The Impact of the 'One-Child Policy' on China's Aggregate Household Savings – An Econometric Analysis

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The purpose of this dissertation is to explore the impact of the One-Child Policy on China's aggregate household savings. There are four proxies for the One-Child Policy: the total fertility rate, annual population growth rate, age structure, and gender ratio. The purpose of this dissertation thus has been achieved by investigating the statistical relationships between these four demographic factors and China's aggregate household savings, in light of the theory of Life-Cycle Saving. An ordinary least squares regression model has been conducted based on the cross-sectional annual data from the National Bureau of Statistics of China and the World Bank for the period of 1980-2012. The results of multiple regressions illustrate that the One-Child Policy has a statistically significant relationship with China's aggregate household savings.

1. Introduction

China's One-Child Policy (OCP) is unique in the history of the world (Choukhmane *et al*., 2014; Greenhalgh, 2008). Before the implementation of the OCP from the 1950s through the 1960s, the total fertility rate (TFR) in Mainland China was approximately 6 children born per woman (The World Bank, 2015). Since the enforcement of the OCP by the Chinese government in 1980 (Greenhalgh, 2008), the TFR in China has continually declined to roughly 1.66 children per woman of childbearing age in 2012 (The World Bank, 2015). Additionally, during the same time period, China's aggregate household savings (CAHS) has experienced an opposite tendency and by 2012 it achieved approximately 39,955.1 billion Chinese Yuan (CNY), an amount that was almost 1,000 times the level before employing the OCP (NBSC, 2013a, citied in the People's Bank of China, 2013, p. 1). Thus, the phenomenon that the rising CAHS coincides with the time, in which the OCP was implemented, forms the main motivation of this dissertation. This topic is important for Chinese policy makers in order to understand the role of demographic policy, such as the OCP, in planning for the mobilisation of CAHS and the formulation of other relevant economic policies.

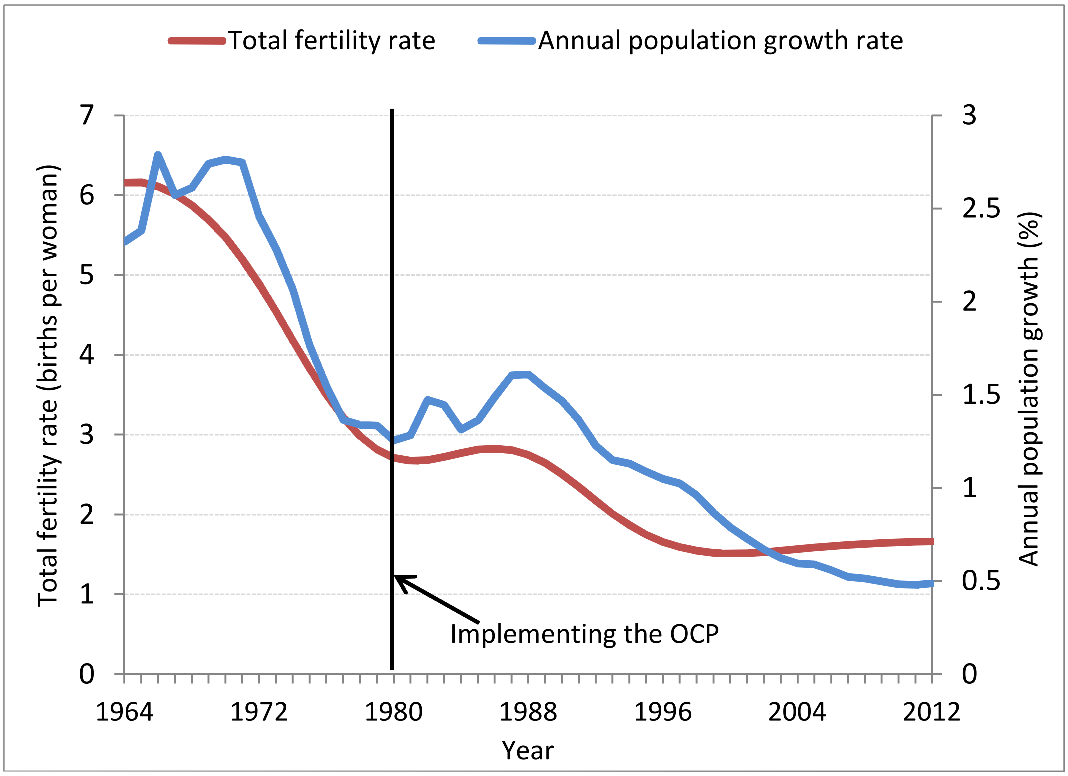
The dissertation aims to conduct a multiple regression analysis of a cross-sectional study in investigating the potential relationship between the OCP and CAHS - examining the effects of the OCP-related variables on CAHS. The term CAHS in this dissertation is measured as the aggregate balance of deposits of Chinese households in banks and other financial institutions (NBSC, 2013a). In order to achieve the purpose of this study, there are four objectives that will be explored. The first objective is to present China's demographic characteristics and the stylised facts of CAHS. Secondly, the existing literature resources on this topic will be discussed to identify the applicable theory of Life-Cycle Saving (LCS) and to help determine the likely variables for the regression models in this dissertation. Based on these pieces of information, the third objective is to set up my hypotheses and then develop an empirical investigation.

The rest of the dissertation is organised as follows. Section 2 provides background information on the evolution of the OCP and its accompanying impacts on the Chinese population, as well as the development of CAHS. Section 3 critically discusses the existing literature concerning the impact of the OCP on CAHS, from both theoretical and empirical perspectives. Section 4 provides a framework for the empirical investigation, which encompasses the methodology, results, discussion and limitations. Additionally, the methodology section involves eleven stages. The first stage simply introduces the annual data from the National Bureau of Statistics of China (NBSC) and the World Bank between 1980 and 2012. The second stage discusses the initial variables that are suggested by the former literature. In the third stage, scatterplots are used to inspect whether a data pattern is linear or nonlinear, aiming to select an appropriate functional form. The next two stages identify the variables and the model applied in this study, respectively. Their validity will be verified by a set of tests, which are included in the remaining stages. Along with relevant theories and literature, the empirical results indicate that the OCP-related variables are jointly significantly in estimating the impact of the OCP on CAHS. The final section highlights limitations and areas for improvement in further studies. The final chapter concludes that the OCP has detectable effects on CAHS.

2. Background

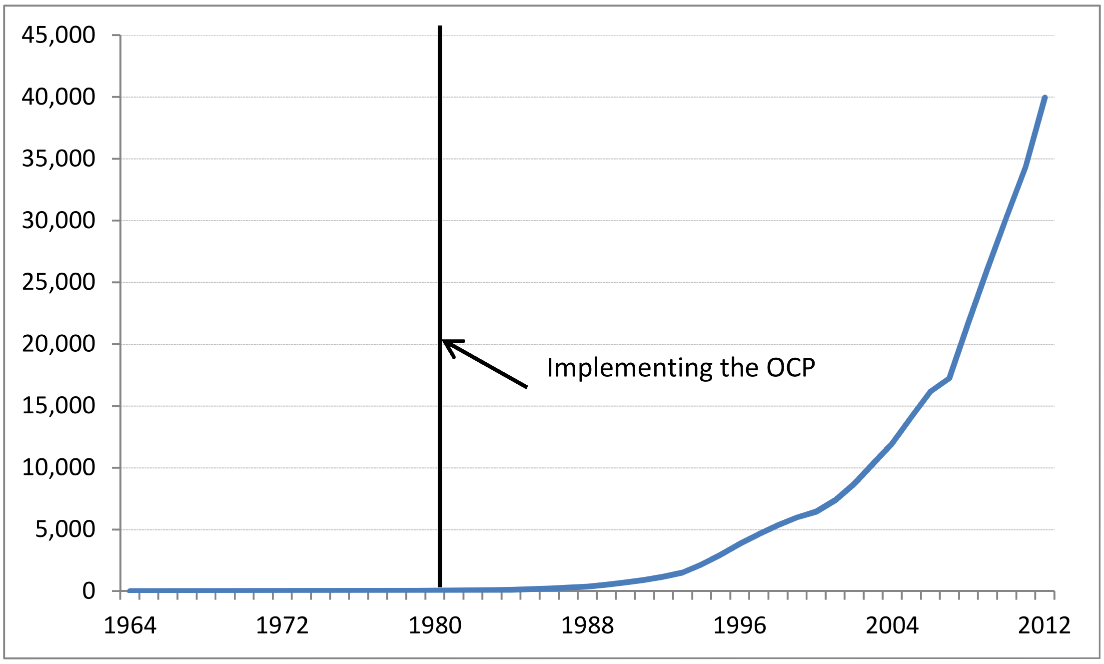
This chapter represents the evolution of the OCP and the corresponding demographic transformation, which is accompanied by the changes in CAHS. Figure 1 demonstrates the trends of the TFR and the annual population growth rate (APGR) in China from 1964 to 2012. Figure 2 displays the growth of CAHS during the same period.

