

The Role of Household Saving in the Economic Rise of China*

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Abstract

The saving rate in China is high by historical and international norms. The high saving rate has funded capital accumulation which in turn has been the primary driver of China's economic growth. We review the evidence on Chinese household saving and conduct a small study to assess the importance of the precautionary motive for saving.

Keywords: Household saving, Precautionary motive, China

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*Very Preliminary.

1 Introduction

In this paper, we report the results of a small study that compares precautionary saving in China to that in the U.S. This is but one of many aspects of household saving in China which has recently received attention in the research community, and household saving itself is only dimension of the country's gross national saving. We are taking a look at a small piece of a very big topic.

The big picture issue is this. Despite the recent media and political attention given to Chinese external surpluses, the primary driver of decades of double-digit Chinese aggregate GDP growth which has lifted millions out of subsistence-level poverty, has not been exports but investment spending. Because the capital account is essentially closed, especially in terms of financial capital, most of China's investment has been financed by domestic sources of saving. That is the sum of government, corporate, and household saving. Of these three components, household saving has been and continues to be the largest piece of gross national saving. Today, household saving is high both by historical and by international standards. Hence, it has been the component that has received the most research. The precautionary motive for saving is, to date, perhaps the least researched aspect of household saving in China.

Developing a thorough and nuanced understanding of Chinese saving is becoming an important topic, however, precisely because of the ongoing and increasing external imbalances between surplus countries such as China and deficit countries such as the U.S. The trajectories of imbalances cannot be sustained and increasingly, calls are being made for China to re-balance its growth away from investment towards consumption. (Less vociferous calls are being made for the U.S. to control its fiscal position and to increase household saving.) This would require less saving by the Chinese and more saving by Americans. Hence, it would appear that a necessary precondition to have a productive conversation about growth re-balancing would be to a good understanding of why the Chinese save so much.

A review of the data, which we do in the next section, will show that China's economic rise since the free market reforms were implemented in 1978 that the Chinese growth model has primarily been investment driven. GDP growth has remained steady and high even during recessionary times of the rest of the world. The investment to GDP ratio has also been high by international standards. The current account surplus to GDP ratio, which has historically been moderate, began to surge only in 2005, hence garnering substantial attention in the policy arena, but what is perhaps less widely discussed is that the investment to GDP ratio has also been rising since 2005. Since the capital account, especially with respect to financial capital, is (nearly) closed, real investment has been financed entirely by domestic sources of saving. A

review of the patterns of saving by household, corporate or enterprise and government sectors shows that the surge in saving that has accompanied (or caused) the surge in the current account has come from the government sector.

A review of recent literature on household saving in China finds that the empirical research has mainly focused on testing aspects of the life-cycle/permanent income theory of saving. In turn, we focus our attention on the effects of the income growth rate, demographic variations, and income uncertainty on the household saving rate. Interestingly, previous research that has looked at these determinants have reported mixed results. We focus on these factors because their behavior has been on the extreme, and hence, their explanatory power should be high. Income growth, we know has been exceedingly high, there have been immense changes in the Chinese demographic structure and these changes should have widespread implications for the saving rate and economic life in China is substantially more risky than it is in the developed/industrialized world. That demographic changes, largely brought on by population control measures (the one-child policy) since the late 1970s should matter stems from reductions in average family size, thereby loosening household budget constraints, and a rise in the old-age dependency ratio which affects the solvency of formal and informal sources of retirement support. The narrative often given for why there should be a strong precautionary element to Chinese household saving is convincing. In a nutshell, the story is that the cradle-to-grave social welfare safety net provided by the government under central planning has been all but dismantled. Housing, education, and old-age income support that once was provided by the enterprises are now the responsibility of individuals. Reform and downsizing of the state sector (1995-2005) resulted in massive movements of labor from State Owned Enterprises (hereafter SOEs) to private and foreign-owned firms and associated increases in income uncertainty. The narrative suggests that economic life is sizably and significantly more risky in China than it is in the United States. This narrative is also backed up by what we find in the data.

The remainder of the paper is organized as follows. The next section undertakes a review of recent trends in GDP growth, investment, and saving in China. Section 3 presents a selected review of the literature on Chinese household saving studies. Section 4 reviews some recent work by the authors on the role of demographic variations on Chinese saving. Section 5 discusses a small scale study on the precautionary motive for saving in China, and Section 6 concludes.

2 Saving and Growth: Some International Comparisons

The story of China's phenomenal economic growth since the implementation of free market reforms in 1978 and its attendant rise in the world economy has been told often and is by

now well known. Table 1 shows annual real GDP growth rates in selected years for the G-3 plus China, where we see three mature economies that have more or less have attained the steady state and one country that is in transition. China experiences high growth rates around 10 percent per year. It experiences only moderate slowdowns to breakneck growth in 1990 and in the aftermath of the Asian financial crisis (1998-99). Certainly Japan did much worse during the Asian crisis. In the recent mortgage-backed securities crisis, the U.S. suffered somewhat, Germany and Japan got clobbered but China seems to have emerged for the most part unscathed. A resumption of pre-crisis growth patterns across all four countries appears to be securely underway.

