ERASMUS UNIVERSITEIT ROTTERDAM
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Master Thesis

Prospects For Internal Rebalancing in China: What Drives High Household Saving?

Abstract

Transitioning the Chinese economy to a more balanced and sustainable economic model in which domestic private consumption plays a greater role in driving economic growth is currently a high priority for Chinese policy makers. To this end, gradually reducing China's elevated household saving rate is critical. In this context, this paper undertakes an empirical analysis of the determinants of high household saving in China, with a view to assessing the prospects for rebalancing efforts and identifying complementary policy objectives that may catalyse the necessary shift. The analysis employs a dynamic panel data model, estimated using fixed-effects panel estimation as well as the Generalised Method of Moments (GMM) methodology. Provincial-level household survey data is decomposed for urban, rural and all households to facilitate deeper analysis. The results suggest that strong income growth, demographic variables, habit formation and precautionary saving motives are important factors behind China's high saving rate. Accordingly, policies aimed at promoting a stable macroeconomic environment, addressing China's aging population, and financial deregulation are likely to assist efforts to boost domestic consumption. Moreover, given projections for slowing GDP growth and an increasing dependency ratio, combined with on-going financial liberalisation, prospects for gradually reducing the household saving rate and increasing domestic consumption growth appear to be strong.

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1. Introduction

"China has embarked on an ambitious rebalancing of its economy — from industry to services, from exports to domestic markets, and from investment to consumption. These reforms are a necessary process that, in the long run, will lead to more sustainable growth."

Christine Lagarde, International Monetary Fund (IMF) Managing Director, 2016

The recent quote from IMF Managing Director, Christine Lagarde, provides an apt characterisation of the scale of the economic and policy challenges currently facing China. In recent decades, China's strong economic performance has been underpinned by an economic model focussed on rapidly expanding fixed investment and exports. However, with weaker global demand, elevated corporate debt levels and mounting evidence of declining efficiency in investment projects, China needs to shift toward a more balanced growth model in which domestic consumption plays a stronger role. To achieve this, addressing China's elevated household saving rate will be critical, and this has become a priority for policy makers.

In this context, this paper undertakes an empirical analysis of the drivers of Chinese household saving, with a view to assessing the prospects for rebalancing, and identifying complementary policy objectives that may catalyse the necessary shift. The analysis employs a dynamic panel data model, estimated using fixed-effects panel estimation and the Generalised Method of Moments (GMM) methodology. The data include 20 annual observations for each of China's 31 provinces. Overall, the analysis suggests that strong income growth, demographic variables, habit formation and precautionary saving motives are important drivers of China's high saving rate. Interestingly, the key determinants of household saving differ for urban and rural households.

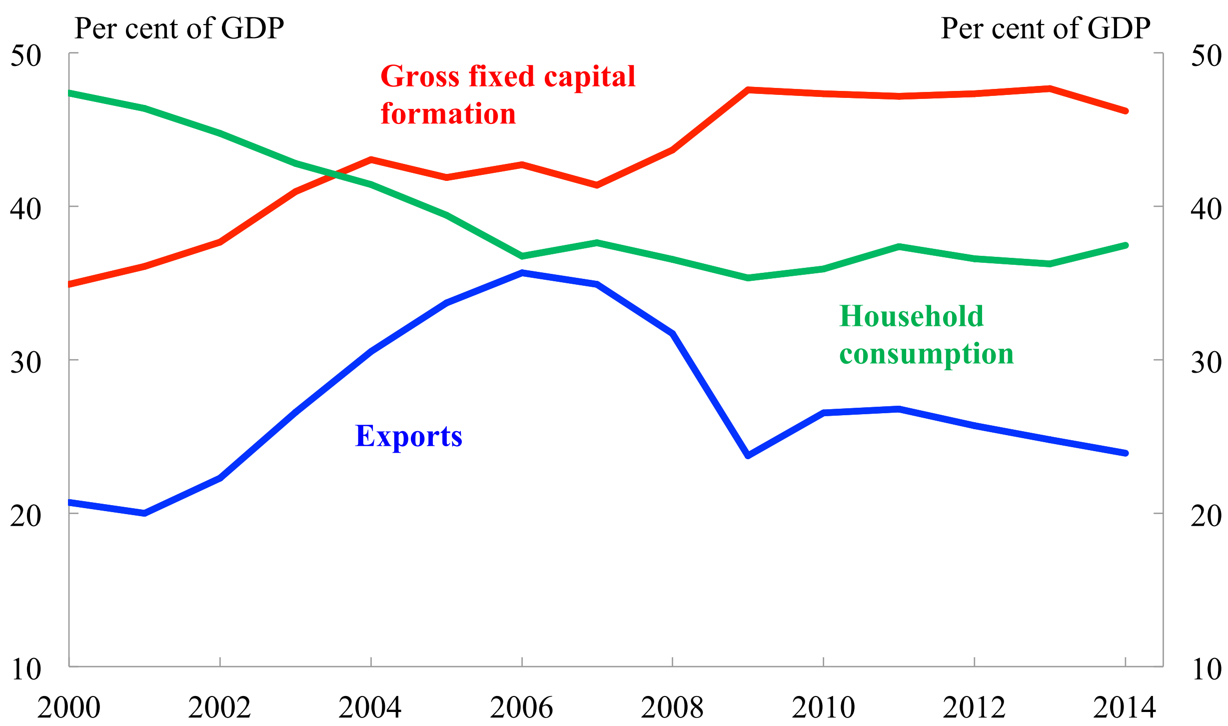
The remainder of this paper is structured as follows. Section Two gives an overview China's growth model to date, recent household saving trends, and structural changes relevant for understanding Chinese saving. Section Three explains theoretical frameworks useful for analysing saving which provide the basis for specifying the empirical model. Section Four reviews existing empirical literature on the determinants of household saving, including studies with a specific focus on China as well as relevant studies with a broader focus. Section Five outlines a number of testable hypotheses regarding the drivers of high household saving in China. The empirical methodology and data used to test the hypotheses are explained in Section Six, while Section Seven presents and analyses the estimation results. Section Eight concludes by relating the results back to the hypotheses, discussing some policy implications of the results and assessing future prospects for rebalancing Chinese domestic demand.

2. China's Growth Model to Date and Household Saving Trends

2.1 The Chinese Growth Model and the Need for Rebalancing

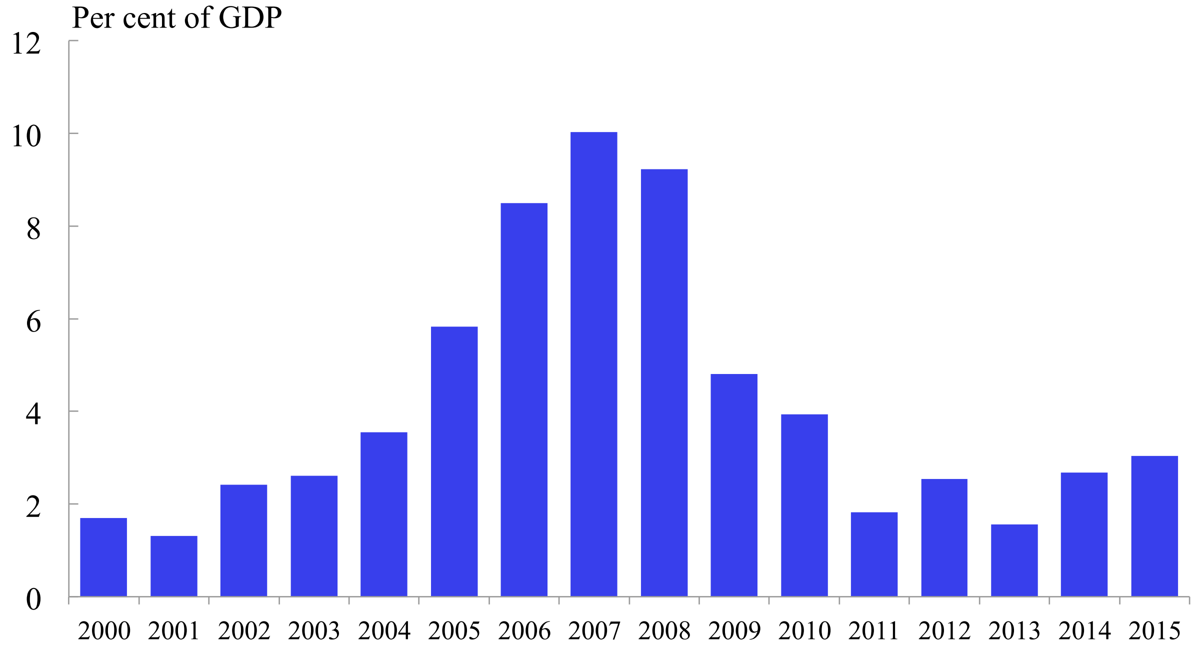
China's extraordinary economic success in recent decades has coincided with its transition toward a more open, market-orientated economy, and its accession to the World Trade Organisation (WTO) in 2001. During this period, and particularly since its WTO accession, China's growth model has focussed on rapid investment and export growth. Accordingly, both exports and investment increased significantly as a percentage of China's GDP, while the share of household consumption in GDP contracted (Figure 1). Combined with a rigid exchange rate regime, the Chinese growth model resulted in the emergence of a large external imbalance. China's current account surplus expanded from around 2 per cent of GDP in 2000 to a peak of over 10 per cent of GDP in 2007 (Figure 2). Indeed, China's current account surplus, alongside those of Germany, Japan and some oil-producing economies, was a source of considerable concern for prominent economists and policy makers during this period, who feared that large imbalances could unwind rapidly as investors became wary of continuing to finance U.S. deficits (Bernanke, 2005; Eichengreen, 2004; and Singh et al., 2013).

Figure 1: Chinese Household Consumption, Exports and Fixed Investment



Source: World Bank

Figure 2: China's Current Account Surplus



Source: World Bank

Yet in the aftermath of the 2008 global financial crisis, China's current account surplus shrank back to around 3 per cent of GDP, driven by a combination of factors including weaker global demand, falling terms of trade, appreciation of the real effective exchange rate and higher domestic investment (Ahuja et al., 2013). However, the external adjustment was not accompanied by stronger domestic consumption. Fixed investment remained the dominant driver of growth, facilitated by a large pool of domestic saving. In recent years, domestic credit has expanded rapidly, although corporate profitability has fallen and there is mounting evidence of declining efficiency in investment projects (Lee et al., 2013).

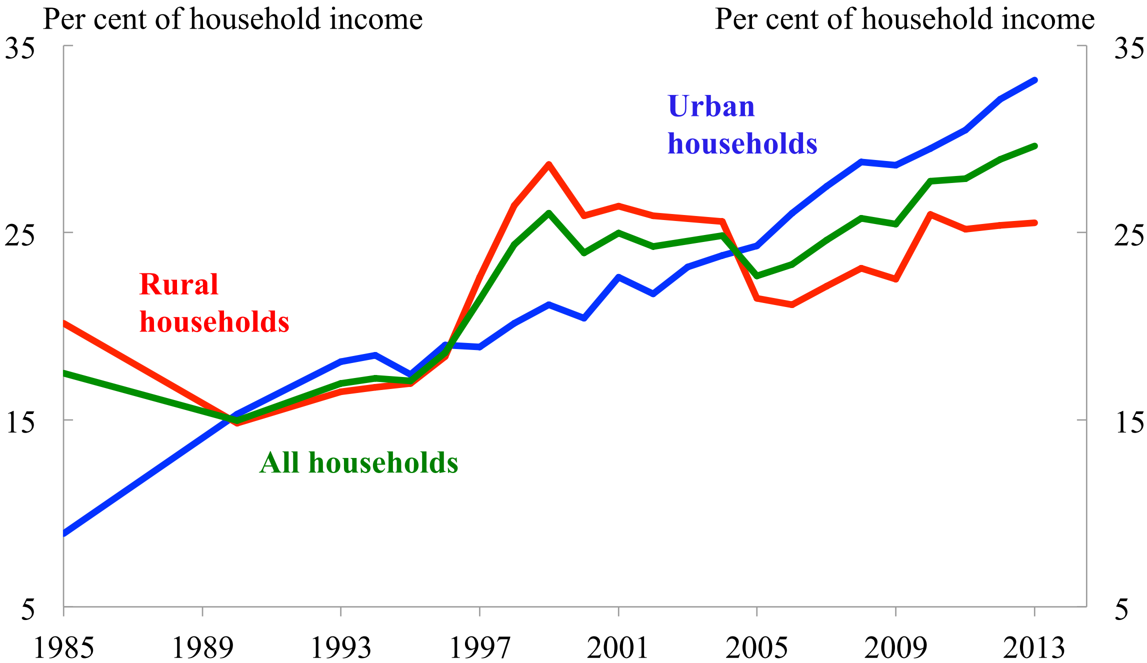
Both Chinese authorities and international institutions such as the IMF have recognised that although external imbalances have subsided, the Chinese economy is over-reliant on investment and rising credit. In response, rebalancing domestic Chinese demand toward private consumption, and gradually reducing reliance on investment as a driver of growth has become a policy priority (IMF, 2015).

In order to achieve this, policy makers need to address China's elevated saving rate, which is among the highest in the world. According to the IMF, reducing household saving is critical to unlocking the potential of private consumption as a driver of economic growth (IMF, 2015). Gaining a clearer understanding of the drivers of China's high household saving rate can provide policy insights to catalyse the necessary shift.

2.1 Stylised Facts About Household Saving in China

Establishing a set of stylised facts and empirical observations about household saving provides a useful platform for the analysis in this paper. First, Chinese household saving is high by historical and international standards. While scholars such as Modigliani and Cao (2004) and Yang et al. (2011) note popular perceptions of a cultural tendency among the Chinese toward frugality and financial prudence, the evidence does not necessarily concur. Prior to 1980, household saving was just 6 to 7 per cent of GDP (Yang et al. 2011). It was only during the 1980s that the household saving ratio began to increase, a trend that momentarily abated in the late 1990s and early 2000s, before continuing (Figure 3).

Figure 3: China's Household Saving Rate



Source: Author's calculations based on data from the China Statistical Yearbooks

Second, provincial level household survey data reveals a large variance in the household saving rate across provinces, and between rural and urban households. In 2013, urban households in Shanxi saved over 40 per cent of income, whereas rural households in the same province saved less than 20 per cent of income. In the same year, rural households in Tibet saved more than 45 per cent of income, while those in Inner Mongolia saved just 15 per cent of income.

Separately, there appears to be a strong positive relationship between household saving and per capita income among urban households, but the relationship is less clear for rural households (Figures 4 and 5). There is also a trend that rural households in wealthier provinces save a larger proportion of income compared to those in poorer provinces, but this trend is less clear among urban households. Both household income and saving have been more volatile for rural households than for urban households.