Figure 1: **The Total Fertility Rate and the Annual Population Growth Rate in China, 1964-2012**



Source(s): based on the World Bank, 2015, p.1; 2013, p.1.

Figure 2: **Aggregate Household Savings in China, 1964-2012**



Source(s): NSBC, 2013a, cited in the People's Bank of China 2013, p. 1.

2.1. Prior to the Implementing the OCP (1949-1979)

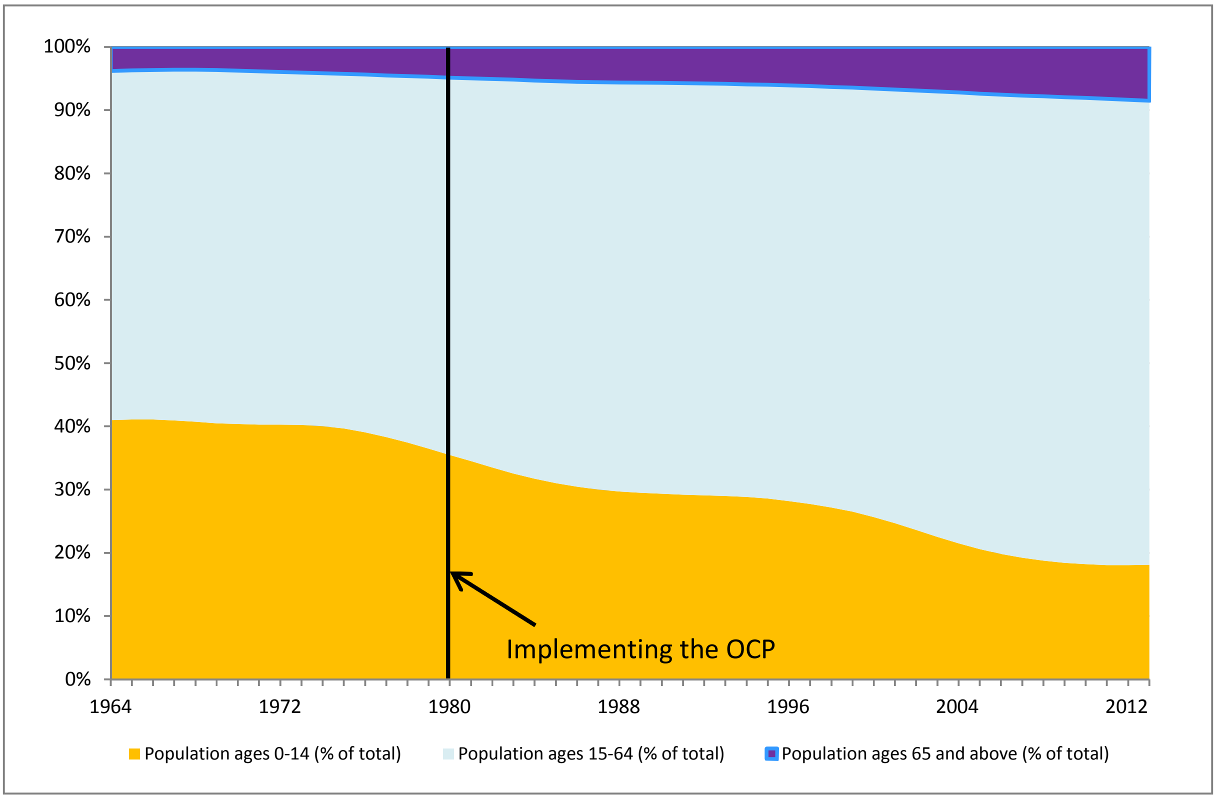
Since the establishment of the People's Republic of China in 1949, the first Chairman, Mao Zedong, encouraged Chinese people to have more children in order to accumulate more human labour (Greenhalgh, 2008). As a result, China's population has dramatically increased from approximately 5.4 billion in 1949 to 8 billion in 1969 (NBSC, 2013b), with an average of 6 children per family (The World Bank, 2015). China accounted for roughly 20 per cent of the world population by the end of 1969 (The World Bank, 2014b); however, it only covered 7.2 percent of the world's landmass by the end of 1969 (The World Bank, 2014a). This can be argued as unsustainable because the population could grow beyond the resources of the country (Greenhalgh, 2008). Hence, in the 1970s, the Chinese government has tried to control Chinese population by the less mandatory approach, such as family planning. It had advocated each family to have later and fewer children (Greenhalgh, 2008). China's TFR had thus declined from 5.5 births in 1970 to 2.8 births per woman in 1979, approximately (see Figure 1) (The World Bank, 2015). Additionally, the APGR in China dramatically reduced to only 1.3 per cent by 1979 (The World Bank, 2013). Under these conditions, China's second-generation leader Deng Xiaoping believed that forcibly restricting Chinese population growth would benefit greater economic prosperity and social development (Potts, 2006). Therefore, the OCP was announced in the late 1979 and formally instituted nationwide by the Central Committee of the Chinese Communist Party on September 1980 (Greenhalgh, 2008). Moreover, CAHS maintained at the relatively low level from 1949 to 1979 (see Figure 2), grew at a rate of 15 per cent annually (NBSC, 2013a, cited in the People's Bank of China, 2013, p. 1).

2.2. After the Introduction of the OCP (1980-2012)

The OCP is a population control policy that aims to alleviate social, economic and environmental consequences of overpopulation (Kane and Choi, 1999). The policy stipulated that Chinese couples of childbearing-age could only have one child, which applied to the majority of the ethnic Han Chinese (Greenhalgh, 2008). According to the 2010 Chinese Census, Han Chinese accounts for 91.5 percent of the total population in Mainland China (Howden and Zhou, 2014). The OCP has been more strictly enforced in urban areas than in rural areas. Rural couples were allowed to have two children if their first-born child was female (Greenhalgh, 2008).

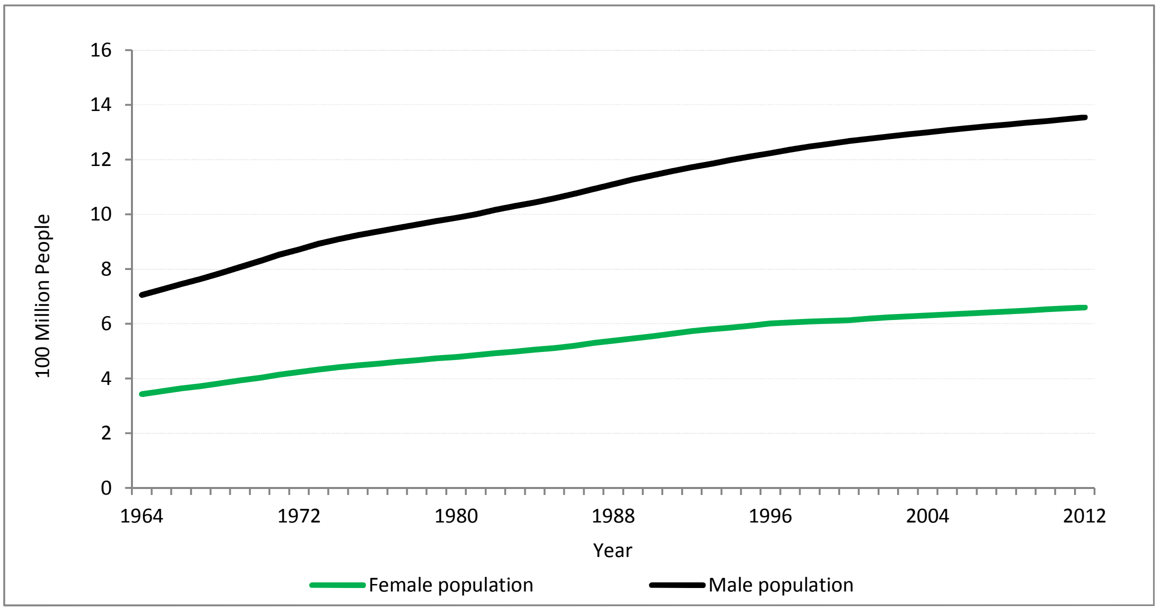
There are four potential demographic impacts induced by the OCP. Firstly, the TFR decreased to an average of 1.66 births per woman in 2012 (The World Bank, 2015) and it was below the replacement fertility rate of roughly 2.1 births per woman (Gu and Li, 2010). In addition, the APGR dropped to only roughly 0.487 per cent by 2012 (see Figure 1) (The World Bank, 2013). These changes had significantly accelerated China's age structural transitions (Gu and Li, 2010). As can be seen from Figure 3, the proportion of the Chinese population that is aged 0-14 was gradually reduced by roughly 17.4 per cent from 1980 to 2012 (The World Bank, 2014c). The percentage of this age group in 2012 was twofold below the value in the year before introducing the OCP (The World Bank, 2014c). Additionally, the shares of both age groups of 15 to 64, 65 and over age have increased by more than 13 and 3.5 per cent, respectively (The World Bank, 2014d; 2014e). The final demographic effect refers to the imbalanced gender ratio, which has become skewed toward males in China after enforcing the OCP (see Figure 4) (NBSC, 2013b; Li *et al*., 2011). When the majority of Han Chinese families was strictly restricted to have one child, male children have been preferred and female children have become highly undesirable in traditional China's context (Li *et al*., 2011). This thus had led to an increase in abortions of female foetuses, particularly in China's rural areas. Furthermore, returning to Figure 2, CAHS has experienced a significant growth of 44720.58 billion CNY in the OCP period from 1980 to 2012. This increase was much larger than in the 17-year period between 1962 and 1979 when CAHS increased by 24.96 billion CNY (NBSC, 2013a, cited in the People's Bank of China, 2013, p. 1).