	USA	Germany	Japan	China
1981	2.54	0.11	4.18	5.20
1985	4.14	2.19	6.33	13.50
1990	1.88	5.72	5.57	3.79
1991	-0.23	5.01	3.32	9.21
1992	3.39	1.87	0.82	14.19
1995	2.51	1.97	1.88	10.90
1997	4.46	1.85	1.56	9.30
1998	4.36	1.82	-2.05	7.80
1999	4.83	1.88	-0.14	7.60
2002	1.81	0.02	0.26	9.10
2003	2.49	-0.24	1.41	10.00
2004	3.57	0.74	2.74	10.10
2005	3.05	0.91	1.93	11.30
2006	2.67	3.57	2.04	12.70
2007	1.95	2.78	2.36	14.20
2008	0.00	0.70	-1.17	9.60
2009	-2.63	-4.67	-6.29	9.20
2010	2.83	3.50	3.94	10.30

To illustrate how China's rapid growth combined with its aggregate size has altered its relative position in the world economy, Table 2 shows the composition of real GDP on a PPP basis of the G-3 plus China since 1978. On a PPP basis, China's economy is bigger than when it is computed in U.S. dollars. In any event, the point is that at the time of the reforms, China was a trivial part of the world economy amounting to only 5 percent of the combined output

of the world's three largest economies. To say that the country was dirt poor would not be an exaggeration. While on a per capita basis, China ranks 126 in the world with per capita GDP 15 percent the size of the U.S., by sheer force of numbers, it is the world's second largest economy.¹ Probably, research in international macroeconomics should not omit or ignore China as we go forward.

Table 2: Share of output. Source PWT7.0

Year	USA	Japan	Germany	China
1978	0.57	0.22	0.16	0.05
1984	0.55	0.22	0.15	0.08
1990	0.53	0.23	0.14	0.10
1995	0.51	0.21	0.13	0.15
1999	0.52	0.19	0.12	0.17
2000	0.52	0.19	0.12	0.17
2001	0.51	0.18	0.12	0.18
2002	0.51	0.18	0.12	0.20
2003	0.50	0.17	0.11	0.21
2004	0.50	0.17	0.11	0.22
2005	0.49	0.16	0.10	0.24
2006	0.48	0.16	0.10	0.26
2007	0.47	0.16	0.10	0.28
2008	0.46	0.15	0.10	0.29
2009	0.44	0.14	0.09	0.32

The source of this growth, it would seem, is the same as predicted from textbook models of growth, namely capital accumulation and improvements in total factor productivity. In China's case, the contribution from capital accumulation may be dominant, as Table 3 shows. The table reports the ratio of investment to GDP (5 year averages) for the G-3 and China. As can be seen, China's investment, which had been on a torrid pace for the last 30 years seems to have accelerated in the 5 years since 2005 which is all the more noteworthy since this interval includes the recent financial crisis. China's experience contrasts sharply with the G-3. Over the years, the investment share of GDP has remained fairly stable in the U.S. while Germany and Japan have experienced fairly large declines (of about 7 percentage points over the sample).

¹CIA World Factbook, 2011.

	Average of previous 5 years			
	USA	Germany	Japan	China
1985	20.8	24.4	29.1	39.2
1990	19.8	24.2	30.5	37.3
1995	17.8	22.8	29.8	40.4
2000	20.1	21.4	26.8	37.4
2005	19.3	17.6	23.5	40.1
2010	17.8	17.7	22.3	45.2

Exports, by comparison, seem to be much less important as a driver of growth, as seen in Table 4 which shows the current account imbalances. China ran deficits in the 1980s before turning into relatively small surpluses until 2004. However, even from 2005 onwards, as the Chinese current account surplus begins to surge, these external imbalances are not that much out of line with those of Germany or Japan. The protracted worsening of the current account deficit for the U.S. is legendary. Perhaps it can be argued that China's current account perhaps amounted to an unusually large percent of GDP in 2006-2008. Along with patterns of growth, patterns of current accounts that were interrupted by the crisis appears also to have resumed. The point isn't that China's current account imbalance is not large (it is), or that exports aren't important (they are). The point is that large current account surpluses in China is a relatively recent phenomenon while high growth has been going on for 30 years.

