) R_t \Phi_{t,\beta}}{1 + \Phi_{t,\beta}}$, and $\beta_2 = -\frac{(1 - \alpha) \tau}{\Phi_{t-1} R_t (1 + \Phi_{t,\beta})}$.

As $\frac{P_{t-1} \Phi_{t-1}}{P_t}$ is the retired population as a ratio out of the working population, it is the ODEP. According to the definition in the assumption, $n_t = P_{t+1}/P_t$ is both the current fertility rate and the young dependency ratio (YDEP). Since the current fertility rate is more likely to have an impact on the future aggregate saving, investment, and current account, I define $N_t$ to be the YDEP in the baseline model. In the later empirical analysis, a lagged-fertility-rate variable will be included.

As for the investment aspect, the agents’ savings consist of domestic physical capital $k_t$ and one-period riskless bond of foreign firms $b_t$. That is, $s_t = k_t + b_t$. To be simple, I assume $k_t$ accounts for $\gamma$ share of $s_t (\gamma \in (0, 1))$, i.e., $k_t = \gamma s_t$. Accordingly, the aggregate capital $K_t = P_t k_t$ and the aggregate investment $I_t = K_t - (1 - \delta) K_{t-1} = K_t = P_t k_t = \gamma P_t s_t$. Using (2) we yield,

$$\frac{I_t}{Y_t} = \frac{\gamma P_t s_t}{P_t y_t} = \gamma (1 - \alpha) \Omega_{s,t} \quad (6)$$

Finally, the current account balance as a share out of GDP using the difference between saving rates and investment rates as an approximation is as follows,

$$\frac{CA_t}{Y_t} = \frac{S_t}{Y_t} - \frac{I_t}{Y_t} = \beta'_0 + \beta'_1 ODEP_t + \beta'_2 YDEP_t \quad (7)$$

Where $\beta'_0 = 1 - \gamma (1 - \alpha)(1 - \tau) - \frac{(1 - \alpha)(1 - \gamma)(1 - \tau + \Phi_{t,\beta})}{1 + \Phi_{t,\beta}}$, $\beta'_1 = \beta_1$, and $\beta'_2 = (1 - \gamma) \beta_2$.

The empirical specifications for the current account are based on the theoretical conclusion Equation (7),

$$\frac{CA}{Y_{i,t}} = \alpha_0 + \alpha_1 ODEP_{i,t} + \alpha_2 YDEP_{i,t} + \alpha_3 Z_{i,t} + u_{i,t} \quad (8)$$
Where $Z_{i,t}$ is a vector of control variables. According to Equation (7), without considering the general equilibrium condition, since $\gamma, \alpha, \tau, \beta, \Phi_t \in (0, 1)$ we can expect that the sign of $\alpha_1$ and $\alpha_2$ are negative, which is the finding of most of the existing literature.

4 A New Empirical Framework

In this section, a new empirical framework that captures the general equilibrium of the global current account balance is introduced, which is an improvement\(^3\) to Graff et al. (2012) in an empirical framework that works on the impact of demographic change on the current account balance in their empirical framework.

4.1 The world sample new framework

The framework starts with dealing with the fixed effect. For a cross-country panel data in this paper, there exists an unobserved country fix effect, e.g., the country’s specific characteristic, and time fixed effect, e.g., the financial crisis happened that year.

The general expression following the specification in Equation (8) including the unobserved country fix effect and time fixed effect for country $i$ at year $t$ is as follows:

$$CA_{i,t} = \beta X_{i,t} + \epsilon_{i,t} = \beta X_{i,t} + \alpha_i + f_t + \mu_{i,t}$$

where $X_{it}$ is a vector of domestic factors that are expected to affect its current account balance in the home country. $\alpha_i$ denotes the unobserved country fixed effect and $f_t$ denotes the unobserved year fixed effect.

In order to remove these two fixed effects, this paper uses the first difference method as follows.

For the world, the average current account of one country (e.g., the home country $i$) for all given time spans is as follows,

$$CA_i = \beta \bar{X}_i + \alpha_i + \frac{1}{T} \sum_{t=1}^{T} f_t + \bar{\mu}_i$$

where $CA_i, \bar{X}_i, \bar{\mu}_i$ denote the average of the current account, variables of interest, and residual for all the years of each country respectively. $T$ is the sample size of years.

For the world, the average current account of all countries in the world for each year $t$ is as

\(^3\)Graff et al. (2012) argue that they want to capture the general equilibrium of global current account balance. However, under their argument that "if a domestic factor affects the home country’s current account balance, it must affect the balance for the ROW in the opposite direction", they just use the difference of independent variables between the home country and rest of world to derive the empirical results. In fact, they do not actually capture the general equilibrium of global current account balance.
follows,

\[ CA_t = \beta X_t + \frac{1}{T} \sum_{i=1}^{I} \alpha_i + f_t + \mu_t \]  \hspace{1cm} (11)

where \( CA_t, X_t, \mu_t \) denote the average of the current account, variables of interest, and residual for all the countries of each year respectively. \( I \) is the total number of countries.

For the world, the average current account of all countries in the world for all given time spans is as follows,

\[ CA = \beta X + \frac{1}{I} \sum_{i=1}^{I} \alpha_i + \frac{1}{T} \sum_{t=1}^{T} f_t + \mu \]  \hspace{1cm} (12)

where \( CA, X, \mu \) denote the average of the current account, variables of interest, and residual for all years and all the countries respectively. \( I \) is the total number of countries. \( T \) is the sample size of years.

The equations (9)-(12) yield the following regression model:

\[ (CA_{it} - CA_i - CA_t + CA) = \beta (X_{it} - X_i - X_t + X) + \hat{V}_i \]  \hspace{1cm} (13)

where \( \hat{V}_i = \mu_{it} - \mu_i - \mu_t + \mu \).

Note that under the general equilibrium condition of current account balance, for each year, the summation of the current accounts of all countries in the world is equal to zero, i.e., \( \sum_{i=1}^{I} CA_i = 0 \) for any \( t \). Also, \( \sum_{t=1}^{T} \sum_{i=1}^{I} CA_{i,t} = 0 \). Accordingly, \( CA_i = \frac{1}{T} \sum_{t=1}^{T} CA_i = 0 \) and \( CA = \frac{1}{I} \sum_{i=1}^{I} \sum_{t=1}^{T} CA_{i,t} = 0 \).

Substituting the conditions refer to \( CA_i = 0 \) and \( CA = 0 \) into equation (13) yields the regression equation for the whole world sample as follows,

\[ (CA_{it} - CA_i) = \beta (X_{it} - X_i - X_t + X) + \hat{V}_i \]  \hspace{1cm} (14)

The equations (9)-(14) are the first contribution of the specification that captures the general equilibrium condition of the global current account balance in this paper.

### 4.2 The new framework for the subsample of emerging countries

Section 4.1 is only true for all countries in the world. This paper aims at examining the impact of demographic changes in emerging economies. For a sub-sample in the world, equation (9) and (10) are still true for a developing country \( i \). Since the average of year fixed effect is only related to the length of time \( T \) rather than related to the number of countries \( I \), the average of year fixed effect \( \frac{1}{T} \sum_{t=1}^{T} f_t \) in equation (10) and equation (12) are the same for both the whole sample, i.e., the world and the sub-sample, i.e., only the emerging economies. Furthermore, if we always calculate the average of country fixed effect \( \frac{1}{I} \sum_{i=1}^{I} \alpha_i \) in equation (11) and equation (12) using the whole world
sample, they are the same. Therefore, the combination of equations (9)-(14) can still exclude the unobserved country fixed effect and time fixed effect, with the corollary that the regression model for the sub-sample of emerging economies is as follows,

The equations (9)-(12) yield the following regression model:

\[
(CA_{it} - CA_i - CA_t + CA) = \beta (X_{it} - \bar{X}_i - \bar{X}_t + \bar{X}) + \bar{V}_i
\]

(15)

where \( \bar{V}_i = \mu_{it} - \bar{\mu}_i - \bar{\mu}_t + \bar{\mu} \). The difference between this subsample framework and the one in Section 4.1 is that, in this section, \( CA_{it}, CA_i, X_{it}, \bar{X}_i \) are for the developing country \( i \) only, which is no longer the whole world sample as in Section 4.1. \( CA_t, CA, \bar{X}_t, \bar{X} \) are for the whole world which is the same as in Section 4.1.

Also, since \( CA_{it}, CA, \bar{X}_t, \bar{X} \) are for the whole world in this case, we have \( CA_t = CA = 0 \). The final regression equation for the sub-sample of developing countries that captures the general equilibrium of current account balance is as follows,

\[
(CA_{it} - CA_i) = \beta (X_{it} - \bar{X}_i - \bar{X}_t + \bar{X}) + \bar{V}_i
\]

(16)

where \( CA_{it}, CA_i, X_{it}, \bar{X}_i \) are for the developing country \( i \) only. \( \bar{X}_t, \bar{X} \) are for the whole world. The regression model for the whole world in Section 4.1 will also be estimated as a robustness test and a comparison with the conventional findings.

### 5 Data and Variables Selection

The object of this paper is the demographic effects on the current account balance. Accordingly, following common practice (e.g., Higgins and Klitgaard (1998)) in the literature, the dependent variable is the ratio of the current account to GDP. The explanatory variables of interest are dependency ratios. The data used here are mainly based on the World Bank’s World Development Indicators for the period from 1960 to 2017, which cover 93 developing countries. The dataset contains a wide range of variables, such as the ratio of current account to GDP, the growth rate, school enrollment, and demographic statistics. Regarding the population age structure, data are available for the proportions of the population under age 15, between 15 and 64, and aged 65 or above. The age group between 15 and 64 is chosen to be the middle-age population, as in the literature on savings and dependency rates. The old-age dependency rate refers to those over middle age relative to the middle-age population, and the total dependency rate is the sum of those under age 15 and those over middle age relative to the total population. In addition to these variables, the World Bank dataset also has information on the ratio of the current account
to output that is of particular interest here.

Again, since the current account is equal to excess saving over investment, three groups of control variables on life-cycle theory, investment return, and financial environment are employed in this paper.

The group of control variables on life-cycle theory consists of life expectancy, fertility rate, share of rural population, labor participation rate, and income growth rate.

As mentioned in the introduction, there exist two opposite effects of the relationship between age and savings. To better investigate the impact of population aging on saving and current account balance and following Li et al. (2007), we introduce the *Life Expectancy* to control the positive effect that individuals save more when they expect to live longer.

