4. Macro Analysis

The Determinants of Saving Rates in the Developed and Developing Economies: The Impact of Social Safety Nets

Charles Yuji Horioka*

1. Introduction

It is often asserted that social benefits (social safety nets) will have a negative impact on the household saving rate because households will not feel the need to save (self-insure) if social benefits are adequate. Similarly, it is often asserted that financial development (an increase in the availability of credit or the relaxation of borrowing constraints) will have a negative impact on the household saving rate because households will not feel the need to save for precautionary purposes if they can borrow freely when necessary. This paper analyzes the determinants of saving rates in developed economies as well as developing economies with emphasis on the impact of social benefits (social safety nets) and social benefits. One purpose of the analysis in this paper is to see whether there is substitutability between social benefits and credit availability, which is plausible since both are risk-coping mechanisms that serve as a substitute for self-insurance (saving).

The paper is organized as follows: In section 2, we briefly survey the theoretical and empirical literature on the impact of social safety nets and credit availability on the household (private) saving rate; in section 3, we discuss our analysis of the determinants of the household saving rate in the developed economies (the member countries of the Organisation for Economic Co-operation and Development (OECD)); in section 4, we discuss our analysis of the determinants of the domestic saving rate in twelve developing economies of Asia; and section 5 concludes.

To summarize the main results of this paper, our analysis of the determinants of the household saving rate in the developed countries of the OECD finds that there are considerable and stable differences among countries in their household saving rates and social benefit ratios but that the latter can explain the former to only a limited extent. In particular, it finds that the age structure of the population and credit availability are more important as determinants of cross-country differences in the household saving rate than the social benefit ratio but that there is substitutability between credit availability and the social benefit ratio, with the impact of credit availability on the household saving rate being negative, as expected, when changes in the social

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benefit ratio are small and positive, contrary to expectation, when changes in the social benefit ratio are large.

Our analysis of the determinants of the domestic saving rate in developing Asia during the 1965-2007 period finds that the main determinants appear to be the aged dependency ratio, income levels, and the level of financial development. We project future trends in domestic saving rates in developing Asia for the 2011-2030 period based on our estimation results and find that the aging of the population will be the main determinant of future trends in domestic saving rates in developing Asia. However, we find that there will not be a sharp decline in saving rates in developing Asia as a whole, at least during the next two decades, inasmuch as there will be substantial variations across economies in the speed and timing of population aging.

2. Survey of the Previous Theoretical and Empirical Literature

In this section, we briefly summarize the theoretical and empirical literature on the impact of the age structure of the population, social safety nets and credit availability on household saving.

Looking first at empirical studies that use cross-country data to analyze the impact of the age structure of the population on saving, numerous studies have found that the aged dependency ratio has a negative and significant impact on the household, private, and national saving rates (see Feldstein (1977, 1980), Modigliani and Sterling (1983), Horioka (1989), Li, Zhang, and Zhang (1987), Edwards (1996), Dayal-Ghulati and Thimann (1997), Bailliu and Reisen (1998), Loayza, et al. (2000), and Bosworth and Chodorow-Reich (2007) for recent examples).

Looking next at the theoretical literature on the impact of social saving nets on household saving, most of this literature has focused on the impact of public old-age pensions on household saving. For example, the seminal paper on this topic (Feldstein (1974) showed that the impact of public old-age pensions on household saving is theoretically ambiguous. On the one hand, the introduction of a public old-age pension system will induce households to save less because they no longer need to rely as much on their own savings to finance living expenses during retirement (the wealth replacement effect), but on the other hand, the introduction of a public old-age pension system will induce households to retire earlier, and this in turn will induce them to save *more* (the induced retirement effect). The net impact of public old-age pensions on household saving will depend on the relative strengths of these two offsetting effects. Moreover, Todo-Rovira and Perez-Amaral (1988) show that the impact of public old-age pensions on private saving will depend on people's expected real rate of growth of retirement benefits and that realistic estimates of this parameter imply a smaller depressing effect on private saving than found by Feldstein (1974).

The literature on the impact of other components of the social safety net on household saving rate is much scarcer but not non-existent. For example, the seminal paper on this topic (Hubbard, Skinner, and Zeldes (1995)) demonstrates theoretically that social insurance programs

with means tests based on assets discourage saving by households with low expected lifetime incomes. Thus, not only public old-age pensions but also other components of the social safety net may have a negative impact on the household saving rate.

Looking next at previous empirical studies that use cross-country data to analyze the impact of social safety nets on household (or private) saving, the vast majority of these previous studies have focused on the impact of public old-age pensions on household saving, and most of them have found that public old-age pensions have a negative and significant impact on household saving. For example, Feldstein (1977, 1980) and Bailliu and Reisen (1998) obtain this finding for a sample of developed economies, while Edwards (1996) and Dayal-Ghulati and Thimann (1997) obtain this finding for a sample of developing economies. The major exceptions are Modigliani and Sterling (1983), who find that the impact of public old-age pensions on private saving is ambiguous because a smaller than expected wealth replacement effect is more than offset by a larger than expected induced retirement effect, and Horioka (1989), who finds that the impact of public old-age pensions on private saving is insignificant because neither of the two effects is significant.

Looking finally at previous empirical studies that use cross-country data to analyze the impact of credit availability on the saving rate, Loayza, et al. (2000) find using a sample of developed and developing economies that the ratio of domestic credit flow to gross national disposable income has a negative and significant impact on the private saving rate.

To summarize, most previous cross-country studies have analyzed the impact of public old-age pensions on household (or private) saving and obtain a negative and significant impact, but few cross-country studies have analyzed the impact of other social programs, and at least one study has found that credit availability has a negative and significant impact on saving.

3. An Analysis of the Determinants of Household Saving Behavior in the Developed Countries of the OECD

In this section, we discuss our analysis of the determinants of the household saving behavior in the developed countries of the OECD.

(1) Estimation Model

In this section, we describe the estimation model we use in our analysis. The estimation model we use is as follows:

$$HHSR = a0 + a1*AGE + a2*SBR + a3*CREDIT + a4*SBR*CREDIT + u,$$

where HHSR = the household saving rate = the ratio of household saving to household disposable income (in percent)

AGE = the aged dependency ratio = the ratio of the aged population (the population aged 65 or older) to the working-age population (the population aged 20 to 64) (in percent)

SBR = the social benefit ratio = the ratio of social contributions and social benefits, other than social transfers in kind, receivable to net household disposable income (in percent)

CREDIT = the credit availability index = the ratio of private credit by deposit money banks and other financial institutions to GDP (in percent).

SBR*CREDIT = the cross-product of SBR and CREDIT

CREDIT is included as a proxy for the degree of financial development (or to put it another way, the availability of private credit or the prevalence of borrowing constraints).

(2) Data Sources

In this section, we describe the data sources of the variables used in our analysis.

(1) The source of the data on the household saving rate HHSR

The data on HHSR were taken from Annex Table 23: Household saving rates of *OECD Economic Outlook*, no. 86 (November 2009).

(2) The source of the data on the aged dependency ratio AGE and population POP

The data on AGE and POP were taken from Panel 2: Detailed Data of United Nations, Population Division (2008).

(3) The source of the data on the social benefit ratio SBR

The data used to calculate SBR were taken from Table 13: Simplified Accounts for Households and NPISH (Non-profit Institutions serving Households) of Organisation for Economic Co-operation and Development (2009) except that the 1995 data for all countries and data on Sweden for all countries were taken from the previous edition of the same, published in 2008. SBR was calculated by dividing line 10 (Social contributions and social benefits, other than social transfers in kind, receivable) by line 15 (Disposable income, net).

(4) The source of the data on credit availability CREDIT

The data on CREDIT were taken from Beck, Demirguc-Kunt, and Ross (1999) and the May 2009 update by the authors, available on-line at:

http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/0,,contentMDK:20696167~pagePK:64214825~piPK:64214943~theSitePK:469382,00.html

Of the 30 member countries of the OECD, data were available on all variables for the following 23 countries: Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Hungary, Ireland, Italy, Japan, the Republic of Korea, the Netherlands, Norway, Poland, Portugal, the Slovak Republic, Spain, Sweden, Switzerland, the United Kingdom, and the United States. The necessary data were not available for Australia, Greece, Iceland, Luxembourg, Mexico, New Zealand, and Turkey. Moreover, data on

saving rates and social benefit ratios were not available for Ireland (1995 and 2000) and data on social benefit ratios were not available for Hungary (1995), Ireland (1995 and 2000), Japan (1995) and Spain (1995). Thus, the total number of observations was 64 or 67, depending on which explanatory variables were included.

(3) Descriptive Statistics

This section presents descriptive statistics on the variables used in our analysis. The descriptive statistics are shown in Table 1, and as can be seen from this table, there is enormous variation in all of the variables used in our analysis. HHSR, the household saving rate, averaged 7.74 percent and ranged from -1.90 percent (in Denmark in 2000) to 17.00 percent (in Italy in 1995). AGE, the age dependency ratio, averaged 24.11 percent and ranged from 9.43 percent (in the Republic of Korea in 1995) to 32.59 percent (in Japan in 2005). SBR, the social benefit ratio, averaged 27.74 percent and ranged from 8.40 percent (in the Republic of Korea in 2000) to 43.90 percent (in Denmark in 1995). Finally, CREDIT, our proxy for credit availability, averaged 96.15 percent and ranged from 14.87 percent (in Poland in 1995) to 195.29 percent (in Japan in 2000).

Table 1: Descriptive Statistics

	Mean	Std. Dev.	Minimum	Maximum
HHSR	7.74	4.41	-1.90	17.00
AGE	24.11	4.35	9.43	32.59
SBR	27.74	8.22	8.40	43.90
CREDIT	96.15	44.76	14.87	195.29

Note: Refer to the main text for variable definitions and data sources.

(4) Estimation Results

In this section, we present the estimation results. The results of the Hausman test indicated that the fixed-effects model was the correct model, and thus we present the results of the fixed-effects model, with the observations being weighted by the population of each country in 1995.