Table 4: Current Account Percentage of GDP

Year	USA	Germany	Japan	China
1980	0.08	-1.73	-1.00	0.14
1985	-2.80	2.65	3.75	-3.75
1986	-3.30	4.21	4.26	-2.43
1989	-1.82	4.56	2.13	-0.96
1990	-1.36	2.93	1.44	3.07
1991	0.05	-1.34	1.96	3.24
1995	-1.53	-1.17	2.12	0.22
2000	-4.18	-1.71	2.56	1.71
2001	-3.86	0.02	2.14	1.31
2002	-4.30	2.01	2.87	2.44
2003	-4.67	1.89	3.22	2.80
2004	-5.31	4.65	3.74	3.55
2005	-5.92	5.11	3.64	7.13
2006	-5.99	6.45	3.91	9.34
2007	-5.11	7.61	4.82	10.64
2008	-4.66	6.73	3.22	9.65
2009	-2.68	5.00	2.82	5.95
2010	-3.21	5.31	3.57	5.21

Hence, China's growth appears not to be explicitly to have been led by exports but by investment and this investment has primarily been funded by internally generated saving. Why? First, the capital account, especially the financial account, is closed in order for the authorities to maintain a fixed exchange rate with some semblance of monetary control. Second, the current account surpluses tell us that the country has been generating net capital outflows. To see the behavior of the various components of China's internal savings, Table 5 shows a breakdown of Chinese saving by sector.

Table 5: Composition of China's saving. Source: Ma and Yang, 2009.

	Percentage share of GDP	Percentage share of National Saving			Percent Household
	Gross Saving	Government	Corporate	Household	Saving Rate
1995	38	7	42	51	17
2000	37	9	44	49	23
2001	38	11	46	43	24
2002	40	13	45	43	23
2003	44	16	42	42	24
2004	47	10	50	40	24
2005	48	13	42	45	23
2006	50	18	38	44	25
2007	52	21	36	43	26
2008	53	21	35	44	27

Here, it can be seen that the post 2005 surge in current account coincides with a surge in government saving. Government saving rose due to increasing revenues but government expenditures have stayed flat. While a jump in household saving is not the cause of the surging external imbalance, China wouldn't have the current account surplus without the support of high household saving rates. As seen from the table, the household sector accounts for the largest share of national saving.

To summarize, we have seen that China's post 1978 reform economic growth is very fast and it has been driven in large part by high investment rates funded by domestic saving of which household saving is the most important component.

2.1 Who cares?

The persistent external deficits in the U.S. and the growing external surplus in China has led to an increase in China bashing [see Ramiriz and Rong (2009)] and intensified calls for re-balancing growth. The International Monetary Fund's 2010 World Economic Outlook (hereafter WEO) devotes an entire chapter to this topic. As the IMF staff puts it,

For the world economy to sustain a high growth trajectory, the economies that had excessive external deficits before the crisis need to consolidate their public finances in ways that limit damage to potential growth and demand while restructuring their financial sectors to avoid renewed speculative excesses. Economies with excessive surpluses need to develop new sources of demand, as economies with ex-

cessive deficits scale back their imports in response to lower expectations about future income.²

The WEO then goes on in chapter 4 to emphasize exchange rate (i.e., RMB) appreciation as the re-balancing mechanism for surplus countries (i.e., China). There are several reasons, however, that the exchange rate mechanism is not likely to be as effective as the IMF staff suggest. First, re-balancing requires not only a reduction from surplus countries but also a reduction from deficit countries. It is difficult to see how an RMB appreciation can have any meaningful effect on U.S. fiscal balances or on U.S. household saving. Second, the argument for using the exchange rate to adjust the current account rests on the supposition that there will be an effective expenditure switching effect. Dong (2007), however, finds that the importance of the expenditure-switching effect has declined over time and concludes that the scope for current account adjustment from changes in the nominal exchange rate are quite limited. Third, as argued by McKinnon (2006), it is unclear what effect an RMB appreciation would have on saving in China but an appreciation most probably would depress investment thus further exacerbating the country's external surplus.

What are the possible channels of an RMB appreciation on saving? An appreciation has a deflationary impact, and to the extent that the private sector holds foreign currency denominated assets, an appreciation might work through a wealth effect to depress consumption. Also, a contraction in exports would reduce output and hence income. Thus, the uncertain effect that an appreciation would have on income and consumption leaves an uncertain impact on saving. Investment, on the other hand is likely to decline as the costs climb for foreign firms engaging in FDI into China and as Chinese exporting firms cut back national investment after finding themselves in a more challenging environment.

Hence, to find new channels of consumption in the surplus countries, it is necessary to understand why that consumption has been blocked off. The flip side of this topic is to understand why China saves so much.

3 Recent Literature on the Chinese Household Saving Rate

In advanced economies with well developed and functioning capital markets and established rules of corporate governance, we can assume that firms are owned by the households and that households exercise decision making over issues such as dividend policy (i.e., corporate saving). This framework is not applicable for China because a significant share of the business sector is

²WEO 2010, page 25.

comprised of State Owned Enterprises (SOEs) which are not under ultimate control of Chinese households. As a result, the topic of Chinese saving is usually divided into corporate saving [See Goldstein and Lardy (2009), Lin (2009), Prasad (2009), Bayoumi et al. (2010), and Huang (2011)] and household saving, which is our focus.

A notable departure from the investigation of mainstream ideas is Zhang and Wei (2009) who examine the role of the male-to-female sex imbalance, that in some areas of China approach 1.5 to 1. The find evidence for the highly original idea that an increase in the male to female sex imbalance in China results in increased competition among men in the marriage market (e.g., the groom's home ownership a pre-condition for marriage) which results in parents of son(s), to accumulate wealth. However, most research on Chinese household saving have been empirical projects that estimate and test implications of the life-cycle saving theory. These papers have studied the influence of income growth, demographic changes, income uncertainty, and culture.