The *Fertility Rate* is captured by a lagged-fertility-rate variable to partly control for any effects brought by new-born children. In the literature on empirical growth, most studies use one-period lagged fertility as an independent variable (see, e.g., Levine and Renelt (1992), Bloom and Williamson (1998), Islam (1995), and Li and Zhang (2007)). Later we will also experiment by using 10-year and 15-year lagged fertility variables. The primary results do not change with these further lags. If the fertility rate increases, the young population who dissaves increases, this will decrease the current account balance.

The *Share of the Rural Population* in the total population is included as a control variable because rural households, especially those in developing countries, may not have as good access to financial intermediation as their urban counterparts and thus have different saving behavior (See for instance Graff et al. (2012)). The rural population has less income than the urban population in general. If the share of rural population increases, the current account is expected to decrease.

The *Labor Participation Rate* is introduced to control the change of labor participation decision when investigating the impact of population aging on labor supply, since labor supply is equal to the product of the quantity of labor force in the labor market and the labor participation rate. If the labor participation rate increases, the investment is expected to increase, which will decrease the current account.

It has typically found a positive effect of longevity and thus population aging on growth (e.g., Ehrlich and Lui (1991); Barro and Sala-i Martin (1990)). The strong positive effect of longevity on growth is interpreted by Barro and Sala-i Martin (1990) as a reflection of growth-enhancing factors (in addition to good health itself ) such as good work habits and high levels of skill. Since we are studying the impact on current account under the scenario that the population is in transition, it is necessary to control the *Income Growth Rate*. The sign of the income growth rate is expected to be positive due to the positive relationship between income growth and savings.

The group of control variables on investment return consists of human capital and the business
cycle.

The Primary School Enrollment (of the adult population) is used as a proxy for the human capital of the middle-age population and is expected to have a positive effect on the current account by raising the rate of return on savings through human capital (See for instance Barro and Lee (2000)). The sign is expected to be negative due to the positive relationship between the human capital and investment.

The GDP gap that is calculated by the relative deviation of annual GDP from potential output, where the latter is derived by HP-filtering ($\lambda = 100$) the logged empirical GDP series is used to control for the business cycle.

The group of control variables on the financial environment consists of financial development, political stability, and the degree of openness of a country.

The standard proxy for financial development or activity is the money and credit volumes represented by $M2/GDP$. It is a common control variable in the open economics literature (See for instance King and Levine (1993)). It is expected to be negative since a developed financial environment can help to increase investment and eventually decrease the current account.

The political stability is another important and common control variable in the open economics literature. Following Graff et al. (2012), for institutional quality and political stability (combined), we use the Political Risk Index from the International Country Risk Guide. A higher value of this index implies better institutional quality and higher political stability. It is expected to be negative due to a stable political environment can help to increase investment and eventually decrease the current account.

Since the financial openness is associated with international capital flows, the regression should control for the financial Openness Measure. This variable is taking advantage of the KAOPEN index constructed by Chinn and Ito (2008), which is the first principle component of variable indicating the presence of multiple exchange rates, variable indicating restrictions on current account transactions, variable indicating restrictions on capital account transactions, and variable indicating the requirement of the surrender of export proceeds that are recorded in the IMF’s Annual Report on Exchange Arrangements and Exchange Restrictions. Using this index instead of a trade openness measure also has the advantage that it is institution-based and therefore less susceptible to endogeneity problems and variation due to business cycles. Notwithstanding, we also use a standard trade openness measure for a robustness check. It is expected to be positive since the financial openness can catalyze international trade.

The coverage of the panel results from a pragmatic approach. We started with the broadest cross-section allowed for by data availability; yet to curb sampling effects due to excessive unbalancedness of the panel, we excluded those countries for which data are available for recent years.
only\textsuperscript{4}. Moreover, following common practice in cross-country studies, I disregarded very small countries\textsuperscript{5}, as their integration into the global economy can be assumed to differ substantially from larger economies, as well as OPEC countries whose national income derives mainly from exporting crude oil. Summary statistics are provided in Table 1.

The correlation matrix of all variables is reported in Table 2.

6 Empirical Result

6.1 The baseline result

The strategy is first to estimate models with only demographic variables, and then to add a number of control variables group by group to test if the results of the more parsimonious specifications are robust.

Under the new framework in Section 4.2, we start by estimating the baseline model (16). The results are reported in Table 3. Figures in parentheses are cluster standard errors by countries. When only the two demographic variables are included in column (1), the estimated coefficient of young dependency ratio (YDEP) is negative and significant at the 10\% confidence level. Nevertheless, the estimated coefficient of the old dependency ratio (ODEP) is positive and insignificant at standard levels. Recall that while most of the literature theory that follows the life-cycle theory finds negative signs for the two demographic variables, a more comprehensive consideration, i.e., introducing the general equilibrium condition of global current account balance leads to no conclusive presumption regarding their signs. Accordingly, we assess statistical significance for different groups of variables for further tests.

In column (2), two more control variables are added, namely, the fertility rate and life expectancy are added to the model, now young dependency ratio remains the negative sign but becomes significant at the 1\% confidence level. Also, the coefficient of the young dependency ratio becomes even larger. The old dependency ratio remains insignificant at standard levels while the sign changes to negative. Thus, interpreting these results mechanically, an increase in the young dependency ratio by one standard deviation may reduce the current account balance by some 0.3 standard deviations. In what follows, we take this as the baseline model for the sensitivity analyses.

In column (3), the group of control variables that are only related to the life-cycle theory is introduced, including the income growth rate, labor participation rate, and the rural population share. This cuts the sample size by nearly one-third. The finding regarding the young dependency ratio remains the same, albeit that the coefficient is only significant at 5\% confidence level.

\textsuperscript{4}This is mainly because these countries became independent entities only recently, particularly after the collapse of the Soviet Union and Yugoslavia.

\textsuperscript{5}My cut-off is 1 million inhabitants during any year from 1960-2017 as recorded in the World Bank Indicator.
In column (4), besides the group of control variables that are only related to life-cycle theory, the pension fund as a share out of GDP is also introduced. This shrinks the sample size to nearly 1/10. The sign of the young dependency ratio remains the same yet insignificant at standard confidence levels. The coefficient of old dependency ratio continues to be insignificant but the sign changes to negative. The purpose of this regression is to test whether the channel that the pension for the retirement period can contribute to the impact of demographic change on the current account balance in developing countries through the savings channel (i.e., a developed pension system refers to completed insurance for retirement life, which will decrease the savings.). However, since the old dependency ratio is insignificance for all four columns till now and the pension income is not related to the young dependency ratio which is significant in the previous three columns, this suggests that the effect of the demographic change is actually not the effect of pension.

In column (5), the group of control variables that contains only the return of investment is added to the regression, including the primary school enrollment rate and the GDP gap that captures the business cycle. The finding regarding the young dependency ratio remains the same, that is, the coefficient is negative and significant at 5% level. The coefficient of the old dependency ratio continues to be insignificant and positive. Interestingly, when controlling for the factors of return to investment, the effect of the young dependency ratio becomes much smaller, i.e., the coefficient changes from -0.3 to -0.221. This suggests that much of the effect of young dependency ratio changes on the current account balance is actually the investment effect. In other words, when the demographic changes, it mainly has an impact on the current account balance through the channel of investment.

In column (6), the group of control variables that are only the proxies of the financial environment is added to the regression, including the financial development (M2/Y), openness measure, and the political risk index. The finding regarding the young dependency ratio remains the same, albeit it is only significant at 10% level. The coefficient of the old dependency ratio continues to be insignificant and positive.

In column (7), the combination of control variables groups of life-cycle and return of investment are added. In column (8) the combination of control variables groups of life-cycle, the return of investment, and financial environment are added. The coefficient of young dependency ratio is no longer significant at standard levels now but the sign remains negative which is consistent with all previous regressions. The coefficient of old dependency ratio continues to be insignificant and the sign remains ambiguous.

Overall, different from the previous studies that tended to find negative effects for both age dependency ratios in a entire world sample or mixed sample of both developed countries and
developing countries, even though not all record both of them as statistically significant, the findings based on the new framework indicate that – after controlling for a reasonable number of confounders and in the sample of developing countries – only young dependency ratio appears to have negative effects on the current account balance and it is statistically significant. This would therefore suggest that the demographic change as a form of the slow down of baby boom indeed has discernible negative impacts on the current account balance, while a question mark is in order regarding the change of old dependency ratio as a form of population aging.

6.2 Test with GMM estimation

In this section, a dynamic panel estimation within the new framework is introduced. The GMM estimation has the following advantages: (1) Considering consumption habits, technological progress and other factors, there may exist inertia for the current account (Bond (2002)). However, a dynamic panel model can better identify and reflect the adjusting speed of dependent variables to a certain extent. (2) Reverse causality: on one hand, the positive impact of export demand increases the demand for labor on the job market. The higher wage rates from the higher demand will increase the opportunity cost of having children, prompting residents to delay their childbearing decisions. This would lead to a declining birth rate and reduce the dependency ratio. On the other hand, for developing countries, the current account surplus means that the country has more foreign exchange reserves for the purchase of advanced medical equipment, which may reduce the mortality of the aging population and the neonatal. The corollary is that the dependency ratio of a country rises. This section uses the dynamic panel GMM model to avoid the bias caused by endogeneity and analyze the impact of the inertia of the current account on the current account surplus as follows:

\[ Y_{i,t} = \beta_0 Y_{i,t-1} + \alpha \bar{X}_{i,t} + \epsilon_{i,t} \]  

(17)

where \( Y_{i,t} = CA_{it} - \bar{CA}_i \), \( \bar{X}_{i,t} = X_{it} - \bar{X}_i - \bar{X}_t + \bar{X} \).

Difference GMM (DIF-GMM) (Arellano and Bond (1991)) and system GMM (SYS-GMM) are two common estimation methods. The characteristics of DIF-GMM estimation is that it first differentiates the equation in order to remove the impact of fixed effects. Then it uses a set of lagging independent variables as the instrumental variables of corresponding variables in the differential equation.\(^6\)

\(^6\)However, it is easy for DIF-GMM estimation to be affected by the weak instrumental variables and cause finite sample errors. It would also lead to a loss of part of the information in the sample. In order to overcome this problem, Arellano and Bover (1995) and Blundell and Bond (1998) proposed the SYS-GMM estimation. SYS-GMM estimation combines differential equations and level equations. In addition, it adds a set of lagging differential variables as the instrumental variables of corresponding variables in level equations. Therefore, SYS-GMM estimation should be used as a robustness test. System GMM is estimated. However, in the tests so far, there are always too many IVs than the panel groups, with the corollary that all the estimators are not significant.
In the following estimation and analysis, due to a large number of observations in the sample, the estimations are performed using a two-step robust process, as this does not require homoskedasticity of the error term, and the standard errors are corrected for small sample bias following Windmeijer (2005). Post-estimation Difference-in-Hansen tests are performed to assess if the DIF-GMM estimators are valid. Both estimators require the first-differenced errors to be serially uncorrelated, which can be tested post-estimation. The serial correlation test shows that there only exists first-order serial correlation but no second-order serial correlation in the differentiated residual.