Figure 3: **Chinese Population by broad Age Groups (1964-2012)**



Sources: based on the World Bank, 2014c, p.1; 2014d, p.1; 2014e, p.1

Figure 4: **Stacked Line Chart of Comparing Male and Female Population in China (1964-2012)**



Source(s): based on NSBC, 2013b, p. 1.

2.3. The Easing of the OCP (2013-Present)

Chinese officials announced the aforementioned four demographic problems have been largely caused by the OCP (The Economist, 2013). In response to this, on March 2013, the Chinese government decided to slightly ease the OCP to a 'two child policy' in many Chinese urban districts. The new policy has adjusted the OCP by transforming from one child to two children, so long as either of the parents is an only child (The Economist, 2013). The relevant data and information of the new policy have not been released, so that its effects on China's demographic problems and CAHS need to be further investigated.

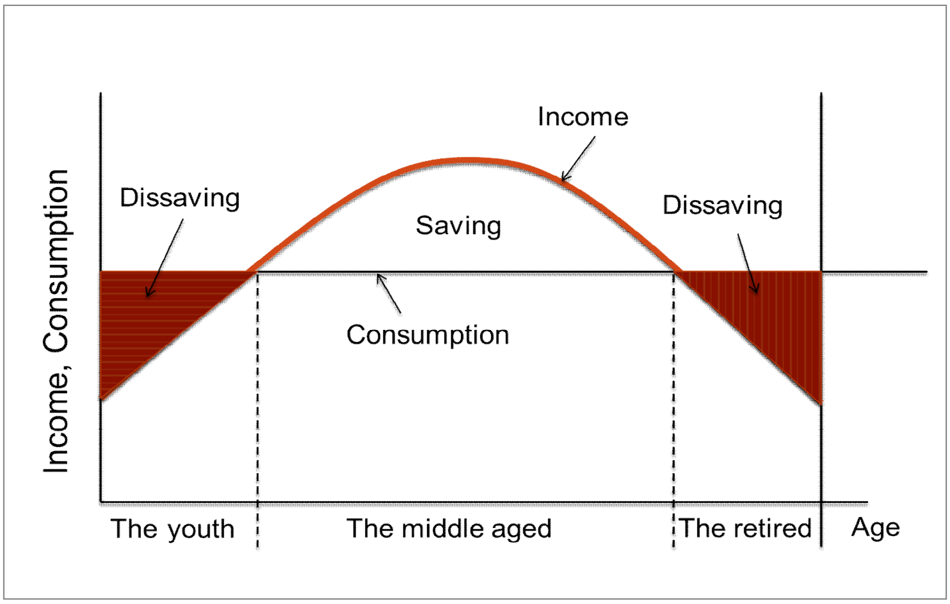
3. Literature Review

The existing academic literature that investigates the relationship between the OCP and CAHS is relatively scarce. These studies are limited because they examine this question by isolating each potential demographic impacts engendered by the OCP. However, these studies have helped accentuate applicable theories and identified four key factors to be the indicators of the OCP. Therefore, this can be advantageous to the empirical analysis in this dissertation. The four factors are: changes in the TFR (Horioka and Wan, 2007; Modigliani and Cao, 2004), the declining annual population growth (Fan and Zhu, 2012; Ito and Rose, 2010; Horioka and Wan, 2007; Cook, 2006), age structure transition (Choukhmane *et al.*, 2014; Zhu *et al.*, 2014) and imbalanced gender ratio (Bulte *et al.*, 2011; Li *et al.*, 2011; Ebenstein, 2010; Zhu *et al.*, 2009; Wei and Zhang, 2008; Zeng *et al.*, 1993).

According to the relevant literature, the theory that underpins the topic of this dissertation is Life-Cycle Saving (LCS), which is commonly used to describe people's overall saving behaviour (Modigliani, 1986; Ando and Modigliani, 1963). There are two main assumptions behind the theory. Firstly, there is a relatively smoother consumption pattern over people's entire life spans (see Figure 5) (Modigliani and Cao, 2004). Secondly, people's lifetime income is likely to differ systematically, following a hump-shaped pattern. Specifically, the entire lifetime can be divided into three periods: the youth (children), the middle-aged (parents) and the old-aged (retired) (Modigliani and Cao, 2004; Ando and Modigliani, 1963). Children are expected to be dissaving in their first period, they will rely on their parents' supports, including childcare costs and education investments (Ando and Modigliani, 1963). In return, children would offer part of their future wage income to their parents' retirement consumptions when they enter the workforce in the next period. It assumed that only the middle-aged people would work for wage incomes and be responsible for their children's subsistence consumptions, educational investments and their parents' retirement consumptions

(Modigliani and Cao, 2004). They would also accumulate more capital to ensure their own retirement consumption (Ando and Modigliani, 1963). In the final period, the retired people's incomes fall and they would negatively contribute to aggregate savings (Horioka and Wan, 2007; Modigliani and Cao, 2004).

Figure 5: **A Life-Cycle Saving Model**



Source(s): based on Modigliani and Cao, 2004; Ando and Modigliani, 1963.

First of all, Becker and his associates (Blake, 1989; 1981; Becker and Tomes, 1976; Becker and Lewis, 1973) develop the theory that there would be a quantity-quality trade-off of children within a family given the fertility restriction. Many other scholars verify that this theory can be used to partly explain CAHS given the OCP (Choukhmane *et al*., 2014; Zhu *et al*., 2014; Angrist *et al*., 2005; Ginther and Pollak, 2003; Behrman *et al*., 1994). This result is also consistent with Rosenzweig and Zhang (2009) and Li *et al*. (2008). Additionally, they utilised the Chinese Census and discovered a negative correlation between the TFR and expenditure on the education of children. This encourages families to save more (Li *et al*., 2008). However, Ahn *et al*. (1994) and Blake (1981) have not come to the same conclusion. This is because they simply regard the TFR as an exogenous variable and ignore the fact that children's development is also affected by their parents (Choukhmane *et al*., 2014; Zhu *et al*., 2014; Rosenzweig and Zhang, 2009).

Turning to the factor of APGR, Cook (2006) argues that population growth would increase the proportion of the working-age population in society, which is positively related to the aggregate household savings and vice versa. Moreover, it is widely recognised that the decreased APGR in

China has always been associated with the changes in age structure of the population (Ito and Rose, 2010). In an analysis of the effects of the age structure transition on CAHS, Cook (2006) reinforces the view that household's propensity to save depends on people within an age group number of each age groups. Following the theory of LCS, savings generated by the middle-aged people are more than the dissavings generated by the youth and the elderly (Cook, 2006). However, his argument has not been assessed by quantitative methods.

In China's context, the measurements of the age structure employed in most studies are the proportion of three age groups (0-14 years, 15-64 years, 65 years and over) (Choukhmane *et al*., 2014; Zhu *et al*., 2014; Liao, 2013; Ma and Yi, 2010). Nevertheless, based on the dynamic panel data between 1995 and 2004 from China's household survey, Horioka and Wan (2007) maintain that there is no significant impact of the demographic composition on CAHS. This argument can be critiqued as inconclusive, as they chose an incomplete time period of 1995-2004. As a result, this would affect statistical significance of estimators. In the meantime, the problem of multicollinearity occurred when putting the young and the elderly aged dependency ratios in the same regression. Therefore, the accuracy of estimation and prediction proposed by Horioka and Wan (2007) is questionable.