Figure 4. Urban Household Income and Saving Rate

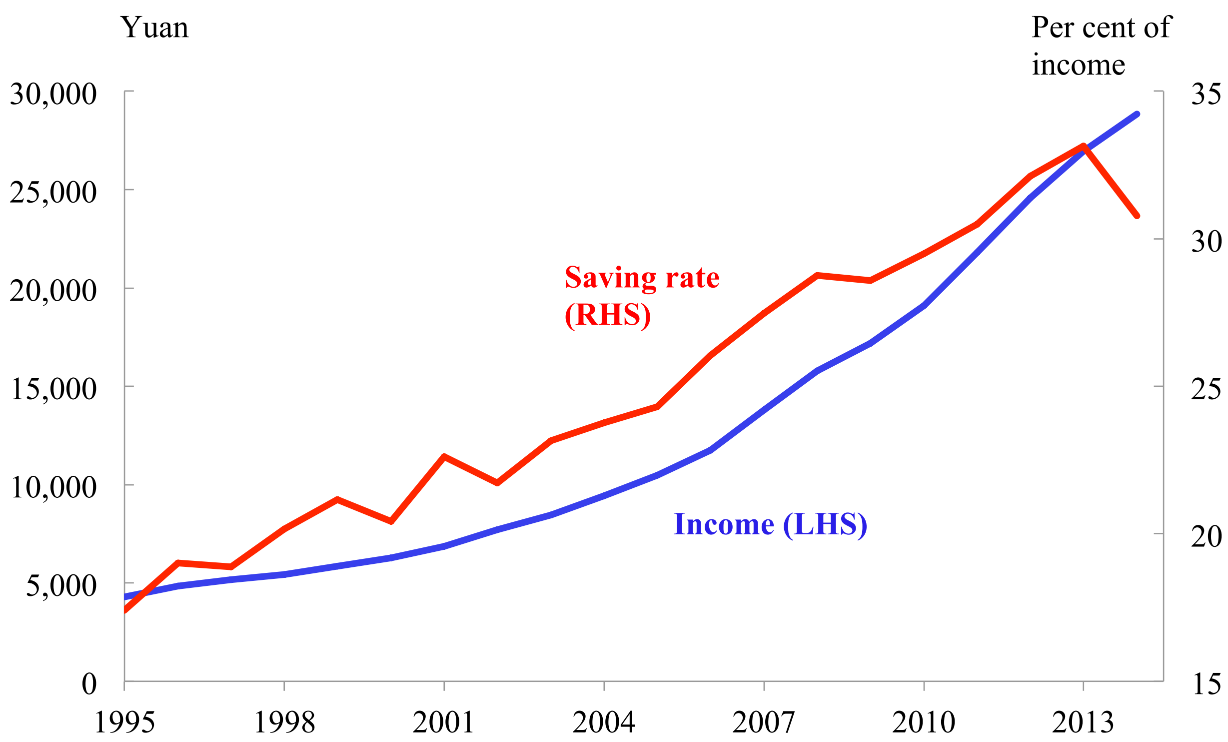
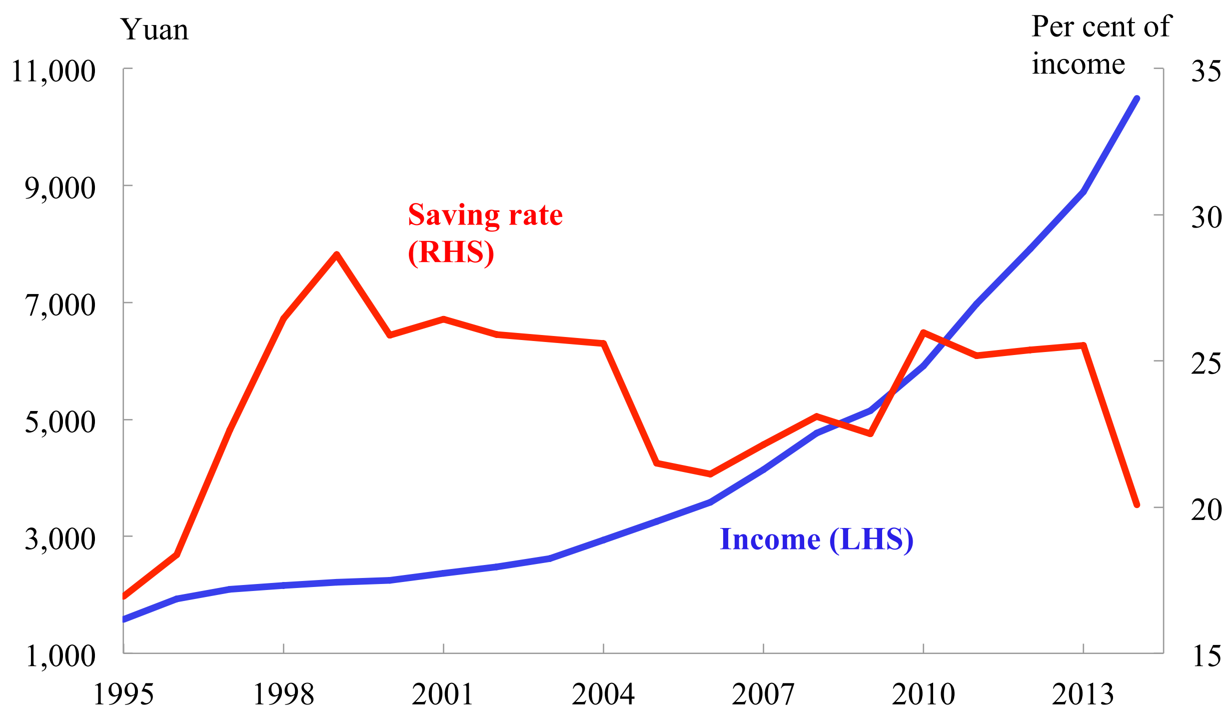


Figure 5. Rural Household Income and Saving Rate



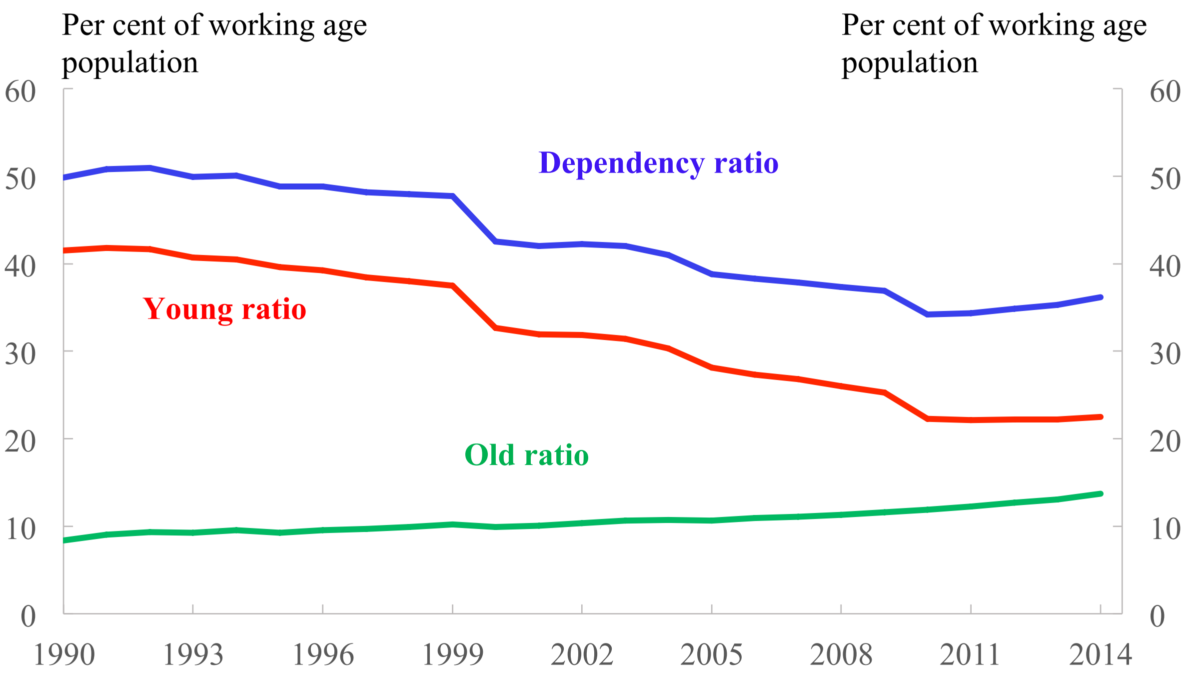
Source: Author's calculations based on data from the China Statistical Yearbooks

Finally, the age-saving profile of Chinese households reveals that saving rates are higher among households with either younger or older household heads, and lower for those households with a middle-aged household head. According to data presented by Chamon et al. (2010), the saving rate in 2005 for households with heads aged 35 to 45 was around 10 percentage points lower than that for households with heads aged in their twenties and with heads aged between 55 and 60. Moreover, the authors demonstrate that this trend endured through the 1990s and the first decade of the 2000s. The result is a persistent U-shaped age-saving profile for Chinese households, in contrast to the hump-shaped age saving profile predicted by the Modgliani-Brumberg life cycle hypothesis.

2.3 Structural Changes in China

In recent decades, China has been subject to a number of profound structural changes that are likely to be relevant for understanding Chinese saving. First, China is undergoing a substantial demographic transition (Figure 6).

Figure 6: China's Demographic Transition



Source: China Statistical Yearbooks
Note: The 'old ratio' is the number of people aged 65 and over expressed as a percentage of those aged 15 to 64 (i.e. the working aged population). Similarly, the 'young ratio' is the number of people aged 0 to 14 expressed as a percentage of those aged 15 to 64, and the 'dependency ratio' is the sum of those aged 0 to 14 and 65 and over, expressed as a percentage of those aged 15 to 64.

In the 1970s, Chinese authorities adopted deliberate policies to curtail population growth (Peng, 2000). Initial efforts focused on delaying marriage and childbirth, spacing births and encouraging fewer children, which culminated with the introduction of the 'one-child policy' in the early 1980s. The impact of these policies was immense, with China's total fertility rate falling from 5.8 in 1970 to 2.8 by the end of that decade (Peng, 2000). However, China now has a rapidly aging population. According to the United Nations (UN), the old age ratio is projected to increase from its current level of around 13 per cent, to 25 per cent in 2030 and 46 per cent in 2050 (UN, 2015).

Separately, the transition from a centrally planned to a more market-based economy has involved wide spread corporate restructuring, and a general decline in the role and importance of state-owned enterprises (SOEs) in the Chinese economy. The transition has been associated with decreased job and income security, and increased probability of displacement (Yang et al. 2011). Giles et al. (2006) estimate that the unemployment rate in urban areas increased from around 7 per cent in 1996 to over 12 per cent in 2002.

Concurrent with SOE restructuring, Chinese authorities began gradually reforming the urban pension system in the late 1980s in order to improve pension coverage and reduce the concentration of risk associated with pension liabilities (Li, 2013). Prior to this time, pensions had traditionally been provided directly by a retiree's former SOE. The reform process was catalysed in 1997 due to worsening financial difficulties faced by SOEs (Ma and Zhai, 2001). For Chinese urban workers and prospective retirees, pension reform has had the effect of gradually reducing retirement income relative to previous earnings. Nationally, the pension replacement rate fell from around 80 per cent of the average wage in the late 1990s, to around 50 per cent of the average wage a decade later (Li, 2013).[1] Lower entitlements imply that households have increasingly had to make their own retirement provisions in order to maintain their quality of life in retirement. Coupled with the increased probability of job loss and enterprise failure, pension reforms may have induced urban households to increase their saving efforts.

3. Theoretical Frameworks for Analysing Saving

This section provides a brief overview of competing theories in mainstream economics that attempt to explain saving behaviour. Although the different models often contradict each other in terms of their underlying assumptions and the conclusions drawn about the key determinants of saving, they provide a useful theoretical basis for the analysis in this paper.

[1] The pension replacement rate is measured as the ratio of pension entitlements to the average wage, multiplied by 100, such that the ratio is expressed as a percentage.

3.1 Keynesian Theory of Saving

According to Keynesian economics, saving is a function of current income (Modigliani and Cao, 2004). Individuals decide whether to consume all or part of their current income, and the remainder is saved. The Keynesian consumption function is defined as:

$$C = c_0 + cY$$

The intercept term 'c_0' represents the amount of consumption that is independent from the current level of income 'Y', while 'c' represents the proportion of each additional unit of income that is consumed, or the marginal propensity to consume (MPC) in Keynesian terminology. Saving is then defined as current income that is not consumed, such that:

$$S = Y - C$$

The saving function can also be expressed in a form similar to the consumption function:

$$S = s_0 + sY$$

At zero or very low levels of income, the Keynesian model allows for individuals to consume more than their current income, resulting in negative saving. Hence, the intercept 's_0' is typically negative. Further, Keynes defines the marginal propensity to save (MPS) as the proportion of each additional unit of income that is saved, which is the counterpart to the MPC. The MPS is equal to the coefficient 's', and can be expressed as:

$$MPS = s = \frac{\Delta S}{\Delta Y}$$

The MPS must be greater than or equal to zero, and less than or equal to one. Keynes hypothesises that the MPS rises closer to one as income increases, as individuals with higher incomes are able to save a larger proportion of each unit of income (O'Donnell, 2003):

$$Y \uparrow \rightarrow \frac{S}{Y} \uparrow$$

As such, a key prediction of the Keynesian saving model is that individuals (or countries) with higher incomes will have a higher saving rate. Similarly, if income increases over time, the saving rate will also increase.

3.2 Life-Cycle Hypothesis

The Life-Cycle Hypothesis (LCH), first introduced by Modigliani and Brumberg in 1954, is based on the notion that individuals decide how to optimally distribute their income over the course of their life, constrained only by their lifetime resources. Individuals tend to save and accumulate wealth in their younger and middle-aged years, in anticipation of retirement when they will no longer earn an income and will rely on their accumulated savings to maintain a decent standard of living (Deaton, 2005).

Following from this view of an individual's lifetime consumption-saving pattern, aggregate saving in a given economy depends on the growth rate of aggregate income and the age structure of the population (Modigliani and Cao, 2004). These factors determine the extent to which the positive saving of the working age population outweighs the dis-saving of the retired population. The saving function implied by the LCH can be expressed as:

$$\frac{S}{Y} = s'_0 + s'g$$

'g' represents growth in aggregate income and the coefficient 's'' is significantly positive, and 's'_0' represents a constant that is zero or very close to zero, such that if aggregate income growth is zero, the saving rate will also be zero (Modgliani and Cao, 2004).