The results of DIF-GMM are reported in Table 4. All estimations reported in the table pass the autocorrelation and over-identification tests described above.

As discussed at the beginning of this section, for all columns in Table 3, the young dependency ratio, the old-age dependency ratio, fertility rate, and life expectancy are treated as endogenous, meaning that only their second and deeper lags are used as instruments. Yet, using too many instruments can lead to a downward bias of the standard errors. Therefore, I limit the number of lags in generating instruments to two, unless the post-estimation diagnostic test results in a demand for longer lags, as well as “collapsing” the moment conditions.

For column (1), by re-estimating the regression in column (2) of Table 3 using DIF-GMM, young dependency ratio is once again significantly negative at the 1% level. On the other hand, the impact of old dependency ratio is still negative and insignificant, as in the other specifications based on my new framework.

The rest of the columns are a number of robustness tests for the dynamic panel model by introducing the same groups of control variables as in the baseline estimation. The remaining variables are treated as exogenous, as they are slowly evolving stock or level variables.

For column (2), by re-estimating the regression in column (3) of Table 3 using DIF-GMM, the group of life-cycle factors is controlled. The young dependency ratio is once again significantly negative but only at the 10% level. This is probably due to multicollinearity.

From column (3) to (6), by re-estimating the regression in column (5)-(8) of Table 3 using DIF-GMM, the group of investment factors, financial environment factors, the combination of the first two groups, and the combination of all three groups are controlled. The estimations of the young dependency ratio are still negative while they are insignificant. This may be due to

---

7 However, in the literature, for example, Graff et al. (2012), the financial development is treated as a predetermined variable, meaning that its first and deeper lags are used as instruments. Furthermore, the labor participation rate, political risk, GDP gap, and income growth are also treated as endogenous, meaning that only their second and deeper lags are used as instruments. But for the tests so far, estimating the model with too many instrumented control variables will lead to the result that all estimations are insignificant.

8 However, in Table 2 we can see that, none of the three variables in the life-cycle group, i.e., the LPrate, Growth_W, and Rural, has a greater than 0.5 correlation coefficient with the YDEP. This is at odds with the results of further baseline and GMM tests that control for only each one of the three variables in the life-cycle group. The further tests show that, only controlling for LPrate will reduce the significance of the estimation of YDEP.
the potential endogeneity brought by the instruments only using the lags of endogenous variables themselves, which can be found from only passing the Hansen Test and Difference-in-Hansen tests of exogeneity of instrument subsets while the Sargan Test is never passed\(^9\). In addition, there may exist multicollinearity when more control variables are added. For example, Table 2 shows that the correlation coefficient between lagFer and YDEP is 0.75. The old dependency ratio is again insignificant.

The first two columns show that the results are robust when dealing with the potential reverse causality. However, for the rest of the columns, due to the potential multicollinearity and the limitation of the lag variables as the instruments, the coefficients of young dependency ratio become insignificant. Overall, the coefficients of the young dependency ratio are consistently negative and significant at only the first two tests in table (4).

### 6.3 The Whole World Sample Test

In this section, in order to further test the robustness of the baseline result and also compare the result under the new framework in this paper with the conventional method in the existing literature, some tests under the new framework using the whole world sample are estimated.

The results are reported in Table 5. All columns are the re-estimation of Table 3 using the model in equation (14) under the new framework.

There are three main findings of the estimations of the whole world sample. First, similar to the subsample of developing countries, for the whole world, the young dependency ratio has a significant negative impact on the current account balance under the general equilibrium condition. Second, in the whole sample, the impact of old dependency ratio on current account is still ambiguous and insignificant, which is at loggerheads over the conventional finding following the life-cycle theory in the existing literature that the both the young dependency ratio and old dependency ratio which dissave have a negative impact on the current account balance. Third, another interesting finding in the whole sample estimation is that the lag one-period fertility rate has a significantly positive impact on the current account balance. The interpretation of this finding is that, the past baby boom could contribute to the human capital by increasing the population in the labor force and finally benefit the current account balance. However, the past baby boom will increase the young dependency ratio which has a negative impact on the current account balance. These two factors jointly contribute to global imbalances in the world. This finding also casts doubt on the literature that examines the effect of fertility rate on current account without including the general equilibrium condition, e.g., Li et al. (2007), which finds the fertility rate has a negative impact on current account balance.

\(^9\)Both Hansen Test and Sargan Test are commonly used tests for weak instrument variables.
7 Conclusion

This paper, accounting for the fact that the global current account balance must be equal to zero, re-examines the impact of demographic change on the current account balance in the developing countries. To achieve this goal, this paper: first, constructs a simple model to derive the regression model that links the current account and demography structure variables; second, designs a new empirical specification to introduce the general equilibrium of global current account balance into the framework; third, uses a panel data of the sample of emerging economies to estimate the relationship between demographic structure and current account balance with this new framework. This paper also investigates whether controlling for the potential endogeneity of demographic changes has a significant impact on the estimated impact of demographic change on national saving, investment, and current account.

Although the details vary from estimation to estimation, as expected, a number of general observations regarding the demographic effects on the current account balance are in order.

Firstly, for the static models, accounting for general equilibrium, the results based on the new framework are noticeably different from the conventional finding following the life-cycle theory in the existing literature that both the young dependency ratio and old dependency ratio which dissave have a negative impact on the current account balance. At the very least, all previous estimations based on the conventional framework are biased.

Secondly, the dynamic models, accounting for the inertia of the current account balance and the endogeneity from the reverse causality, give relatively consistent and robust results for the impact of YDEP on current account within the new frameworks.

Thirdly, overall, the main finding of this paper is that the young dependency ratio has a robust and significant negative impact on the current account but the old dependency ratio has an ambiguous and insignificant impact on the current account under the general equilibrium condition for not only the developing countries but also the whole world. The latter finding is at loggerheads over with the traditional literature that finds a negative impact of both young and old population on the current account balance in the mixed sample with both developing and developed countries. However, this is not contradictory to the theoretical arguments. This is because population aging could affect both savings and investment, leaving its effect on excess saving over investment (i.e. the current account balance) ambiguous. Furthermore, people moving toward retirement may save more, and retirees may dissave more slowly due to longevity uncertainty. In this regard, it is plausible for population aging to have either a positive or a negative impact on the current account balance, or no discernible impacts at all – as found in this study.
## Table 1: Statistics of the Data

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<th>Variable</th>
<th>Description</th>
<th>Obs</th>
<th>Mean</th>
<th>Std. Dev.</th>
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<td>.0154849</td>
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<tr>
<td>X_lagFer</td>
<td>Fertility Rate</td>
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<td>Life Expectancy</td>
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<td>X_LPrate</td>
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<td>X_Rural</td>
<td>Rural Population Share</td>
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Table 2: Cross-correlation Table

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<th>Life</th>
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<th>Growth_W</th>
<th>M2_Y</th>
<th>LRate</th>
<th>Rural</th>
<th>PoliticalRisk</th>
<th>Pension_Y</th>
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Table 3: Baseline Result

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Early Retirement, Pension System and Current Account Surplus in China

Xin Liang*

Abstract

This paper studies the role of early retirement and pension system reform as drivers of China’s persistent high savings and current account surplus with the aid of a dynamic model calibrated to China. In the model, by incorporating the fact of early retirement and the feature of the pension system in China, the dominant early retirement effect coupled with the wealth substitution effect can increase the household’s savings, which results in high saving rates in China. The current account surplus is due to the high savings and the domestic firms have financial borrowing friction to access domestic investment. The earlier and earlier actual retirement age finally results in the growing saving rates and current account surplus under the restriction of domestic investment.

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JEL classification: D91,F32,H55,O16

Keywords: early retirement, social security, current account, China
1 Introduction

Since the “Reform and Opening” policy was launched in 1978, China’s economic and social development has achieved remarkable unprecedented changes, one of which is the large and persistent external imbalances (Figure 1). China has run a current account surplus since 1994 and, by 2016, it had accumulated a net foreign asset which amounted to 35.4%\(^1\) of its GDP. A classical open-economy model predicts a large net capital inflow rather than an outflow in developing countries whose has the high domestic return to capital. However, in the case of China, which has experienced a growing current account surplus, the combination of high growth and a high return to capital and a growing foreign surplus is puzzling.

\[\text{Current account balance of China}\]

Source: International Monetary Fund, Balance of Payments Statistics Yearbook

In addition, China has undergone a spectacular economic transformation involving not only fast economic growth and sustained capital accumulation, but also major shifts in different systems, for example, the social security system. The gradually implemented pension system reform from 1995 to 1997 changed the pension system in China from a pure Pay-As-You-Go (PAYG) to a combination of both PAYG and Fully Funded (FF). This is the very time when China’s current account turned surplus. This is not coincident. With the reform of the pension system, which is highly related to the income of retirement, the behaviors of consumption, saving and investment of households will change during both the working period and the retirement period, which contributes to the change of current account.

\(^1\)Data source: World Bank national accounts data, International Monetary Fund and author’s calculation.
China also sets up a much earlier mandatory retirement age\textsuperscript{2} than other countries with a similar life expectancy and allows for early retirement.\textsuperscript{3} Under this circumstance, what accompanies the process of the pension reform is a noteworthy phenomenon that Chinese people choose to retire earlier than the mandatory retirement age. In addition, the average retirement age is trending lower constantly. According to the China Health and Nutrition Survey (CHNS) and China Labor-Force Dynamics Survey (CLDS), the average retirement age surged from 53 to 57 in the 1980s. Afterward, it has decreased from age 57 in 1992 persistently to about 54 in 2004. Finally, the average retirement age remained relatively stable at around 53 from 2005 to 2015 (Figure 2). Another evidence of the fact that people are retiring earlier is shown in Figure 3. Figure 3 exhibits the labor force participation rates of different older groups in China in 2000 and 2010. The male labor participation rate nearly remains unchanged from 2000 to 2010 for the male before the male mandatory retirement age. But it declines substantially for age 60+ group from 2000 to 2010. The female labor participation rate has the greatest decrease among the age 50-54 group while the rest groups quit the labor market more than those in 2000. These facts can offer potential channels of the early retirement and pension system to explain the high savings and current account surplus in China.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure2.png}
\caption{Average retirement age in China}
\textbf{Source:} CHNS and China Labor-force Dynamic Survey(CLDS)
\end{figure}

\textsuperscript{2}Age 60 for male workers and age 50 for female worker. For female government officials, the retirement age is 55.