Moreover, based on the general equilibrium overlapping generations model, China's Census databases, as well as China Health and Retirement Longitudinal Study, Choukhmane *et al*. (2014) and Zhu *et al*. (2014) conclude that the reduction in overall expenditures owing to fewer young people (ages 0-14) has contributed to higher CAHS. However, Zhu (2011), Kelley and Schmidt (1995) and Weil (1994) explain this from a different perspective. The decline in the young population would have the consequence of a fall in the middle-aged people. This, however, would be negatively related to aggregate household savings (Zhu, 2011; Kelley and Schmidt, 1995; Weil, 1994).

Additionally, there are statistically significant results suggesting that the middle-aged population in China is motivated to accumulate more physical and human capital in order to be responsible for their next generation and their retired parents (Choukhmane *et al*., 2014; Zhu *et al*., 2014; Banerjee *et al*., 2010; Wang, 2009). As for the elderly population in China, Zhu *et al*. (2014), Modigliani and Cao (2004) and Kraay (2000) state that they tend to save more with a lower fertility rate. The result is also supported by Ito and Rose (2010), who concluded that private savings of the elderly people in China are largely from public pensions and family's financial support and both also positively contributed to CAHS. What is more, there is another interpretation that the elderly would accumulate more financial wealth in expectation of lower support from their children, given the fertility restriction. In other words, a rise in the elderly population can have the effect to cause aggregate savings increasing, not decreasing (Choukhmane *et al*., 2014; Zhu *et al*., 2014; Wang, 2009).

Finally, the male-biased sex ratio in China has partially resulted from male preference and gender-selection technologies, which was mainly attributed to the enforcement of the OCP in 1980 (Bulte *et al*., 2011; Li *et al*., 2011; Ebenstein, 2010; Zhu *et al*., 2009; Zeng *et al*., 1993). Li *et al*. (2011) make use of the 1990, 2000, and 2005 Chinese Census data and a difference-in-difference estimator to predict that the OCP has led to 7.0 extra males per 100 females. Bulte *et al*. (2011) and Wei and Zhang (2009) conclude that the imbalanced sex ratio in China could account for approximately half of the actual increase in CAHS between 1990 and 2007. Their findings were authenticated based on Chinese regional and household-level survey data. As they explained, Chinese households with a son tend to increase their savings in order to improve their son's competitiveness in marriage markets. In addition to that, households with a daughter in both urban and rural areas do not reduce their savings, probably because their parents attempt to improve their daughter's bargaining power after marriage. This is held in studies by Li *et al*. (2011) and Wei and Zhang (2008) who conclude that the male-biased sex ratio in China has a statistically significant positive impact on CAHS. By the way of comparing savings survey data in households with sons versus those with daughters, their results illustrate that households with sons tend to increase their savings more than households with daughters on average, and this becomes more apparent where households in a region with a more skewed sex ratio (Li *et al*., 2011; Wei and Zhang, 2011; 2008).

On the contrary, other empirical studies suggest that aggregate household savings would decline in response to a male-biased sex ratio (Griskevicius *et al*., 2012; Weir *et al*., 2011; Kvarnemo and Anhesjo, 1996; Taylor and Bulmer, 1980). Due to the increasing intensity of the competition between the same-sex, men would be motived to increase their consumptions during their courtship in order to signal their attractiveness. As a consequence, aggregate household savings would decline. Nonetheless, this finding has not been verified in the case of China given the OCP.

Therefore, this study will aim to explore whether there is empirical evidence to show that the introduction of the OCP can affect CAHS, in light of the theory of LCS. Furthermore, the empirical model in this dissertation will only measure the impacts of the four factors (the proxies for the OCP) on CAHS. Importantly, there are three main research gaps derived from the aforementioned literature, which will be improved in this dissertation. Firstly, there are no studies examining the impact of the OCP on CAHS – grouping together the OCP-related factors to simultaneously assess their impacts on CAHS. Secondly, there will be a larger sample size. Using a 33-year period (1980–2012) allows an appropriate length of time for the evaluation of the policy effect: the OCP has been carried out from 1980 to 2012. The third contribution is to use the number of male population as the indicator of the male-biased gender ratio, in order to avoid the problem of collinearity in the later empirical analysis.

4. Empirical Investigation

4.1. Methodology

The empirical strategy in this dissertation is to conduct an econometric study with multiple regressions based on the cross-sectional data. Moreover, the coefficients of these regressions will be estimated using ordinary least squares (OLS) methods. There are three reasons for choosing this methodology. Firstly, an econometric study is a quantitative analysis of an actual economic phenomenon based on theories and observations (Stock and Watson, 2012). Secondly, multiple regression analysis allows investigating the joint effect of all targeted explanatory variables on the dependent variable, which is more informative in predicting the impact of the OCP on CAHS. Thirdly, the purpose of a cross-sectional study is to investigate the relationships between interest variables and this is in accord with the title of this dissertation (Stock and Watson, 2012). The following eleven stages will be explored to help generate more valid empirical results.

4.1.1. The Data

The annual data used in this study are derived from the National Bureau of Statistics of China (NBSC) and the World Bank throughout the time period 1980-2012. The set of data can be classified into the cross-sectional data, since it consists of multiple entities observed at a particular time period (Stock and Watson, 2012). The annual data on China's aggregate household savings, the percentage of Chinese population that is male, as well as China's total enrollment in the higher education are extracted from the NBSC. Moreover, China's TFR, annual population growth rate, the Chinese population aged between 0-14, 15-64, 65 and over are taken from the World Bank database. The data employed are contained in the appendices.

It is also important that the data for the years of 1982, 1990, 2000 and 2010 from the NBSC are the Census year estimates. Except that, other data sets from the NBSC are estimates from the annual national sample survey conducted by the Department of Population and Employment Statistics (NBSC, 2013b). Compared with other informal survey data, the Chinese official data seems to be more representative and reliable. The data from the NBSC are inconsistent with the data published in the World Bank. This, according to Stock and Watson (2012), would not introduce bias in the further empirical analysis, because the data are missing on the value of variables. Overall, it can be suggested that both data sources have relatively higher levels of accessibility and usability.

4.1.2. Initial Variables

A core set of initial variables has been selected on the basis of theoretical reasoning and suggestions from the literature reviews. The dependent variable is CAHS. Additionally, there are four independent variables, which are the TFR, annual population growth, demographic structure and gender ratio (Choukhmane *et al.*, 2014; Zhu *et al.*, 2014; Li *et al.*, 2011; Ebenstein, 2010; Wei and Zhang, 2011; 2008; Zeng *et al.*, 1993). Both the dependent and independent variables are measured at the continuous level. In this dissertation, the demographic structure factor is represented by three different age categories that are 0-14, 15-64 and over 64 years old (Choukhmane *et al.*, 2014; Zhu *et al.*, 2014; Liao, 2013). The number of male population is the proxy for the male-skewed sex ratio. Table 1 demonstrates the symbols and measure unit of all initial variables. Notably, an education variable (substituted by the total enrolment in the higher education) highlighted in the literature is also included in the regression analysis, because it can help the further discussion.