The LCH has several implications regarding the drivers of aggregate saving. First, growth in aggregate income is a key determinant of the saving rate, and contrary to the Keynesian model, the saving rate is independent of the level of income. Second, demographic structure and population growth are also critical. An expanding working age population results in higher saving due to faster aggregate income growth and a greater ratio of savers compared to those in retirement. Conversely, an aging population and an increasing dependency ratio will reduce the saving rate, other factors equal (Modgliani and Cao, 2004).

3.3 Permanent Income Hypothesis

The Permanent Income Hypothesis (PIH), first introduced by Friedman in 1957, posits that an individual's observed income is more volatile than their consumption because of a preference to smooth consumption over time by borrowing or saving in a given period as needed (Meghir, 2004).

An individual's income in a given time period can be divided into a 'permanent' and a 'temporary' component. In its most basic and restrictive form, the model assumes no uncertainty, a discount factor of one, constant relative risk aversion utility and identical per period utility.[2] Permanent income in a given period is equal to the sum of an initial endowment of wealth and lifetime income, distributed evenly across time periods. Mathematically, this can be expressed as:

[2] Many of these assumptions can be relaxed without affecting the results of the model.

$$Y_t^P = \frac{1}{T}\left(A_0 + \sum_{t=1}^{T} Y_t\right)$$

A temporary deviation in actual income earned and permanent income is known as 'transitory income' and is equal to:

$$Y_t^T = Y_t - \frac{1}{T}\left(A_0 + \sum_{t=1}^{T} Y_t\right)$$

According to the model, individuals consume according to their permanent income, and consumption responds on a one-to-one basis to changes in permanent income. In contrast, consumption is entirely insensitive to transitory income. Since saving is the difference between income and consumption, saving is equal to transitory income (Pistaferri, 2001).

Therefore, the PIH implies that saving occurs due to temporary windfall gains in income, and does not respond to changes in permanent income. By extension, the model does not imply any systematic pattern between income levels or income growth, and the saving rate.

3.4 Buffer-Stock Model

Proponents of the buffer-stock model assume that individuals save and accumulate wealth in order to insulate themselves against unpredictable fluctuations in future income. As Carroll et al. (1992) describe, individuals facing uncertainty are both impatient, implying they prefer to consume in the current period rather than in the future, but are also prudent, implying they have a precautionary saving motive to protect against future income shocks.

As a result of these conflicting motivations, individuals are assumed to have a target wealth-to-income ratio. If wealth is below target, fear and prudence will dominate and saving will increase until the target ratio is reached. Conversely, if wealth is above target, impatience will dominate and wealth will be drawn down (Carroll et al., 1992).

The buffer-stock model has some alternative implications regarding the determinants of the aggregate saving rate compared to the LCH and PIH models. First, the level of wealth is an important determinant of saving decisions. Lower wealth will tend to result in a higher saving rate and vice-versa. In addition, an increase in the expected probability of future negative income shocks will increase saving and vice-versa. For example, a perceived increase in the likelihood of future unemployment will induce a greater effort to save current income, reflecting the precautionary saving motive.

4. Empirical Studies of Household Saving

In recent decades, a number of empirical studies have sought to examine the determinants of household saving behaviour, both in the Chinese context and more broadly. Empirical models tend to be shaped by one or several of the consumption-saving models explained above. Ultimately, the conclusions drawn about the determinants of saving vary widely, according to the estimation technique, and the countries and data examined.

4.1. Studies with a Broad International Focus

An early study by Leff (1969) focuses on the relevance of demographic factors to explain differences in saving rates between countries. Leff uses a log-linear model and cross-sectional data for 74 countries, and finds that both young and old ratios have a significant and strong negative correlation with the saving rate. Moreover, splitting the sample into developed and developing countries reveals that the quantitative importance of demographic variables is stronger in developing countries.

Feldstein also made a number of important early contributions to the empirical literature on household saving, in which his primary focus was the impact of social security and government transfers on household saving. Feldstein (1974) attempts to measure the impact of social security benefits on household saving in the U.S. by adapting the traditional life-cycle savings model to make the extent of retirement endogenous. He uses data for the period 1929 to 1972, reflecting the period that social security had been in place at the time writing. Feldstein's results suggest that the introduction of social security reduced personal saving by 30 to 50 per cent. However, Feldstein's conclusions are not supported by the findings of a later study by Koskela and Viren (1983). They use an augmented disequilibrium saving model applied to a panel of 16 countries belonging to the Organisation of Economic Cooperation and Development (OECD) for the years 1960 to 1977 to test the effect of social security benefits on saving rates. Ultimately, Koskela and Viren find that social security variables have no significant impact on the saving rate.

Schmidt-Hebbel et al. (1992) conduct a seminal investigation that is the first to use cross-country household saving data prepared on a consistent basis to analyse the determinants of household saving in developing countries. They adopt a panel regression model with fixed-effects to test the significance of a range of determinants of household saving in ten developing countries. In contrast to the earlier findings of Leff, they find that demographic variables are not statistically significant, although they argue this could be due to a lack of variation in these measures over time, combined with fixed-effects estimation which only considers cross-country variation in country dummy variables. Further, when growth in household income is decomposed into trend and transitory components, the authors find that the coefficient estimates for transitory income indicate a much lower marginal propensity to save from positive income shocks than is implied by the PIH.

Several later studies in the 1990s seek to investigate the impact of financial deregulation in developed countries during the late 1970s and 1980s on household saving rates. Bayoumi (1993) uses a panel of data for the eleven regions of the UK for the years 1975 to 1988 to analyse the impact of financial deregulation. His results confirm his a priori expectation that financial deregulation, and the associated increase in financial innovation and access to credit, is associated with a 2.5 percentage point fall in the household saving rate, holding other factors constant. Bayoumi also finds that increasing household wealth accounted for a larger share of the falling household saving rate during this period, which is broadly consistent with the buffer-stock model. Similarly, Jappelli and Pagano (1994) find evidence that financial deregulation contributed to lower saving rates in OECD countries. They use an overlapping generations model fitted to a panel of data for OECD countries for the period 1960 to 1987. They also find evidence that the presence of liquidity constraints leads to a higher household saving rate, and also to increased sensitivity of the saving rate to income growth.

4.2. Studies Focusing on China

In the Chinese context, Kraay (2000) makes a valuable contribution to the literature on Chinese saving by providing a detailed account of the discrepancy between two methods of measuring Chinese household saving. The first method involves calculating the difference between household income and non-capital expenditures for a given period using household surveys. The second method involves calculating the change in the stock of assets held by households during a given period. Kraay notes that during his sample period of 1978 to 1995, there is a widening divergence between the two measures, with the asset-based measure indicating almost twice the household saving rate compared to the survey-based measure by the end of the period. Ultimately, Kraay argues that the survey-based measure is likely to be more accurate, although it may underestimate the actual level of saving.

With this caveat in mind, Kraay assesses the relevance of forward-looking consumption and saving models to explain variance in the household saving rate in China. Such models predict that greater uncertainty about future income will increase the saving rate, to the extent that households have a precautionary saving motive. In addition, expectations of higher future income lead to a lower saving rate, as households seek to smooth lifetime consumption in the face of a rising income profile. Kraay uses the assumption of rational expectations to justify using actual future income as a proxy measure of expected future income. He regresses the survey-based measure of the household saving rate against expected future income and expected future income volatility, as well as vector of other variables. Kraay finds that expected future income is positively correlated with the saving rate for rural but not urban households, but that proxies for income uncertainty are not significant for the saving rate.

A later study by Modigliani and Cao (2004) seeks to examine the extent to which the LCH can account for the rise in Chinese household saving. They find that rapid income growth and the transformation in China's demographic structure explain around two thirds of the rapid rise in China's household saving in preceding decades. Hence, they argue that the LCH framework has significant explanatory power in the Chinese context.

Horioka and Wan (2007) conduct a dynamic panel analysis using a reduced form linear model, also underpinned by the LCH. They use a panel of data for China's 31 provinces for the period 1995 to 2004, and find that the lagged saving rate and disposable income growth account for much of the variation in China's household saving rate in this period. The real interest rate and inflation are also relevant factors in some cases. Interestingly, Horioka and Wan find that demographic variables are often not statistically significant, although this could be due to similar issues identified by Schmidt-Hebbel et al. (1992). Horioka and Wan conclude that their findings provide limited support for the LCH. They also note there is some support for the PIH given the positive and significant coefficient for the interest rate, although the strong role of lagged saving indicates inertia in saving decisions.

Finally, Chamon et al. (2010) use a calibrated buffer-stock saving model with a panel of Chinese households for the period 1989 to 2006 to analyse the drivers behind China's U-shaped age-saving profile curve. They find that higher household income has been accompanied by increased income volatility, and within their model, this is consistent with younger households increasing their saving ratio. They also argue that the increase in saving among older households is consistent with a decrease in the pension replacement ratio after the 1997 pension reforms. Chamon et al. argue that together, increased income uncertainty and the declining pension replacement ratio can explain around half of the rise in Chinese saving during their sample period.

5. Testable Hypotheses

This section presents a number of hypotheses about the determinants of Chinese household saving that will be tested in the remainder of the paper. The hypotheses draw on the findings of previous studies, the implications of different saving models, and relevant economic and demographic developments in China.

Hypothesis One: Growth in household income is a key driver of the household saving rate in China. Higher income growth leads to a higher saving rate.

As outlined above, the LCH implies a positive relationship between income growth and the saving rate. Casual empirical observation provides support for this hypothesis, though more so for urban than for rural households (Figures 4 and 5). The findings of Horioka and Wan (2007) and Carroll (2000), provide further support.

Hypothesis Two: Demographic factors are important drivers of Chinese saving. The declining young ratio is expected to be associated with higher saving, while the rising old ratio is expected to be associated with lower saving.

As Modigliani and Cao (2004) argue, a lower young ratio has a dual effect that leads to higher saving: (1) 'fewer mouths to feed' implies that households are able to save a greater proportion of their income; and (2) fewer children reduces the traditional safety net in Chinese culture, whereby the younger generation takes care (financially and otherwise) of the older generation in their later years. Separately, the LCH predicts that a higher old ratio means that more people are dissaving relative to those who are saving, and other factors equal, the aggregate saving rate will be lower.

Hypothesis Three: 'Saving inertia' is present in the Chinese economy.

The household saving rate for the previous period is expected to be a relevant explanatory variable for the current household saving rate. Specifically, a positive correlation is expected between previous and current saving rates. Although this hypothesis is at odds with the PIH, it is consistent with theories of habit formation in consumption (Carroll, 2000). Horioka and Wan (2007) also find evidence of saving inertia in Chinese households.

Hypothesis Four: Chinese households save for precautionary reasons.

Consistent with the buffer-stock saving model, and the empirical findings of Chamon et al (2010), an increase in uncertainty or expected future income volatility is expected to induce Chinese households to increase their saving rate.

Hypothesis Five: Household wealth in China is negatively correlated with saving.

The buffer-stock model posits that individuals have a target wealth-to-income ratio, and increase their saving efforts if wealth is below target. Reflecting this, lower wealth should be associated with a higher saving rate, holding other factors constant, and vice-versa. The hypothesis is supported by the findings of Bayoumi (1993), although Bayoumi's study was in the context of the UK.

Hypothesis Six: Growth in consumer credit is negatively correlated with household saving in China.

Generally, a lack of affordable credit can be expected to lead to a higher saving rate (Jappelli and Pagano, 1994). Although outstanding credit in China has expanded in past decades, the growth rate of consumer credit issued has slowed in more recent years. This is expected to be associated with a greater need for households to rely on their own savings rather than short-term credit to smooth their consumption.

Hypothesis Seven: The decline in the pension replacement ratio in China has induced urban households to save more.

A lower pension replacement ratio implies that households must rely more on private saving to maintain their quality of life in retirement. As outlined in Section Two, the national pension replacement ratio in China has fallen substantially since the pension reforms of 1997. Moreover, the declining pension replacement rate is expected to be more relevant for urban than for rural households, as pension coverage in the latter remains very low (Shi, 2006). The hypothesis is supported by the findings of Chamon et al. (2010), who argue that pension reforms are a key factor behind the increase in China's saving rate, and its U-shaped age-saving profile.

Hypothesis Eight: More broadly, the drivers of household saving are different for rural households than for urban households.

Given significant differences in income levels, income volatility, saving rates and access to pension programmes, the determinants of household saving are likely to differ for rural and urban households. For example, the fact that rural households face higher income volatility relative to urban households, suggests that precautionary saving motives may be a more significant determinant of saving for rural households.

6. Methodology and Data

6.1 Empirical Model

The above hypotheses are tested using provincial-level Chinese data, and a dynamic panel data model. Cross sections of the panel include data for each of China's 31 provinces, and time series data include annual data observations for the period 1995 to 2014 inclusive, subject to some missing observations.

Model specification is loosely based on the LCH, which predicts that the saving rate is determined by the age structure of the population and the growth rate of income. However, the standard LCH model is modified to include a number of additional variables to test specific hypotheses. The estimated model is expressed in Equation (1):

$$SR_{t,i} = \beta_{0i} + \beta_1 CHY_{t,i} + \beta_2 YOUNG_{t,i} + \beta_3 OLD_{t,i} + \beta_4 DEP_{t,i} + \beta_5 SR_{t-1,i} + \beta_6 UNCERT_{t,i} + \beta_7 INFL_{t,i} + \beta_8 WEALTH_t + \beta_9 CRED_t + \beta_{10} PRR_t + \beta_{11} INT_t + \varepsilon_{t,i} \quad (1)$$

The dependent variable ($SR_{t,i}$) is the household saving rate at time 't' in province 'i'. The explanatory variable $CHY_{t,i}$ is the growth rate of real household income at time 't' in province 'i'. The growth rate of income is a key explanatory variable for any empirical estimation of the LCH (Modigliani and Cao, 2004). It is included to test whether higher income growth leads to a higher save rate in China, as the LCH predicts (Hypothesis One). It is expected to enter with a positive sign.

The explanatory variables '$YOUNG_{t,i}$', '$OLD_{t,i}$' and '$DEP_{t,i}$' represent the young ratio, old ratio and dependency ratio at time 't' in province 'i' respectively. The young ratio is measured as the number of people aged 0 to 14, expressed as a percentage of those aged 15 to 64 (i.e. the working aged population). Similarly, the old ratio is the number of people aged 65 and over expressed as a percentage of those aged 15 to 64, and the dependency ratio is the sum of those aged 0 to 14 and 65 and over, expressed as a percentage of those aged 15 to 64. Inclusion of these demographic variables reflects the prediction of the LCH that age structure is an important determinant of the saving rate (Hypothesis Two). Each demographic variable is expected to enter with a negative coefficient.