\textsuperscript{3}The retirement policy in China is that, according to the State Council Provisional Regulations on Retirement and Resignation of Workers, if they have worked for more than ten years, male employees should retire at age 60, female employees should retire at age 50 and female cadres should retire at age 55. In the heavy labor and high-risk industries, for example, the mining industry, male should retire at 55 and female should retire at 45. If employees lost the ability to work which is proven by hospitals, male should retire at 50 and female should retire at 45.
There are already some explanations for the high saving rates and current account surplus in China from different perspectives including consumption-smoothing theory, culture, demographic change, pension system and uncertainties. However, there are different shortcomings and the findings are inconclusive. The details of these imperfections in the existing literature are discussed in the next section.

While being consistent with salient qualitative and quantitative features of the Chinese experience, this paper suggests that early retirement and pension system reform had a large impact on mainly the savings. Since China has an earlier retirement age and also allows for early retirement, in the life-cycle model of this paper, these facts cause Chinese households to increase saving in order to cover the longer period of the retirement periods over which accumulated assets will be spread. In addition, the financial friction in the banking sector causes China’s firm cannot fully access to the banks’ loan. This decreases the domestic investment rate. The difference between saving and domestic investment finally contributes to the large current account surplus. The impact of this channel appears quantitatively large, and the model predicts a positive current account balance for China for the majority of the simulation period.

Earlier research (e.g., Gourinchas and Rey (2014)) on external imbalances based on the basic neoclassical theory has focused on the industrialized world, and struggled to explain the capital flows from fast-growing emerging economies to industrialized countries, including the capital outflows from China. Yet, the implications for global imbalances of the fact that East Asian countries save more to finance old age consumption because of their poor PAYG systems are still unexplored. In addition, there have already been some possible explanations for this global imbalances from different perspectives including the structure of trade and specialization patterns (e.g., Jin (2012)), privatization of state-owned enterprises, (e.g., Song et al. (2011)), non-traded sector, (e.g., Rothert and Short (2016)), fertility and

![Figure 3: LFPR in Different Age Groups in China](image)

Source: 2000 population census and 2010 population census

Figure 3: LFPR in Different Age Groups in China
Source: 2000 population census and 2010 population census
longevity or one child policy (e.g., Bárány et al. (2016), İmrohoroğlu and Zhao (2018)), large-scale economic reform, (e.g., Buera and Shin (2009)), etc. However, this strands of literature puts more emphasis on the underdevelopment of financial markets in the emerging economies and their inability to supply safe assets has caused the flight of capital from the emerging markets, while less emphasis on explaining the observed high household savings and both the urban and rural household economic behaviors. In addition, a strand of literature has shown that PAYG can substitute for savings, but why the saving in China with a PAYG pension system is still so high remains unexplained. One of the answers could be the PAYG pension system is underdeveloped which is hard to sustain the same consumption level after retirement. However, other important factors remain to be explored. If people retire earlier, either required to (i.e., mandatory retirement) or choose to (i.e., voluntary retirement), they have to increase their saving in order to support the longer retirement with fewer pension benefit. This is the so-called "induced retirement effect" proposed by Feldstein (1974).

The main contribution of this paper is to provide a new explanation (i.e., the early retirement) for the persistent external imbalances in China. The paper is related to the literature using life-cycle models to analyze external imbalances, population aging and social security, but also more generally to the literature on external imbalances between emerging and industrialized economies. We go one more step to explore the effect of early retirement coupled with the pension system. This paper also relates to existing work on pension system and economic growth such as Feldstein (1974), Kotlikoff (1996), Docquier and Paddison (2003), Kaganovich and Meier (2012) and so on, which focus mostly on the pure PAYG system in developed countries. In addition, the model tries to capture the induced retirement effect and the wealth substitution effect proposed by Feldstein (1974), which, to my knowledge, is the first time. Finally, this paper differs from the literature which studies China’s capital outflows that do not take into account the difference between urban and rural regions. This paper constructs detailed demographic and pension system models that capture both the urban and rural feature in China.

The rest of the paper is organized as follows. Section 2 discusses the related literature. Section 3 presents the model. Section 4 parameterizes the model and calibrate it to the data. Section 5 presents the results and dynamic analysis. Finally, section 6 concludes.

2 Literature Review

This paper is mainly related to the body of literature which puts emphasis on pension system as the main determinant of global imbalances. Samwick (2000) uses cross-sectional evidence to prove that countries with PAYG systems tend to have lower saving rates. Eugeni (2015) investigates the relationship between East Asian countries’ high propensity to save and global imbalances in a two-country OLG model where only one of them has the pension system. This paper shows that the high
saving behavior of emerging economies and capital outflows to the United States can be attributed to their poor PAYG social security system. Different from the traditional context of perfect foresight, full information, and in a time-consistent manner, Börsch-supan and Härtl (2017) sheds light on selected aspects of pension economics in Asian economies including the volume of savings for old-age provisions, international diversification of retirement savings, and global spillover effects of pension reforms when households are myopic and time is inconsistent. They find that the volume of savings for old-age provision is substantially lower in a world with many myopic households, which a substantially lower contributes to international capital flows. Niemeläinen (2017) uses a life-cycle model to study the role of population aging and the low level of pension income in retirement as drivers of China’s persistent trade surplus vis-a-vis the United States. The model shows that the fast increase in life expectancy coupled with the relatively low pension expenditures can contribute to its high savings, the persistent trade surplus and the accumulation of a sizeable net foreign asset position. İmrohoroğlu and Zhao (2018) argue that inadequate insurance through government programs for the elderly and the decline in family insurance due to the one-child policy led to an increase in the household saving rate. The increase in the saving rate coupled with the financial frictions preventing the increased household saving from being invested in domestic firms resulted in large current account surpluses. Yet, the literature ignores the urban and rural features which are highly related to the difference between the urban and rural pension system in China.

The interaction between the pension system and other factors, e.g., demographic changes, etc, is another strand in the literature. Saarenheimo (2005), Domeij and Martin (2016) and Bárány et al. (2016) use multi-period OLG models to analyse questions related to external imbalances, population aging and social security in a multi-country setting. In specific, Saarenheimo (2005) studies the effects of population aging on global variables including the real interest rate, asset prices and external imbalances in a 73-cohort OLG model with five countries. Domeij and Martin (2016) analyze the effects of demographic transition on the international capital flows in a model economy consisting of 18 OECD countries and the rest of the world. Bárány et al. (2016) analyze the role of demographic change together with credit constraints and social security on external capital flows in a multi-country setting. Ferrero (2010) analyses the effects of demographics, fiscal policy and productivity on the external balance between the US and six other industrialized countries. The main finding is that productivity differentials together with demographic developments can explain the majority of the dynamics of the bilateral trade balance between these industrialized countries during the simulation period (1970-2005). However, if the model is extended to include China, the predictions are counterfactual, which remains to be explored. Furthermore, the interaction between pension system and other possible factors, e.g., the retirement age that is going to be the main concern in this paper, remains unexplored.

Recent literature on external imbalances in China typically highlights the role of financial markets.
Caballero et al. (2016) develops a model which rationalizes the international capital flows as a global equilibrium outcome driven by differences in different regions’ abilities to supply financial assets. Also Mendoza et al. (2009) argues that when countries with less developed financial markets, resulting in low enforceability of financial contracts, integrate to the international financial system, capital flows towards more developed financial markets occur. Song et al. (2011) proposes a model for the Chinese economy in which the firms are heterogeneous in productivity and in access to the financial markets. The capital outflows occur because the productive firms have limited access to financial markets, and therefore the domestic financial markets are unable to provide sufficient investment opportunities to the households despite high productivity growth. Different from the emphasis on financial markets, this paper gives more weight on the new explanation of high savings in China than frictions in financial markets. The friction in financial markets in this paper is a tool to sustain the higher rate of return to capital of firms and help the high savings outnumbers the domestic investment.

The last strand of related literature is about the contribution of endogenous retirement and pension system on savings. Sánchez Martín (2010) assesses the pension reform in the Spanish economy whose major policies include delaying legal retirement ages and reducing the generosity of pension benefits. They find that low-skilled workers tend to retire early and average-skilled workers anticipate retirement. In addition, the pension reform extends the length of the averaging period in the pension formula, which reduces the size of pension benefits and finally leads to higher levels of personal savings and capital accumulation. Fehr et al. (2003) investigates five different reform proposals by means of an overlapping generations model with endogenous retirement age and heterogeneous individuals for the Norwegian economy. This paper finds that the expansion of their social security systems has discouraged labor market participation in general and induced early retirement. The majority of households still keep early-retiring, resulting in that the pension benefits are reduced and people increase their savings. Díaz-Giménez and Díaz-Saavedra (2017) studies the 2011 and 2013 reforms of the Spanish public pension system and finds that Spanish pension systems which include important non-actuarial benefits encourage early retirement. The reforms by means of delaying the legal retirement ages finally lead to an increase in the duration of the working lives, the aggregate effective labor and savings due to lower retirement pensions. However, the reforms studied in this strand of literature manipulate the mandatory retirement age, while the pension reform in China from 1995 to 1997 did not. Furthermore, early retirement in China is not mainly due to pension reform. For example, Feng et al. (2008) uses the China Health and Nutrition Survey to find that the lay-off in the 1990s is the main cause of early retirement in the 1990s in China. Thereafter, this paper is not going to explain the reason for early retirement in China. We just take the early retirement as given, and explore its impact on the saving rates and current account.
3 Model

In this section, we present a multiperiod life-cycle model for our analysis of China’s saving, investment and the current account. The model consists of conventional workers and the firms that share similar features to the entrepreneurial firms in Song et al. (2011). A period in the model stands for one year of real time, which is denoted by \( t \) when referring to calendar time and by \( j \) when referring to age. We model the agents from their born to death, which will be further discussed in section 4.1, but the representative agents only have an impact on the economy when they enter the labor market at age \( 22 \), work until age \( J_W \), and live up to age \( J \). Many cohorts are included in the model. The economy in this model begins in 1995. Different cohorts enter in the year 1995 with different starting ages. Agents are assumed to be either workers or entrepreneurs. Workers earn labor income during their working years, make exogenous retirement decision before or at the mandatory retirement age and receive social security after they retire. There is no private insurance market and the annuity markets are closed as assumptions. The entrepreneurs are the residual claimants of the firm’s profits. We assume that entrepreneurs are not in the pension system. The entrepreneurs work as managers for \( J_E - 22 \) years and earn managers income. They retire as entrepreneurs by investing their lifetime managers income to run the firm at age \( J_E + 1 \). More discussion of entrepreneurs will be elaborated in Section 3.2.