The results are shown in Table 3, and as can be seen from this table, the coefficient of AGE is negative (in the -0.85 to -1.00 range) and statistically significant at at least the 5 percent significance level, as expected, indicating that a one percentage point increase in AGE reduces the household saving rate by 0.85 to 1.00 percentage points. The coefficient of CREDIT is negative (in the -0.033 to -0.036 range) and statistically significant at at least the 10 percent significance level, as expected, indicating that a one percentage point increase in CREDIT lowers the household saving rate by 0.033 to 0.036 percentage points (if the cross-product of CREDIT and

Table 2: The Determinants of the Household Saving Rate

Model	Constant	AGE	SBR	CREDIT	SBR*CREDIT	R-squared	F-stat.	No. of obs.
1	27.573	-0.846				0.408	22.590	67
	4.250	0.178				0.028	0.000	
	6.49	-4.75				0.000		
	0.000	0.000						
2	22.789	-0.847	0.197			0.258	2.770	64
	8.339	0.371	0.331			0.044	0.075	
	2.73	-2.28	0.59			0.007		
	0.009	0.028	0.556					
3	35.721	-1.003		-0.036		0.523	7.660	67
	7.189	0.263		0.016		0.021	0.002	
	4.97	-3.81		-2.16		0.000		
	0.000	0.000		0.036				
4	31.079	-0.980	0.151	-0.033		0.388	2.230	64
	11.376	0.449	0.266	0.018		0.025	0.099	
	2.73	-2.18	0.57	-1.81		0.002		
	0.010	0.035	0.575	0.079				
5	39.772	-0.993	-0.232	-0.103	0.0033	0.437	3.020	64
	12.225	0.444	0.371	0.039	0.0018	0.006	0.030	
	3.25	-2.24	-0.62	-2.66	1.89	0.001		
	0.002	0.031	0.537	0.012	0.067			

Note: The first figure indicates the estimated coefficient, the second figure indicates the standard error, the third figure indicates the z-value, and the fourth figure indicates the p-value. The first R-squared is within, the second R-squared is between, and the third R-squared is overall. The figure below the F-statistic is the p-value.

SBR is not included). The coefficient of SBR is positive and totally insignificant, indicating that it does not have a significant impact on the household saving rate. Finally, if the cross-product of CREDIT and SBR are included, the coefficient of CREDIT is negative and statistically significant, as before, but it increases in absolute magnitude (to -0.103) and its significance level also increases (to close to the 1 percent level), while the coefficient of the cross-product term CREDIT*SBR is positive (0.0033) and statistically significant at the 10 percent significance level. This implies that, in economies with no social benefits whatsoever, a one percentage point increase in CREDIT lowers the household saving rate by 0.103 percentage points and that a one percentage point increase in SBR reduces the impact of CREDIT (in absolute magnitude) by 0.33 percentage points. This implies that the impact of CREDIT will be zero when SBR changes by 0.103/0.33 = 3.12 percentage points, negative, as expected, when SBR changes by less than 3.12 percentage points, and positive, contrary to expectation, when SBR changes by more than 3.12 percentage points.

Thus, it appears that the age structure of the population and credit availability are more important as determinants of cross-country differences in the household saving rate than the social benefit ratio but that there is substitutability between credit availability and the social benefit ratio, with the impact of credit availability on the household saving rate being negative, as expected, when changes in the social benefit ratio are small and positive, contrary to expectation, when changes in the social benefit ratio are large.

Our results concerning CREDIT are consistent with the findings of Loayza, et al. (2000),

who find using a sample of developed and developing economies that the ratio of domestic credit flow to gross national disposable income has a negative and significant impact on the private saving rate.

(5) Conclusion

In this section, we presented cross-country data on household saving rates and social safety nets in the developed countries of the OECD and analyze the determinants of cross-country differences in household saving rates with emphasis on the impact of social safety nets, the age structure of the population, and borrowing constraints thereon. To summarize the main findings of this section, we found that there are considerable and stable differences among economies in their household saving rates and social benefit ratios but that the latter can explain the former only to a limited extent, with the age structure of the population and borrowing constraints being more important as determinants of cross-country differences in household saving rates.

Perhaps one reason for our failure to detect a significant impact of social safety nets on the household saving rate is that we did not take account of the breakdown of social safety nets among the various categories. For example, social assistance aimed at the poor might have a very different impact on household saving than a universal health insurance or public pension system. One avenue for further research is to try breaking down social benefits into its various components.

4. An Analysis of the Determinants of the Domestic Saving Rate in the Developing Economies of Asia

In this section, we discuss our analysis of the determinants of the domestic saving rate in the developing economies of Asia.

Developing Asia has been characterized by high domestic and national saving rates almost across the board in recent years, and these high saving rates have made possible not only high levels of domestic investment but also large capital outflows (current account surpluses) (see, for example, the data presented in Park and Shin (2009)). To put it another way, the developing economies of Asia have oversaved and underinvested, leading to large current account imbalances (surpluses), as asserted by Bernanke (2005) and others.

However, population aging is projected to occur at a rapid rate in developing Asia, which will presumably lead to a sharp decline in saving rates. If so, the large current account imbalances (surpluses) that currently exist will go away by themselves without any need for government intervention. However, if other factors, such as culture, financial sector development, or corporate sector saving, are the dominant determinants of saving rates, it is possible that saving rates will remain high in developing Asia despite the rapid aging of its population.

The purpose of this section is to present data on trends over time in domestic saving rates in twelve economies in developing Asia during the 1960-2008 period, to analyze the determinants of those trends, and to project trends in domestic saving rates in these same economies during the

next twenty years (2010-2030 period). The twelve economies included in our analysis include the People's Republic of China (PRC); Hong Kong, China; India; Indonesia; Republic of Korea; Malaysia; Pakistan; Philippines; Singapore; Chinese Taipei; Thailand, and Vietnam, which comprise 95 percent of developing Asia.

(1) A Survey of Previous Empirical Studies and Determinants of Saving

There have been many previous empirical analyses of the determinants of national and domestic saving rates using cross-section or panel cross-country data or time series data for individual economies, among them Modigliani (1970), Feldstein (1977, 1980), Modigliani and Sterling (1983), Horioka (1989), Edwards (1996), Dayal-Ghulati and Thimann (1997), Bailliu and Reisen (1998), Higgins (1998), Loayza, et al. (2000), Chinn and Prasad (2003), Luhrman (2003), International Monetary Fund (2005), Bosworth and Chodorow-Reich (2007), Ito and Chinn (2007), Kim and Lee (2008), Park and Shin (2009), and Horioka and Yin (2010). The present study is based most closely on Higgins (1998), Bosworth and Chodorow-Reich (2007), and Park and Shin (2009).

These studies suggest an important role for demographic variables based on the life cycle model. Looking first at the impact of the age structure of the population, since the aged typically finance their living expenses by drawing down their previously accumulated savings, the aged dependency ratio (the ratio of the aged population to the working-age population) should have a negative impact on the saving rate, and similarly, since children typically consume without earning income, the child dependency ratio (the ratio of children to the working-age population) should also have a negative impact on the saving rate. However, a lower child dependency ratio means fewer children to provide care and financial assistance during old age and hence the child dependency ratio could have a positive impact on the saving rate. Park and Shin (2009) and most other studies find that the aged dependency ratio and the youth dependency ratio both decrease the national saving rate, as expected. Moreover, they also find that life expectancy has a positive impact on the saving rate because a lengthening of life expectancy increases people's retirement spans and necessitates more saving for retirement and that the labor force participation rate of aged has a negative impact on the saving rate because an increase in the labor force participation rate of the aged shortens people's retirement spans and reduces the amount of saving needed for retirement.

A high growth rate of real GDP is another important factor, creating a virtuous cycle in which rapid income growth makes it easy to save, and high saving feeds back through capital accumulation to promote further growth. Bosworth and Chodorow-Reich (2007) as well as Park and Shin (2009) find that both contemporaneous and lagged real per capita GDP growth rates increase the national saving rate. Moreover, Park and Shin (2009) also find that the level of per capita income has a significant nonlinear or more precisely convex relationship with the saving rate in Asia, but Bosworth and Chodorow-Reich (2007) do not find a significant effect.

Aside from the demographic and GDP-related variables, financial development is also

considered to be a crucial factor, but the direction of its impact is ambiguous theoretically as well as empirically. For example, Loayza, et al. (2000) as well as Horioka and Yin (2010) find that it has a negative impact, while Park and Shin (2009) find that its impact is insignificant. Anecdotal evidence suggests that the relationship between financial development and saving rate can be nonlinear depending on the level of financial development. For example, Jha, et al. (2009) suggest that the greater availability of saving instruments and better accessibility to banks may promote *higher* saving, contrary to the negative impact found by Loayza, et al. (2000) and Horioka and Yin (2010). This paper investigates this possible nonlinear relationship between financial development and the saving rate.

Others argue that many of the developing Asian economies have underdeveloped public pension systems and social insurance systems more generally and that this encourages precautionary saving by households. Jha, et al. (2009) argue that the underdeveloped social insurance system is one of the factors that contributed to the recent rise in household saving in the PRC. Moreover, Horioka and Yin (2010) argue for a complementary relationship between the social benefit ratio and the level of financial development by analyzing the determinants of the household saving rate using panel data on 23 member countries of the OECD for the years 1995, 2000, and 2005, with a higher social benefit ratio reducing the negative impact of the level of financial development on the household saving rate.

Finally, the surge in corporate saving has gained increasing attention since the early 2000s, for example by ADB (2009) and others. Since households, particularly in Asia, have not reduced their saving enough to offset the increase in corporate saving, it has often been claimed that the increase in corporate saving has become an important determinant of private saving in recent years.