In terms of the role of income or income growth, Kraay (2000) finds saving rate of rural households fall with higher expectations of future income growth. Modigliani and Cao (2004) find that the saving rate increases with an increase in the long-term growth rate as well as with the deviation of the growth rate from the long-run growth rate. Horioka and Wan (2006) find the saving rate to increase with provincial per capita income growth. These results are mixed but are also puzzling since from the standpoint of the life-cycle theory, households should save or dissave to smooth consumption over the life-cycle. Kraay's results make sense. Probably, the right way to interpret Modigliana and Cao and Horioka and Wan's results is that households view a current increase in the growth rate as transitory so the increased saving is in response to transitory income. This interpretation is supported by Meng's (2003) finding that household consumption increases in response to an increase in both transitory and permanent income.

Researchers have also looked for evidence for habit persistence as evidence for a cultural influence on saving. The idea here is that a fundamental part of Chinese culture is thrift. Modigliani and Cao (2004) reject this idea on prima facie grounds from the observation that the household saving rate in the pre-reform era was very low, averaging 3.9 percent from 1959 to 1977. This was, however, during the central planning era when people participated in an extensive social safety net provided by the state so there may have been few reasons to save. As to the evidence on habit persistence, Horioka and Wan (2006) find that an increase in today's saving rate leads to a higher saving rate tomorrow which they interpret as evidence for habit persistence, whereas Chamon and Prasad fail to find current saving growth to be related to lagged saving growth.

Chamon and Prasad (2010) discovered that the traditional hump-shaped age-saving profile

had in recent years become U-shaped in China, with young and older (still working) households saving a higher fraction of income than middle-aged households. They investigate and find evidence that the shifting burden from the state to individuals for health and education has resulted in the U-shape. Young households save more in anticipation of future high education expense for their young children while older households save more in anticipation of high future medical care costs. Song and Yang (2010) explain the emergence of the U-shaped profile as resulting from the age-earnings profile. They document that the earnings of young workers grow faster than those of older workers while at the same time, cohort-specific age-earnings profile is flatter than what is normal for a transition economy. Hence, the flattened age-earnings profile combined with high entry wages give young workers an incentive to increase saving because their income won't grow very fast over time. For older households, they argue that the saving rate has increased in recent years due to the reforms in the Chinese pension system which has reduced coverage and left the system unfunded.

Demographic factors, as a determinant of saving, is widely discussed but usually not found to be quantitatively or empirically important. In theory, we expect an increase in the youth dependency (e.g., the ratio of youths to working aged people) ratio to lower saving since holding income constant, a higher level of household expenditures should be devoted to children's consumption. We would also expect an increase in the old-age dependency ratio (the ratio of retirees to working aged) to lower saving since the elderly will be financing their consumption from dissaving, whereas an increase in future old-age dependency ratio should increase saving on the grounds that there will be fewer workers to provide support in retirement.

Here, the econometric evidence here is mixed. Kraay (2000) did not find the dependency ratio (he used population divided by employment) to be significant, Modigliani and Cao (2004) found that an increase in the young dependency ratio was associated with a decline in the saving rate, while the evidence in Horioka and Wan (2006) was mixed (sometimes significant, other times not. Also, sometimes the slope coefficients were positive, other times negative). Chamon and Prasad (2010) find only a very small effect of demographics on the saving rate.

The evidence on the precautionary motive for saving is similarly mixed. Kraay (2000) finds future income uncertainty to be insignificant whereas Meng (2003) finds that the saving rate is positively related to past (lagged) income uncertainty and to an increase in the probability of being unemployed. Chamon, Liu and Prasad (2010) examine the China Health and Nutrition Survey (CHNS), the same data set that we employ below, to determine that variance of transitory income increased from 0.04 in 1991 to 0.162 in 2004. This is evidence that income risk has increased in recent years. They then use this to inform their parameterization of a quantitative model in which finitely lived (to age 85) agents with CRRA utility and age-dependent

discount factors. Permanent income becomes deterministic in retirement period. In parameterizing their model, they set the subjective discount factor to be 0.97, the real interest rate to be 1.4 percent which they say matches the real interest rate in China from 1989 to 2005 and a coefficient of relative risk aversion of 4.5. People live with certainty to 60 then survival probabilities kick in. No bequests, assets are lost upon early death. Their main findings are that the estimated increase in volatility of transitory income increases the saving rate by young households by 4 percent. The increased volatility does not affect the saving rate of older households because they already have built up the buffer stock. Pension reform, which they model as a decline in the replacement rate from 78 to 60 percent explains an increase in the saving rate by older household of about 6 or 8 percent but does little to change the saving rate of younger households.