This model abstracts from some potentially important features. First, the model considers neither idiosyncratic nor intergenerational risk. Even though these two risks are important, it is difficult to insure in emerging economies. Second, the model ignores within-cohort inequality since public pensions can also provide some intragenerational redistribution. Last but not least important, we do not consider altruism within families as in, e.g., İmrohoroglu and Zhao (2018). The reason is supported by Cai et al. (2006), who argue that the fact that elder people receive transfers from their children in response to negative income shocks happens mainly in urban China rather than pervasive in both urban and rural areas. Furthermore, they also empirically find that such transfers can only provide very limited insurance.

3.1 Worker’s Problem

The life-time utility function of the representative agent at time \( t \) is as follows,

\[
U_t = \sum_{j=0}^{J} \beta^j s_j u(c_{t, j}, h_{t, j})
\]  

where \( \beta \) stands for a time discount factor, \( s_j \) is the unconditional probability of surviving till age \( j \) for an agent and \( s_j = \prod_{i=1}^{j} \psi_i \). \( \psi_i \) is the conditional survival probability from age \( j - 1 \) to age \( j \). \( c_{t, j} \) denotes the consumption and \( h_{t, j} \) denotes the labor supply.

---

4Chinese teenagers generally enter college at 18 and graduate at age 22.

5There are two reasons to choose 1995 as the beginning year of this model. First, China’s pension system reform started to implement between 1995-1997. Second, China’s current account started to increase in 1995.
The utility function is as follows,

\[ u(c_{t,j}, h_{t,j}) = \log(c_{t,j}) - \frac{\zeta_{ht,j}}{1 + \theta} \]  

(2)

The budget constraint for a representative worker (\( j \leq J_W \)) is as follows,

\[ c_{t,j} + a_{t+1,j+1} = (1 + r_t)a_{t,j} + (1 - \tau_{t,j})w_t\epsilon_j\eta_j h_{t,j} \]

(3)

where \( a_{t+1,j+1} \) is the asset holding for the next period, and \( r_t \) is the domestic saving interest rate. \( \tau_t \) is the labor income tax and \( w_t \) is the wage rate. \( \epsilon_j \) is the deterministic age-dependent productivity at age \( j \). \( \eta_j \) represents the human capital at age \( j \).

In addition, since there is no private insurance market, each individual has to self-insure the risks she faces through asset accumulation. In any period \( t \), a retired individual of age \( J_W + 1 \leq j \leq \bar{J} \) faces the following budget constraint,

\[ c_{t,j} + a_{t+1,j+1} = (1 + r_t)a_{t,j} + p_{t,j} \]

(4)

Following Song et al. (2015), \( p_{t,j} \), the pension received at period \( t + j \) by an agent who worked until period \( t + J_W \) (and who became “adult” in period \( t \)) is computed as follows:

\[ p_{t,j} = \sigma_{t+J_W}[(\nu\bar{y}_{t+j} + J_W + (1 - \nu)\bar{y}_{t+j-1}] \]

(5)

where \( j > J_W \); \( \nu \) measures the importance of indexed average wage in the determination of social security benefits; and \( \sigma_t \) denotes the replacement rate in period \( t \) and \( \bar{y}_t \) is the average pre-tax labor earnings for workers in period \( t \):

\[ \bar{y}_t \equiv \frac{\sum_{j=0}^{J_W} \mu_{t-j}w_t\epsilon_{t-j}\eta_{t-j}h_{t-j,t}}{\sum_{j=0}^{J_W} \mu_{t-j}s_j} \]

(6)

where \( \mu_{t-j} \) is the number of agents of cohort \( t-j \) (i.e., who became economically active in period \( t-j \)) who have survived until period \( t \). In particular, \( \mu_j \) is the population of age \( j \) at year \( t \). \( j \) is the survival probability from age \( j \) to age \( j + 1 \). The numerator in equation (7) is the total pension contribution from the working population at year \( t \). And the denominator in equation (7) is the total working population. This fraction represents the "Average Indexed Monthly Earnings" (AIME) of average wage at time \( t \), which is consistent with the pension reform regulation.
3.2 Entrepreneur’s Problem

In this section, we construct a dynamic general equilibrium model that delivers the wage and interest rate sequence.

The rural production sector is a traditional production sector that chooses capital and labor to maximize a Cobb-Douglas production function $Y_r = K_r^{\alpha_r} (A_r N_r)^{1-\alpha_r}$. Where $\alpha_r$ is the capital-labor elasticity, $K_r$ and $N_r$ are the effective capital and labor input, $A_r$ is the productivity. The optimizing condition implies that $w_r = (1 - \alpha_r)(K_r A_r N_r)^{\alpha_r}$ and $r_r = \alpha_r(K_r A_r N_r)^{\alpha_r - 1} - \delta$.

The urban production sector is in the spirit of the E-type firm in Song et al. (2011). The urban entrepreneurs delegate the management of their firms to specialized agents called managers, which can run more productively than rural firms. Nevertheless, the urban firms are subject to credit constraints which the rural firms do not. The production function function of an urban firm is $Y_u = K_u^{\alpha_u} (\chi A_u N_u)^{1-\alpha_u}$ where $\chi > 1$ denotes the extra efficiency units per worker.

In the following section, for the sake of simplicity, the subscript of urban $u$ is omitted when discussing urban production sector while the the subscript of rural $r$ will still remain in case of causing confusion.

The optimization problem of an urban entrepreneur is to maximize profits subject to the incentive constraint for managers and borrowing constraint as follows,

$$\max_{M_t, N_t} \Xi_t(\Omega_t) = K_t^{\alpha_t} (\chi A_t N_t)^{1-\alpha} - (\rho_t + \delta) K_t - M_t - w_t N_t$$

s.t. $M_t \geq \psi K_t^{\alpha_t} (\chi A_t N_t)^{1-\alpha}$

and

$$(1 + r_t^l) L_t \leq \xi [\chi K_t^{\alpha_t} (A_t N_t)^{1-\alpha} + (1 - \delta) K_t - w_t N_t]$$

Where $\xi$ is the parameter that measures the financial friction. The technology parameter $A_t$ grows at the exogenous rate $g$. $K_t = \Omega_t + L_t$. $\Omega_t$ is the entrepreneur’s own capital stock; $L_t$ is the loan she borrows from the domestic bank with domestic interest rate $r_t^l$. $\psi < 1$ denotes the share of output that received by managers.

The optimal contract implies that the incentive constraint is binding:

$$M_t = \psi K_t^{\alpha_t} (\chi A_t N_t)^{1-\alpha}$$

The firm’s optimization of equations (7), (8) and (9) imply that the wage rate $w_t$, and the net return to capital $\rho_t$, are given by

$$w_t = (1 - \alpha)(1 - \psi) \chi^{1-\alpha}(K_t^{\alpha_t})$$
\[ p_t = \alpha (1 - \psi) \chi^{1-\alpha} \left( \frac{K_t}{A_t N_t} \right)^{\alpha - 1} - \delta \]  

(12)

Substituting the equation \( K_t = \Omega_t + L_t \), (11) and (12) into equation (9) yields,

\[ (1 + r_t^l) L_t \leq \xi (1 + p_t) (\Omega_t + L_t) \]  

(13)

In this paper, the firm’s credit constraint is always binding, from equation (13) the loan of the firm is given by,

\[ L_t = \frac{\xi (1 + p_t)}{1 + r_t^l - \xi (1 + p_t)} \Omega_t \]  

(14)

3.3 The life-time problem

The life-time maximizing problem of workers is as follows,

\[
\begin{align*}
\text{max} & \quad U_t = \sum_{j=0}^{J} \beta^j s_j \left( \log (c_{t,j}) - \chi \frac{h_{t,j}^{1+\frac{1}{\theta}}}{1+\frac{1}{\theta}} \right) \\
\text{s.t.} & \quad \sum_{j=0}^{J} \frac{s_j}{R_j} c_{t,j} = \sum_{j=0}^{J} \frac{s_j}{R_j} (1-\tau_{t,j}) w_t \epsilon_j \eta_j h_{t,j} + \sum_{j=J_W+1}^{J} \frac{s_j}{R_j} p_{t,j} 
\end{align*}
\]  

(15)

Standard analysis yields the first-order conditions:

\[ c_{t,0} = \lambda^{-1} \]  

(16)

\[ c_{t,j} = \lambda^{-1} \beta^j R^j = (\beta R)^j c_{t,0}, \text{ for } j \in \{0, 1, ..., J\} \]  

(17)

\[ h_{t,j} = \left( \frac{w_t}{c_{t,j}} \right)^{\theta}, \text{ for } j \in \{1, 2, ..., J_W\} \]  

(18)

where \( \lambda \) is the Lagrange multiplier associated with the resource constraint.

The agent with entrepreneurial skill works as a manager until age \( J_E \) and earn the management income \( M_t \). And during this time can only invest her savings in bank deposits (as can workers) which yields an annual gross return \( R_t = r_t^l \). As she reaches age \( J_E + 1 \), she retires to become an entrepreneur. In this case, she invests her life-time accumulated wealth in her own business yielding the annual return \( R_{E,t} \) and hire managers and workers. Thereafter, she becomes the residual claimants of the firm’s profits. We assume that entrepreneurs are not in the pension system. Their lifetime budget constraint is then given by
\[
\sum_{j=0}^{J_E} s_j c_{t+j} + \sum_{j=J_E+1}^{J} \frac{1}{R_j} \prod_{v=t+J_{E}+1}^{t+j} R_{E,v} c_{t,j} = \sum_{j=0}^{J_E} s_j M_t
\]  (19)

3.4 Government

The government taxes the labor income to finance the pension system. Given an initial pension trust fund, \( P_0 \), the government intertemporal budget constraint is as follows,

\[
P_0 + \sum_{t=0}^{\infty} \frac{1}{R_t} \left( \tau_t \sum_{j=0}^{J_W} \mu_{t-j \omega \tau} s_{j \tau} (t-j) \eta_{t-j} h_{t-j,t} \right) \geq \sum_{t=0}^{\infty} \frac{1}{R_t} \left( \sum_{j=J_W+1}^{J} \mu_{t-j s_{j \tau} (t-j,t)} \right)
\]  (20)

where the left hand side of the constraint is the pension contribution from the working population; the right hand side of the constraint is the pension payment to the retired population.