(2) Trends in the Domestic Saving Rate in Developing Asia

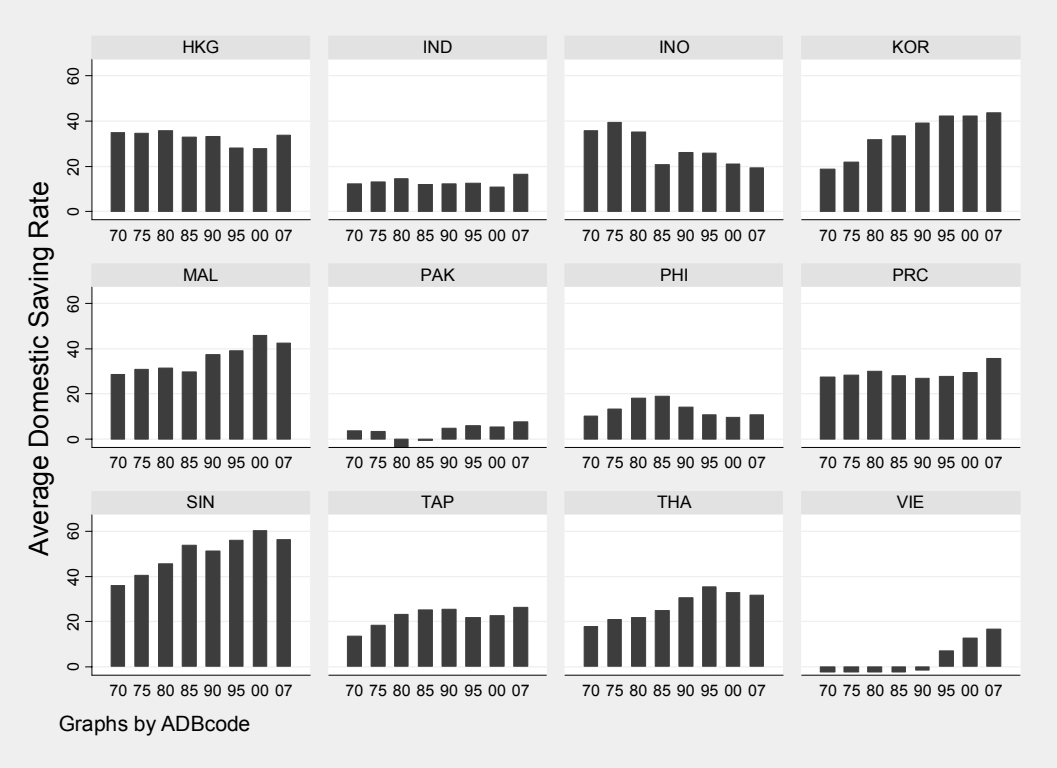
In this section, we discuss past trends in the domestic saving rate and in the determinants thereof in developing Asia. Throughout this paper, we use the real domestic saving rate, which is computed by subtracting the consumption and government shares of real GDP per capita from 100.

Figure 1 shows trends over time in the domestic saving rate, and as can be seen from this figure, trends over time vary substantially among the twelve economies considered here, but most economies in the region have saved substantial amounts during the past 40 years. Korea, Singapore, Malaysia, Thailand, and Chinese Taipei are the best examples. The domestic saving rates in these five economies rose sharply during the 1970s and 80s, exceeding or reaching close to 40% of GDP by the early 1990s. While the domestic saving rates of the economies of developing Asia declined in the late 1990s due to the Asian financial crisis, they then resumed their upward climb in the 2000s, reaching a new high except in the Philippines and Pakistan.

A milder but steady upward trend in domestic saving rates was observed in the PRC and India between 1970 and 2000, after which both countries experienced surges in their domestic

saving rates, partially driven by soaring corporate savings.[1] The sharp increase in domestic saving rates, particularly in the PRC, in the 2000s has been blamed for the soaring global current account imbalances and hence for the global financial crisis that occurred in 2008. Meanwhile, a few economies in developing Asia (such as Hong Kong (China), China, Indonesia, and the Philippines) have shown a moderate downward trend in their domestic saving rates since the early 1980s. While domestic saving rates are still above 20% in Hong Kong (China), China and Indonesia, the already low saving rate in the Philippines declined to below 6% in 2003 before edging up slightly.[2] Moreover, a few economies with very low domestic saving rates are noteworthy. Vietnam, for example, showed negative domestic saving rates throughout the 1970s and 80s, until the country transitioned to a market economy in the 1990s. Similarly, Pakistan's domestic saving rate was negative until the mid-1980s.

Figure 1: Real Domestic Saving Rate (% of GDP)



Source: Penn World Table version 6.2, authors' calculation (see Appendix Table 1)

Note: HKG=Hong Kong, China, IND=India, INO=Indonesia, KOR=Korea, MAL=Malaysia, PAK=Pakistan, PHI=Philippines, PRC=People's Republic of China, SIN=Singapore, TAP=Chinese Taipei, THA=Thailand, and VIE=Vietnam.

Various factors affected the trends in domestic saving rates described above. First of all,

[1] The saving rates of India and the PRC are greater in magnitude if one looks at a nominal measure.

[2] This declining trend is reversed for Indonesia if we look at a nominal measure such as that from *World Development Indicators* of the World Bank. This is probably due to the high inflation rate Indonesia was experiencing during this period.

many of the economies in our sample experienced rapid demographic transition. Life expectancy rose sharply from an average of about 53 in the early 1960s to 73 in the late 2000s in the sample as a whole. Consequently, the aged dependency rate also increased from 6.5 to 10.2 percent on average during the same period. Population aging has been particularly significant in Hong Kong, China; Korea; Singapore; and Chinese Taipei. Meanwhile, the aged dependency rate has been declining somewhat in Pakistan and Vietnam. The youth dependency rate shows a uniform picture, declining in all of the economies in our sample, though to a lesser extent in Pakistan. The labor participation rate of the aged has generally been declining throughout the sample period while domestic saving rates have been increasing. While population aging has been progressing steadily, other factors have also come into play, obscuring the relationship between demographics and the domestic saving rate (Figure 2, Panels A and B).

Financial sector development, in particular, played a significant role in developing Asia. James, et al. (1989) discuss the role played by financial incentives such as raising interest rates on time and saving deposits in increasing the domestic saving rate when the financial system was still shallow in the 1970s in Korea and Singapore, for example. Financial deepening accelerated after the mid-1980s, driven by financial liberalization in many economies. The developing Asian economies in our sample recorded deepening of their credit markets exceeding 100% of GDP except in India, Indonesia, Pakistan, the Philippines, and Vietnam. As opposed to earlier financial incentives, financial deepening would be expected to contribute toward reducing the need for precautionary saving. Panel C in Figure 2 shows a possible nonlinearity. Moreover, these demographic and financial developments were accompanied by the continuing but uneven increase in per capita GDP and its growth rate, as shown in panels D and E in Figure 2.

Public spending such as social and/or pension benefits are also important as a factor driving up precautionary savings if they are insufficient and households are worried about their future livelihoods. Public expenditures on social services including spending on pensions as well as education and health services have generally been low in developing Asia, averaging less than 5% of gross national disposable income during the sample period, which is far lower than in the OECD countries where most economies spent more than 15% of GDP on social services and pensions as of 2005.[3] Moreover, expenditures on social services and pensions have not shown an obvious upward trend in most economies in developing Asia. Panel F in Figure 2 suggests that higher social services expenditures are associated with lower domestic saving rates. The next section tries to disentangle the impact of these various factors driving domestic saving rates in developing Asia.

(3) Estimation Results concerning the Determinants of Domestic Saving Rates

In this section, we present our estimation results concerning the determinants of domestic saving rates in developing Asia during the 1965-2007 period. We estimated both a country-

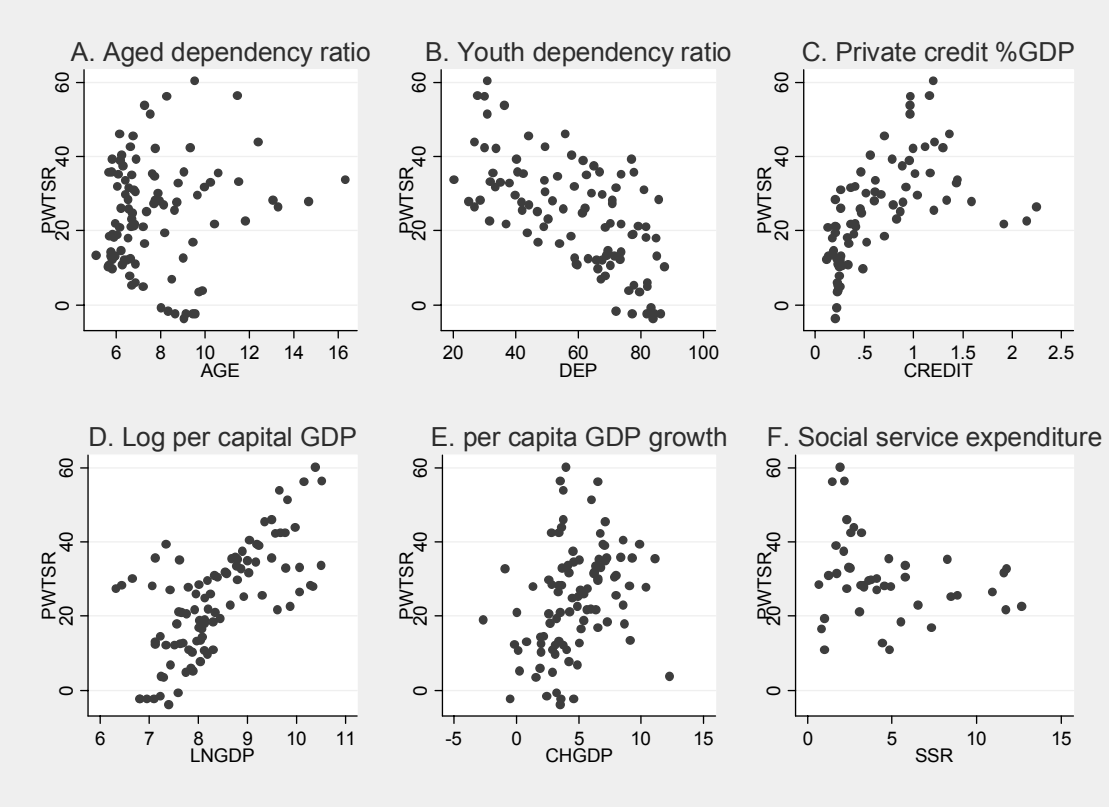
[3] The sole exceptions are Mexico, Korea, and Turkey, whose ratios of public expenditures on social services and pensions to GDP are equivalent to those in developing Asia.

fixed-effects model and a random-effects model with robust standard errors, and following past studies such as Bosworth and Chodorow-Reich (2007) and Park and Shin (2009), the observations are five-year averages except for the most recent period which includes the years between 2000 and 2007. Thus, we have maximum of 8 observations per economy, and a maximum of 78 total observations. The reduced form estimating equation is given by:

$$SR_{i,t} = \beta_{0,i} + \beta_1 * AGE_{i,t} + \beta_2 * DEP_{i,t} + \beta_3 * LNGDP_{i,t} + \beta_4 * CREDIT_{i,t} + \beta_4 * X_{i,t} + u_{i,t}$$

where = 1, … 12 (1=PRC (PRC), 2=HKG (Hong Kong, China), 3=INO (Indonesia), 4=IND (India), 5=KOR (Republic of Korea), 6=MAL (Malaysia), 7=PAK (Pakistan),

Figure 2: Domestic Saving Rate (% of GDP) versus Its Determinants



Source: See Appendix Table 1
Note: PWTSR = Domestic saving rate

8=PHI (Philippines), 9=SIN (Singapore), 10=THA (Thailand), 11=TAP (Chinese Taipei), and 12=VIE (Vietnam); and t=1, … 8 (1=1965-69, 2=1970-74, 3=1975-79, 4=1980-84, 5=1985-1989, 6=1990-1994, 7=1995-1999, and 8=2000-2007). $SR_{i,t}$ represents the real domestic saving rate in an economy i at time t; $AGE_{i,t}$ is the aged dependency ratio (the ratio of

the population aged 65 or older to the population aged 15-64); $DEP_{i,t}$ is a youth dependency ratio (the ratio of the population aged 14 or younger to the population aged 15-64); $LNGDP_{i,t}$ is the log of per capita real GDP; $CREDIT_{i,t}$ is the ratio of private credit from deposit money banks and other financial institutions to GDP; and $X_{i,t}$ is a vector of the other explanatory variables included in the estimation model. Details concerning the variables used in our analysis can be found in Appendix Table 1.