The explanatory variable $SR_{t-1,i}$ is the saving rate in the previous time period in province 'i'. The lagged saving rate is included to test for the presence of saving inertia (Hypothesis Three), and is expected to enter with a positive coefficient. The explanatory variable

'$UNCERT_{t,i}$' represents expected future income volatility at time 't' in province 'i'.[3] This variable is included to test whether Chinese households demonstrate precautionary saving motives (Hypothesis Four). It is expected to enter with a positive coefficient.

The explanatory variable '$INFL_{t,i}$' represents the CPI inflation rate at time 't' in province 'i'. As noted by Kraay (2000), the effect of inflation on the saving rate depends on a number of factors including the extent to which households understand the full implications of inflation, the extent and duration of inflation, and which measure of saving is used. As noted by Horioka and Wan (2007), inflation is often included in empirical regressions as a proxy for price and general macroeconomic stability. Therefore, it is expected to enter with a positive sign, reflecting precautionary saving motives (Hypothesis Four).

The explanatory variable '$WEALTH_t$' represents national net household wealth as a percentage of GDP at time 't'. It is included to test whether Chinese households exhibit buffer-stock saving behaviour (Hypothesis Five). It is expected to enter with a negative coefficient. The explanatory variable '$CRED_t$' represents real growth in national consumer credit at a time 't'. This variable is included to test the hypothesis that easier availability of credit reduces the need for saving (Hypothesis Six). It is expected to enter with a negative coefficient. The explanatory variable 'PRR_t' represents the national pension replacement ratio at time 't'. The pension replacement ratio is measured as the proportion of the average wage that a retiree receives from the pension after retiring. It is included to test the hypothesis that the decline in the pension replacement ratio in China is associated with higher saving among urban households (Hypothesis Seven). It is expected to enter with a negative coefficient.

Finally, the explanatory variable 'INT_t' represents the national real interest rate on one-year deposits at time 't'. As noted by Romer (2012), the effect of interest rate changes on saving decisions depends on whether substitution or income effects dominate decision-making. As such, it is difficult to form a priori expectations about the effect of changes in the interest rate on Chinese saving.

6.2. Data

Data for the household saving rate variable ($SR_{t,i}$) are obtained from the annual household survey data published in the China Statistical Yearbooks. The data allow for calculation of the annual saving rate for urban and rural households separately for each of China's 31 provinces.

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[3] The methodology used to derive a data series for expected future income uncertainty is described in detail in the following section.

Urban household saving is calculated as the difference between household disposable income and household consumption, and rural household saving is measured as the difference between per capita net income and per capita consumption. The different approach for rural and urban households reflects the availability of data in the China Statistical Yearbooks. The saving rate is then calculated as saving divided by income, multiplied by one hundred in order to express the rate as a percentage. Household disposable income and per capita net income are used as the denominator for urban and rural households respectively. This approach for measuring household saving is broadly consistent with the method suggested by Kraay (2000), and with the methodology used by Horioka and Wan (2007).

Unfortunately, the China Statistical Yearbooks do not provide aggregated income and consumption data for all households (rural and urban). In order to aggregate urban and rural data into a single series for total household saving in each province, it is first necessary to construct a data series for the urbanisation rate for each year and for each province. Further difficulties arise because provincial-level data for urbanisation rates are only available for the years 2005 to 2014, and not for the full sample period of 1995 to 2014. To overcome this problem, the average annual rate of change in the urbanisation ratio is calculated for each province based on the available data for 2005 to 2014. The average rate is then applied retrospectively to approximate the urbanisation ratio in each province for the years prior to 2005, yielding a complete approximation for the urbanisation ratio for each province and for all years in the sample. This approach is justified by the fact that the vast majority of Chinese provinces exhibit a steady trend of increasing urbanisation according to the data available for 2005 to 2014. Moreover, aggregate urbanisation data available at the national level reveals that the trend of a steadily increasing urbanisation rate was also present during the 1990s and early 2000s.

Finally, the aggregate saving rate for all households in each region is constructed by calculating the weighted average of the rural and urban saving rates, using the urbanisation ratio series for each year and each province as the weight. This methodology yields a saving rate series for all households very similar to that of Horioka and Wan (2007).

Calculations for the income growth variable (‘$CHY_{t,i}$’) are based on the same household income data series from the China Statistical Yearbooks used to calculate household saving rates. Hence, disposable household income is used for urban households while net household income is used for rural households. First, the annual per cent change in income is calculated for urban and rural households separately for each time period and for each province. As this calculation yields nominal income growth, the rate is subsequently adjusted by subtracting the CPI inflation rate for each province and each year in order to obtain real annual income growth. Hence, income growth for urban households is the per cent change in annual real disposable income, and income growth for rural households is the per cent change in annual real net income. The same methodology used to estimate the saving rate for all households is also applied to estimate the aggregate income growth series for each province. Specifically, the weighted average of urban and rural income growth rates are calculated for each province and each year, using the urbanisation ratio series as the basis for the weights. This yields a complete income growth series for all households for each province and each year.

Data for the demographic variables ('$YOUNG_{t,i}$', '$OLD_{t,i}$', and '$DEP_{t,i}$') are obtained from the China Statistical Yearbook, which provides data for each ratio separately for each of China's 31 provinces and over the sample period. However, the data are not available separately for rural and urban areas within each province, so the same data series is used for both rural and urban regressions.

Expected future income volatility ('$UNCERT_{t,i}$') is measured by calculating the unweighted standard deviation of real income growth for the period three years ahead of the current period. As such, a time series for income volatility can be generated for rural, urban and all households in each province using the income data generated for the variable '$CHY_{t,i}$'. However, observations are missing for the years 2012 to 2014 reflecting the absence of data to calculate the standard deviation of income growth three years ahead for these years. The methodology used to estimate expected future income volatility follows that of Kraay (2000) by utilising the assumption of rational expectations. Hence, observed volatility in future income growth can be used as a proxy for the average expectation of future income volatility, as rational expectations implies that the net sum of forecasting errors is zero.

Data for the inflation variable ('$INFL_{t,i}$') are obtained from the China Statistical Yearbook. CPI inflation rates are available at the provincial level, but are not available separately for rural and urban areas within each province. As such, the same data are used for rural, urban and all households.

Data used to calculate the national household wealth-to-GDP variable ('$WEALTH_t$') are obtained from Oxford Economics and the IMF's World Economic Outlook (WEO) database. The ratio is calculated by dividing the net wealth of the household sector in current prices (obtained from Oxford Economics) by nominal GDP (sourced from the IMF), and multiplying the result by 100 to obtain the wealth-to-GDP ratio as a percentage. Unfortunately, the data only allow for the construction of a national series for the wealth-to-GDP ratio, and hence the national ratio is applied for all provinces and all household types in each regression.

The data used to calculate the real growth rate of national consumer credit variable (‘$CRED_t$’) are obtained from the People’s Bank of China (PBOC) and the China Statistical Yearbook. The PBOC publishes annual data for the total value of national consumer credit outstanding from 1998 onward. This data series is first adjusted for inflation using annual CPI data from the China Statistical Yearbook in order to obtain the real level of credit outstanding at the 1998 price level. It is then straightforward to calculate the annual real rate of expansion of outstanding consumer credit, hence generating a series for annual growth in consumer credit issuance. Unfortunately, observations for the first four years of the sample are missing (1995 to 1998 inclusive), and again, the data only allow for the construction of a single annual series at the national level, which is used for all provinces and all household types in each regression.

The data used to calculate the national pension replacement rate variable (‘PRR_t’) are obtained from the China Statistical Yearbook. Specifically, the rate is estimated using data for the number of participants receiving the basic urban pension, total pensions paid by pension funds, and the average wage of urban workers. Dividing total pensions paid by the number of participants receiving pensions yields the average pension per participant, and subsequently dividing the average pension by the average wage yields an estimate of the pension replacement rate. This methodology yields an annual series for the pension replacement rate very similar to that reported by Li (2013). Again, the data required to compute the series are available only at the national and not the provincial level. Hence, the national pension replacement rate is applied for all provinces and all household types in each regression.

Data used to calculate the national real annual interest rate variable (‘INT_t’) are obtained from the PBOC. Following the methodology of Horioka and Wan (2007), the one-year real deposit rate is used as an indicator for real interest rates. The series is calculated based on daily data for the one-year nominal deposit rate, published by PBOC. To the extent that different rates were in effect within the same calendar year, an average annual nominal rate is calculated using weights according to the number of days that each rate was in effect during the given year. Finally, the average annual nominal rate is deflated for inflation by subtracting the national CPI inflation rate (from the China Statistical Yearbook) from the nominal interest rate. Again, the data only allow for the construction of a single series for the national real deposit rate, which is applied for all provinces and all household types in each regression.

Although the range of data for the sample spans from 1995 to 2014 (20 years inclusive), a number of observations are lost as a result of including the series for the lagged saving rate and income growth (data not available for the first year, 1995), credit growth (data not available for the first four years, 1995-1999), and income volatility (data not available for the final three years, 2012-2014). As a result of these factors, the sample size is significantly reduced. In addition, data are missing for income, saving and inflation for the year 2003. In order to avoid losing further observations, values for the income and saving in 2003 are estimated by taking the average of values for 2002 and 2004. This method is justified as the series for each of these variables is steadily increasing over time, and there is no reason to suspect that 2003 would be an outlier. On the other hand, the series for inflation appears more random and without a clear trend. In this case, the national rate of inflation in 2003 is used as an estimate for the inflation rate for each province in 2003.

Finally, a note of caution about the coverage and quality of Chinese data is in order before proceeding further. A number of studies have questioned the reliability of China's economic data (for example, see Koch-Wesser (2013), Rawski (2001), and Kraay (2000)). In order to minimise the risk that poor quality data compromise the results of this analysis, household survey data is used wherever possible in preference over other sources such as national accounts data. In the context of analysing household saving, Kraay (2000) argues that household survey data is more appropriate and likely to be more accurate. Nonetheless, results should be treated with caution, and with this caveat firmly in mind.

6.2. Estimation Techniques

The model is first estimated using OLS panel regression with fixed cross-section effects. The use of fixed cross-section effects reflects significant differences between Chinese provinces. As such, it is appropriate to introduce cross-sectional dummy variables and allow for separate intercept estimates for each province.

The model is estimated using aggregated data for all households (urban and rural), and also for urban and rural households separately in order to test whether the determinants of household saving differ across rural and urban households (Hypothesis Eight). In each case, the model specification is identical, except that the explanatory variable pension replacement rate (PRR_t) is excluded for the rural household saving regression. This reflects the fact that the data for the pension replacement rate relates to urban pension schemes, and that pension coverage in rural areas is very low (Shi, 2006).

A number of robustness checks are performed to minimise the risk of unreliable parameter estimation and hypothesis testing. All data series are tested for stationarity using multiple unit root tests. Explanatory variables are also tested for multicollinearity. Additionally, estimated equations are tested for heteroscedasticity, autocorrelation and cross-section dependence, and when required, remedial action is taken by re-estimating the models with robust standard errors (either White Period or Period SUR Panel Corrected Standard Errors (PCSE)). Separately, each estimated equation is tested for redundant fixed effects, in order to check whether including fixed cross-section effects is necessary and appropriate.

Further, as demonstrated by Nickell (1981), OLS estimators in a dynamic model with fixed-effects tend to be biased in samples with a small number of time observations, as is the case in this study. As a counter-balance for this potential problem, the panel model is also estimated using the GMM technique for all households in aggregate, and for rural and urban households separately. GMM estimation has the additional option of including lagged variables as instruments for explanatory variables suspected of being endogenous. Hence, GMM estimation provides a robustness check against potential bias in the fixed-effects estimators and endogeneity. Moreover, GMM estimators are robust to heteroscedasticity, and distributional assumptions regarding the error terms more broadly (Baum et al., 2003). The GMM methodology employed involves taking differences of all variables, and using two lagged observations of all variables as instruments to counter any endogeneity issues.

7. Results

Before estimating Equation (1), a number of tests are run on the underlying data. As demonstrated by Abadir (1993), using non-stationary data for OLS estimation of dynamic models can result in significantly biased estimators. Hence, each variable is separately tested for non-stationarity by comparing the results of the Levin, Lin and Chu (LLC) test, the Im, Pesaran, and Shin (IPS) test and the Augmented Dicker Fuller (ADF) test. This approach reflects the analysis by Maddala and Wu (1999) regarding the relative strengths and weaknesses of common unit root tests for panel data. Each test is run separately with both an intercept only, and an intercept and trend component. The results of the tests reveal that data for the old ratio, young ratio, dependency ratio, wealth-to-GDP ratio and the pension replacement ratio are likely to be non-stationary (Table A1.1, Appendix). The urban saving rate and lagged urban saving rate also appear to be non-stationary, while the saving rates for rural households and for all households are stationary. This result is not surprising given that

Figures 4 and 5 show a steady upward trend over time in the urban saving rate, while it is more difficult to decipher a time trend in the rural saving rate.

To rectify the problem, first differences are taken for all non-stationary variables and unit root tests are re-applied to test whether the variables are stationary in first difference form. The results suggest that taking first differences yields a stationary series in each case, except perhaps for the pension replacement rate (Table A1.2, Appendix). Although there may be some risk that the differenced pension replacement rate remains non-stationary, the data are left in first differenced form rather than taking second differences for ease of interpretation.

Further, the explanatory variables are tested for the presence of multicollinearity. Casual inference from Figure 6 suggests that the young ratio and overall dependency ratio are likely to be closely correlated. Moreover, initial estimation of Equation (1) yields high R-squared statistics for all households, and for urban and rural households separately, although few explanatory variables are individually significant. According to Gujarati (2003), this is a common symptom of multicollinearity. The correlation coefficient matrices for urban, rural and all households datasets reveal that the dependency and young ratios are positively correlated with a correlation coefficient of around 0.95 (Tables A2.1-3, Appendix). At the same time, the real interest rate is strongly negatively correlated with inflation, and credit growth is strongly positively correlated with the pension replacement ratio. As a further check, auxiliary regressions are estimated in which each explanatory variable in Equation (1) is regressed against all other explanatory variables. The R-squared statistics from the auxiliary regressions are reported in Tables A2.4-A2.6 in the Appendix. The explanatory power of the auxiliary regressions is above the absolute value of 0.80 when the regressand is any of the demographic variables, the real interest rate, inflation and consumer credit growth. This is the case for each of the datasets for urban, rural and all households.

As a remedial measure, the dependency ratio and real interest rate variables are excluded from the model. Much of the variance in the overall dependency ratio is captured by the young ratio, and Hypothesis Two can be tested with only the young and old ratios included. Although including the deposit interest rate as an explanatory variable is common practice among empirical studies of saving, in the case of China, real interest rates were often close to, or even below zero during the sampling period. It is reasonable to expect that both income and substitution effects of interest rate changes are likely to be muted in this environment. Hence, excluding the real interest rate is not expected to diminish the fit or appropriateness of the model.