3.5 Current Account

In the competitive equilibrium of the open economy setting, the current position of the net foreign assets is equal to the difference between private savings deposited in the bank account and bank loans borrowed by the domestic firms plus the difference between government saving and investment. That is:

\[
NFA_t = (S^g_t - I^g_t) + S_t - I^d_t
\]  (21)

\[
CA_t = NFA_t - NFA_{t-1}
\]  (22)

where the private savings deposited in the bank account \( S_t \) is equal to the entrepreneurial agents’ (i.e., managers) savings plus both urban and rural workers’ savings. The bank loans \( I^d_t = L_t \) borrowed by the domestic firms is equal to the rural firms’ capital and the urban firms’ capital excluding their own capital stocks. The government savings \( S^g_t \) and investment \( I^g_t \) is not endogenously determined in the model, which will be elaborated in the calibration of the government sector.

4 Calibration

4.1 Demographics

This section describes and parametrizes the demographic model similar to Song et al. (2015) in this paper.

China faces a major demographic transition not only in the form of the population growth but also the internal rural-urban migration. This demographic transition interacts with the function and
sustainability of the pension system and saving-investment behaviors. Therefore, we construct in this section a detailed demographic model. We model both the exogenous population growth and rural-urban migration by: first, a model without internal rural-urban migration; second, an extended model of migration with fixed age-gender-specific emigration rates over time.

4.1.1 Population projections without rural-urban migration

We first start with a model without rural-urban migration. The initial population is classified according to their birthplaces, ages, and genders. Under the no-rural-urban migration framework, we take advantage of the initial population size and distribution from the adjusted 1995 census data, to project the population in 2000. And the projected 2000 population is targeted to the adjusted 2000 census data. Regardless of the mentioned time span issue, another reason for this is that, there is a consensus among economists\(^6\) that birth rates have been underreported in Chinese census data, causing a downward bias of the census data. Take the 2000 census as an example, Zhai and Chen (2007) use the primary school enrollment rate to adjust the census data and find that there is a deficit of 29.67 to 37.83 million age 0 to 9 children in the 2000 census. To heed this concern, for the 1995 census, we take the rural-urban population and age-gender distribution from the 1995 census and adjust the data with the subsequent National Bureau of Statistics (NBS) revisions. For the 2000 census, we not only take the same variables from the 2000 census with the same revisions but also adjust this according to the linear estimates in Zhai and Chen (2007), which is to calculate the missing number of children of each age group and add them to the data.

For the mortality rates in the population projection, the general idea is that, we first take the initial group-specific mortality rates from data, and then set the mortality rates to match some specific years in the future. Finally, in the long run, the mortality rate is fixed. In particular, the initial group-specific mortality rates are derived from the 1995 census. The life expectancy at birth in the initial year is 70.8 years, which is close to the World Development Indicator figure in the same year (70.2). The three specific years are chosen to be 2020, 2050, and 2080. The mortality rates chosen for these three future years can match the demographic projection until 2080 by Yi (2007). We use linear interpolation over the intermediate periods. After 2080, the mortality rate is assumed to be fixed. This can imply a long-run life expectancy of 81.9 years.

For the choice of fertility rates, we follow the same logic as the choice of mortality rates. The initial group-specific (urban and rural) fertility rates for 1995 and 2000 are taken from the 1995 one-percent population survey and the 2000 census, respectively. We interpolate linearly the years 1996-1999. Between 2000 and 2012\(^7\), we assume age-specific fertility rates (urban and rural) to be the same as the

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\(^6\)Mi (2004), Zhang (2005), Zhai and Chen (2007), etc.

\(^7\)The reason to cut off this time span is that, in 2013, the third plenum of the Chinese Communist Party’s 18th Party Congress announced the plan allowing couples to have two children if one of them is an only child, which was rapidly implemented by provinces.
2000 level. The average urban and rural total fertility rates (TFR) are 1.2 and 1.98\(^8\) in the projection, respectively. Between 2013 and 2050, to be consistent with the claim of the Chinese authorities, as outlined by the National Health and Family Planning Commission\(^9\) and the estimation in Yi (2007)\(^10\), we assume age-specific fertility rates in the rural area to remain constant, i.e., 1.98 and age-specific fertility rates in the urban area to be 1.8\(^11\). After 2050, the long-run TFR is assumed to be 2.0766 following the United Nations population forecasts. In particular, we linearly interpolate the TFRs for the years 2051-2099 from 1.98 to 2.08 in the rural area and from 1.8 to 2.08 in the urban area to smooth the demographic change.

### 4.1.2 Population projections with rural-urban migration

In the rapid process of industrialization and urbanization in China, a large scale of the rural population migrates to the city, which will have a profound impact on both the rural and urban population structure. If we use the place of permanent registered residence (i.e., Hukou) as a classification standard, there are mainly two categories of rural-urban migrants\(^12\). The first category consists of people who physically move from rural to urban areas but retain a rural Hukou. We call it the Floating Population. The second category comprises people who change their Hukou from rural to urban even they do not physically move to cities. We call it the Permanent Population. The sum of the two categories is called the net migration flow (NMF).

Generally, it is difficult to estimate and predict the rural-urban migration, even for developed countries. The pervasive legal and administrative regulations in China compound this problem. Although emigration rates are likely correlated with a series of factors including the urban-rural wage gap, pension and health care entitlements for migrants, the rural old-age dependency ratio, and so on, we have to and can only abstract from these factors and assume that the demographic migration only depends on the age distribution of rural workers. Accordingly, in this simple model of migration, we assume that the age-gender specific emigration rates that are estimated from the 1995-2000 population projection are fixed over time. To incorporate rural-urban migration in our population projection, we make two assumptions. First, the age-gender-specific migration rates remain constant after 2000 at the level of our estimates for the period 1995-2000. Second, once the migrants have moved to an urban area, their fertility and mortality rates are assumed to be the same as those of urban residents.

The general idea to estimate the NMF and the age- and gender-specific distribution and use these as the backbone of the projection of migration. We first use the 1995 census to construct a projection of

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\(^8\)The estimated value from the 2000 census and earlier surveys are between 1.5 and 1.8 (see, e.g., Zhang and Zhao, 2006).

\(^9\)Source: Xinhuanet November 15, 2013

\(^10\)Yi (2007) estimates that the second-child policy would increase the urban TFR from 1.2 to 1.8 (the second scenario in Yi (2007)).

\(^11\)\(^12\)The difference is significant since most non-resident workers are currently not covered by any form of urban social insurance including pensions.
the rural and urban population without migration until 2000 based on the method described in section 4.1.1. We then estimate the age- and gender-specific distribution by taking the difference between the 2000 projection of the population without migration and the actual population in the data according to the 2000 survey.

### 4.1.3 Results for the population projection

According to our estimates, the overall NMF between 1995 and 2000 was 91.3 million, corresponding to 10.2% of the rural population in 2000. Our estimate implies an annual flow of 18.3 million migrants between 1996 to 2000, (equal to an annual 2.3% of the rural population). This index is in line with estimates of earlier studies. For instance, Ying (2003) estimates an annual flow between 17.5 and 19.5 million in the period 1996-2000.

![Emigration Rates from Rural Areas by Age and Gender](image)

**Figure 4:** The figure shows rural-urban migration rates by age and gender as a share of each cohort. The estimates are smoothed by five-year moving averages.

The estimated age-gender-specific migration rates are shown in Figure 4. Both the female and male migration rates peak at age twenty-five, with 7% for both females and males. The migration rate falls gradually at later ages, remaining above 1% until age forty-five for males and until age forty-eight for females. Migration becomes negligible which is less than 0.5% after age fifty.

Table 1 compares the actual migration structure with our estimates. We also include the estimation in Song et al. (2015) to provide more information. Even though Song et al. (2015) can match the data better between age 15 and 44, there exist two points in their paper worth doubting. First, they use the data in 2000 to project the population and migration in 2005 and then target the age distribution
Table 1: Age Structure of migration (%)

<table>
<thead>
<tr>
<th>Age</th>
<th>&lt;15</th>
<th>15-29</th>
<th>30-44</th>
<th>45-59</th>
<th>60+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ave. of 1995-2000 Census data</td>
<td>9.03</td>
<td>60.53</td>
<td>22.14</td>
<td>5.81</td>
<td>2.49</td>
</tr>
<tr>
<td>Simulation in this paper</td>
<td>15.48</td>
<td>51.51</td>
<td>27.07</td>
<td>7.33</td>
<td>-0.57</td>
</tr>
<tr>
<td>Simulation in Song et al. (2015)</td>
<td>25.8</td>
<td>64.8</td>
<td>26.5</td>
<td>-8.6</td>
<td>-8.6</td>
</tr>
</tbody>
</table>

of migration between 1995-2000 with their 2000-2005 projection. In fact, the distribution should be different in these two different time intervals. Second, the two distributions in Song et al. (2015) after age 45 are relatively large and negative. This may be due to their overestimation of "<15" group which is 16.77% greater than the data. In fact, due to the culture in China that "people prefer to die at where they were born", the rural-urban migrants could go back to rural when they become old, for example, −0.57% of the 60+ group in this paper’s estimation. But the rural-urban migrants aged 45+ account for a 17.2% reversal rural-urban migrants is less possible. Accordingly, the estimation in this paper is more reasonable.

Figure 5 plots the old-age dependency ratio \(^{13}\) for rural and urban areas (solid lines). We also plot the old-age dependency ratio in the no migration counterfactual (dashed lines). The projected urban old-age dependency ratio is 63% in 2050, but it would be as high as 90% in the no migration counterfactual. The Chinese pension system only covers urban workers. Accordingly, its sustainability hinges on the urban old-age dependency ratio. If we ignore the rural-urban migration, the population projection and the calculation that is associated with the pension system are bias.