Our estimation results are shown in Table 3 and 4. The results are shown for seven specifications in panels 1 through 7 for both the fixed and random-effects models. While the results of standard tests such as the Hausman specification test suggest the use of random-effects models, we show the results for both random and fixed-effects models. This is because omitting country-fixed-effects seems to increase the residuals for some economies, such as the PRC, and because we are interested in knowing whether there are significant country-fixed-effects when explaining domestic saving rates. When a country-fixed-effects model is estimated, the reference economy is PRC (i = 1).

All seven estimation models include the six variables, AGE and DEP, per capita real GDP (LNGDP) and its squared term (LNGDPSQ), and CREDIT and its squared term (CREDITSQ). Other macroeconomic variables, such as the growth rate of per capita real GDP (CHGDP), the inflation rate (INFL), and the nominal interest rate (INT) (or the real interest rate, RINT) as well as public expenditures on social services and pensions as a percent of Gross National Disposable Income (SSR) and fiscal balance as a percent of GDP (FISC) are then added in models 2 through 7.

As the tables show, our results are satisfactory and broadly consistent with those of previous studies. Looking first at the basic models (models 1-3 in Tables 1 and 2), the coefficient of AGE (the aged dependency ratio) is negative and significant, as expected (-0.83 to -0.95 in the fixed-effects model and -1.55 to -1.69 in the random-effects model). However, the sign of the coefficient of DEP (the youth dependency ratio) is not stable and it is totally insignificant in both the fixed-effects model and random-effects models, which is not surprising given the offsetting effects mentioned earlier.

Turning to the GDP-related variables, the coefficient of LNGDP (the log of real per capita GDP) is negative and significant, as expected, with its square term being positive and significant, suggesting a nonlinear (convex) relationship with the domestic saving rate, as was also found by Park and Shin (2009).

Turning to the financial variables, the availability of private credit exhibits a concave relationship with the domestic saving rate, with the coefficient of CREDIT (the ratio of private credit to GDP) being positive and significant and the coefficient of its squared term being negative and significant. This nonlinear relationship indicates that financial development leads to a higher domestic saving rate up to a point, after which it works to lower the domestic saving rate, consistent with anecdotal evidence reported in Jha, et al. (2009).

As for the coefficients of CHGDP (the rate of change of real per capita GDP), INT (the nominal interest rate), INFL (the inflation rate), and RINT (the real interest rate), they are not significant in any model except that the coefficient of CHGDP is positive and significant in the random-effects version of model 5.

When FISC (the ratio of the fiscal balance to GDP) is added to the explanatory variables (models 3, 4, 6 and 7), its coefficient is positive, as expected, but it is significant only in the random-effects version except for model 6. Moreover, the coefficients of AGE and LNGDP become insignificant except for the coefficient of AGE in the random-effects version of model 3, and the coefficients of CHGDP, INT, INFL, and RINT remain insignificant except for the coefficient of INFL in the fixed-effects and random-effects versions of model 3 and the coefficient of RINT in the fixed-effects version of model 6.

When SSR (the ratio of public expenditures on social services and pensions to Gross National Disposable Income) is added to the explanatory variables (models 4 and 7), only the coefficients of the two credit-related variables are significant in the fixed-effects versions of models 4 and 7 while only the coefficients of the two credit-related variables and the coefficients of FISC and SSR are significant in the random-effects versions of models 4 and 7, with the coefficient of FISC being positive and the coefficient of SSR being negative, as expected.

Finally, the results of the fixed-effects models show that the country-fixed-effects are significant for most economies (except for Korea, Malaysia, and Singapore) with a significant negative sign when the PRC is taken as the reference economy, indicating a very high domestic saving rate in the PRC.

In sum, the main determinants of the domestic saving rate in developing Asia during the 1965-2007 period appear to be the age structure of the population (especially the aged dependency ratio), income levels, and the level of financial development except as noted above and moreover, the direction of impact of each factor is more or less as expected.

Table 3: Results of Fixed Effects Model

Model	AGE	DEP	LNGDP	LNGDPSQ	CREDIT	CREDITSQ	CHGDP	INT	INFL	FISC	SSR	RINT	R-squared	Obs
1	**-0.95**	**-0.03**	**-43.13**	**2.92**	**14.48**	**-6.46**							**0.76**	**78**
	0.41	0.07	8.82	0.53	5.17	1.87							1.00	
	-2.30	-0.41	-4.89	5.53	2.80	-3.46							0.97	
2	**-0.89**	**0.06**	**-33.67**	**2.42**	**15.14**	**-6.26**	**0.13**	**-0.05**	**-0.02**				**0.69**	**70**
	0.46	0.12	11.93	0.71	5.75	1.93	0.16	0.15	0.15				1.00	
	-1.92	0.51	-2.82	3.40	2.63	-3.25	0.85	-0.36	-0.16				0.97	
3	**-0.57**	**0.05**	**-20.08**	**1.50**	**12.27**	**-4.50**	**0.17**	**0.16**	**-0.33**	**0.28**			**0.78**	**56**
	0.43	0.09	13.09	0.76	6.29	2.12	0.20	0.17	0.14	0.21			1.00	
	-1.34	0.60	-1.53	1.96	1.95	-2.13	0.83	0.93	-2.37	1.31			0.98	
4	**-0.18**	**-0.04**	**-23.60**	**1.46**	**19.19**	**-6.48**	**0.22**	**-0.30**	**-0.20**	**0.25**	**-0.67**		**0.82**	**35**
	0.62	0.26	28.57	1.63	8.56	2.54	0.42	0.37	0.24	0.31	0.69		1.00	
	-0.29	-0.17	-0.83	0.90	2.24	-2.55	0.52	-0.79	-0.84	0.80	-0.97		0.99	
5	**-0.83**	**0.05**	**-35.63**	**2.53**	**14.88**	**-6.25**	**0.16**					**0.03**	**0.69**	**70**
	0.44	0.12	12.19	0.73	5.74	1.91	0.17					0.14	1.00	
	-1.88	0.41	-2.92	3.49	2.59	-3.27	0.93					0.21	0.97	
6	**-0.40**	**0.05**	**-20.81**	**1.56**	**12.12**	**-4.58**	**0.23**			**0.26**		**0.30**	**0.77**	**56**
	0.41	0.08	13.42	0.78	6.01	2.07	0.20			0.22		0.15	1.00	
	-0.99	0.60	-1.55	1.99	2.02	-2.21	1.13			1.20		1.96	0.98	
7	**0.42**	**-0.03**	**-11.06**	**0.90**	**16.07**	**-6.22**	**0.04**			**0.38**	**-0.68**	**0.11**	**0.81**	**35**
	0.67	0.25	25.29	1.49	7.62	2.53	0.33			0.33	0.67	0.26	1.00	
	0.62	-0.14	-0.44	0.61	2.11	-2.46	0.12			1.14	-1.02	0.44	0.98	

Note: The figures are the estimated coefficient (first row), the robust standard error (second row), and the z-value (third row). ' is within, the second R-squared is between, and the third R-squared is overall. The country fixed effects are not shown to save

Table 4: Results of Random Effects Model

Model	Const.	AGE	DEP	LNGDP	LNGDPSQ	CREDIT	CREDITSQ	CHGDP	INT	INFL	FISC	SSR	RINT	R-sq	Obs
1	203.20	-1.58	-0.08	-46.79	3.15	15.35	-6.71							0.75	78
	49.34	0.47	0.08	10.74	0.63	5.95	2.19							0.68	
	4.12	-3.39	-0.95	-4.36	4.98	2.58	-3.06							0.74	
2	156.49	-1.55	-0.03	-37.31	2.64	14.78	-6.12	0.24	-0.12	0.01				0.67	70
	63.70	0.51	0.10	14.30	0.84	6.08	2.11	0.19	0.18	0.17				0.73	
	2.46	-3.07	-0.27	-2.61	3.14	2.43	-2.90	1.28	-0.68	0.05				0.77	
3	96.11	-0.78	0.04	-23.12	1.70	12.40	-4.69	0.21	0.12	-0.30	0.30			0.78	56
	67.86	0.45	0.09	14.69	0.83	5.77	1.91	0.20	0.18	0.16	0.17			0.70	
	1.42	-1.73	0.45	-1.57	2.04	2.15	-2.46	1.06	0.66	-1.92	1.77			0.70	
4	31.08	-1.42	0.12	-2.93	0.34	31.88	-10.68	-0.03	-0.94	-0.22	1.02	-0.94		0.65	35
	189.00	1.14	0.19	40.26	2.29	9.98	3.34	0.61	0.71	0.72	0.38	0.50		0.87	
	0.16	-1.25	0.60	-0.07	0.15	3.19	-3.20	-0.05	-1.34	-0.30	2.71	-1.87		0.82	
5	171.93	-1.69	-0.06	-40.65	2.85	14.63	-6.15	0.31					-0.04	0.66	70
	64.89	0.54	0.10	14.36	0.84	6.23	2.20	0.18					0.18	0.75	
	2.65	-3.15	-0.64	-2.83	3.39	2.35	-2.80	1.70					-0.22	0.78	
6	104.21	-0.79	0.02	-25.93	1.91	12.63	-5.00	0.32			0.30		0.23	0.76	56
	78.37	0.52	0.10	17.08	0.98	5.88	2.01	0.23			0.19		0.19	0.70	
	1.33	-1.52	0.20	-1.52	1.95	2.15	-2.49	1.38			1.54		1.19	0.70	
7	-32.11	-0.91	0.23	4.96	0.03	34.87	-11.71	0.04			1.04	-0.99	-0.09	0.52	35
	188.66	1.16	0.16	41.26	2.38	8.15	3.09	0.61			0.38	0.58	0.87	0.89	
	-0.17	-0.79	1.39	0.12	0.01	4.28	-3.79	0.07			2.74	-1.73	-0.10	0.79	

Note: The figures are the estimated coefficient (first row), the robust standard error (second row), and the z-value (third row).
The first R-squared is within, the second R-squared is between, and the third R-squared is overall.