3.1 Demographics and Saving in a Parameterized Overlapping Generations model

China’s demographic landscape has undergone such significant change in the last 30 years, that it is surprising that the empirical literature has not found more systematic evidence of the effect of demographic variation on the saving rate. The most dramatic change is what we think can be defended as an exogenous decline in fertility resulting from enforcement of the one-child policy. As Table 6, Chinese women had a fertility rate of over 6 between 1950 to 1954, but now this figure is even lower than for the U.S.

Table 6: Total Fertility Rates

Year	China	USA
1950-54	6.1	3.4
1970-74	4.8	1.8
1975-79	2.9	1.8
1990-94	1.8	2.0
2005-09	1.8	2.1

Source: Curtis, Lugauer and Mark (2011)

Figure 1 illustrates the magnitude of the changes in China’s age distribution. In this figure, the ratio of the population aged 0 to 17 to the number aged 18 to 60 (labeled young to working) provides us with a measure of family size. Family size is relatively flat until 1975 then falls steadily through 2009. The other series is the old-age dependency ratio (aged 60 to 85 relative to working aged). The old-age dependency ratio begins to rise around 1990 and is projected

to trend upwards sharply after 2009. The current working age population has relatively few retirees to support, but when the current workers retire, there will be relatively few workers to support them. The dramatic change comes from the decline in fertility and also an increase in the average life span.

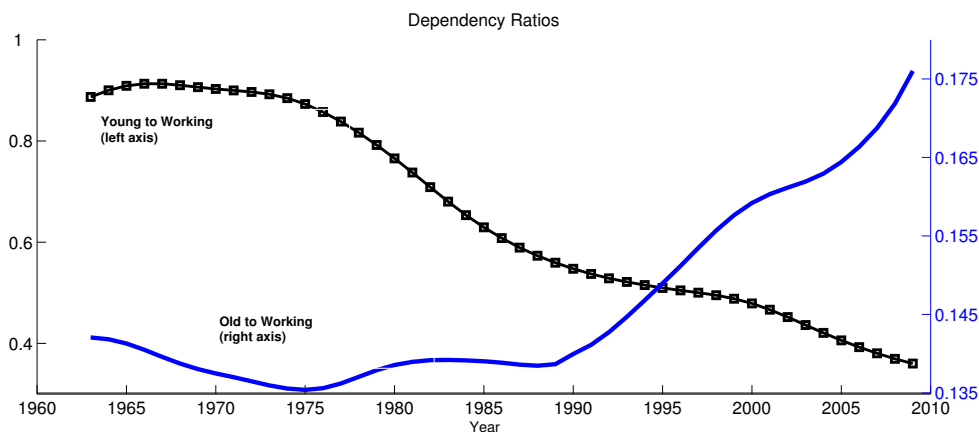


Figure 1: Demographic variation in China. (Source: Curtis, Lugauer and Mark (2011)).

In a quantitative analysis of Chinese household saving, Curtis, Lugauer and Mark (2011) do find that demographic changes explain a substantial amount of the variation in the household saving rate. They provide a quantitative analysis with a large-scale perfect foresight overlapping generations model where agents live for 85 years. Consumers begin to exercise decision making when they are 18. From age 18 to 47, they work and raise children. Following Barro and Becker (1989), dependent children’s utility enter into parent’s utility where parents choose the consumption level of the young until they leave the household. Agents aged 18 to 63 work, give a portion of their labor income to their retired parents, and save for their own retirement. The aged live on their accumulated assets and support from their children with remaining assets are bequeathed to the living upon death.

There is a partial equilibrium model in which households supply labor inelastically and take labor and interest income as exogenous. They parameterize the model taking future demographic changes, labor income (given by the marginal product of labor) and interest rates (the marginal product of capital less depreciation) as exogenously given from the data. The preference parameters for household utility when children are present are taken from Manuelli and Seshadri (2010). The amounts that adult children give to support their aged and retired parents were taken from estimates by Lee and Xiao (1998). Curtis, Lugauer and Mark then “run” the model 1963 to 2008 feeding in the data on demographics, wages and interest rates, which they treat as the transition between two steady states and find that the implied variation

of the saving rate are driven in large part by a combination of the changing family size and the relative size of the working population—what they call the composition effect. and find the model can account for a sizable share of the time-series variation of the household saving rate. The baseline run of their model is shown in Figure 2.

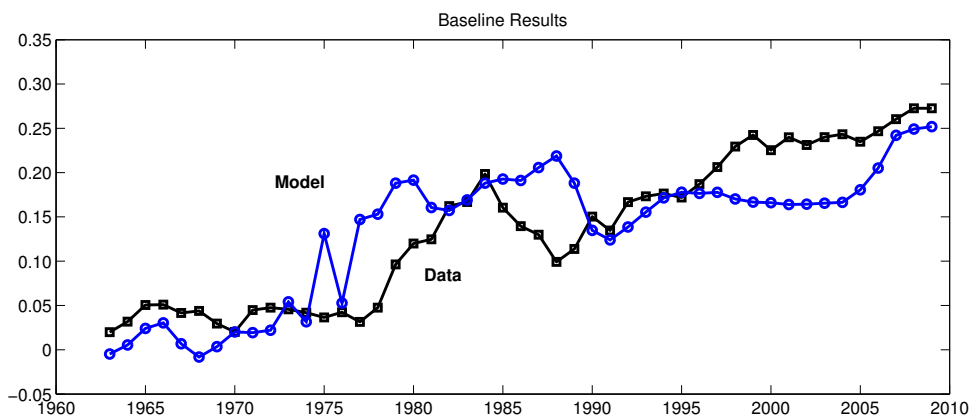


Figure 2: Baseline results from Curtis, Lugauer and Mark (2011).