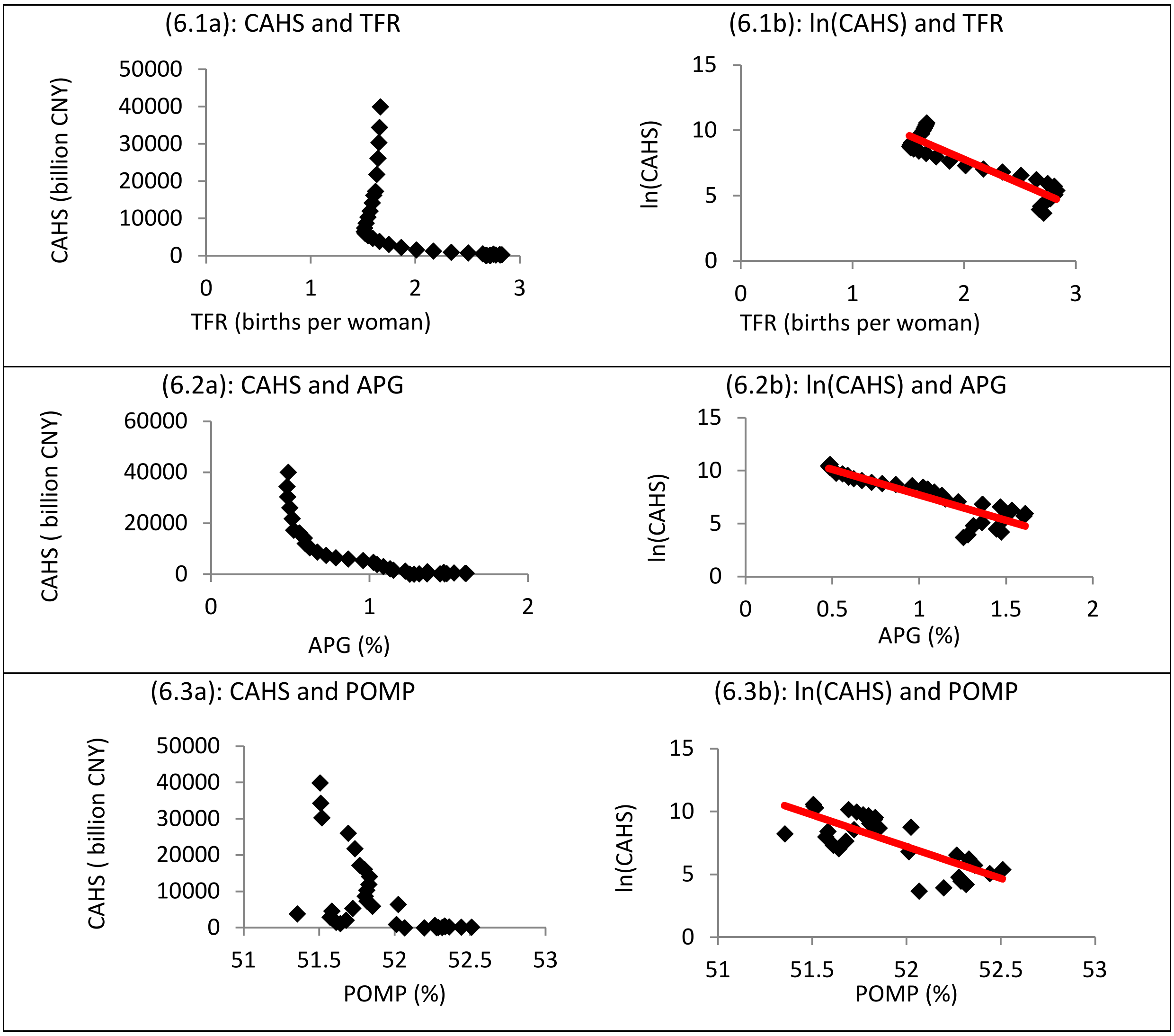
Table 1: **Summary of Initial Variables**

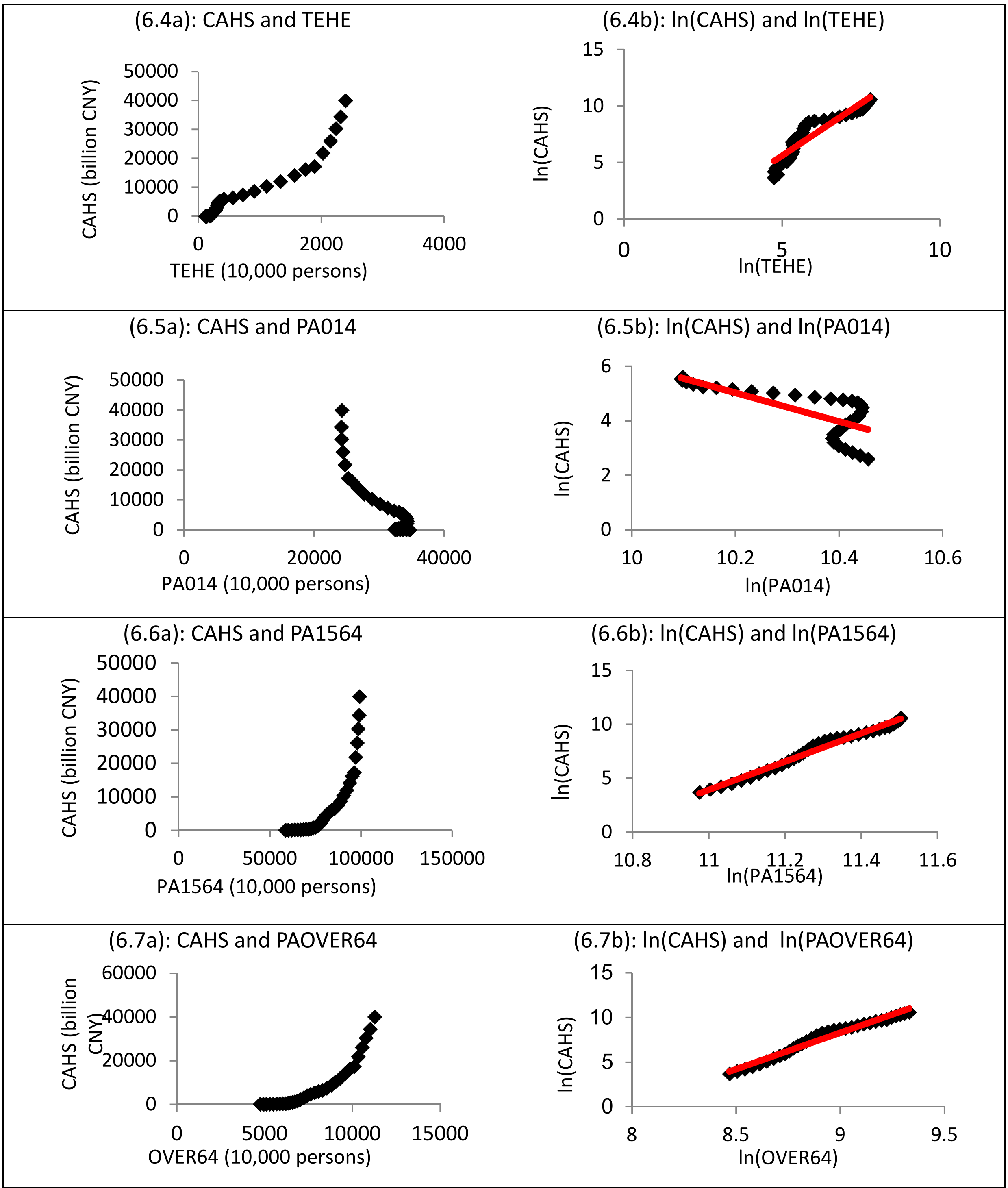
Initial Variables	**Symbols**	**Unit of Measurement**
China's aggregate household savings	CAHS	Billion Chinese Yuan
Total fertility rate	TFR	Births per woman
Annual population growth	APG	Percentage
The percentage of male population	POMP	Percentage
Population aged 0 to 14	PA014	10,000 Persons
Population aged 15 to 64	PA1564	10,000 Persons
Population aged 65 and above	PAOVER64	10,000 Persons
The total enrolment in the higher education	TEHE	10,000 Persons

4.1.3. Function Form Specification

Before setting up an estimated regression model, it is helpful to examine a scatter plot of the data in order to visually see, which regression function is most likely going to be a good fit in this dissertation. According to Stock and Watson (2012), if the relationship between the independent and dependent variables in scatterplots is non-linear, the general strategies are modifying the data and modeling nonlinear functions. In Figure 6, the scatterplots on the left side indicate linear-linear functions, and the log-transformed scatterplots are displayed on the right side. It can be seen that the right-side figures provide a better fit to the data and have approximately linear patterns. Thus, using logarithmic functions can make correlations between the independent and dependent variables more interpretable, based on a percentage basis. Apart from that, there are two additional advantages of using logarithmic functions. The first is that they do not have to be concerned about the units of measurement (Stock and Watson, 2012). Secondly, they can be a remedy for skewed data due to the presence of outliers (see Figure 6).

Figure 6: **Scatterplots of Linearity between the Dependent Variable and Each of the Independent Variables**





Source(s): scatterplots drew based on the data collected from NBSC, 2013a; 2013b; 2013c and the World Bank, 2013; 2014b; 2014c; 2014d; 2014e; 2015.

4.1.4. Variable Identification

Having selected relatively appropriate regression functions, the new variables used in the regression model in this dissertation will be presented in this section. The interpretations of all new variables are in Table 2.