(4) Projections of Domestic Saving Rates for 2011-2030

In this section, we discuss our projections of domestic saving rates for 2011-2030. Comparing out-of-sample projections based on the random-effects and country-fixed-effects models suggests that the random-effects model does not perform as well as the fixed-effects model in fitting the domestic saving rate for a number of economies such as the PRC, Singapore, Pakistan, and the Philippines. The projections from the random-effects models underestimate the saving rates of the former two economies while overestimating those of the latter two economies. This is consistently true for all seven random-effects models. For the PRC, omitting the country-fixed-effect would yield a far lower saving rate of about 24% of GDP for the 2000-2007 period—10 percentage points lower than the actual rate. A possible explanation for the case of the PRC is omitted factors such as the increase in the corporate saving rate during this period (IMF, 2009) and/or the distorted sex ratio of those of marrying age (Wei, 2009). Another example of an obvious deviation of the fitted saving rate from the actual rate is the Philippines. The fitted saving rate based on the random-effects model does not seem to show the decline observed in the actual rate. The rapidly increasing coverage of the social security system has been suggested as one of the explanations for why this might be (Terada-Hagiwara, 2009). However, if one views these factors as being of a cyclical or temporary nature, as was apparently the case in the recent past, the random-effects model may in fact be a more suitable model for generating "long-term" projections. Thus, we generate projections using both models.

Our projections for the next two decades, 2011-2020 and 2021-2030, rely on the United Nations' (U.N.) projections of the age structure of the population (the aged and youth dependency ratios) and the GDP projections in Lee and Hong (2010). Since projections of financial development are not available, we assume that financial deepening progresses according to the level of per capita income. We first identify the income group of the 12 economies in the next two decades and then use the level of the credit to GDP ratio for the corresponding income group in 2008.[4]

Saving rate projections are generated for the periods 2011-2020, and 2021-2030 using the coefficients in both the fixed and random-effects variants of model 1. Table 5 and Figures 3 and 4 show future projections of domestic saving rates for the twelve economies in our sample.

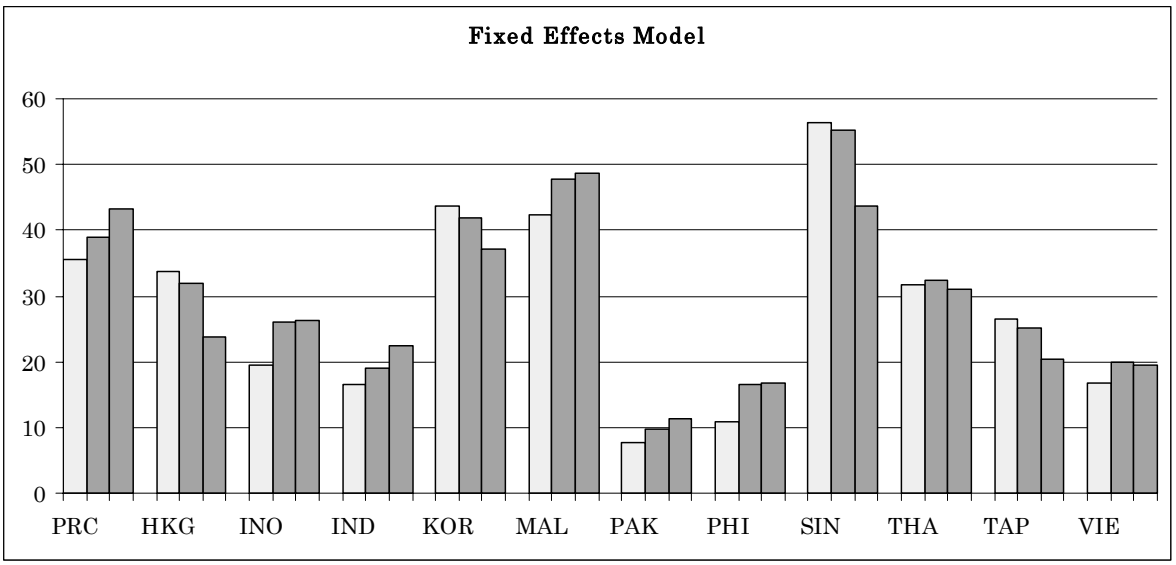
[4] Based on this assumption, the credit to GDP ratio will deepen to 130% by the 2021-2030 period in the PRC inasmuch as this economy is projected to belong to the high income group by then. Likewise, the credit to GDP ratio is assumed to deepen in Korea, Malaysia, and Singapore to 130% in the next two decades—a slight improvement relative to the recent past. The credit to GDP ratio is assumed to be 105% in the upper middle income group including Thailand and 46% in the lower middle income group including Indonesia, India, Pakistan, and the Philippines.

Table 5: Average Domestic Saving Rate Projections

	Country	PRC	HKG	INO	IND	KOR	MAL	PAK	PHI	SIN	THA	TAP	VIE
FE	2011-2020	39.0	31.9	25.9	19.1	41.8	47.8	9.6	16.5	55.2	32.4	25.1	20.0
	2021-2030	43.3	23.9	26.3	22.4	37.2	48.6	11.2	16.7	43.8	31.1	20.4	19.5
RE	2011-2020	28.4	37.7	22.5	23.5	31.5	40.4	22.3	23.3	37.9	25.7	27.2	21.8
	2021-2030	29.2	20.5	20.8	25.6	19.5	38.9	23.5	22.3	14.9	20.2	15.1	17.9

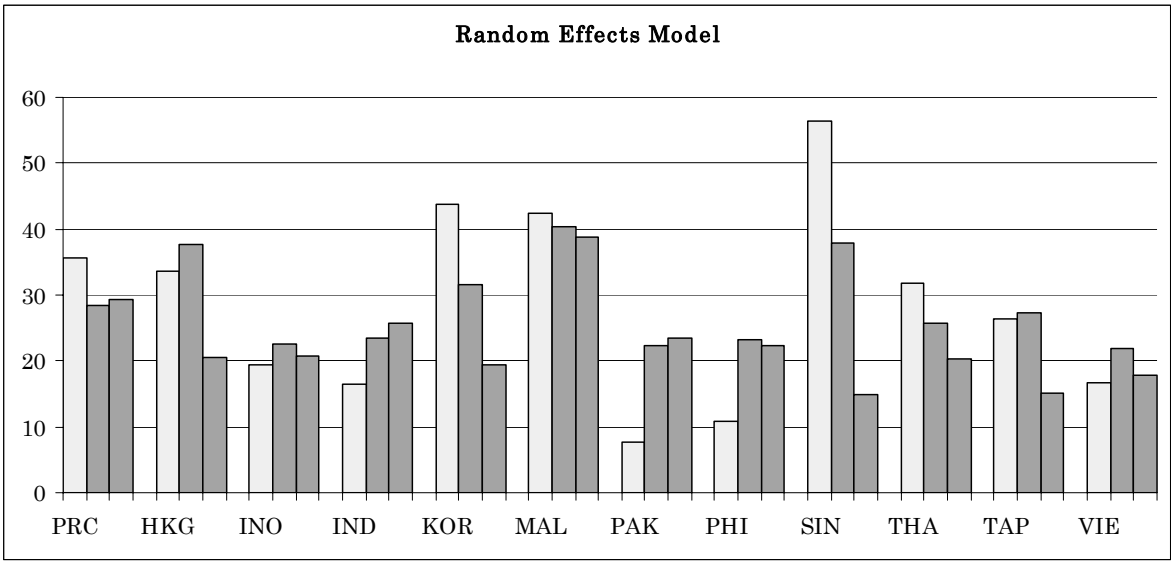
Source: Authors' calculation, Lee and Hong (2010), United Nations. World Population Prospects, The 2008 Revision, available at http://esa.un.org/unpp

Figure 3: Past and Future Domestic Saving Rates based on Fixed-Effects Model
2000-2007 (left bar, actual), 2011-2020 (middle bar, projection),
and 2021-2030 (right bar, projection)



Source: Authors' calculation, Lee and Hong (2010), United Nations. World Population Prospects, The 2008 Revision, available at http://esa.un.org/unpp

Figure 4: Past and Future Domestic Saving Rates based on Random-Effects Model
2000-2007 (left bar, actual), 2011-2020 (middle bar, projection),
and 2021-2030 (right bar, projection)



Source: Authors' calculation, Lee and Hong (2010), United Nations. World Population Prospects, The 2008 Revision, available at http://esa.un.org/unpp

The aging of the population appears to be the dominant determinant of future trends in domestic saving rates, and financial deepening to a lesser extent. As expected, domestic saving rates are expected to show a downturn by 2030 in the economies in which the aging of the population is expected to proceed the most rapidly. The projections based on the fixed-effects model show that the rapidly aging economies (Hong Kong, China; Korea; Singapore; and Chinese Taipei), where the aged dependency ratio is projected to reach close to or above 40% by 2030, will show a 6 to 12 percentage point decline in their domestic saving rates during the next two decades. The saving rate is projected to show a slight downturn by 2030 in economies in which the aging of the population is expected to proceed at a slower pace (Thailand), and it is projected to continue increasing or level off until 2030 in those economies in which the aging of the population is expected to proceed at the slowest pace (the PRC, Indonesia, India, Malaysia, Pakistan, Philippines, and Vietnam).

There are two economies, the PRC and Malaysia, which show opposite trends depending on which model we use. The domestic saving rates of these two countries are projected to decline from the 2000s to the 2020s if a random-effects model is used but are projected to continue increasing if a fixed-effects model is used. This is due to differences in the estimated coefficient of AGE, which is much larger in absolute terms when the random-effects model is used even though the coefficients of the other explanatory variables are relatively similar. Thus, the increase in the aged dependency ratio in these two economies is projected to cause a much larger decline in their domestic saving rates when the random-effects model is used than when the

fixed-effects model is used.

Our projections are broadly similar even if we assume that financial deepening does not progress as assumed, which confirms the importance of the demographic variables.[5]

The dramatic differences among economies in developing Asia in projected future trends in their domestic saving rates are not surprising because there is a 30 to 40 year gap in the timing of population aging in the 12 economies in the sample, as can be seen from Table 6. As a result of these dramatic differences in the timing of the demographic transition in the coming decades, the decline in domestic saving rates will not occur simultaneously in the economies of developing Asia but will rather be spread out over a half-century, with the decline in domestic saving rates in some economies being offset by the increase in domestic saving rates in other economies until at least 2040.