3.2 Precautionary Saving

Many authors have commented that public policy changes in China have resulted in increased income risk for Chinese workers. One significant reform involves the pension system (Sin, 2005). During the central planning period, citizens were guaranteed employment in SOEs or other state institutions and as such, were provided with basic pensions, health care, and education. These benefits were provided by and paid for by the SOEs. There were no employee contributions. Then in the late 1980s, the country embarked on a series of SOE reforms. The privatization of small and medium sized SOEs and the hardening of the budget constraints on surviving SOEs meant significant curtailing of promised benefits. In 1991, a two-pillar pension system was implemented which consisted of a social PAYGO pension from which SOEs were supposed to contribute 17 percent of wages, and an individual accounts system from which employees would contribute 8 percent of wages and SOEs to contribute 3 percent. A major reform to the pension system was put in place in 1997 which was aimed at covering the entire urban workforce and would provide health, unemployment, disability, and maternity benefits. This was the plan, *de jure*. The *de facto* experience has been much different. Sin (2005) and Dunaway and Arora (2007) estimate that less than half of urban workers are covered and only 12 percent of rural workers are covered. With only 30 percent of the population living in urban areas as of 2005, they estimate that less than 25 percent of the nation as a whole is covered.

Why the low coverage? The reforms have been bogged down by “legacy costs.” That is the difference between the benefits of those covered in the old system and the new system. Since the old system was unfunded and the new system set contribution rates to fund a lower replacement rate, the transition to the new system has turned out to be an unfunded liability. Since the system is unfunded, the incentive is not to participate.

Another reform involved the privatization and/or closing of loss-making small to medium sized SOEs, and the hardening of surviving SOE budget constraints (1995-2005). During this time, downsized employees who may reasonably have expected lifetime employment to find themselves terminated with only modest benefits. Those who transitioned to the private or foreign-owned sector are either employed in the spot market or on a term contract basis [Ma and Yang (2010), Meng (2003)]. Such changes in policy have reduced income security and in the face of a poorly developed domestic credit market, should result in an increase in precautionary saving. In a slightly different context, Ben Bernanke (2005) cites the precautionary motive for having generated a world-wide saving glut, resulting in low interest rates and (financial) capital flows to the U.S.

3.2.1 Estimates of Income Uncertainty

Instead of looking at the change in income uncertainty over time, as in Chamon, Liu and Prasad, we are interested in a comparison of the precautionary motive between the U.S. and China. In ongoing research with Horag Choi, the authors have made use of two micro data sets. The Panel Study of Income Dynamics (PSID) which is a widely used and well-known longitudinal household survey, is used to represent the U.S., and the China Health and Nutrition Survey (CHNS) is used to represent China. Carroll, Hall, and Zeldes (1992) (hereafter CHZ) used individual-level data from the PSID to characterize the income uncertainty of US households for the years 1968-85. We follow the same process as CHZ to estimate the income uncertainty faced by US households in more recent years and by Chinese households. To make as close of a comparison to the U.S. as possible, we sample the data from the CHNS and the PSID to match the time-frame as closely as possible. From the CHNS, we use data from the 1991, 1993, 1997, 2000, 2004, and 2006 waves and from the PSID we use data from the 1992, 1994, 1998, 2001, 2005 and 2007 waves.

3.2.2 Modeling the income process

“Labor income” Y_t is assumed to evolve according to

$$Y_t = P_t e^{u_t},$$

where e^{u_t} is a multiplicative transitory shock in year t and P_t is permanent labor income in year t (i.e. the value of income when $e^{u_t} = 1$). The log of P is assumed to follow a random walk with drift,

$$\ln P_{t+1} = \ln G + \ln P_t + n_{t+1}$$

or in levels,

$$P_{t+1} = GP_t e^{n_{t+1}}$$

where G is the gross growth rate for permanent income, and e^{n_t} is the multiplicative shock to permanent income in year t . The income data appears to be distributed lognormally, except at the lower tail of the income distribution. Hence, as in CHZ, we model transitory income as a mixture of a lognormal distribution and a (near) zero event which is defined as an observation of non capital income that fall below 10 percent of trend income.

In the CHNS urban sample, 69 near-zero income events occur. If these events are independent and short lived, then each household has a 1.52% chance of experiencing nearly zero income in any year. In the rural areas, the chance of a zero income event is 2.52%. By comparison, using PSID data, CHZ find that US households have only a 0.65% chance of experiencing a near-zero income event.³ The chance of experiencing a near-zero income event is more than three times higher in China than in the US. In rural China, the chance of experiencing near-zero income exceeds 2.5%.