Figure 6 shows the projected population dynamics (solid lines). We also compare the population model without migration (dash lines, counterfactual) with the population model with migration (benchmark). There are mainly three findings for the benchmark: first, the rural population declines over the whole period; second, the urban population as a share out of the total population increases from 51% in 2010 to 83% in 2050 and to over 95% in 2100; third, between 2050 and 2100 there are two opposite forces that tend to make the urban population stable: on the one hand, fertility becomes very low in urban areas from 2050 to 2100\(^{14}\); on the other hand, there decreasing rural population (red solid line), i.e., the immigration to urban areas is still increasing and sizable, which offsets the negative urban population growth.

Finally, Figure 7 plots the dynamics of China’s total population from 1995 to 2100. The simulated population in the model of this paper is in solid line. The dashed line shows the population projection by United Nation population forecasts. The population projection in this paper rises from 1.20 billion to 1.38 billion until 2030 and then declines to 1.15 billion in 2100. The United Nation projection rises from 1.22 billion to 1.41 billion until 2030 and then declines to 1.0 billion in 2100. Both the simulation and the United Nation projection peak at around 2030 and start to decline. The comparison shows that

\(^{13}\)The number of population aged 60+: as percentage of population in working age (15-60)

\(^{14}\)The urban benchmark (black solid line) line become flat and even starts to decline after 2050
Figure 5: The figure shows the projected old-age dependency ratio, defined as the ratio of population 60+ over population 18-59, for 1995-2100 (solid lines) broken down on urban and rural population. The dashed lines show the corresponding ratios under the zero migration counterfactual (i.e., the natural population dynamics).

Figure 6: The figure shows the projected population dynamics for 1995-2100 (solid lines) broken down by rural and urban population. The dashed lines show the corresponding natural population dynamics (i.e., the counterfactual projection under a zero urban-rural migration scenario).
this demographic model can project a valid population prediction.

4.2 Preferences

A period in the model stands for one year of real-time. The representative agent only has an impact on the economy when she enters the labor market at age $J_W$, which is the retirement age in data in China as described in Section 1, and lives up to age $J = 100$. To focus on the period (1995-2010) studied in this paper, the retirement age before 1995 is set to be 60. In particular, according to the data, the retirement age from 1995 to 1998 is 55, from 1999 to 2004 it is 54 and the retirement age is set to be 53 after 2005. Hence, workers retire after $(J_W = 22)$ years of work. The discount factor is set to $\beta = 1.01286$ to match the average aggregate savings rate in China between 1995-2010 (i.e., 42.8%). The Frisch elasticity of labor supply $\theta$ is set to equal to 0.5, in line with the classical estimation in labor economics (Keane (2011)).

4.3 Labor income

To consistent with the estimated wages of workers with high school education in Ge and Yang (2014), which is the median level of labor income, urban hourly wages are assumed to grow at the rate of 5.7% between 1995 and 2013. From 2013 to 2031, the annual growth for this time interval is set to 4.9%. From 2031 to 2040, the annual growth is set to 3.6%. After 2040, to be in line with wage growth in the United States over the last century, the annual wages grow at 2% per year.
For the human capital variable $\eta_j$, it is matched to the average years of education by cohort according to Barro and Lee (2013) before 1990. We linearly extrapolate $\eta_j$ for cohorts born after 1990 and assume that when the average years of schooling reach the current level for the US (i.e., 12), the growth ceases in the year 2000. Per year of education is assumed to have an annual return of 10%.

We estimate the age-specific productivity $\{\epsilon_j\}_{j=22}$ using the China Health and Nutrition Survey (CHNS) data and the method in Song and Yang (2010) to make it be consistent with the empirical evidence on gross labor earnings for Chinese urban workers. This implies an average annual return to the age-specific experience of 0.5%.

For the initial distribution of workers and retirees’ wealth in 1995, due to the missing survey in 1990 in the China Household Income Project (CHIP) and the limitation of CHIP(1988), we have to and can only set the initial distribution of agents’ wealth in 1990 to be the same as the empirical distribution of financial wealth in 1995 in the CHIP. We simulate the model throughout the 1990-1995 period given the initial wealth distribution in 1990 to endogenously obtain the distribution of private wealth in 1995. To exclude human capital growth, we discount it using an annual wage growth of 5.7%. The distribution of that entrepreneurial wealth is obtained by assuming that all entrepreneurs are endowed with the same initial wealth in 1990.

4.4 Technology

The capital share of output $\alpha$ is set to 0.5, which is in line with the estimate in Bai et al. (2006). The depreciation rate $\delta$ is set to 0.1 such that the annual depreciation rate of capital is 10%.

We set the parameters $\psi = 0.27$ and $\chi = 2.73$ to match the capital-output ratio and the rate of return on capital of high productivity firms as documented by Song et al. (2011), respectively.

We set the initial level of productivity $A_0$ to 9.6% of US’s GDP per capita in 1995. This yields a GDP per capita equal to 20% of the US level in 2010, which is consistent with the data. Between 2000-2013, we set the growth rate of productivity $g_t$ so that the model generates an average labor income growth of 7.5%. After 2013, productivity growth is forecasted by Song et al. (2011) to slow down. Accordingly, from 2013 to 2040 we linearly interpolate $g_t$ to fall to zero. In particular, between 2013 and 2040, China is expected to grow at a rate of 6.5%. In this case, the GDP per capita in China will be 68% of the US level by 2040 and remain stable while growing at the long-run world rate thereafter.

For the rural area, we set $\alpha_r = 0.3$ to match the investment rate in the rural area in 1995 data. The rural wage grows at the rate that can generate the rural-urban wage gap to increase from 1.84 in 2000 to 3.48 in 2040 and stays constant thereafter.
4.5 Financial Sector

The rate of return to capital for the firm is endogenously obtained from the production function. The domestic interest rate is equal to the lending rate and the rate of return on foreign bonds. We set the rate of return of the long-term U.S. Treasury bills to the value of the rate of return on foreign bonds since a major fraction of China’s foreign reserves are invested in the U.S. T-bills.

We set the financial friction parameter $\xi = 0.43$ to match the fact as documented by Song et al. (2011) that the Chinese firms on average have about 50% loan to assets ratio.

4.6 Government and pension system

Along the transition path, the actual data on government saving rate (as % of GDP) and government investment rate (as % of GDP) are used for values of $S_g^t$ and $I_g^t$ in Section 3.5.

In line with the 1995-1997 pension reform in Sin (2005), we assume that pensioners retiring before 1997 continued to earn a $\sigma_1 = 78\%$ replacement rate throughout their retirement. Moreover, those retiring after 1997 are entitled to a $\sigma_2 = 60\%$ replacement rate. In the long-run, i.e., 2030, to balance the pension fund, we set $\sigma_3 = 0.3913$ as documented in Song et al. (2015). The reason is as follows. According to Figure 7, both the UN projection and this paper’s simulation predict a peak of the population at around 2030. Afterward, the population will decline. This will reduce the population who contribute to the pension system and finally ruin the sustainability of the pension system unless the government lowers the pension replacement rate. We assume a constant social security tax equal to 20%, in line with the empirical evidence. The indexation of the average wage is $\nu = 0.6$ according to the pension rule in China.

This paper also takes into account the fact that the current pension system of China only covers a fraction of the urban workers. The coverage rate has grown from 45% in 2001 to 60% in 2011 according to China Statistical Yearbook 2012. Therefore, the pension coverage rate is assumed to be constant at 60%. Those non-covered workers neither pay the social security tax nor do they receive pension incomes.

The initial wealth of government $P_0$ is set to 0.7% of GDP, matching the 43 billion RMB that is the cumulative balance of pension fund for urban workers in 1995 according to the National Statistics Bureau of China.

Table 2 summarizes all parameter values mentioned.
Table 2: Parameters values in the benchmark model

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Value</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta$</td>
<td>Subjective time discount factor</td>
<td>1.01286</td>
<td>Target average savings rate 1995-2010</td>
</tr>
<tr>
<td>$\theta$</td>
<td>Frisch elasticity of labor supply</td>
<td>0.5</td>
<td>Keane (2011)</td>
</tr>
<tr>
<td>$\zeta$</td>
<td>Weight of leisure</td>
<td>1</td>
<td>Galindev (2009)</td>
</tr>
<tr>
<td>$\alpha$</td>
<td>Capital labor elasticity</td>
<td>0.5</td>
<td>Bai et al. (2006)</td>
</tr>
<tr>
<td>$\alpha_r$</td>
<td>Capital labor elasticity (rural)</td>
<td>0.3</td>
<td>Target investment rate (rural) in 1995</td>
</tr>
<tr>
<td>$\delta$</td>
<td>Depreciation rate</td>
<td>0.1</td>
<td>Bai et al. (2006)</td>
</tr>
<tr>
<td>$\psi$</td>
<td>Share of output received by managers</td>
<td>0.27</td>
<td>Song et al. (2011)</td>
</tr>
<tr>
<td>$\chi$</td>
<td>Extra efficiency units per worker</td>
<td>2.73</td>
<td>Song et al. (2011)</td>
</tr>
<tr>
<td>$\xi$</td>
<td>Financial friction parameter</td>
<td>0.43</td>
<td>Imrohoroglu and Zhao (2018)</td>
</tr>
<tr>
<td>$\tau$</td>
<td>Social Security Tax</td>
<td>0.20</td>
<td>Pension Rule in China</td>
</tr>
<tr>
<td>$\sigma_1$</td>
<td>Pension Replacement Rate (&lt;1997)</td>
<td>0.75</td>
<td>Pension Rule in China</td>
</tr>
<tr>
<td>$\sigma_2$</td>
<td>Pension Replacement Rate (1997-2030)</td>
<td>0.60</td>
<td>Pension Rule in China</td>
</tr>
<tr>
<td>$\sigma_3$</td>
<td>Pension Replacement Rate (&gt;2030)</td>
<td>0.3913</td>
<td>Song et al. (2015)</td>
</tr>
<tr>
<td>$\nu$</td>
<td>Indexation of average wage</td>
<td>0.6</td>
<td>Pension Rule in China</td>
</tr>
</tbody>
</table>

5 Quantitative Results

In this section, we first construct a benchmark scenario with workers’ early retirement and pension reform between 1995-1997 to show the validity of this model. Then we consider a set of alternative scenarios to one-by-one analyze the two major mechanisms (i.e., early retirement effect and wealth substitution effect) that cause the current account surplus in China.

5.1 The benchmark result

This section shows the benchmark results including the saving rate, the investment rate, and the current account along the transition path. Before the initial steady state, a pre-transition simulation has been run to derive the initial steady state under the two major following assumptions. First, we assume that before 1990 workers supply 1 unit of labor and consume all the income. Second, before 1980, the wage growth rate was 0; from 1980 to 1995, the wage growth rate is constant and equal to the wage growth rate in 1980.