Table 2: **Summary of Key Variables**

Variables	**Symbols**	**Unit of Measurement**
Dependent variable		
The logarithm of China's aggregate household savings	ln(CAHS)	-
Independent variables		
Total fertility rate	TFR	Births per woman
Annual population growth	APG	Percentage
The percentage of male population	POMP	Percentage
The logarithm of population aged 0 to 14	ln(PA014)	-
The logarithm of population aged 15 to 64	ln(PA1564)	-
The logarithm of population aged 65 and above	ln(PAOVER64)	-
The logarithm of the total enrolment in the higher education	ln(TEHE)	-

Additionally, Table 3 illustrates the descriptive statistics of these variables, including mean, standard deviation (SD) and extremum. The mean value is used to describe central tendency of the data set (Stock and Watson, 2012). The SD measures the dispersion in the distribution of a variable (Stock and Watson, 2012). For example, the SD of POMP is close to 0, which indicates that the data points tend to be very close to the mean of the set. While the variable POP014 has a relatively higher SD with approximately 5.27, implying the data set has more variability than expected. Thus, the measure of SD could be a useful estimate in the further analysis. The range of variables is indicated by the minimum and maximum (Stock and Watson, 2012).

Table 3: **Summary of Descriptive Statistics**

Variables	**Observations**	**Mean**	**Standard Deviation**	**Minimum**	**Maximum**
ln(CAHS)	33	9.96626	2.112902	5.980909	12.8981
TFR	33	2.031727	0.5260668	1.51	2.826
APG	33	1.006378	0.3929961	0.479151	1.610071
POMP	33	51.90987	0.3217522	51.35361	52.50872
ln(PA014)	33	10.33186	0.1285476	10.09463	10.45553
ln(PA1564)	33	11.28529	0.159795	10.97519	11.50343

ln(PAOVER64)	33	8.922371	0.2555643	8.467196	9.330637
ln(TEHE)	33	6.102102	1.057227	4.739701	7.779599

4.1.5. Model Specification and Hypotheses

From what has been discussed above, the estimated non-linear regression model below is therefore preferred in this study (see Equation 1). Furthermore, the coefficients in this model are estimated using OLS and they are denoted $\widehat{\beta_0}$, $\widehat{\beta_1}$, $\widehat{\beta_2}$,$\widehat{\beta_3}$, $\widehat{\beta_4}$, $\widehat{\beta_5}$, $\widehat{\beta_6}$ and $\widehat{\beta_7}$. The OLS error term ϵ_1 contains all the other potential factors besides the existing independent variables that determine the value of the dependent variables (Stock and Watson, 2012). The theory of quantity-quality trade-off of children (Blake, 1989; 1981) suggests that the coefficient of TFR is likely to be negative. Additionally, according to the theory of LCS (Modigliani, 1986; Ando and Modigliani, 1963), there are hypotheses: $\widehat{\beta_5} < 0$ and $\beta_7 < 0$. While the sign of $\widehat{\beta_6}$ is supposed to be positive. However, due to the lack of theoretical consensus on the effects of APG and POMP on CAHS, their corresponding signs of $\widehat{\beta_1}, \widehat{\beta_2}$ and $\widehat{\beta_3}$ cannot be determined a priori at this stage.

<u>Equation 1:</u> **The Regression Model**

$$\ln \widehat{CAHS} = \widehat{\beta_0} + \widehat{\beta_1} TFR + \widehat{\beta_2} APG + \widehat{\beta_3} POMP + \widehat{\beta_5} \ln PA014 + \widehat{\beta_6} \ln PA1564 + \widehat{\beta_7} \ln PAOVER64 + \epsilon_1$$

4.1.6. Multicollinearity

In a multiple regression model, imperfect multicollinearity is a phenomenon where two or more predictor variables are highly correlated – but not perfectly correlated (Stock and Watson, 2012). If so, the coefficients on at least one individual regressor would be imprecisely predicted (Hair *et al.*, 2010; Adkins and Hill, 2008). However, the overall fit of the equation will be largely unaffected by this problem. This dissertation has significantly diminished the impact of the multicollinearity by transforming the data and expressing in logarithms (see section 4.1.3).

4.1.7. Heteroscedasticity

Although heteroscedasticity does not lead to biased parameter estimates, it violates the OLS assumption that errors are both independently and identically distributed. As a result, the estimated SE will be incorrect and confidence intervals with the desired confidence level cannot be produced

(Hayes and Cai, 2007). In order to deal with this problem, this dissertation has made advantages of Stata.13 to estimate heteroscedasticity-robust standard errors.

4.1.8. Shapiro-Wilk W test

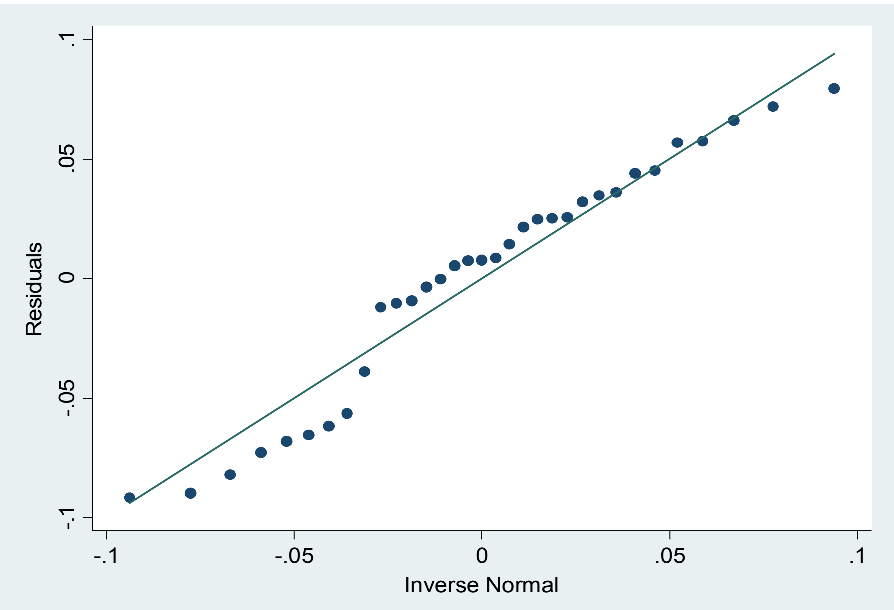
The test will be performed to validate the normality of the data (Ghasemi and Zahediasl, 2012). It is a fundamental condition in the further statistical analysis, because their validity depends on the normality of the data. The null-hypothesis of this test is that the data used in this dissertation follow a normal distribution. If the p-value is greater than the chosen level, which is 0.05 in this case, then the null hypothesis cannot be rejected and there is evidence that the data tested are from a normally distributed population (Ghasemi and Zahediasl, 2012). In Table 2, the p-value of 0.0556 is significant at $p< 0.05$, which is sufficient to establish normality of the data.

Table 4: **Shapiro-Wilk W test for the Normality of the Data**

Variable	Observations	W	V	z	Prob>z (p-value)
Residual	33	0.93778	2.124	1.567	0.05856

This result is also confirmed by the graphical assessment of normality (see Figure 7). The figure plots the quantiles of residuals against the quantiles of a normal distribution. It can be seen that residuals from the database are reasonably normally distributed.

Figure 7: **Quantile Plot**



4.1.9. Pearson Product Moment Correlation Test

The previous efforts have provided the sufficient conditions in order to produce the Person's correlation test. This test not only can examine whether there is an association between each explanatory variables and CAHS, but also the strength of this relationship that exists between them. From Table 4, all explanatory variables (left-side) are significant at the 1% level of significance, which implies these variables play an important role in explaining CAHS, as said in the literature. Thus, it reflects the variables selected in this dissertation are relatively satisfied.

Table 5: **Pearson's Correlation Test**

	ln(CAHS)
TFR	-0.9171***
APG	-0.8962***
POMP	-0.7711***
ln(HETE)	0.9269***
ln(PA014)	-0.7388***
ln(PA1564)	0.9922***
ln(PAOVER64)	0.9862***

Source(s): *** denotes statistically significant at 1% level of significance.

4.1.10. Inferential Test

The inferential statistics are useful in empirical evaluation. F-statistic and t-statistic, as the main hypothesis tests, will be employed in the further empirical discussion. Additionally, t-tests are performed to test for a single coefficient and F-tests aim to test joint hypotheses about regression coefficients. First of all, the null and alternative hypotheses need to be stated clearly before they can be tested. The two-sided alternative hypothesis used in this dissertation can be expressed as follows:

Equation 2: **Null and Alternative Hypotheses**

$$H_0 : = 0$$
$$H_1 : \neq 0$$

where H_0 and H_1 are the null and alternative hypotheses, respectively.

Moreover, the p-value will then be computed to examine whether the null hypothesis is rejected at three different significance levels - 1%, 5%, and 10% (Stock and Watson, 2012). Notably, the p-value should be used only as guidelines and be treated as the tentative results until explained and confirmed by the relevant studies (Stock and Watson, 2012).