Under the strong assumptions already made, the variance of the shocks can be estimated by regressing the sample variance of $\ln Y_{it-m} - \ln Y_{it}$ on m and a constant for all values of m that can be calculated. Using the urban sample, we estimate a standard deviation for the transitory shock of 0.523 and an estimated standard deviation for the permanent shock of 0.146. Chamon, Liu, and Prasad (2010) have also used the Chinese data to calculate the income shock process, obtaining similar estimates.⁴ In the rural sample, the shock's standard deviations equal 0.121 (permanent) and 0.604 (transitory).⁵ They do not allow for near-zero income events in their parameterization, however.

³It is probably not fair to compare our results restricted to no business owners with CHZ. Owning a business is difficult to define in our data set, and these results should probably be interpreted with caution.

⁴Chamon, Liu, and Prasad (2010) used a slightly different methodology and do not include the 2009 data. They estimate the standard deviation to the permanent income shock to be 0.134 and the transitory component to be 0.402 in 2004 urban Chinese households, the most recent year for which they have calculations.

⁵We have also run the exercise without dividing income by the national trend (annual mean). We obtain xx near zero events, standard deviation to permanent income of 0.xxx, and a standard deviation of temporary income of 0.xxx, for the urban sample.

CHZ estimated the standard deviation of permanent income shocks to be 0.126 and transitory to be 0.163, based on US PSID data. We have also redone the PSID analysis using similar years to those available in the Chinese data. We obtain a probability of a near-zero income event (p) of 0.99%, standard deviation of permanent income of 0.121, and standard deviation of temporary shock of 0.41. A summary of the income process parameters used by Carroll (1997), Chamon et al., plus our estimates from the PSID and CHNS is given in Table ?

	Carroll	Chamon et al	USA	China
G	1.02		1.02	1.07
$\text{Prob}(e^u) = 0$	0.0065	n.a.	0.008	0.024
$\sigma(u)$:Transitory	0.16	0.604	0.41	0.58
$\sigma(n)$:Permanent	0.126	0.121	0.121	0.127

4 The Economic Model

We consider the consumption and saving decision of an infinitely-lived representative household. At time t , the household takes as given its non-human marketable assets valued at A_t and receives exogenous “labor” income of Y_t , which can be spent on consumption goods C_t or assets to take into the next period A_{t+1} . In line with the literature, and the low level of credit market development in China, we assume that the household is borrowing constrained such that $0 \leq A_t$. There are no other assets available to the household. No contingent claims or other instruments to diversify away labor income risk. The household thus faces the flow budget constraint

$$R(Y_t + A_t - C_t) \leq A_{t+1} \tag{1}$$

where $R = (1 + r)$ is the (constant) gross real interest rate earned on assets.

The household seeks to maximize lifetime expected utility,

$$E_t \sum_{j=0}^{\infty} \beta^j \frac{C_{t+j}^{(1-\gamma)}}{1-\gamma} \tag{2}$$

subject to (1), where the period utility function has the standard constant relative risk aversion form with coefficient of relative risk aversion $\gamma > 0$ and subjective discount factor $0 < \beta = \frac{1}{1+\delta} < 1$, where δ is the subjective rate of time preference.

We rewrite the model in stationary form by normalizing variables by last period’s permanent component of income, P_{t-1} . Lower case variables denote this normalization, hence $c_t \equiv C_t/P_{t-1}$,

and so forth. The household's problem can be rewritten to maximize $E_t \sum_{j=0}^{\infty} \beta^j \frac{c_{t+j}^{1-\gamma}}{1-\gamma}$ subject to the flow budget constraints $a_{t+1}(G/R)N_t \leq a_t + GN_tV_t - c_t$. Written in recursive form, the household's problem is

$$V(a_t, n_t, u_t) = \max \left\{ \frac{c_t^{1-\gamma}}{1-\gamma} + \beta E_t (V(a_{t+1}, n_{t+1}, u_{t+1})) \right\} \quad (3)$$

subject to $a_{t+1}(G/R)N_t \leq a_t + GN_tV_t - c_t$, where (a_t, n_t, u_t) is the state at date t . After solving for the individual's optimal consumption and asset purchase rules, we 'run' the model for 30 periods for 20,000 individuals. Initial asset levels are set to zero in these experiments.

These people are, in the vernacular of Carroll (1997) are buffer stock savers. They have a target wealth to income ratio. In the experiments, we start people out with zero assets. Their initial saving rates are very high as they accumulate towards their target wealth. The transitional period lasts about 12 periods after which the steady state has more or less been achieved. Hence, the steady state values that we report are averages from periods 20 to 30.

4.1 Results

The experimental results are shown in Table 9. Household saving is aggregate household income (summed over the 20,000 individuals) minus aggregate consumption. Total income is the sum of labor income and interest on assets. Scaled net wealth is current assets plus labor income minus consumption as a proportion of permanent income. Scaled assets is the steady state asset to permanent income ratio.