Wald tests are performed for Equation (1) with the differenced variables substituted for those variables found to be non-stationary in level form. The tests confirm that the dependency ratio and real interest rate are jointly insignificant for urban, rural and all households, and can be dropped from the model without affecting its goodness of fit (Tables A4.1-3). Moreover, re-estimating the auxiliary regressions without the interest rate and dependency ratio, and with the non-stationary variables in first difference form, yields much lower R-squared statistics (below 0.60 in all cases), suggesting that collinearity between the explanatory variables is significantly lower following these amendments (Tables A3.1-6). With the issues of non-stationary data and multicollinearity resolved, an amended version of Equation (1) can be estimated, which is expressed as follows:

$$SR_{t,i} = \beta_{0i} + \beta_1 CHY_{t,i} + \beta_2 d(YOUNG_{t,i}) + \beta_3 d(OLD_{t,i}) + \beta_5 SR_{t-1,i} + \beta_6 UNCERT_{t,i} + \beta_7 INFL_{t,i} + \beta_8 d(WEALTH_t) + \beta_9 CRED_t + \beta_{10} d(PRR_t) + \varepsilon_{t,i} \quad (2)$$

As with Equation (1), the pension replacement rate is omitted in the model for rural households. For urban households, first differences are also taken for the saving rate and lagged saving rate. Otherwise, Equation (2) is identical for urban, rural and all households.

Once estimated, Equation (2) is tested for the presence of autocorrelation, heteroscadisticity and cross-section fixed effects, each of which can have adverse consequences for the accuracy of coefficient estimates, and/or hypothesis testing. The dynamic form of the model and the unbalanced panel data sample precludes the use of the Durbin-Watson test to investigate autocorrelation. Instead, the test proposed by Wooldridge to detect autocorrelation in panel data is conducted, and the results reveal the presence of first-order serial correlation (test results are summarised in Tables A5.1-3, Appendix). In addition, the amended Breusch-Pagan test suggested by Verbeek (2012) to detect heteroscedasticity in panel data reveals a strong probability of heteroscedastic error terms in the urban regression, and a weaker probability of heteroscedastic errors in the rural and all household estimations (test results are summarised in Tables A6.1-3, Appendix). Further, both Breusch Pagan LM and Pesaran tests suggest there is cross-section dependence in the fixed-effects estimations of Equation (2) (Tables A7.1-3, Appendix). As noted by Hoechle (2007), ignoring cross-section dependence in panel estimation can yield biased results and unreliable statistical tests. As a result, fixed-effects panel estimations employ both White Period and Period SUR PCSE methods to derive the covariance matrix and improve the accuracy of hypothesis testing. The former controls for heteroscedasticity and autocorrelation in the error terms, while the latter additionally accounts for cross-section dependence. Results for all households are shown in Table One below.

Table 1. Results for All Households

OLS and GMM panel estimation
Dependent variable: household saving rate (SR)

	Fixed Effects	**Fixed Effects**	**GMM**
	(White covariance matrix)	(Period SUR, PCSE)	(White covariance matrix)
Transformations	Differences of non-stationary variables	Differences of non-stationary variables	First differences (all)
Constant	10.002 (1.756)***	10.002 (1.555)***	
Income growth (CHY)	0.116 (0.054)**	0.116 (0.063)*	0.170 (0.027)***
D(Young ratio (YOUNG))	-0.077 (0.132)	-0.077 (0.104)	-0.507 (0.076)***
D(Old ratio (OLD))	-0.304 (0.125)**	-0.304 (0.140)**	-0.707 (0.160)***
Lagged saving rate (SR_{t-1})	0.555 (0.058)***	0.555 (0.056)***	0.396 (0.023)***
Future income uncertainty (UNCERT)	0.032 (0.219)	0.032 (0.136)	-0.152 (0.159)
Inflation (INFL)	0.096 (0.038)**	0.096 (0.061)	0.155 (0.057)***
D(Wealth-to-GDP ratio (WEALTH))	-0.013 (0.007)*	-0.013 (0.008)	0.016 (0.005)***
Consumer credit growth (CRED)	0.001 (0.002)	0.001 (0.003)	-0.011 (0.002)***
D(Pension replacement ratio (PRR))	0.159 (0.057)***	0.159 (0.057)***	0.268 (0.033)***
Observations	374	374	312
R-squared	0.837	0.837	
F-statistic	44.135	44.135	
Probability (F-statistic)	0.000	0.000	
J-statistic			24.024
Probability (J-statistic)			0.346

*Significant at10% significance level; **Significant at 5% significance level; ***Significant at 1% significance level
Note: Standard errors are included in brackets beneath each coefficient estimate.

Overall, the model performs well in explaining the saving rate for all households in China, with an R-squared statistic of approximately 0.84 for the fixed-effects model, and the F-statistic is highly significant. Testing for redundant fixed-effects reveals that fixed-effects dummy variables are highly jointly significant, verifying the choice of estimating the model with fixed cross-section effects (test results are summarised in Table A8.1, Appendix). The results indicate that income growth is positively correlated with the saving rate. The coefficient for income growth suggests that a one percentage point increase in household income growth is associated with a 0.12 percentage point increase in the saving rate. The coefficient estimate is significant at the 5 per cent significance level with White robust errors, and at the 1 per cent significance level with Period SUR PCSE. The result is also supported by GMM estimation, which suggests an even larger positive effect of income growth on the saving rate. Coefficients for the differenced young ratio have the expected negative sign, but are not significant in the fixed-effects estimation. However, GMM estimation suggests an even stronger negative relationship between the young ratio and saving rate, which is significant at the one per cent significance level. All three estimation methods suggest a strong and statistically significant negative relationship between the differenced old ratio and the saving rate. Fixed-effects estimation suggests that a one percentage point increase in the change in the old ratio is associated with 0.30 percentage point decrease in the saving ratio.

There is strong evidence of habit formation among Chinese households in all three estimation methods. The coefficient for lagged saving in the fixed-effects estimation suggests that a one percentage point increase in the saving rate last year is associated with a 0.56 percentage point increase in the saving rate in the current period. GMM estimation yields a lower, but still positive and statistically significant coefficient estimate for lagged saving. Interestingly, different estimation techniques produce coefficients with different signs for future income volatility, although none are statistically significant. The results of all estimation methods suggest that higher inflation is associated with a higher saving rate. In the fixed-effects estimation, a one percentage point increase in inflation is associated with a 0.10 percentage point increase in the saving rate, however the result is not significant with Period SUR PCSE. The GMM coefficient is lower but still positive, and significant at the one per cent level. The coefficient estimates for the differenced wealth-to-GDP are positive but very small, which is contradictory to the expected relationship that higher wealth leads to lower saving. Only the GMM coefficient is statistically significant.

The coefficient estimates for consumer credit growth are not statistically different to zero in the fixed-effects estimation, but GMM estimation produces a small negative coefficient of -0.01, significant at the one per cent level. Overall, the results do not provide strong evidence of a meaningful relationship between credit growth and the saving rate for all households. Finally, the coefficients for the differenced pension replacement ratio are positive, contrary to a priori expectations, and statistically significant at the one per cent significance level in all three estimations.

Turning to the results for urban households (Table 2), the model at first glance appears to be much weaker in terms of explaining variation in the saving rate. The R-squared statistic for the fixed-effects model is just 0.18 and the F-statistic is low, although still statistically significant. However, the goodness-of-fit statistic cannot be compared to the results for all households and rural households, as the urban saving rate has been transformed by taking first differences to account for non-stationarity, whereas the saving rates for rural and all households are in levels. For urban households, the cross-sectional dummy variables are not significant, which most likely reflects that the independent variable, and a number of explanatory variables are in differenced form in this model (Table A8.2, Appendix).

Table 2. Results for Urban Households

OLS and GMM panel estimation
Dependent variable: D(Household saving rate (SR))

	Fixed Effects (White covariance matrix)	**Fixed Effects** (Period SUR, PCSE)	**GMM** (White covariance matrix)
Transformation	Differences of non-stationary variables	Differences of non-stationary variables	First differences (all)
Constant	-1.316 (1.025)	-1.316 (0.561)**	
Income growth (CHY)	0.141 (0.102)	0.141 (0.048)***	0.156 (0.015)***
D(Young ratio (YOUNG))	-0.262 (0.088)***	-0.262 (0.071)***	-0.147 (0.048)***
D(Old ratio (OLD))	0.022 (0.086)	0.022 (0.112)	-0.040 (0.066)
D(Lagged saving rate (SR_{t-1}))	-0.210 (0.087)**	-0.210 (0.052)***	0.566 (0.029)***
Future income uncertainty (UNCERT)	0.268 (0.075)***	0.268 (0.072)***	-0.166 (0.041)***
Inflation (INFL)	0.171 (0.072)**	0.171 (0.064)***	0.185 (0.020)***
D(Wealth-to-GDP ratio (WEALTH))	0.008 (0.010)	0.008 (0.010)	-0.008 (0.006)
Consumer credit growth (CRED)	-0.005 (0.003)	-0.005 (0.002)**	0.008 (0.001)***
D(Pension replacement ratio (PRR))	0.013 (0.041)	0.013 (0.045)	-0.096 (0.022)***
Observations	401	401	371
R-squared	0.182	0.182	
F-statistic	2.057	2.057	
Probability (F-statistic)	0.000	0.000	
J-statistic			27.741

Probability (J-statistic)	0.184

*Significant at10% significance level; **Significant at 5% significance level; ***Significant at 1% significance level
Note: Standard errors are included in brackets beneath each coefficient estimate.

All estimation methods suggest a positive relationship between income growth and the saving rate for urban households. Fixed-effects estimation suggests a one percentage point increase in income growth leads to an increase in the change in the saving rate of 0.14, although the result is not statistically significant when White Period errors are used. Coefficient estimates for the demographic variables contrast to those for all households. All coefficients for the young ratio are negative and highly significant, with the fixed-effects estimator suggesting that a one percentage point increase in the young ratio is associated with a 0.26 percentage point decrease in the saving rate. For urban households, the old ratio is not statistically different to zero under any estimation technique. The negative coefficient estimates for the lagged saving rate produced by the fixed effects estimation appear to contradict Hypothesis Three. The estimates suggest an increase of one percentage point in the saving rate last period leads to a decrease of 0.21 percentage points in the saving rate this period. In contrast, the GMM coefficient suggests a positive and highly significant relationship.

Interestingly, fixed-effects estimation produces a positive and highly significant coefficient for expected future income uncertainty, consistent with Hypothesis Four, while GMM estimation produces a negative coefficient. Fixed-effects estimation suggests that a one unit increase in expected future income volatility is associated with an increase of 0.27 percentage points in the change in the saving rate, while GMM estimation suggests a negative relationship. The coefficient for inflation is positive and highly significant under all estimation techniques, with fixed-effects estimation indicating that a one percentage point increase in inflation leads to a 0.17 percentage point increase in the change in the saving rate. The GMM estimate suggests a relationship of similar magnitude.

The fixed-effects estimation of the coefficient for the wealth-to-GDP ratio for urban households is again not statistically different to zero, which is consistent with the fixed effects estimate for all households. The GMM coefficient is also not statistically significant, hence corroborating the fixed-effects result. Congruent to the results for all households, evidence for a meaningful relationship between credit growth and saving among urban households is lacking. Coefficient estimates for the pension replacement ratio are very small and point in opposite directions. Fixed-effects estimation produces coefficients with a positive sign, in contrast to a priori expectations, and the estimated coefficients are not significant at any significance level. In contrast, GMM estimation yields a statistically significant coefficient with the expected negative sign.

Finally, the results for rural households are presented in Table 3 below. The fixed effects model appears to perform well, with an R-squared statistic of 0.85, similar in magnitude to that for all households. The F-statistic of 50.13 indicates the explanatory variables are jointly significant in explaining the saving rate, and testing for redundant fixed-effects reveals that cross-sectional dummy variables are highly significant for rural households (Table A8.3).

Table 3. Results for Rural Households

OLS and GMM panel estimation
Dependent variable: household saving rate (SR)

	Fixed Effects (White covariance matrix)	**Fixed Effects** (Period SUR, PCSE)	**GMM** (White covariance matrix)
Transformation	Differences of non-stationary variables	Differences of non-stationary variables	First differences (all)
Constant	8.128 (2.163)***	8.128 (1.683)***	
Income growth (CHY)	0.285 (0.079)***	0.285 (0.080)***	0.144 (0.038)***
D(Young ratio (YOUNG))	-0.175 (0.194)	-0.175 (0.154)	0.001 (0.076)
D(Old ratio (OLD))	-0.159 (0.201)	-0.159 (0.225)	-1.389 (0.267)***
Lagged saving rate (SR_{t-1})	0.549 (0.069)***	0.549 (0.055)***	0.139 (0.019)***
Future income uncertainty (UNCERT)	0.026 (0.196)	0.026 (0.165)	0.942 (0.195)***
Inflation (INFL)	-0.118 (0.080)	-0.118 (0.092)	-0.155 (0.061)**
D(Wealth-to-GDP ratio (WEALTH))	-0.035 (0.011)***	-0.035 (0.012)***	0.020 (0.007)***
Credit growth (CRED)	0.017 (0.004)***	0.017 (0.004)***	0.08 (0.003)***
Observations	371	371	309
R-squared	0.852	0.852	
F-statistic	50.131	50.131	
Probability (F-statistic)	0.000	0.000	
J-statistic			25.895
Probability (J-statistic)			0.306

*Significant at10% significance level; **Significant at 5% significance level; ***Significant at 1% significance level
Note: Standard errors are included in brackets beneath each coefficient estimate.

Results for rural households provide the strongest evidence for a meaningful positive relationship between income growth and the saving rate. Fixed effects estimation indicates that a one percentage point increase in income growth is associated with a 0.28 percentage point increase in the saving rate. GMM estimation also yields a positive coefficient, and in all cases, the results are significant at the one per cent significance level. Interestingly, demographic variables are not statistically significant in any estimation, except for the old ratio as estimated by GMM, the coefficient for which indicates the expected negative relationship. Overall however, the evidence suggests that demographic factors are not important for the saving rate among rural households.