4.1.11. Goodness of Fit

According to Stock and Watson (2012), the values of R-squared and adjusted R-squared are used to qualify how the model fits the data. The R-squared measures how much variation of the dependent variable can be explained by the explanatory variables. The R-squared value tends to be higher by adding additional predictors in the model and thereby cannot state whether a regression model is adequate. Instead, the adjusted R-squared would be more relevant indicator of the goodness of fit of the model, because it would increase when the new added independent variable has a correlation to the dependent variable (Stock and Watson, 2012). The value of root mean squared error also provides a measure of overall performance of an estimator.

4.2. Results

The final regression results in Tables 6 have omitted superfluous variables, diminished the severity of multicollinearity, and corrected for the problem of heteroscedasticity. The columns labeled (1) through (5) each report separate regressions, which have the same dependent variable, ln(CAHS). Additionally, each explanatory variable follows the estimated regression coefficients, with their robust standard errors below them in parentheses. The constant is the predicted value of dependent variable when all explanatory variables equal zero. The final four rows include the summary statistics for regressions. They are F-statistics, adjusted R-squared, root mean square error and the sample size.

Table 6: **Regression Results**

	Dependent Variable ln(CAHS)				
Explanatory Variables	(1)	(2)	(3)	(4)	(5)
TFR	-3.684***	-2.283***	-2.179***	-2.623***	-0.356**
	(0.293)	(0.552)	(0.851)	(0.262)	(0.195)
APG		-2.136***	-2.145***	3.762***	0.446**
		(0.660)	(0.691)	(0.565)	(0.207)
POMP			-0.193	-0.699**	-0.346***
			(0.665)	(0.225)	(0.062)
ln(TEHE)				2.011***	

				(0.157)	
ln(PA014)					2.659*** (0.644)
ln(PA1564)					2.875** (1.000)
ln(PAOVER64)					7.172*** (0.661)
Constant	17.450*** (0.606)	16.754*** (0.585)	26.547 (33.626)	35.545** (11.250)	-95.692*** (11.603)

			Summary Statistics		
F-Statistics testing all variables=0					0.000
Adjusted R-squared	0.8360	0.8692	0.8650	0.9851	0.9993
Root Mean Square Error	0.85556	0.76406	0.7763	0.25795	0.05542
Number of Observations	33	33	33	33	33

Notes: * denotes statistically significant at 10% level of significance (p<0.1)
** denotes statistically significant at 5% level of significance (p<0.05)
*** denotes statistically significant at 1% level of significance (p<0.01)
Robust standard errors are in parentheses.

4.3. Discussion

As can be seen from Table 6, the first estimated regression only takes into account the TFR as an independent variable. The null hypothesis that the coefficient of TFR is zero is rejected at the 1% significance level. It follows that a one-unit decrease of TFR can expect CAHS to increase by 368.4 per cent. However, when an additional independent variable APG is added in the regression (2), the coefficient on TFR appreciably rises from -3.684 to -2.283 while it remains statistically significant at the 1% significance level. Simultaneously, the adjusted R-squared slightly increases from 0.8360 to 0.8692. This seems enough to warrant including APG in the regression as a deterrent to omitted variable bias. The APG variable is significantly different from zero at the 1% significance level and negatively associated with CAHS. A 213.6 per cent growth in CAHS occurs with each 1 per cent decline in APG, holding the TFR variable constant. However, the sign of the coefficient on APG has switched from positive in the regressions (2) and (3) to negative in the last two regressions. Thus, it can be argued that regressions (2) and (3) could suffer from the omitted variable bias, implying both education and age structure factors could be the important determinants of CAHS. According to the last two regressions, APG is significantly and positively associated with CAHS. This outcome can be explained by the arguments proposed by Ito and Rose (2010) and Cook (2006). In China's context, the lower population growth rates induced by the OCP have caused losses in the working-age population, who are potential savers in an economy (Choukhmane *et al*., 2014; Zhu *et al*., 2014; Banerjee *et al*., 2014; 2010; Wang, 2009). As a result, decreased APG can contribute negatively to CAHS.

In addition to other variables in regression (2), POMP is added in regression (3). Comparing those two regressions, the coefficients on both TFR and APG are significant at the 1% significance level, but that on POMP is not statistically significant. Nevertheless, it becomes significant at the 5% level of significance, after adding ln(TEHE) into the regression (4). Apart from that, the adjusted R-squared increases from 0.8650 in regression (3) to 0.9851 in regression (4). Moreover, the coefficient on ln(TEHE) is zero is rejected at 1% level and positively associated with CAHS. These findings together indicate that the incorporation of ln(TEHE) in regression (4) can be able to provide a better model to explain CAHS.

On the one hand, it is observed that the statistical significance of POMP is altered and it becomes negatively related to CAHS. Although this contrasts with the results suggested by Li *et al*. (2011) and Wei and Zhang (2008), it agrees with the arguments proposed by Griskevicius *et al*. (2012), Weir *et al*. (2011), Kvarnemo and Anhesjo (1996), as well as Taylor and Bulmer (1980). They argued that aggregate household savings could decline in response to the male-biased sex ratio. With higher competitiveness in Chinese marriage market, men tend to enhance their attractiveness by increasing their conspicuous consumption during their courtship. Consequently, CAHS would decrease.

On the other hand, based on the results in regression (4), an increase in the number of people enrolled in the higher education by 1 percentage point is associated with an increase in CAHS by 1.093 percentage points, other variables being equal. The outcome is in accordance with the following interpretations by Choukhmane *et al*. (2014), Zhu *et al*. (2014), Rosenzweig and Zhang (2009), Angrist *et al*. (2005), Ginther and Pollak (2003), Behrman *et al*. (1994) and Becker and Lewis

(1973). They maintain that the fertility control can lead to a trade-off between quantity and quality of children and this hence could contribute higher CAHS. Parents are expected to receive financial support from their children for their retirement consumption. Thus, they would be encouraged to allocate more savings to invest in children's education, especially given the fewer dependent children under the OCP (Schultz, 2004). This would also help to account for the negative association between TFR and CAHS, as expected.

The final regression further exposes the effects of demographic transition by attempting to account for the impacts of three age groups on CAHS. There are four arguments can be made from the regression (5). Firstly, the coefficient on ln(PA014) is statistically different from zero at the significance level of 1%. The positive coefficient indicates that a percentage point decrease in the population aged between 0 and 14 would lead to a decrease in CAHS by approximately 2.659 percentage points, after controlling for the other variables in the model. This result contradicts my hypothesis that the sign of the coefficient on PA014 would be negative, but it reinforces the hypotheses by Zhu (2011), Kelley and Schmidt (1995) and Weil (1994). The decline in the proportion of people of non-working age of 0-14 has been brought about a rapid decline in the TFR under the OCP. Hence, there will be a fall in the number of young population entering into the labour market, which then could reduce CAHS.

Secondly, the estimated parameter of ln(PA1564) is statistically different from zero at the 1% level of significance and also has the expected sign. The coefficient on the parameter of ln(PA1564) means that the effect of 1 per cent increase in number of people aged 16-54 is expected to have 2.875 per cent increase in CAHS, controlling for the other variables in the model. The results are in line with those obtained by Choukhmane *et al*. (2014), Zhu *et al*. (2014), Banerjee *et al*. (2010), Wang (2009) and Ando and Modigliani (1963). These studies suggest that the increased share of middle-aged working population, which has been classified as potential savers in the society, has the potential to stimulate CAHS. This manifests in three different ways. First of all, this age group would accumulate more capital to support and educate their children in order to obtain higher returns from their children when they retired. The second point is that few children to support them in retirement, which accordingly stimulates them to save more to secure their retirement consumption. As a final point, they are responsible for their old parents with financial transfers and this also motives them to save more (Choukhmane *et al*., 2014; Zhu *et al*., 2014; Banerjee *et al*., 2010; Curtis, 2011; Wang, 2009; Bloom and Williamson, 1998; Ando and Modigliani, 1963).

Thirdly, the estimated coefficient on ln(PAOVER64) is positive and significant at the 1% significance level, which is inconsistent with my expectations. The result demonstrates that if the retired population increased by 1 per cent, CAHS would increase by 7.172 percentage points accordingly, holding constant the other independent variables. However, this agrees with the investigations by Ito and Rose (2010), Modigliani and Cao (2004) and Kraay (2000). It has been interpreted from two different perspectives. According to Ito and Rose (2010), the population aged 65 and over in China strongly depends on public pensions and family financial transfer from their children, who are middle aged; this can positively contribute to CAHS. Alternatively, due to the OCP, the elderly have fewer children can rely on. They thus tend to accumulate excess savings for themselves (Zhu, 2011). Overall, it seems that these demographic changes can be powerful drivers of CAHS.