Table 6: Average Domestic Saving Rate Projections

Economy	The Year in which the Population Aged 65 or Older in the Total Population Reaches 14 percent	The Year in which the Demographic Bonus Ends
PRC	2020-25	2015
HKG	2010-15	2010
INO	2040-45	2030
IND	2050-55	2035
KOR	2015-20	2015
MAL	2040-45	2020
PAK	After 2055	After 2055
PHI	2050-55	2040
SIN	2015-20	2010
THA	2020-25	2010
TAP	2015-20	2018
VIE	2030-35	2020
Japan	1990-95	1990

Note: The demographic bonus is defined as the period during which the proportion of those aged 14 or younger falls below 30 per cent and the proportion of those aged 65 years or older remains below 15 per cent.

Source: The United Nations' (U.N.) projections available at http://esa.un.org/unpp, and the Statistical Yearbook for Taipei, China, available at http://www.cepd.gov.tw/encontent/m1.aspx?sNo=0000063.

[5] If financial deepening does not progress and remains at the average level of 2000-2007 , the domestic saving rates of a number of economies such as Indonesia, India, Pakistan, and the Philippines will be higher than our projections by 1 to 3 percentage points, while the domestic saving rates in the PRC and Malaysia will be lower than our projections by 0.2 percentage points.

Moreover, the projected decline in domestic saving rates from the 2000s until the 2030s in the rapidly aging economies ranges from 6.0 percentage points (Chinese Taipei) to 12.9 percentage points (Singapore), which is about the same or larger than what other already aging economies such as Japan have experienced over the last 20 years. In Japan, the domestic saving rate declined from its peak of 39% in the late 1980s to 33% in the early 2000s, during which time the aged dependency ratio rose from 16% to 29%. The more pronounced decline in developing Asia's domestic saving rate might be due to the fact that aging is expected to progress more rapidly. Nonetheless, the fact that more than half (seven) of the economies in developing Asia are projected to show increases in their domestic saving rates suggests that the decline in domestic saving rates in developing Asia as a whole will proceed only gradually, at least until 2040, meaning, for better or worse, that global imbalances are not likely to be eliminated any time soon.

(5) Summary and Conclusions

In this section, we conducted an econometric analysis of the determinants of domestic saving rates in developing Asia during the 1960-2007 period and found that the main determinants of the domestic saving rate in developing Asia during the 1960-2007 period appear to be the age structure of the population (especially the aged dependency ratio), income levels, and the level of financial development, and moreover, that the direction of impact of each factor is more or less as expected.

We then projected future trends in domestic saving rates in developing Asia during the 2011-2030 period and found that the aging of the population will be the main determinant of future trends in domestic saving rates. However, we found that there will be substantial variation from economy to economy, with the rapidly aging economies showing a sharp downturn in their domestic saving rates by 2030 and the less rapidly aging economies showing only a moderate downturn or no downturn by 2030. Thus, it does not appear that there will be a sharp decline in saving rates in developing Asia as a whole, at least during the next two decades, meaning, for better or worse, that global imbalances are not likely to be eliminated any time soon.

5. Overall Conclusions and Policy Implications

In this paper, we found that the age structure of the population (especially the aged dependency ratio) and financial development (credit availability) are the most important determinants of saving rates in both developed and developing economies and that the development of the social safety net and income levels are also important in some cases.

Turning to the policy implications of our findings, our finding that there is not a clear relationship between social safety nets and saving rates implies that improving social safety nets will not necessarily reduce household saving rates and stimulate consumption, but doing so may be desirable in any case because it will obviate the need for households to worry about unexpected contingencies, retirement security, etc., thereby enhancing household welfare. Moreover, our finding that financial development is more important as a determinant of saving rates implies that

the development of capital markets (and the relaxation of borrowing constraints) will alleviate the need for precautionary saving (self-insurance), which is very inefficient, and serve as a partial substitute for the development of social safety nets, especially in economies with underdeveloped social safety nets, leading to lower saving, higher consumption, and higher household welfare. Thus, a two-pronged approach of simultaneously developing social safety nets and private capital markets may be the most effective way to enhance household consumption and welfare.

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Appendix: Table 1: Descriptive Statistics

Variable		Data source	Note
Real domestic saving rate	SR	Computed as 100-kg-kc. Heston et al., Penn World Table version 6.3 (PWT) 1/	kg is Government Share of Real GDP per capita , and kc is Consumption Share of Real GDP per capita. Both from PWT.
Aged dependency ratio	AGE	"SP.POP.DPND.OL" from World Development Indicators (WDI) of World Bank 2/ and the *Statistical Yearbook* for Taipei,China 3/	Ratio of the population aged 65 or older to the population aged 15-64
Youth dependency ratio	DEP	"SP.POP.DPND.YG" from WDI and the *Statistical Yearbook* for Taipei,China	Ratio of the population aged 0-14 to the population aged 15-64
Real per capita GDP	LNGDP	"rgdpch" from Penn World Table version 6.3	Real GDP per capita (2005 Constant Prices: Laspeyres)
Real per capita GDP growth	CHGDP	"grgdpch" from Penn World Table version 6.3	Growth rate of Real GDP Chain per capita (rgdpch)
Private credit by deposit money banks and other financial institutions (% of GDP)	CREDIT	"pcrdbofgdp" from Beck and Demirguc-Kunt (2009) and line 32D from International Financial Statistics (IFS) of the International Monetary Fund for the PRC	Private Credit by Deposit Money Banks and Other Financial Institutions
Public expenditure on social services and pensions (% of GNDI)	SSR	CEIC Data Company Ltd., and Department of Budget and Management for the Philippines. 4/	Government Expenditure on Social services divided by Gross National Disposable Income

Fiscal balance (% of GDP)	FISC	CEIC Data Company Ltd., Asian Development Outlook Database, Key Indicators (various issues) of Asian Development Bank 5/, Bank of Thailand 6/, and Bank Negara Malaysia 7/.	Surpluses are positive and deficits are negative
Interest rate	INT	IFS, and the Central Bank of the Republic of China (Taipei,China's central bank) for Taipei,China. 8/	Used data on the deposit rate (line 60L of IFS) except for India, Pakistan, and Korea, for which we used the discount rate (line 60 of IFS)
Inflation rate	INFL	"NY.GDP.DEFL.KD.ZG" from WDI	
Real interest rate	RITN	IFS, WDI, and the Central Bank of the Republic of China	Computed as ln((1+INT/100)/(1+INFL/100))

Note:

1/ Available at http://pwt.econ.upenn.edu/php_site/pwt_index.php

2/ Available at http://devdata.worldbank.org/dataonline/

3/ Available at http://www.cepd.gov.tw/encontent/m1.aspx?sNo=0000063

4/ Available at http://www.dbm.gov.ph/index.php?id=32&pid=9

5/ Available at http://www.adb.org/Statistics/ki.asp

6/ Available at http://www.bot.or.th

7/ Available at http://www.bnm.gov.my

8/ Available at http://www.cbc.gov.tw/ct.asp?xItem=30010&CtNode=517&mp=2

Appendix Table 2: Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
PWTSR	24.0	14.3	-8.4	61.9
AGE	7.8	2.2	3.8	16.7
DEP	60.5	19.4	17.7	91.3
CHGDP	4.4	4.2	-14.2	20.2
LNGDP	7075.4	8549.6	435.8	44619.0
INFL	7.7	5.0	0.0	39.1
INT	7.8	5.2	0.0	39.1
CREDIT	0.6	0.5	0.1	2.4
FISC	-1.4	4.2	-16.7	16.1
SSR	4.8	3.4	0.7	16.9

Uncertainty of Public Pension and Precautionary Saving in Japan —Evidence from the Micro Data of Close-to-retirement Households

Wataru Suzuki* and Yanfei Zhou**

Introduction

The Japanese net household saving rate (national accounting base) slid to a historical low level of 3.2% in 2006, from 11.4% in 1997. However, the savings behavior of each individual household, measured by the gross saving rate (also named "surplus ratio") of worker households, remained around 25–30% in the 2000s (see Table 1). Even retirement-age households, with a head-of-household aged 60 or over, save nearly 10% of their disposable income each year. Meanwhile, Japanese households' wealth accumulation is still the highest among the OECD countries. Elderly households, however, are the major holders of this huge accumulation of wealth: households with heads-of-household aged 60 or over own 78.6% of total net financial wealth, while their share of the population is only 37.4% (see Table 2). A recent simulation study by Uemura (2008) suggests that Japanese elderly households hold a total of 179 trillion yen of excessive savings, compared with the predicted amount based on a typical life-cycle model.

This huge wealth holding of Japanese elderly households, however, is regarded by government and business as a potential source of Japanese economic recovery. If part of the elderly households' wealth and savings could be shifted to consumption, strong domestic demand would be created, and the stagnant Japanese economy may then have a good chance of recovering. The Japanese government has already introduced policies to encourage elderly households to spend some of their financial wealth: (1) a tax cut for inter vivos transfers (e.g., the tax-free cap for housing fund donation to children or grandchildren was raised from 3.3 million yen to 5.5 million yen in 2001, and then to 15 million yen in 2010), and (2) expanding social security expenditure in order to ease the anxieties of elderly nationals. The current Democratic Party regime treats social security expansion not only as an antirecession measure but also as a long-term economic growth strategy (Democratic Party Manifesto 2009). One of their theoretical bases, however, is that social security expansion could alleviate elderly households' insecurity and lead to more active consumption.

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The social security system is undoubtedly a critical source of uncertainty for nationals. Uncertainty significantly affects household saving/consumption, because it is a universal experience (e.g., uncertain longevity, unexpected disaster and sickness, etc.) and because Japanese households are highly risk averse. For instance, a well-run medical care system or long-term nursing care system could ease households' uncertainties about medical-care or nursing-care costs in the future, and hence reduce households' need for excessive savings. On the contrary, the absence of such systems could encourage excessive saving by households.

Recently, a surge in anxiety about the sustainability of the public pension system has introduced a major uncertainty for Japanese households. As we will explain in Section 2, public pension uncertainty is very likely to be responsible for the precautionary savings and excessive wealth accumulation by elderly households. The essential question is as follows: how much precautionary saving result from public pension uncertainty? Answers to this puzzle will be critical for the evaluation of the Democratic Party's social security expansion policy and for the development of future growth strategies. Nevertheless, very few empirical studies have been conducted on this topic.