The coefficient for lagged saving is positive and highly significant under all three estimation methods. The fixed effects estimation suggests that a one percentage point increase in the saving rate last period is associated with a 0.55 percentage point increase in saving in the current period. The GMM estimator is lower, but still positive and highly significant. Fixed effects coefficient estimates for both expected income uncertainty and inflation are not statistically different to zero, suggesting that greater uncertainty is not associated with higher saving among rural households as expected. On the other hand, GMM estimation produces the expected positive and significant relationship between expected income uncertainty and the rural saving rate, but a negative relationship between inflation and the rural saving rate. In all cases, the estimated coefficients for the wealth-to-GDP ratio are highly significant but very small. Moreover, fixed effects estimation results in the expected negative coefficient, while GMM estimation results in a positive, but very small coefficient. Finally, the coefficient for credit growth is positive and highly significant under all three estimation methods, which contradicts a priori expectations expressed under Hypothesis Six that stronger credit growth is associated with lower saving. That said, the coefficients are very small, casting doubt over whether there is a meaningful relationship between credit growth and rural saving. This may be because poorer households in China have weaker access to both formal and informal credit markets, and rural households on average have significantly lower incomes compared to their urban counterparts (Yuan, 2015). As credit data in this study is obtained at the national level, it may obscure an imbalance in access to credit between urban and rural households.

To summarise, once non-stationary variables and multicollinearity are accounted for, the model in Equation (2) performs well in explaining variation in Chinese household saving rates. There is robust evidence that household income growth is a positive driver of household saving rates for all households, urban households and particularly for rural households. There is also strong evidence of saving inertia among Chinese households, given the clear positive relationship between past and present saving in almost all estimations of the model. Demographic variables also appear to be important, though more so for urban and overall households, than for rural households. For the former, both the young and old ratios have the expected negative coefficients in most cases. There is some evidence that higher future income uncertainty drives higher saving among urban households, but the relationship is tenuous, particularly among rural households. In some cases, evidence suggests inflation is associated with higher saving, though not among rural households. There is little evidence for a clear or meaningful relationship between wealth and household saving ratios, and the same can be said for credit growth and saving. There is very little evidence that the pension replacement rate is negatively associated with household saving as hypothesised.

Finally, a note of caution is appropriate with regard to the estimation results. As mentioned previously, dynamic panel estimation with fixed-effects can suffer from the 'Nickell Bias', which results in inconsistent parameter estimation. Hence, GMM estimations are intended as a form of robustness check for the fixed-effects estimations. However, the estimated standard errors for GMM coefficients are suspiciously small, which results in most variables being highly significant. Although the GMM models are estimated with a robust White Period covariance matrix that corrects for heteroscedasticity and autocorrelation, it is possible that errors are not estimated accurately as a result of cross-section dependence. As noted by Hoechle (2007), cross-section dependence can result in unreliable statistical testing. Hence, there are sufficient reasons to treat both the fixed-effects and GMM results with caution.

8. Conclusion

This paper tests a number of hypotheses regarding the drivers of high household saving in China, in the context of policy makers' efforts to rebalance domestic demand such that private consumption plays a stronger role as a driver of economic growth. Based on the results, Hypothesis One can be confirmed with a reasonable degree of confidence. There is convincing evidence that strong growth in household income has been a factor behind higher saving rates in China in recent decades. There is also evidence in favour of Hypothesis Two, regarding the role of demographic factors in explaining household saving. In particular, results indicate that the falling young ratio appears to have been a driver of higher urban household saving, however the evidence for rural households is not convincing. This may be due to the fact that policies aimed at reducing Chinese population growth in earlier decades were more targeted toward urban households (Peng, 2000). Together, the results regarding Hypotheses One and Two provide strong support for the explanatory power of the LCH in the

Chinese context, and are broadly consistent with the findings of Modigliani and Cao (2004) and Horioka and Wan (2007), although the latter conclude that the evidence is weaker regarding demographic factors.

Hypothesis Three can be also be confirmed. There is strong evidence that high saving in the past is associated with high saving in the present, suggesting that habit formation and saving inertia are important factors behind China's high saving rate. While this conclusion is consistent with behavioural theories of habit formation, it is at odds with the implications of the LCH and PIH models. Again, the finding is consistent with Horioka and Wan (2007). Evidence for Hypothesis Four must be carefully nuanced. If both inflation and expected income volatility are interpreted as volatility indicators, there is substantial evidence that urban households and households overall save for precautionary reasons, consistent with the buffer-stock model of saving. However, the same conclusion cannot be drawn for rural households. Hence, Hypothesis Four can be confirmed for urban but not rural households.

The results do not support Hypotheses Five and Six. Coefficient estimates for the differenced wealth-to-GDP ratio are very small, often have conflicting signs and are rarely statistically significant. Hence, this study does not find convincing evidence of a meaningful relationship between household wealth and saving. Credit growth coefficients also tend to be small, and often have a positive sign, contradicting the a priori hypothesis that stronger credit growth is associated with lower saving, expressed under Hypothesis Six. As with household wealth, evidence of a meaningful relationship between consumer credit growth and household saving is lacking, and Hypothesis Six cannot be confirmed.

The evidence for Hypothesis Seven is also disappointing. Only the GMM coefficient for the pension replacement rate for urban households has the expected negative sign, while coefficients under fixed-effects estimation are positive and not significant. On balance, evidence that a lower pension replacement ratio for urban households is associated with higher saving is not compelling, and Hypothesis Seven cannot be confirmed. Finally, results suggest that the drivers of saving are indeed different for urban and rural households, as expressed under Hypothesis Eight. For urban households, higher income growth, a lower young ratio and an aversion to uncertainty appear to be key drivers of high saving. For rural households, strong income growth and past saving habits are unambiguously the most important drivers of household saving, while demographic factors appear not to be relevant.

Again, the conclusions drawn are subject to concerns about the quality of Chinese economic data, and the respective weaknesses associated with fixed-effects estimation of dynamic panel models, and with GMM estimation in the presence of cross-section dependence. Hence, the estimation results and associated conclusions should be interpreted with these caveats in mind.

That said, the results provide several policy insights as Chinese policy makers attempt to catalyse the transition toward stronger consumption growth. First, facilitating a stable macroeconomic environment is likely to assist with gradually reducing the household saving rate. In particular, achieving stable, low inflation and consistent GDP and income growth are likely to be important. The IMF's recommendation of pursuing potentially lower, but ultimately more sustainable GDP growth is likely to ease high saving rates (IMF, 2015).

Second, although deliberate policies to reduce the birth rate in China were scaled back in the 1990s, the after-effects continue to have a significant impact on China's demographic structure. Efforts to gradually reverse the chronic trend of a declining young ratio may help to reverse China's high saving ratio. Moreover, such policies may also assist with the related issue of improving the long-term sustainability of the pension system. That said, this policy implication is likely to be controversial for a country with such a large population, and where historically, policy efforts have aimed to achieve the opposite goal of containing the birth rate and overall population growth.

Separately, pursuing further financial deregulation and improving access to affordable credit, particularly among poorer and rural households is likely to be consistent with the objective of lowering the saving rate. Although the evidence in this study regarding the relationship between credit growth and saving is not strong, existing literature finds a negative relationship between financial deregulation and saving rates in other contexts (for example, Bayoumi, 1993). Moreover, the difficulties faced by poorer Chinese households in accessing affordable credit are well documented by Yuan, (2015).

All factors considered, it is reasonable to expect that the household saving rate will gradually decline from its historical high going forward. Gradually slowing GDP growth, the prospect of further financial liberalisation, and the UN's projections for rising old and overall dependency ratios are all likely to weigh on household saving. Future studies could add further value by developing a framework to test the combined impact of these factors for household saving in China.

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Appendix

A1. Testing for Stationarity in All Variables

Table A1.1 Unit Root Tests: All Variables in Level Form

Variable: Saving rate, all households		
Intercept only		
Null hypothesis: Unit root		
	Test Statistic	**Probability**
Levin, Lin & Chu (LLC)	-6.74	0.000
Im, Pesaran, & Shin (IPS)	-6.20	0.000
ADF - Fischer	151.01	0.000
Intercept and trend		
Null hypothesis: Unit root		
	Test Statistic	**Probability**
Levin, Lin & Chu (LLC)	-2.44	0.007
Im, Pesaran, & Shin (IPS)	-3.99	0.000
ADF - Fischer	113.36	0.000
Conclusion: No evidence of non-stationarity		
Variable: Lagged saving rate, all households		
Intercept only		
Null hypothesis: Unit root		
	Test Statistic	**Probability**
Levin, Lin & Chu (LLC)	-5.56	0.000
Im, Pesaran, & Shin (IPS)	-5.18	0.000
ADF - Fischer	144.76	0.000
Intercept and trend		
Null hypothesis: Unit root		
	Test Statistic	**Probability**
Levin, Lin & Chu (LLC)	-1.18	0.12
Im, Pesaran, & Shin (IPS)	-3.69	0.000
ADF - Fischer	101.27	0.001
Conclusion: On balance, evidence suggests the data are stationary		
Variable: Income growth, all households		
Intercept only		
Null hypothesis: Unit root		
	Test Statistic	**Probability**
Levin, Lin & Chu (LLC)	-6.61	0.000
Im, Pesaran, & Shin (IPS)	-7.60	0.000

ADF - Fischer	172.67	0.000
Intercept and trend Null hypothesis: Unit root		
	Test Statistic	**Probability**
Levin, Lin & Chu (LLC)	-5.52	0.000
Im, Pesaran, & Shin (IPS)	-7.37	0.000
ADF - Fischer	173.38	0.000
Conclusion: No evidence of non-stationarity		

Variable: Young ratio Intercept only Null hypothesis: Unit root		
	Test Statistic	**Probability**
Levin, Lin & Chu (LLC)	-10.77	0.000
Im, Pesaran, & Shin (IPS)	-3.86	0.000
ADF - Fischer	122.22	0.000
Intercept and trend Null hypothesis: Unit root		
	Test Statistic	**Probability**
Levin, Lin & Chu (LLC)	1.54	0.938
Im, Pesaran, & Shin (IPS)	4.34	1
ADF - Fischer	63.51	0.423
Conclusion: Substantial evidence of non-stationarity		

Variable: Old ratio Intercept only Null hypothesis: Unit root		
	Test Statistic	**Probability**
Levin, Lin & Chu (LLC)	-2.25	0.012
Im, Pesaran, & Shin (IPS)	1.08	0.859
ADF - Fischer	44.86	0.950
Intercept and trend Null hypothesis: Unit root		
	Test Statistic	**Probability**
Levin, Lin & Chu (LLC)	-5.34	0.000
Im, Pesaran, & Shin (IPS)	-3.54	0.000
ADF - Fischer	100.66	0.001
Conclusion: Substantial evidence of non-stationarity		

Variable: Dependency ratio Intercept only		

Null hypothesis: Unit root		
	Test Statistic	**Probability**
Levin, Lin & Chu (LLC)	-7.23	0.000
Im, Pesaran, & Shin (IPS)	-2.22	0.013
ADF - Fischer	83.45	0.036
Intercept and trend		
Null hypothesis: Unit root		
	Test Statistic	**Probability**
Levin, Lin & Chu (LLC)	-1.74	0.041
Im, Pesaran, & Shin (IPS)	-0.08	0.467
ADF - Fischer	75.34	0.119
Conclusion: Significant evidence of non-stationarity		

Variable: Future income volatility, all households		
Intercept only		
Null hypothesis: Unit root		
	Test Statistic	**Probability**
Levin, Lin & Chu (LLC)	-6.41	0.000
Im, Pesaran, & Shin (IPS)	-6.60	0.000
ADF - Fischer	147.75	0.000
Intercept and trend		
Null hypothesis: Unit root		
	Test Statistic	**Probability**
Levin, Lin & Chu (LLC)	-6.47	0.000
Im, Pesaran, & Shin (IPS)	-5.43	0.000
ADF - Fischer	129.20	0.000
Conclusion: No evidence of non-stationarity		

Variable: Inflation		
Intercept only		
Null hypothesis: Unit root		
	Test Statistic	**Probability**
Levin, Lin & Chu (LLC)	-20.45	0.000
Im, Pesaran, & Shin (IPS)	-18.69	0.000
ADF - Fischer	384.74	0.000
Intercept and trend		
Null hypothesis: Unit root		
	Test Statistic	**Probability**
Levin, Lin & Chu (LLC)	-17.58	0.000
Im, Pesaran, & Shin (IPS)	-14.46	0.000

ADF - Fischer	276.29	0.000
Conclusion: No evidence of non-stationarity		
Variable: Wealth-to-GDP ratio		
Intercept only		
Null hypothesis: Unit root		
	Test Statistic	**Probability**
Levin, Lin & Chu (LLC)	-4.00	0.000
Im, Pesaran, & Shin (IPS)	0.50	0.692
ADF - Fischer	37.90	0.993
Intercept and trend		
Null hypothesis: Unit root		
	Test Statistic	**Probability**
Levin, Lin & Chu (LLC)	-8.44	0.000
Im, Pesaran, & Shin (IPS)	-7.25	0.000
ADF - Fischer	147.25	0.000
Conclusion: Some evidence non-stationarity		
Variable: Consumer credit growth		
Intercept only		
Null hypothesis: Unit root		
	Test Statistic	**Probability**
Levin, Lin & Chu (LLC)	-12.99	0.000
Im, Pesaran, & Shin (IPS)	-9.80	0.000
ADF - Fischer	199.50	0.000
Intercept and trend		
Null hypothesis: Unit root		
	Test Statistic	**Probability**
Levin, Lin & Chu (LLC)	-6.92	0.000
Im, Pesaran, & Shin (IPS)	-1.70	0.044
ADF - Fischer	66.43	0.327
Conclusion: On balance, evidence suggest the data are stationary		
Variable: Pension replacement ratio		
Intercept only		
Null hypothesis: Unit root		
	Test Statistic	**Probability**
Levin, Lin & Chu (LLC)	-15.19	0.000
Im, Pesaran, & Shin (IPS)	-7.09	0.000
ADF - Fischer	150.03	0.000
Intercept and trend		

Null hypothesis: Unit root		
	Test Statistic	**Probability**
Levin, Lin & Chu (LLC)	5.56	1.000
Im, Pesaran, & Shin (IPS)	6.26	1.000
ADF - Fischer	7.42	1.000
Conclusion: Significant evidence of non-stationarity		

Variable: Real interest rate		
Intercept only		
Null hypothesis: Unit root		
	Test Statistic	**Probability**
Levin, Lin & Chu (LLC)	8.91	1.000
Im, Pesaran, & Shin (IPS)	-1.87	0.031
ADF - Fischer	58.00	0.621
Intercept and trend		
Null hypothesis: Unit root		
	Test Statistic	**Probability**
Levin, Lin & Chu (LLC)	-12.87	0.000
Im, Pesaran, & Shin (IPS)	-16.68	0.000
ADF - Fischer	319.65	0.000
Conclusion: Limited evidence of non-stationarity		