Fourthly, in order to more fully understand how the aforementioned four key factors (TFR, APG, gender ratio, demographic structure) affect CAHS, it is useful to compute an F-test to assess the significance of these four factors through testing coefficients of all dependent variables equal to zero versus at least one of them differs from zero. This is also why ln(TEHE) was dropped in the final regression. The regression (5) reveals that the full set of variables is jointly significant at the 1% level in explaining CAHS. Apart from that, the final regression yields a relatively higher adjusted R-squared with 0.9993, compared to 0.8360 in the first regression. These together indicate that the regression has greater explanatory power in explaining CAHS.

What is more, the estimated effects of TFR on CHAS change substantially from first to the final regression, and it always remain a negative sign and statistically significant at the 1% level of significance (see Table 6). This indicates that TFR is a potent predictor of CAHS. Moreover, its negative sign is in line with my hypothesis, which is also supported by many other studies (Choukhmane *et al*., 2014; Zhu *et al*., 2014; Rosenzweig and Zhang, 2009; Li *et al*., 2008; Angrist *et al*., 2005). In the regression (5), a one-unit decrease of TFR is estimated to raise CAHS by 35.6 per cent.

Overall, the aforementioned statistical evidence can be used to conclude that the OCP (indicated by the four factors) plays a significant role in contributing CAHS.

4.4. Limitations

Although every attempt has been made to ensure that the above regression models fit the purpose of this dissertation. The major limitations of the models were mainly caused by the problems of data used in this dissertation. There were variables that could not be included in the model due to the lack of data during the period of 1980-2012. For example, it would have been useful to analyse household aggregate savings in urban and rural areas (Ge *et al*., 2012; Qian, 1998), as well as in different regions (Choukhmane *et al*., 2014). Subsequently, the regressions used in this study may suffer from omitted variable bias. The corresponding results might be biased (Stock and Watson, 2012) and the impact of the OCP on CAHS would thus be underestimated. This also has the potential to produce the high values of R-squared and Adjusted R-squared.

5. Conclusion

This empirical dissertation has investigated the potential relationship between the One-Child policy (OCP) (it was applied only to the Han Chinese) and China's aggregate household savings (CAHS). The aim of this dissertation has derived from the fact that a decrease in the TFR as a result of the OCP is accompanied by a dramatic growing trend in CAHS from 1980 to 2012. The dissertation has, firstly, reviewed the theory and relevant literature in order to assist in the formulation of methodology and hypotheses. Specifically, the existing literature has helped identify four factors as the proxies for the OCP: the TFR, the annual population growth rate, the age structure, as well as the gender ratio. In addition, the theory of Life-Cycle Saving led by Modigliani (1986) has been taken as the theoretical foundation.

Accordingly, a multiple regression analysis has been constructed based on the cross-sectional annual data from the Chinese official database and the World Bank between 1980 and 2012. I have employed a set of methods with the purpose of generating more valid empirical results; particularly the Shapiro-Wilk W test, Person's correlation test and Inferential test. The final empirical results indicate that not only the individual variable is statistically significant at the 1% level of significance; the set of variables is also jointly significant in estimating CAHS; TFR, the population aged 15-64, 65 and over are all statistically significant in explaining changes in CAHS. Moreover, according to the adjusted R-squared value, the model I created seems to fit the data well. These together have led to the conclusion that the OCP has had detectable effects on CAHS. The estimated signs of the coefficients on the youth and the elderly are inconsistent with the theory of LCS and my hypotheses. However, this result has been supported by many other studies. Due to the limitation in data, further improvements of the study are necessary to have a more satisfactory result, such as an analysis of classifying CAHS by different regions. Although this study has limitations, it is among the first to measure the impact of the OCP on CAHS. It has also overcome two main defects existing in previous literature which often had a small sample size and isolated the impact of each factor on CAHS.

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Appendix

Appendix A

Table A1: **Data on aggregate household savings, the percentage of male population and the total enrolment in the higher education in China (1980-2012)**

Year	China's aggregate household savings (100 Million Chinese Yuan)	The percentage of male population (Percentage)	The total enrolment in the higher education (10,000 persons)
1980	395.8	52.06475	114.4
1981	523.4	52.19492	127.9
1982	675.4	52.31433	115.4
1983	892.9	52.28717	120.7
1984	1,214.70	52.27555	139.6
1985	1,622.60	52.44018	170.3
1986	2,237.80	52.50872	188
1987	3,083.40	52.35938	195.8725
1988	3,819.10	52.33394	206.5923
1989	5,184.50	52.32918	208.2111
1990	7,119.60	52.26434	206.2695
1991	9,244.90	52.01123	204.3662
1992	11,757.30	51.64	218.4376
1993	15,203.50	51.61004	253.6
1994	21,518.80	51.67697	279.9
1995	29,662.30	51.57113	290.6
1996	38,520.80	51.35361	302.1
1997	46,279.80	51.58225	317.4
1998	53,407.47	51.72051	340.9
1999	59,621.83	51.85274	408.5874
2000	64,332.38	52.02248	556.09
2001	73,762.43	51.81509	719.07
2002	86,910.65	51.8033	903.36
2003	103,617.65	51.8135	1108.6
2004	119,555.39	51.82818	1333.5
2005	141,050.99	51.83171	1561.777

2006	161,587.30	51.79724	1738.844
2007	172,534.19	51.768	1884.895
2008	217,885.35	51.73505	2021.025
2009	260,771.66	51.69124	2144.657
2010	303,302.49	51.51592	2231.793
2011	343,635.89	51.5083	2308.508
2012	399,551.00	51.50481	2391.316

Sources: NBSC, 2013a, p.1; 2013b, p.1; 2013c, p.1.

Appendix B

Table B1: **Data on the total fertility rate, annual population growth, population aged 0 to 14, aged 15 to 64, aged 65 and over in China (1980-2012)**

Year	Total fertility rate	Annual population growth	Population aged 0 to 14	Population aged 15 to 64	Population aged 65 and over
	(Births per woman)	(Percentage)	(10,000 persons)	(10,000 persons)	(10,000 persons)
1980	2.71	1.254221	34735.99	58406.94	4756.15799
1981	2.673	1.280952	34204.33	60024.56	4931.057753
1982	2.682	1.472675	33713.93	61797.03	5119.619005
1983	2.72	1.44495	33238.89	63551.65	5312.366206
1984	2.769	1.312069	32806.32	65165.89	5501.651272
1985	2.811	1.361699	32521.4	66716.38	5690.59672
1986	2.826	1.487399	32425.56	68243.12	5875.318131
1987	2.806	1.603605	32505.87	69751.32	6050.379102
1988	2.745	1.610071	32707.33	71178.52	6206.60739
1989	2.644	1.53317	32968.39	72485.87	6342.563691
1990	2.506	1.467303	33260.33	73700.83	6468.358236
1991	2.342	1.364434	33564.9	74795.61	6594.867701
1992	2.171	1.225536	33857.9	75752.17	6729.382808
1993	2.009	1.149619	34113.36	76661.55	6878.947501
1994	1.865	1.130261	34293	77624.81	7045.75308
1995	1.746	1.086509	34344.04	78668.05	7227.531686
1996	1.656	1.048142	34261.19	79801.09	7422.45152
1997	1.591	1.02345	34049.73	81032.17	7629.846199
1998	1.546	0.95955	33672.45	82352.46	7846.793264
1999	1.52	0.865851	33095.62	83759.6	8071.606163
2000	1.51	0.787957	32318.23	85271.96	8304.808897
2001	1.514	0.726381	31331.82	86913.83	8546.728028
2002	1.527	0.67	30169.39	88658.49	8796.284356
2003	1.546	0.622861	28931.01	90423.64	9055.666334
2004	1.566	0.593933	27752.12	92105.23	9324.903869
2005	1.585	0.588125	26736.35	93633.4	9598.135823

2006	1.602	0.558374	25910.11	94953.42	9862.593102
2007	1.617	0.522272	25259.44	96065.69	10110.92549
2008	1.63	0.512387	24784.98	96993.56	10344.96615
2009	1.642	0.497381	24462.21	97744.56	10569.55
2010	1.65	0.48296	24269.46	98331.19	10792.24269
2011	1.657	0.47915	24212.63	98763.89	11024.79095
2012	1.663	0.487231	24291.4	99054.57	11278.31665

Sources: The World Bank, 2015, p.1; 2014c, p.1; 2014d, p.1; 2014e, p.1; 2013, p.1.