The present paper therefore uses a unique survey conducted by the Japan Institute for Labour Policy and Training (JILPT) in 2009 to tackle this problem. An important contribution of the JILPT survey is the provision of data on public pension uncertainty: the anticipated percentage change (APC) in public pension benefits with respect to the present benefit level, and the ideal amount (IA) of public pension for retirement. These data enable us to construct two indexes of public pension uncertainty: anticipated change rate in public pension benefits, and the expected change in the value of public pension benefits (APC×IA). Additionally, to assess precautionary savings motives more precisely, we limit our samples to people close to retirement for whom the labor income risk should be relatively small, following Lusardi (1997). Our estimates indicate that public pension uncertainty affects household wealth accumulation significantly, and that precautionary savings make up nearly 10% of net and 5% of gross financial wealth accumulation by close-to-retirement households.

1. Research Background and Literature Review

1.1 Background

(i) Households' surplus ratio remains high

The most recent Japanese net household saving rate (national accounting base) has slid to a historical low of 3.2% in 2006, from 11.4% in 1997. Along with population aging and capital depreciation, the net household saving rate may reach as low as zero or even become

negative in the long run (NIRA 2008). Accordingly, perception of Japanese household saving behavior has changed notably. Horioka (2004) compares net household saving rates between Japan and 13 other OECD countries and finds that Japan has not had the highest saving rate since the mid 1980s. He thus concludes that Japan may no longer be regarded as the nation of enthusiastic savers it once was.

Table 1 Household saving rates in Japan (1996–2008) (%)

	96	97	98	99	00	01	02	03	04	05	06	07	08
National Accounting Index (SNA)	10.4	11.4	10.7	10	7.9	5.2	4.6	3.9	3.4	3.5	3.2		
Kakei Survey Index													
Workers' H. : all	28.0	28.0	28.7	28.5	27.9	27.9	27.0	25.9	25.7	25.3	27.5	26.9	26.6
Workers' H. : head aged 60 or over	21.8	22.4	22.5	21.0	18.4	19.6	14.5	12.8	10.5	8.5	9.0	11.1	9.0
Retiree's H.: head aged 65 or over	-6.0	-6.3	-6.1	-7.4	-8.8	-13.3	-17.5	-16.8	-23.2	-20.7	-21.2	-24.9	-25.5

Source: Cabinet Office "Annual Report of National Accounting", MIC "Annual Report of Kakei Survey".

Notes: (1) The Kakei Survey workers' H. data relate to two-or-more person households. (2) There is a huge gap between the SNA index and the Kakei Survey index (also named "surplus ratio"). The SNA index is computed using macro data, and it is much lower than the Kakei Survey index largely because it (a) includes retired and unemployed households, and (b) has taken into account capital depreciation and imputed house rent.

However, in examining the saving behavior of each household, we get a different image. The gross saving rate (also named "surplus ratio") of the workers' households has been as high as 25–30% in the 2000s (see Table 1). Even retirement-age households, with heads-of-household aged 60 or over, save nearly 10% of their disposable income each year. Meanwhile, Japanese households' wealth accumulation remains among the highest of OECD countries. According to OECD statistics for 2006, the ratio of household net financial wealth to disposable income is 403.7% in Japan, which is notably higher than in the US (309.1%), Britain (291.3%), Germany (198.3%), and other OECD countries.

Hence, a simple question arises: do Japanese households save excessively and accumulate too much wealth? Dekle (1990) believes the answer is yes, at least for elderly households. Using a 1983 Japanese household survey, Dekle (1990) finds an obvious absence of dissaving among Japanese elderly households, based on there being no significant differences in total wealth between different age groups for Japanese elderly households. A recent simulation study by Uemura (2008) suggests that Japanese elderly households have around 179 trillion yen of excessive savings, compared with the predicted amount based on a

typical life-cycle model. Japanese households were estimated to hold a total of 456.9 trillion yen in net financial wealth in 2004, which is equal to nearly one year of GDP[1] in Japan (see Table 2). Elderly households, however, are the major holders of this huge stock of financial wealth: households with heads-of-household aged 60 or over own 78.6% of the total net financial wealth, while their population share is only 37.4%.

Table 2 Household wealth accumulation, by age of the household head

(2004, unit: 10,000 yen)

	Number of Households (A)		Net wealth (B)	Net financial wealth (C)	Housing& land assets	Other fixed assets	Annual income	Wealth/ income	share of total net wealth	share of total net financial wealth
0–29	5,271,641	(10.7%)	817	-8	679	146	469	1.7	2.3%	-0.1%
30–39	7,714,522	(15.7%)	1,459	-212	1,514	158	597	2.4	6.1%	-3.6%
40–49	7,570,791	(15.4%)	2,712	148	2,393	171	777	3.5	11.2%	2.5%
50–59	10,161,606	(20.7%)	4,160	1,020	2,955	186	878	4.7	23.0%	22.7%
60–69	9,034,720	(18.4%)	5,556	1,884	3,499	173	624	8.9	27.3%	37.3%
70 and over	9,309,250	(19.0%)	5,961	2,026	3,817	117	542	11.0	30.1%	41.3%
Total	49,062,530	(100.0%)	3,900	950	2,786	164	696	5.6	100.0%	100.0%

Source: Bureau of Statistics "National Census 2005", "National Survey of Family Income and Expenditure 2004".

Notes: (1) The shares are computed by the authors. Share of total net wealth = $(B_i \times A_i)/\Sigma_j(B_j \times A_j)$; share of total net financial wealth = $(C_i \times A_i)/\Sigma_j(C_j \times A_j)$. (2) The total household net financial wealth (456.9 trillion yen) = $\Sigma_j(C_j \times A_j)$.

(ii) Public pension uncertainty surges

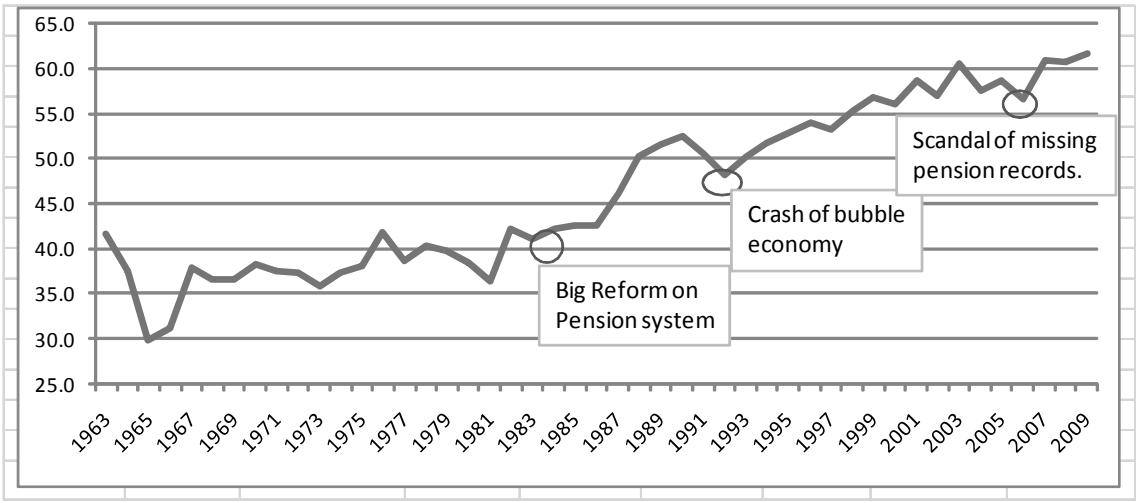
Recently, increasing concern about the sustainability of the public pension system has made this a more important uncertainty factor for Japanese households. According to the Social Security Survey conducted by the Japan Institute of Life Insurance (Seimei Hoken Bunka Center) in 2007, 69.2% of respondents feel somewhat anxious about life in retirement because they believe that the public pension cannot provide a reliable retirement income, which is 10.2 percentage points higher than the 1998 survey. Accordingly, the saving motive for living expenses during old age (namely "retirement saving") seems to be stronger.

A long-lasting annual survey by the Central Council for Financial Services Information shows that the saving motive for living expenses during old age has been sharply gaining weight since 1985, the year that Japan enacted significant reforms of its public pension system. Figure 1 shows the proportion of respondents that admitted having a saving motive for living expenses during old age. The retirement saving motive fluctuated around 30–40% before 1985; it then rose steadily thereafter, with an accelerated speed after the crash of the bubble economy in 1992 and after the scandal of the missing pension records in 2007. In 2009, 61.6%

[1] The total gross financial wealth of Japanese households was estimated to be as much as 1,410.4 trillion yen in 2009 (Source: Bank of Japan "Statistics of Flow-of-Fund Account").

of Japanese reported that they were saving for retirement, almost a 20-percentage-point increase from 42.5% in 1985.

Figure 1 Historical trend of saving motive for living expenses during old age (%)



Source: the Central Council for Financial Services Information (Kinyu Koho Chuo Iinkai) (ed.) "Kakei no Kinyu Kodou ni Kansuru Seron Chosa" (Public Opinion Survey on Household Financial Choices), time series statistics from 1963 to 2009.

(iii) How can public pension uncertainty depress household consumption?

Japan's public pension system is a two-tiered system in which the first tier (namely, the "basic pension") is common for all nationals while the second tier is divided into three parts according to the occupation of the insurees: the Employees' Pension System to which private salaried workers belong, the Mutual Aid Association Pension System to which government workers belong, and the National Pension System[2] to which the self-employed and all others belong. All of these public pension systems are essentially operated on a pay-as-you-go basis. Thus, in a society in which fertility is declining and the population is aging, it becomes necessary to raise the contribution rate or cut the benefits of pensioners in order to keep a balanced budget.

Japan's population is known to be aging at its fastest rate in human history (Horioka et al. 2007). In 2008, the ratio of the productive-age (15–64 years) population to the elderly (65 and over) population reached 33.6%, which implies that it takes three productive-age people to support one elderly person. This ratio is projected to reach 50.2% in 2023 and 85.7% at the age peak of 2072. Besides this rapid aging process, the stagnation of economic growth in the past two decades has worsened the fiscal situation of the public pension system.

[2] The maximum benefit level for the "basic pension" is 66,000 yen per month. Pensioners belonging to the National Pension System are eligible for the "basic pension" only, while pensioners belonging to the other two systems are eligible for a second-tier benefit proportional to his/her total earnings for their working lifetime.

Because of the significant political power of the elderly population, until the 1994 reform, the public pension budget was balanced mainly by increasing the contribution rate. The benefits of pensioners were protected, and few retirees felt any anxiety over their pension benefits. Raising the contribution rate repeatedly as a budget balancing mechanism, of course, imposed heavy burdens on working households and resulted in further distrust of the public pension system among young generations. Accordingly, the number of dropouts and premium defaulters within the National Pension System has increased sharply since the 1990s (Suzuki and Zhou 2010). In 2008, the default rate for the national pension premium reached as high as 37.9%.