In 1995, we shock the initial steady state by both imposing the pension reform and the fact that workers choose to retire earlier than the mandatory retirement age. In specific, for the early retirement, being consistent with the data shown in Section 1, the retirement age from 1995 to 1998 is 55, from 1999 to 2004 it is 54 and the retirement age is set to be 53 after 2005 until the end of dynamic. As for the pension reform, the pension replacement rate decreases from 0.78 to 0.60 following the pension rule in
China. We use the actual data on the TFP growth rate, government saving rate and investment rate (as % of GDP), and the rate of return on foreign bonds along the transition path and assume perfect foresight for all these components.

Since this model does not capture the 2008 financial crisis, to avoid the impact of that crisis, we only focus and compare the current account along the transition path generated by the model to the Chinese data between 1995 to 2010 to evaluate whether the model is capable of accounting for the rise and the fall in China’s current account surplus. The model that captures the 2008 financial crisis for a longer comparing period will be further developed.

To target the current account data in the beginning year (i.e., 1995), the actual data of government saving rates and investment rates (% of GDP) are used to calculate the gap between the simulated current account and the actual current account in data in 1995. The first period of the simulated current account is adjusted using the gap. Therefore it is exactly the same as the data in 1995. Then the gap grows by adding the difference between government saving and investment next period along the transition path. Finally, the growing gap in each period will be used to adjust the simulated current account, which is the results shown in Figure 8.

The simulated benchmark economy and the data starting from 1995 are shown in Figure 8. In Panel (a) of Figure (8), the time series path of the current account in the model, especially after the 2000s, tracks the trend and fluctuation in the data reasonably well. In the data, after a hump-shaped change between 1995-2000, the current account surplus increases from 1.7% of GDP in 2000 to 9.9% in 2007 and 9.1% in 2008. After 2008, it starts to decline to reach 6.6% in 2010 (see Table 3). In the benchmark economy, the current account surplus experiences a similar hump-shaped fluctuation between 1995-2000. Then it increases from 2.7% of GDP in 2000 to 8.4% in 2007 and 9.9% in 2008. After 2008, it starts declining and reaches 3.9% of GDP in 2010. Given the model can match the persistent rise in the current account in the 2000s well, we have to admit that, it over-predicts the current account surpluses from 1995-2000.

Panels (b) and (c) of Figure 8 show the aggregate saving and investment rates simulated by the model and the data. Since in the calibration we set the time discount factor $\beta$ to target the average saving rates between 1995-2010 rather than the saving rate in the initial year, it is fair to claim that the model can track the time path of China’s aggregate saving and investment rates reasonably well. In particular, it captures the general increasing trends in the two rates between 2000-2008. In the data, the aggregate saving rate increases from 36% to 52% between 2000 and 2008. During the same period, the investment rate increases from 33% to 54%. In the simulated model, we can observe that the rate of change of aggregate saving rate is increasing while the rate of change in the investment rate is decreasing during this period. This results in an increase in the current account balance, which again confirm the trend in panel (a).
5.2 Counterfactual and sensitivity analysis

This section explores the main reasons that drive the current account balance up in China. The findings support that the increase in the current account balance up to 2008 is a result of the increase in the household saving rate and the financial constraints facing the entrepreneurs. In addition, the rise in the aggregate saving rates is jointly driven by the early retirement and pension reform in China in the 1990s. In particular, the younger actual retirement age than the mandatory retirement age and the reduced pension income due to the pension reform jointly led to the increase in the household saving rate especially after 2000 as the actual retirement age become younger and younger\footnote{Recalling that we follow the actual data of retirement age and set the retirement age in the model to be 55 from 1995-1998, 54 from 1999-2004 and 53 since 2005.}.

\begin{table}[h]
\centering
\begin{tabular}{lcccccc}
\hline
\hline
Current Account (% of GDP) & & & & & & \\
Benchmark model & 0.22 & 2.73 & 3.67 & 8.39 & 9.95 & 3.90 \\
Data & 0.22 & 1.69 & 3.52 & 9.94 & 9.14 & 6.63 \\
\hline
\end{tabular}
\caption{Current Account, Saving, Investment Along the Transition Path}
\end{table}

Figure 8: Current Account, Saving and Investment Along the Transition Path (Baseline)
the financial friction that stops the increased household saving being invested in domestic firms, the rise in the saving rate finally results in large and increasing current account surpluses up to 2008.

5.2.1 Counterfactual 1: Early Retirement + No Pension Reform

To examine the impact of the 1990s pension reform on the current account, we simulate a counterfactual scenario in which the 1990s pension reform is never implemented. In particular, this means that the pension replacement rate is 0.76 from the beginning to 2040. Figure 9 shows the results of this experiment. Consistent with our "wealth substitution effect" mechanism, i.e., the pension income can substitute for the savings that are prepared for the retirement period, the current account balance is substantially lower during the entire period and the rise in the current account surplus after 2000 is much smaller in this counterfactual economy. This is largely due to the decline in the saving rate as a result of the increased pension income that is caused by the increased pension replacement rate from 0.60 to 0.78 between 1997-2040 compared with the case in the benchmark model. For the investment side, this channel does not have the same impact on the investment behavior of the firms, consequently giving rise to similar investment rates in the benchmark model as shown in panel (c) of Figure 8 and the “Early+No Reform Model”.

![Figure 9: Current Account, Saving and Investment Along the Transition Path (Early+No Reform)](image-url)
5.2.2 Counterfactual 2: No Early Retirement + Pension Reform

To examine the impact of the early retirement on the current account, we simulate a counterfactual scenario in which the early retirement never happens. In particular, this means that the actual average retirement age is just exactly the same as the male mandatory retirement age, i.e., 60. Figure 10 shows the results of this experiment. Consistent with our "early retirement effect" mechanism, i.e., people will save more in order to cover a longer period over which the accumulated asset will be spread if they retire earlier, the current account balance is substantially lower during the entire period and the rise in the current account surplus after 2000 is much smaller in this counterfactual economy. This is largely due to the decline in the saving rate as a result of no need to save more to cover the longer retirement periods in the benchmark scenario with early retirement (panel (b) of Figure 8). Furthermore, when we compare the current account and the saving rate in this scenario with panel (a) and panel (b) of Figure 8, the “No Early+Reform Model” case drives down more current account and saving rate than the “Early+No Reform Model” case. In panel (a) and panel (b) of Figure 9, the lowest point of current account and saving rate are equal to -9% and 22% in 2001, respectively. However, in panel (a) and panel (b) of Figure 10, the lowest point of current account and saving rate are equal to -4% and 38% in 2001, respectively. Both the saving rate and current account are obviously smaller in Counterfactual 2 than in Counterfactual 1. This means that the "early retirement effect" has a stronger positive effect on saving rate thus on current account than the "wealth substitution effect" has. Again, this channel does not have the same impact on the investment behavior of the firms, consequently giving rise to similar investment rates in the benchmark model as shown in panel (c) of Figure 8 and the “No Early+Reform Model”.

5.2.3 Counterfactual 3: No Early Retirement + No Pension Reform

To examine the joint impact of the 1990s pension reform on the current account, we simulate a counterfactual scenario in which the early retirement never happens and the pension reform is never implemented. In particular, this means that the pension replacement rate is 0.76 from the beginning to 2040 and the actual average retirement age is just exactly the same as the male mandatory retirement age, i.e., 60. Figure 11 shows the results of this experiment. Consistent with our "wealth substitution effect" and "wealth substitution effect" mechanisms, the current account balance is the lowest in all scenarios during the entire period and the rise in the current account surplus after 2000 is much smaller in this counterfactual economy. This is largely due to the decline in the saving rate as a result of the shorter retirement periods and the increased pension income comparing with panel (b) of Figure 8. Finally, this channel does not have the same impact on the investment behavior of the firms, consequently giving rise to similar investment rates in the benchmark model as shown in panel (c) of Figure 8 and the “No Early+No Reform Model”.
Figure 10: Current Account, Saving and Investment Along the Transition Path (No Early+Reform)
Figure 11: Current Account, Saving and Investment Along the Transition Path (Early+No Reform)
6 Conclusion

The persistent long-run current account surplus and high saving rates in China have attracted the sight of scholars for the past 20 years. However, very few pay attention to the prospect of the fact that workers are actually retiring earlier than the mandatory retirement age and its interaction with the pension system. In this paper, we analyze the positive and dominant effects of early retirement and its interaction with the pension system with the aid of a dynamic model calibrated to China.

A number of existing studies more or less explore the relationship between the pension system reform and saving rates, current account in China (see, e.g., Song et al. (2015), and He et al. (2019), İmrohoroğlu and Zhao (2018)). Our analysis concurs with their view that the pension reform in the 1990s does have an impact on the saving rates and even current account in China. We step further to explore a new channel that is the early retirement effect: it would increase the saving rates due to people save more to cover the longer periods over which the accumulated asset will be spread. In a society suffers financial friction (i.e., the borrowing constraint to loan in banks) like China, this high saving and restricted domestic investment would imply a current account surplus. Furthermore, the fact reflected in the data that people are retiring earlier for the past 20 years drives the saving rates increasing, which results in a growing current account surplus. That could be one of the necessary reason that China government is gradually postponing the female mandatory retirement age from 50 to 55 and finally to 60 as the same as the males.

The results are subject to some caveats. First, the fact that early retirement has a positive impact on the saving rates and current account surplus in China. The earlier and earlier average retirement age is one of the major reason that causes the growing current account surplus for the past 20 years. Nevertheless, we do not allow the agent to retire endogenously while we just use the average retirement age in the data. On the contrary to the restriction of integer retirement age in this model, the average retirement age is non-integer in the data. The difference would cause estimation bias. In the future version of this paper, the model will be extended into a model with endogenous retirement decision. Second, the 1990s pension reform has a positive impact on the saving rates and current account. However, we do not follow the pension rule in China before and after the reform with 100% accuracy. We just follow Song et al. (2015) and İmrohoroğlu and Zhao (2018). We do not model the subsequent series of pension reform (e.g., the 2005 pension reform) in this paper. In the future version of this paper, these two points will be considered into the model. Finally, we compare the two channels in this paper and find that the early retirement effect has a larger impact on the saving rates and current account than the 1990s pension reform has. Similar to Song et al. (2015), we abstract from the crowding-out effect of public pensions on within-family old-age care, consider neither idiosyncratic nor inter-generational risk. We believe that extending the analysis in these directions would not overturn our main insights.
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