Table 9					Household	Household		
					Saving Rate	Saving Rate	Scaled	Scaled
Line	Country	γ	δ	r	Total Income	Labor Income	Net Wealth	Assets
1	China	2	0.02	0.02	0.101	0.077	1.875	1.787
2	China	2	0.02	0.03	0.104	0.067	1.996	1.921
3	China	2	0.02	0.04	0.111	0.059	2.139	2.079
4	China (g=0.02)	2	0.02	0.02	0.057	0.021	2.624	2.623
5	China (g=0.02)	2	0.02	0.03	0.063	0.004	2.855	2.878
6	China (g=0.02)	2	0.02	0.04	0.067	-0.020	3.117	3.172
7	USA	2	0.02	0.02	0.045	0.017	1.764	1.756
8	USA	2	0.02	0.03	0.057	0.008	2.174	2.181
9	USA	2	0.02	0.04	0.073	-0.006	2.683	2.713
10	USA (g=0.07)	2	0.02	0.02	0.060	0.045	1.002	0.952
11	USA (g=0.07)	2	0.02	0.03	0.064	0.040	1.092	1.048
12	USA (g=0.07)	2	0.02	0.04	0.074	0.041	1.202	1.163
13	China	2	0.04	0.00	0.085	0.085	1.521	1.421
14	USA	2	0.04	0.00	0.025	0.025	1.042	1.019
15	China	5	0.02	0.02	0.178	0.140	3.399	3.238
16	China	5	0.02	0.03	0.177	0.119	3.467	3.337
17	China	5	0.02	0.04	0.181	0.101	3.581	3.476
18	China (g=0.02)	5	0.02	0.02	0.085	0.033	3.778	3.768
19	China (g=0.02)	5	0.02	0.03	0.083	0.004	3.856	3.885
20	China (g=0.02)	5	0.02	0.04	0.082	-0.027	3.966	4.036
21	USA	5	0.02	0.02	0.073	0.032	2.745	2.725
22	USA	5	0.02	0.03	0.079	0.013	2.933	2.937
23	USA	5	0.02	0.04	0.083	-0.009	3.125	3.158
24	USA (g=0.07)	5	0.02	0.02	0.125	0.097	2.114	2.009
25	USA (g=0.07)	5	0.02	0.03	0.129	0.085	2.224	2.135
26	USA (g=0.07)	5	0.02	0.04	0.135	0.073	2.352	2.277

A higher interest rate leads to a decline in the saving rate out of labor income. This is due to the income effect arising from an interest rate change which causes consumption to increase (recall that labor income is exogenous and doesn't change with the interest rate). The saving rate out of total income, which includes interest income on assets, does increase with

the interest rate. This results from the substitution effect which tilts consumption towards the future. Higher interest rates induce these people to accumulate more assets.

Variations in the growth rate of labor income work in the same way as variations in the interest rate. The experiments reported in lines 4 through 6 take the experiments of lines 1 through 3 but lowers the assumed growth rate from 7 percent to 2 percent. Lower growth results in lower saving rates but higher target wealth and asset ratios. This relationship between growth and saving rate is precisely what we see in the data. High growth countries are also high saving rate countries. An increase in the growth rate thus acts in a similar way to an increase in the interest rate. Since these buffer stock savers want to maintain a target wealth to income ratio, asset accumulation needs to take place at a higher rate in the high growth economy since income is rising at a faster rate. Hence the high growth country will have a higher saving rate.

If we compare lines 1 through 3 with lines 7 through 9, we get a general comparison between saving behavior of Chinese and American households. The model predicted saving rates out of total income in China are nearly twice the rates implied for U.S. households. Targeted wealth to income ratios are not very different.

The primary factor in this model that drives the difference in saving across countries seems not to be the higher level of labor income risk in China but the higher growth rate. If we compare lines 4 through 6 to lines 7 through 9, we can see that. In both sets of experiments, the growth rate of labor income is set to 2 percent per year. What differs, say between line 4 and line 7 is the distribution of the income shocks. The difference in risk accounts for only a small amount of the difference in saving rates.

The experiment of lines 13 and 14 uses the same rate of time preference and interest rate as Carroll (1997) in his benchmark simulations.

Lines 15 through 26 repeat the experiments of lines 1 through 12 but with a coefficient of risk aversion of 5. Here, the same patterns of behavior emerge with saving rates and target wealth levels increasing in both the interest rate and the growth rate. Even in this simple model, we can get the Chinese people to save at quite high rates if we make them sufficiently risk averse.

5 Conclusion

China's high growth and emergence in the world economy has been made possible in part by the willingness of its households to save a high fraction of their income. The high Chinese saving rate, however, is not so much a puzzle as it can be explained by quantitative implementations of standard neoclassical models of household consumption and saving decisions. What makes

them want to save so much is the environment that they live in. Some of the more salient features of that environment are a relatively rapid decline in family size and an increase in old age dependency, substantially riskier non-capital income streams and a higher growth rate.

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