Variable: Saving rate, urban households		
Intercept only		
Null hypothesis: Unit root		
	Test Statistic	**Probability**
Levin, Lin & Chu (LLC)	-1.12	0.132
Im, Pesaran, & Shin (IPS)	1.97	0.976
ADF - Fischer	55.92	0.693
Intercept and trend		
Null hypothesis: Unit root		
	Test Statistic	**Probability**
Levin, Lin & Chu (LLC)	-2.57	0.005
Im, Pesaran, & Shin (IPS)	-3.40	0.000
ADF - Fischer	110.53	0.000
Conclusion: Significant evidence of non-stationarity		

Variable: Lagged saving rate, urban households		
Intercept only		
Null hypothesis: Unit root		
	Test Statistic	**Probability**

Levin, Lin & Chu (LLC)	-0.06	0.475
Im, Pesaran, & Shin (IPS)	4.18	1.000
ADF - Fischer	37.36	0.994
Intercept and trend		
Null hypothesis: Unit root		
	Test Statistic	**Probability**
Levin, Lin & Chu (LLC)	-5.96	0.000
Im, Pesaran, & Shin (IPS)	-4.03	0.000
ADF - Fischer	106.13	0.000
Conclusion: significant evidence of non-stationarity		
Variable: Income growth, urban households		
Intercept only		
Null hypothesis: Unit root		
	Test Statistic	**Probability**
Levin, Lin & Chu (LLC)	-10.27	0.000
Im, Pesaran, & Shin (IPS)	-10.65	0.000
ADF - Fischer	227.66	0.000
Intercept and trend		
Null hypothesis: Unit root		
	Test Statistic	**Probability**
Levin, Lin & Chu (LLC)	-8.44	0.000
Im, Pesaran, & Shin (IPS)	-6.46	0.000
ADF - Fischer	159.71	0.000
Conclusion: No evidence of non-stationarity		
Variable: Future income volatility, urban households		
Intercept only		
Null hypothesis: Unit root		
	Test Statistic	**Probability**
Levin, Lin & Chu (LLC)	-5.89	0.000
Im, Pesaran, & Shin (IPS)	-6.62	0.000
ADF - Fischer	148.99	0.000
Intercept and trend		
Null hypothesis: Unit root		
	Test Statistic	**Probability**
Levin, Lin & Chu (LLC)	-7.27	0.000
Im, Pesaran, & Shin (IPS)	-6.89	0.000
ADF - Fischer	154.21	0.000

Conclusion: No evidence of non-stationarity		
Variable: Saving rate, rural households		
Intercept only		
Null hypothesis: Unit root		
	Test Statistic	**Probability**
Levin, Lin & Chu (LLC)	-1.09	0.137
Im, Pesaran, & Shin (IPS)	-4.81	0.000
ADF - Fischer	132.96	0.000
Intercept and trend		
Null hypothesis: Unit root		
	Test Statistic	**Probability**
Levin, Lin & Chu (LLC)	-2.10	0.018
Im, Pesaran, & Shin (IPS)	-4.10	0.000
ADF - Fischer	119.85	0.000
Conclusion: On balance, the data appear to be stationary		
Variable: Lagged saving rate, rural households		
Intercept only		
Null hypothesis: Unit root		
	Test Statistic	**Probability**
Levin, Lin & Chu (LLC)	-4.30	0.000
Im, Pesaran, & Shin (IPS)	-6.72	0.000
ADF - Fischer	160.27	0.000
Intercept and trend		
Null hypothesis: Unit root		
	Test Statistic	**Probability**
Levin, Lin & Chu (LLC)	-4.65	0.000
Im, Pesaran, & Shin (IPS)	-5.7	0.000
ADF - Fischer	139.59	0.000
Conclusion: No evidence of non-stationarity		
Variable: Income growth, rural households		
Intercept only		
Null hypothesis: Unit root		
	Test Statistic	**Probability**
Levin, Lin & Chu (LLC)	-1.65	0.050
Im, Pesaran, & Shin (IPS)	-3.40	0.000
ADF - Fischer	117.76	0.000
Intercept and trend		
Null hypothesis: Unit root		

	Test Statistic	Probability
Levin, Lin & Chu (LLC)	-7.96	0.000
Im, Pesaran, & Shin (IPS)	-9.45	0.000
ADF - Fischer	199.85	0.000
Conclusion: No evidence of non-stationarity		

Variable: Future income volatility, rural households
Intercept only
Null hypothesis: Unit root

	Test Statistic	Probability
Levin, Lin & Chu (LLC)	-8.85	0.000
Im, Pesaran, & Shin (IPS)	-8.87	0.000
ADF - Fischer	192.05	0.000

Intercept and trend
Null hypothesis: Unit root

	Test Statistic	Probability
Levin, Lin & Chu (LLC)	-6.47	0.000
Im, Pesaran, & Shin (IPS)	-3.75	0.000
ADF - Fischer	114.56	0.000
Conclusion: No evidence of non-stationarity		

Table A1.2. Unit Root Tests: Variables Transformed by Taking First Differences

Variable: Saving rate, urban households (first difference)
Intercept only
Null hypothesis: Unit root

	Test Statistic	Probability
Levin, Lin & Chu (LLC)	-18.28	0.000
Im, Pesaran, & Shin (IPS)	-17.99	0.000
ADF - Fischer	377.35	0.000

Intercept and trend
Null hypothesis: Unit root

	Test Statistic	Probability
Levin, Lin & Chu (LLC)	-14.20	0.000
Im, Pesaran, & Shin (IPS)	-13.89	0.000
ADF - Fischer	273.25	0.000

Conclusion: No evidence of non-stationarity

Variable: Lagged saving rate, urban households (first difference)
Intercept only
Null hypothesis: Unit root

	Test Statistic	Probability
Levin, Lin & Chu (LLC)	-24.55	0.000
Im, Pesaran, & Shin (IPS)	-21.23	0.000
ADF - Fischer	441.72	0.000

Intercept and trend
Null hypothesis: Unit root

	Test Statistic	Probability
Levin, Lin & Chu (LLC)	-3.31	0.001
Im, Pesaran, & Shin (IPS)	-5.93	0.000
ADF - Fischer	144.29	0.000

Conclusion: No evidence of non-stationarity

Variable: Young ratio (first difference)
Intercept only
Null hypothesis: Unit root

	Test Statistic	Probability
Levin, Lin & Chu (LLC)	-4.10	0.000
Im, Pesaran, & Shin (IPS)	-6.43	0.000
ADF - Fischer	161.97	0.000

Intercept and trend
Null hypothesis: Unit root

	Test Statistic	Probability
Levin, Lin & Chu (LLC)	-17.52	0.000
Im, Pesaran, & Shin (IPS)	-16.13	0.000
ADF - Fischer	322.66	0.000

Conclusion: No evidence of non-stationarity

Variable: Old ratio (first difference)

Intercept only

Null hypothesis: Unit root

	Test Statistic	Probability
Levin, Lin & Chu (LLC)	-19.94	0.000
Im, Pesaran, & Shin (IPS)	-18.28	0.000
ADF - Fischer	385.24	0.000

Intercept and trend

Null hypothesis: Unit root

	Test Statistic	Probability
Levin, Lin & Chu (LLC)	-16.15	0.000
Im, Pesaran, & Shin (IPS)	-14.28	0.000
ADF - Fischer	282.75	0.000

Conclusion: No evidence of non-stationarity

Variable: Dependency ratio (first difference)

Intercept only

Null hypothesis: Unit root

	Test Statistic	Probability
Levin, Lin & Chu (LLC)	-19.17	0.000
Im, Pesaran, & Shin (IPS)	-16.89	0.000
ADF - Fischer	362.66	0.000

Intercept and trend

Null hypothesis: Unit root

	Test Statistic	Probability
Levin, Lin & Chu (LLC)	-18.04	0.000
Im, Pesaran, & Shin (IPS)	-16.67	0.000
ADF - Fischer	326.21	0.000

Conclusion: No evidence of non-stationarity

Variable: Wealth-to-GDP ratio (first difference)

Intercept only

Null hypothesis: Unit root

	Test Statistic	Probability
Levin, Lin & Chu (LLC)	-27.32	0.000

Im, Pesaran, & Shin (IPS)	-23.38	0.000
ADF - Fischer	486.44	0.000
Intercept and trend Null hypothesis: Unit root		
	Test Statistic	**Probability**
Levin, Lin & Chu (LLC)	-23.91	0.000
Im, Pesaran, & Shin (IPS)	-19.15	0.000
ADF - Fischer	363.83	0.000
Conclusion: No evidence of non-stationarity		
Variable: Pension replacement ratio (first difference) Intercept only Null hypothesis: Unit root		
	Test Statistic	**Probability**
Levin, Lin & Chu (LLC)	-15.41	0.000
Im, Pesaran, & Shin (IPS)	-11.95	0.000
ADF - Fischer	244.96	0.000
Intercept and trend Null hypothesis: Unit root		
	Test Statistic	**Probability**
Levin, Lin & Chu (LLC)	-3.21	0.001
Im, Pesaran, & Shin (IPS)	-0.42	0.338
ADF - Fischer	41.09	0.981
Conclusion: Some evidence of non-stationarity		

A2. Testing for Multicollinearity in Equation One

Table A2.1 Correlation Coefficients (all households)

	CRED	DEP	CHY	UNCERT	INFL	INT	SR_{-1}	PRR	OLD	WEALTH	YOUNG
CRED	1.00	0.34	-0.37	0.24	-0.58	0.66	0.03	0.89	-0.28	-0.33	0.39
DEP	0.34	1.00	-0.16	0.29	-0.27	0.32	-0.20	0.42	-0.16	-0.29	0.95
CHY	-0.37	-0.16	1.00	-0.15	0.11	-0.16	-0.01	-0.39	0.30	0.34	-0.23
UNCERT	0.24	0.29	-0.15	1.00	-0.11	0.12	-0.01	0.24	-0.15	-0.20	0.31
INFL	-0.58	-0.27	0.11	-0.11	1.00	-0.90	-0.05	-0.64	0.12	0.23	-0.28
INT	0.66	0.32	-0.16	0.12	-0.90	1.00	-0.02	0.71	-0.14	-0.21	0.33
SR_{-1}	0.03	-0.20	-0.01	-0.01	-0.05	-0.02	1.00	-0.02	0.07	0.00	-0.20
PRR	0.89	0.42	-0.39	0.24	-0.64	0.71	-0.02	1.00	-0.30	-0.55	0.47
OLD	-0.28	-0.16	0.30	-0.15	0.12	-0.14	0.07	-0.30	1.00	0.15	-0.44
WEALTH	-0.33	-0.29	0.34	-0.20	0.23	-0.21	0.00	-0.55	0.15	1.00	-0.31
YOUNG	0.39	0.95	-0.23	0.31	-0.28	0.33	-0.20	0.47	-0.44	-0.31	1.00

Table A2.2 Correlation Coefficients (urban households)

	DEP	WEALTH	INFL	SR_{-1}	CRED	PRR	INT	OLD	CHY	UNCERT	YOUNG
DEP	1.00	-0.28	-0.26	-0.30	0.33	0.41	0.31	-0.16	-0.09	0.35	0.95
WEALTH	-0.28	1.00	0.24	0.40	-0.32	-0.55	-0.21	0.16	0.13	-0.25	-0.31
INFL	-0.26	0.24	1.00	0.34	-0.57	-0.65	-0.89	0.12	-0.22	-0.20	-0.28
SR_{-1}	-0.30	0.40	0.34	1.00	-0.34	-0.51	-0.33	0.16	0.03	-0.29	-0.32
CRED	0.33	-0.32	-0.57	-0.34	1.00	0.89	0.66	-0.27	-0.01	0.25	0.38
PRR	0.41	-0.55	-0.65	-0.51	0.89	1.00	0.71	-0.29	0.03	0.31	0.46
INT	0.31	-0.21	-0.89	-0.33	0.66	0.71	1.00	-0.14	0.19	0.19	0.33
OLD	-0.16	0.16	0.12	0.16	-0.27	-0.29	-0.14	1.00	0.16	-0.20	-0.45
CHY	-0.09	0.13	-0.22	0.03	-0.01	0.03	0.19	0.16	1.00	-0.09	-0.13
UNCERT	0.35	-0.25	-0.20	-0.29	0.25	0.31	0.19	-0.20	-0.09	1.00	0.38
YOUNG	0.95	-0.31	-0.28	-0.32	0.38	0.46	0.33	-0.45	-0.13	0.38	1.00

Table A2.3 Correlation Coefficients (rural households)

	CRED	DEP	CHY	UNCERT	INFL	INT	SR_{-1}	YOUNG	WEALTH	OLD
CRED	1.00	0.34	-0.61	0.05	-0.58	0.66	0.16	0.39	-0.33	-0.28
DEP	0.34	1.00	-0.35	0.04	-0.27	0.32	-0.14	0.96	-0.29	-0.16
CHY	-0.61	-0.35	1.00	-0.02	0.43	-0.52	-0.10	-0.40	0.42	0.27
UNCERT	0.05	0.04	-0.02	1.00	0.04	0.01	0.02	0.06	-0.08	-0.06
INFL	-0.58	-0.27	0.43	0.04	1.00	-0.90	-0.18	-0.28	0.23	0.12
INT	0.66	0.32	-0.52	0.01	-0.90	1.00	0.11	0.33	-0.21	-0.14
SR_{-1}	0.16	-0.14	-0.10	0.02	-0.18	0.11	1.00	-0.13	-0.15	0.00
YOUNG	0.39	0.96	-0.40	0.06	-0.28	0.33	-0.13	1.00	-0.31	-0.44
WEALTH	-0.33	-0.29	0.42	-0.08	0.23	-0.21	-0.15	-0.31	1.00	0.17
OLD	-0.28	-0.16	0.27	-0.06	0.12	-0.14	0.00	-0.44	0.17	1.00

Table A2.4 Auxiliary Regressions for Equation One (all households)

This table reports the R-squared statistics from regressing each explanatory variable against all other explanatory variables in Equation One, for all households

Regressand	**R-squared**
Income growth	0.25
Young ratio	0.99
Old Ratio	0.99
Dependency Ratio	0.99
Lagged Saving Rate	0.08
Future Income Volatility	0.15
Inflation	0.81
Wealth-to-GDP Ratio	0.50
Credit Growth	0.84
Pension Replace	0.90
Interest Rate	0.85

Table A2.5 Auxiliary Regressions for Equation One (urban households)

This table reports the R-squared statistics from regressing each explanatory variable against all other explanatory variables in Equation One, for urban households

Regressand	**R-squared**
Income growth	0.15
Young ratio	0.99
Old Ratio	0.99
Dependency Ratio	0.99
Lagged Saving Rate	0.34
Future Income Volatility	0.20
Inflation	0.81
Wealth-to-GDP Ratio	0.50
Credit Growth	0.84
Pension Replacement Rate	0.91
Interest Rate	0.85

Table A2.6 Auxiliary Regressions for Equation One (rural households)

This table reports the R-squared statistics from regressing each explanatory variable against all other explanatory variables in Equation One, for rural households

Regressand	**R-squared**
Income growth	0.48
Young ratio	0.99
Old Ratio	0.99
Dependency Ratio	0.99
Lagged Saving Rate	0.12
Future Income Volatility	0.08
Inflation	0.82
Wealth-to-GDP Ratio	0.24
Credit Growth	0.57
Interest Rate	0.85

A3. Testing for Multicollinearity in Equation Two

Table A3.1 Correlation Coefficients (all households)

	D(OLD)	D(PRR)	D(WEALTH)	D(YOUNG)	CHY	UNCERT	INFL	SR_{-1}	CRED
D(OLD)	1.00	0.05	0.02	0.24	0.08	0.06	-0.07	-0.07	-0.17
D(PRR)	0.05	1.00	0.04	0.13	0.24	0.01	0.01	0.01	-0.03
D(WEALTH)	0.02	0.04	1.00	-0.17	0.11	0.01	-0.52	-0.06	0.28
D(YOUNG)	0.24	0.13	-0.17	1.00	0.11	0.07	0.09	0.08	-0.18
CHY	0.08	0.24	0.11	0.11	1.00	-0.15	0.11	-0.01	-0.37
UNCERT	0.06	0.01	0.01	0.07	-0.15	1.00	-0.11	-0.01	0.24
INFL	-0.07	0.01	-0.52	0.09	0.11	-0.11	1.00	-0.05	-0.58
SR_{-1}	-0.07	0.01	-0.06	0.08	-0.01	-0.01	-0.05	1.00	0.03
CRED	-0.17	-0.03	0.28	-0.18	-0.37	0.24	-0.58	0.03	1.00

Table A3.2 Correlation Coefficients (urban households)

	D(WEALTH)	D(YOUNG)	D(OLD)	D(PRR)	CHY	UNCERT	INFL	SR_{-1}	CRED
D(WEALTH)	1.00	-0.16	0.02	0.06	0.24	0.03	-0.51	-0.09	0.28
D(YOUNG)	-0.16	1.00	0.24	0.14	0.00	0.13	0.09	0.12	-0.17
D(OLD)	0.02	0.24	1.00	0.03	0.12	0.07	-0.08	-0.12	-0.16
D(PRR)	0.06	0.14	0.03	1.00	0.10	-0.11	0.04	0.26	-0.01
CHY	0.24	0.00	0.12	0.10	1.00	-0.09	-0.22	0.03	-0.01
UNCERT	0.03	0.13	0.07	-0.11	-0.09	1.00	-0.20	-0.29	0.25
INFL	-0.51	0.09	-0.08	0.04	-0.22	-0.20	1.00	0.34	-0.57
SR_{-1}	-0.09	0.12	-0.12	0.26	0.03	-0.29	0.34	1.00	-0.34
CRED	0.28	-0.17	-0.16	-0.01	-0.01	0.25	-0.57	-0.34	1.00

Table A3.1 Correlation coefficients (rural households)

	CRED	D(OLD)	D(WEALTH)	D(YOUNG)	CHY	UNCERT	INFL	SR_{-1}
CRED	1.00	-0.16	0.28	-0.17	-0.61	0.05	-0.58	0.16
D(OLD)	-0.16	1.00	0.02	0.24	-0.06	0.13	-0.07	-0.01
D(WEALTH)	0.28	0.02	1.00	-0.17	-0.14	-0.09	-0.52	-0.02
D(YOUNG)	-0.18	0.24	-0.17	1.00	0.20	0.00	0.09	0.03
CHY	-0.61	-0.06	-0.14	0.20	1.00	-0.02	0.43	-0.10
UNCERT	0.05	0.13	-0.09	0.00	-0.02	1.00	0.04	0.02
INFL	-0.58	-0.07	-0.52	0.09	0.43	0.04	1.00	-0.18
SR_{-1}	0.16	-0.01	-0.02	0.03	-0.10	0.02	-0.18	1.00

Table A3.4 Auxiliary Regressions for Equation Two (All households)

This table reports the R-squared statistics from regressing each explanatory variable against all other explanatory variables in Equation Two, for all households

Regressand	R-squared
Income growth	0.25
D(Young ratio)	0.13
D(Old Ratio)	0.13
Lagged Saving Rate	0.03
Future Income Volatility	0.08
Inflation	0.50
D(Wealth-to-GDP Ratio)	0.32
Credit Growth	0.49
D(Pension Replacement Rate)	0.08

Table A3.5 Auxiliary Regressions for Equation Two (urban households)

This table reports the R-squared statistics from regressing each explanatory variable against all other explanatory variables in Equation Two, for urban households

Regressand	R-squared
Income growth	0.12
D(Young ratio)	0.14
D(Old Ratio)	0.14
D(Lagged Saving Rate)	0.09
Future Income Volatility	0.15
Inflation	0.50
D(Wealth-to-GDP Ratio)	0.30
Credit Growth	0.42
D(Pension Replacement Rate)	0.10

Table A3.6 Auxiliary Regressions for Equation Two (rural households)

This table reports the R-squared statistics from regressing each explanatory variable against all other explanatory variables in Equation Two, for rural households

Regressand	R-squared
Income growth	0.43
D(Young ratio)	0.13
D(Old Ratio)	0.18
Lagged Saving Rate	0.06
Future Income Volatility	0.04
Inflation	0.52
D(Wealth-to-GDP Ratio)	0.32
Credit Growth	0.55

A4. Excluding Interest Rate and Dependency Ratio From Equation Two: Wald Tests

Table A4.1 Wald Test (all households)

Null hypothesis: Coefficients for interest rate and dependency ratio are jointly zero		
	Test Statistic	**Probability**
F-statistic	2.71	0.068
Chi-square	5.42	0.067
Conclusion: Do not reject the null hypothesis at the one or five per cent significance levels, and conclude that the interest rate and dependency rate are jointly insignificant for all households		

Table A4.2 Wald Test (urban households)

Null hypothesis: Coefficients for interest rate and dependency ratio are jointly zero		
	Test Statistic	**Probability**
F-statistic	1.71	0.183
Chi-square	3.42	0.181
Conclusion: Do not reject the null hypothesis and conclude that the interest rate and dependency rate are jointly insignificant for urban households		

Table A4.3 Wald Test (rural households)

Null hypothesis: Coefficients for the interest rate and dependency ratio are jointly zero		
	Test Statistic	**Probability**
F-statistic	1.26	0.295
Chi-square	2.52	0.284
Conclusion: Do not reject the null hypothesis and conclude that the interest rate and dependency rate are jointly insignificant for rural households		

A5. Testing Equation Two for Autocorrelation: Wooldridge Tests

Table A5.1 Wooldridge Test (all households)

Auxiliary 1: $d(SR_{t,i}) = \beta_{0i} + \beta_1 d(CHY_{t,i}) + \beta_2 d(YOUNG_{t,i}) + \beta_3 d(OLD_{t,i}) + + \beta_4 d(SR_{t-1,i}) + \beta_5 d(UNCERT_{t,i}) + \beta_6 d(INFL_{t,i}) + \beta_7 d(WEALTH_t) + \beta_8 d(CRED_t) + \beta_9 d(PRR_t) + \varepsilon_{t,i}$

Auxiliary regression 2: $RESIDS\ (aux1) = \alpha RESIDS\ (aux1)_{-1}$

Null hypothesis: Coefficient estimate for α is not statistically different to -0.5

Coefficient estimate (α)	**Test statistic** (α = -0.5)	**Probability** (α = -0.5)
-0.07	7.45	0.000

Conclusion: Reject the null hypothesis and conclude that α is statistically different to -0.5. There is first-order autocorrelation in the model

Table A5.2 Wooldridge Test (urban households)

Auxiliary regression 1: $d(SR_{t,i}) = \beta_{0i} + \beta_1 d(CHY_{t,i}) + \beta_2 d(YOUNG_{t,i}) + \beta_3 d(OLD_{t,i}) + + \beta_4 d(SR_{t-1,i}) + \beta_5 d(UNCERT_{t,i}) + \beta_6 d(INFL_{t,i}) + \beta_7 d(WEALTH_t) + \beta_8 d(CRED_t) + \beta_9 d(PRR_t) + \varepsilon_{t,i}$

Auxiliary regression 2: $RESIDS(aux1) = \alpha RESIDS(aux1)_{-1}$

Null hypothesis: Coefficient estimate for α is not statistically different to -0.5

Coefficient estimate (α)	**Test statistic** (α = -0.5)	**Probability** (α = -0.5)
-0.15	6.91	0.000

Conclusion: Reject the null hypothesis and conclude that alpha is statistically different to -0.5. There is first order autocorrelation in the model

Table A5.3 Wooldridge Test (rural households)

Auxiliary regression 1: $d(SR_{t,i}) = \beta_{0i} + \beta_1 d(CHY_{t,i}) + \beta_2 d(YOUNG_{t,i}) + \beta_3 d(OLD_{t,i}) + + \beta_4 d(SR_{t-1,i}) + \beta_5 d(UNCERT_{t,i}) + \beta_6 d(INFL_{t,i}) + \beta_7 d(WEALTH_t) + \beta_8 d(CRED_t) + \varepsilon_{t,i}$

Auxiliary regression 2: $RESIDS(aux1) = \alpha RESIDS(aux1)_{-1}$

Null hypothesis: Coefficient estimate for α is not statistically different to -0.5

Coefficient estimate (α)	**Test statistic** (α = -0.5)	**Probability** (α = -0.5)
0.02	8.62	0.000

Conclusion: Reject the null hypothesis and conclude that alpha is statistically different to -0.5. There is first order autocorrelation in the model

A6. Testing Equation Two for Heteroscedasticity: Breusch-Pagan Tests

Table A6.1 Breusch-Pagan Test (all households)

Auxiliary regression: $(\widehat{Resids(eq}2)_{t,i})^2 = \beta_{0i} + \beta_1(CHY_{t,i}) + \beta_2 d(YOUNG_{t,i}) + \beta_3 d(OLD_{t,i}) + \beta_4(SR_{t-1,i}) + \beta_5(UNCERT_{t,i}) + \beta_6(INFL_{t,i}) + \beta_7 d(WEALTH_t) + \beta_8(CRED_t) + \beta_9 d(PRR_t) + \varepsilon_{t,i}$

Null hypothesis: All coefficients are jointly equal to zero, except for the constant

R-squared (aux)	Test statistic[4]	Critical value (α=0.05)
0.040799	15.18	16.919

Conclusion: Do not reject the null hypothesis at the one or five per cent significance levels, and conclude that heteroscedasticity is unlikely to be present

Table A6.2 Breusch-Pagan Test (urban households)

Auxiliary regression: $(\widehat{Resids(eq}2)_{t,i})^2 = \beta_{0i} + \beta_1(CHY_{t,i}) + \beta_2 d(YOUNG_{t,i}) + \beta_3 d(OLD_{t,i}) + \beta_4 d(SR_{t-1,i}) + \beta_5(UNCERT_{t,i}) + \beta_6(INFL_{t,i}) + \beta_7 d(WEALTH_t) + \beta_8(CRED_t) + \beta_9 d(PRR_t) + \varepsilon_{t,i}$

Null hypothesis: All coefficients are jointly equal to zero, except for the constant

R-squared (aux)	Test statistic	Critical value (α=0.05)
0.147698	54.94	16.919

Conclusion: Reject the null hypothesis and conclude that heteroscedasticity is present

Table A6.3 Breusch-Pagan Test (rural households)

Auxiliary regression: $(\widehat{Resids(eq}2)_{t,i})^2 = \beta_{0i} + \beta_1(CHY_{t,i}) + \beta_2 d(YOUNG_{t,i}) + \beta_3 d(OLD_{t,i}) + + \beta_4(SR_{t-1,i}) + \beta_5(UNCERT_{t,i}) + \beta_6(INFL_{t,i}) + \beta_7 d(WEALTH_t) + \beta_8(CRED_t) + \varepsilon_{t,i}$

Null hypothesis: All coefficients are jointly equal to zero, except for the constant

R-squared (aux)	Test statistic	Critical value (α=0.05)
0.064186	14.94	15.507

Conclusion: Do not reject the null hypothesis at the one or five per cent significance levels, and conclude that heteroscedasticity is unlikely to be present

[4] The test statistic is given by $N(T-1) * R^2_{aux}$, as outlined by Verbeek, 2012.

A7. Testing Equation Two for Cross-section Dependence

Table A7.1 Cross-section Dependence (all households)

Null hypothesis: No cross-section dependence		
	Test Statistic	**Probability**
Breusch Pagan LM	712.27	0.000
Pesaran Scaled LM	8.11	0.000
Pesaran CD	13.76	0.000
Conclusion: Reject the null hypothesis conclude that cross-sectional dependence is present		

Table A7.2 Cross-section Dependence (urban households)

Null hypothesis: No cross-section dependence		
	Test Statistic	**Probability**
Breusch Pagan LM	598.85	0.000
Pesaran Scaled LM	4.39	0.000
Pesaran CD	5.59	0.000
Conclusion: Reject the null hypothesis and conclude that cross-section dependence is present		

Table A7.3 Cross-section Dependence (rural households)

Null hypothesis: No cross-section dependence		
	Test Statistic	**Probability**
Breusch Pagan LM	892.47	0.000
Pesaran Scaled LM	14.02	0.000
Pesaran CD	19.26	0.000
Conclusion: Reject the null hypothesis and conclude that cross-section dependence is present		

A8. Testing Equation Two for Redundant Fixed Effects

Table A8.1 Redundant Fixed Effects (all households)

Null hypothesis: Fixed cross-section effects are redundant		
	Test Statistic	**Probability**
Cross-section F-statistic	2.69	0.000
Cross-section Chi-square	80.83	0.000
Conclusion: Reject the null hypothesis and conclude that cross-section dummy variables are statistically significant		

Table A8.2 Redundant Fixed Effects (urban households)

Null hypothesis: Fixed cross-section effects are redundant		
	Test Statistic	**Probability**
Cross-section F-statistic	0.67	0.908
Cross-section Chi-square	21.73	0.864
Conclusion: Do not reject the null hypothesis. Fixed cross-section effects are likely to be irrelevant		

Table A8.3 Redundant Fixed Effects (rural households)

Null hypothesis: Fixed cross-section effects are redundant		
	Test Statistic	**Probability**
Cross-section F-statistic	2.51	0.000
Cross-section Chi-square	75.72	0.000
Conclusion: Reject the null hypothesis and conclude that cross-section dummy variables are statistically significant		