In the 1994 pension reform (and reforms thereafter), the Japanese government had no choice but to begin cutting the benefits of pensioners step by step. Firstly, in the 1994 reform, the eligible age for the basic pension benefit was postponed from 60 to 65 years in a phased manner. Then in the 1999 reform, the eligible age for the second-tier benefit was changed from 60 to 65 in a phased manner. The 1999 reform reduced pensioner benefits by 20% in incremental steps. The 2004 reform introduced a new system named "Macro Economic Slide" (MES), whereby the benefit amount of pensioners was lowered automatically along with the declining birth rate and the increasing longevity of the elderly.[3] According to simulations by the Japanese government, no further benefit reductions or eligible age postponing will be necessary until 2023 if the MES functions well. However, because the peak of population aging will occur in 2075, the risk of further cuts in pension benefits will be very high over the longer term.

In summary, for most Japanese households, including the close-to-retirement households, public pension uncertainty arises from not only the existing MES but also the unavoidable future reforms. As Horioka (1990) warned, uncertainty in the future provisions of the Japanese public pension system will cause Japanese households to discount future benefits heavily and to save excessively.

1.2 Literature review

The idea that people engage in saving as protection against income risk represents an important innovation in the life-cycle permanent-income hypothesis in explaining excessive household saving and wealth accumulation. Many empirical studies have been performed to evaluate the importance and magnitude of precautionary saving, but so far the findings are inconclusive. As Lusardi (1997) stresses, one of the major problems of empirical work is how

[3] The public pension system was regulated by law to be reformed once every five years, based on forecasts of the future financial situation of the system. After the introduction of MES in 2004, however, this "once every five years reform" is regarded as unnecessary, and it was deleted from law.

to construct an exogenous direct index of income risk. Some studies (e.g., Skinner 1998) use occupation as a proxy for income risk, but this is criticized for selectivity bias, because people may choose occupations depending upon their degree of risk aversion. Other studies (e.g., Guiso et al. 1992; Lusardi 1997, 1998) utilize households' expectations about the probability of unemployment or nominal earnings changes as a proxy for income risk. These studies may suffer from measurement error, because the self-reported earnings variance refers to one-period-ahead forecasts of income and cannot be interpreted as a measure of lifetime earnings variance. Other studies using income variance within homogeneous groups (e.g., Dardanoni 1991; Carroll and Samwick 1998) as a proxy for income risk. However, this measure of income risk is not appropriate unless the income variability of households within each group is homogenous enough and the income variance varies significantly across different groups.

As a whole, empirical studies that use occupation or subject earnings variance as a proxy for income risk find little evidence in favor of the precautionary saving model. For example, Skinner (1998) compares the saving rates across different occupations and finds that people in riskier occupations, such as farmers or the self-employed, are in fact saving less than are people in professions with less income variability. Guiso et al. (1992) and Lusardi (1997) both employ households' expected nominal earnings changes as a measure of income risk from the 1989 Italian SHIW. They find that precautionary savings explain only 2–2.8% of total wealth accumulation. Additionally, Lusardi (1998) constructs an income risk index by using information about the subjective probability of job loss from the Health and Retirement Survey. He then finds that although precautionary saving has a role in explaining excessive saving and wealth accumulation by people close to retirement, it explains only a small part (2–4.5% of net financial wealth) of total wealth accumulation.

On the other hand, empirical studies using the variance of the income of homogeneous groups as a measure of income risk have in general obtained results supportive of the precautionary saving model. For instance, Carroll and Samwick (1998) divide the Panel

Study of Income Dynamics sample into 26 groups according to the occupation, industry, and education of the head-of-household, with the variance and log of the income within each group employed as proxies for income uncertainty. As a result, they find that wealth and uncertainty are positively related, and that precautionary savings account for 45% of total net worth and 32% of very-liquid assets for households with heads-of-household aged younger than 50 years. Using cross-section data for Britain, Dardanoni (1991) estimates income variances by grouping the sample into dozens of groups with respect to the industry, economic position, and skill level of the head-of-household. His estimates indicate that more than 60% of savings arise as a precaution against future risk. Furthermore, Kazarosian (1997) decomposes

individual-specific income uncertainty into permanent and transitory components using National Longitudinal Survey. He finds that the impact of uncertainty on the ratio of wealth to permanent income is highly significant, and that a doubling of uncertainty increases the ratio of wealth to permanent income by 29%.

Empirical studies of Japanese precautionary saving, although still limited, have become more common since the 2000s. Zhou (2003) improves upon the methodology of Dardanoni (1991) and applies it to Japanese household-level data. Specifically, she divides a representative Japanese sample into 56 homogeneous groups with respect to the education, age, and occupation of the head-of-household, and regards the income variances within each group as proxies for income risk for each household in that group. Zhou (2003) finds that precautionary saving represents 5.6% of the total savings of salaried-worker households and 64.3% of the total savings of farmers and self-employed households. Bessho and Tobita (2008) quote job loss rates and standard deviations of income by gender, age, education, and marital status from macro statistics, and then match this information with Japanese household-level data to obtain proxies for income uncertainty. They find that uncertainty is positively related to the wealth-to-income ratio, and that precautionary savings account for 6–15% of household net financial assets.

Many recent empirical studies shed light upon the effect of uncertainties in the social security system on household saving. The uncertainty of medical expenses, however, is one of the hottest topics. Using data from the 1989 Survey of Consumer Finances, Starr-McCluer (1996) finds that, contrary to expectations, insured households maintain a much higher level of wealth than comparable households without insurance do. She concludes that savings and health insurance are related for reasons that have little to do with certainty and precautionary motives. In contrast, Chou et al. (2003) find supportive evidence for the hypothesis of precautionary saving for medical expenses uncertainty. Using a natural experiment associated with the 1995 introduction of the National Health Insurance program in Chinese Taipei, they find that the program reduced households' savings by an average of 8.6–13.7%, with the largest effects for households with the least savings. Additionally, Palumbo (1999) uses a health-uncertainty model to predict household consumption expenditures, and his simulations imply that uncertain future out-of-pocket medical expenses reduce household annual consumption among elderly American couples by 7%.

There have been very few empirical studies of precautionary saving with respect to social security uncertainty in Japan, with the exception of Suzuki et al. (2008) and Murata (2003). Using Japanese micro data, Suzuki et al. (2008) examine whether the introduction of the Japanese Long-term Care Insurance System in 2000 has reduced households' precautionary saving or not. Contrary to their expectations, they find that households' gross

financial assets remain constant or even slightly higher among elderly households. As Suzuki et al. (2008) admit in their paper, the uncertainty reduction effect of the Long-term care Insurance System might be cancelled out by other social changes (e.g., a sharp increase in public pension uncertainty, a rise in the unemployment rate, etc.).

On the other hand, Murata (2003) uses information about households' attitudes toward the public pension system[4] from a Japanese household survey to proxy public pension uncertainty. Although the final result is inconclusive, she finds supportive evidence for the precautionary saving model when limiting the sample to households where grown-up children do not coreside with their parents. That is, households besides coresidences with higher levels of anxiety toward the public pension system have a higher wealth-to-income ratio than comparable households that feel comfortable with the present pension system. Given that the average financial assets holdings of households with some anxiety about the pension system are 2.1 million yen higher than their counterparts', Murata (2003) suggests that precautionary saving because of public pension uncertainty could account for 1/4 to 1/3 of household financial wealth.

The present paper focuses on the impact of public pension uncertainty on household wealth accumulation, but it improves upon Murata's (2003) approach in the following ways. First, we use more specific and quantitative measures for public pension uncertainty instead of the abstract, four-choice dummy variable used in Murata (2003). Second, we limit our sample to people close to retirement, for whom labor income risk should be relatively small and public pension uncertainty should be relatively dominant, while Murata's sample is young households with members aged 27–37 years, for whom saving for child-rearing and housing are so prominent that it is difficult to save for public pension uncertainty. Third, we use econometric simulation techniques to estimate the precise magnitude of precautionary saving because of pension uncertainty instead of depending on descriptive statistics for approximate estimates.

2. Data and Empirical Model

2.1 Data

This study uses household data from the Survey on the Employment and Work Conditions of Elderly People (SEWCEP), a survey that was conducted by the Japan Institute for Labour Policy and Training in 2008. To ensure that the sample was representative of the Japanese population, the sample was selected from the Basic Residential Registers ("Jyumin

[4] The variable is discontinuous and includes four choices: very comfortable, anxious about benefit cuts, anxious about the sustainability of the system, and no plan to rely on the system.

Kihon Daicho"), based on a two-stage stratified sampling procedure. To improve the response rate, the questionnaires were distributed by surveyors instead of mailing. Surveyors distributed and explained the questionnaire to subjects in person, and several days later, the surveyors visited the subjects again to collect the questionnaires. Five thousand individuals aged between 55 and 69 years received the questionnaire throughout Japan, of whom 3,602 responded. The response rate was 72.0%.

Because of the necessity of estimating permanent income and the need to limit our sample to the close-to-retirement households, we used subjects (N=1,012) that met the following three conditions: (1) presently working and earning some labor income, (2) not yet receiving any public pension benefit, and (3) head of the household.[5] We took the predicted labor income of the head-of-household from his/her income function as a proxy for his/her permanent income. (See Appendix I for details.)

The SEWCEP collected very detailed data on retirement plans, pension participation, household holdings of financial assets and debts, and consumption. Most interestingly, the SEWCEP provides unique information that can be used to construct proxies for public pension uncertainty.

(i) Measuring public pension uncertainty

SEWCEP includes data on the anticipated percentage change (APC) in public pension benefits with respect to the present benefit level. The anticipated percentage change is determined in two steps: first, the respondents are asked to predict whether they think that their own public pension benefit will (a) rise, (b) drop, or (c) remain unchanged/unknown compared with the present benefit level.[6] Then, those who responded (a) or (b) are requested to provide the specific percentage (m%) change that they expect. We take the APC as 0% for "(c) remain unchanged/unknown" cases, –m% for "(b) drop" cases, and +m% for "(a) rise" cases.

Our second candidate measure of public pension uncertainty is the anticipated value change (AVC) of the public pension, which equals APC multiplied by the IA of the public pension for retirement. IA, however, is constructed by multiplying the ideal amount of living expenses in retirement by the ideal financing rate of the public pension benefit.[7]

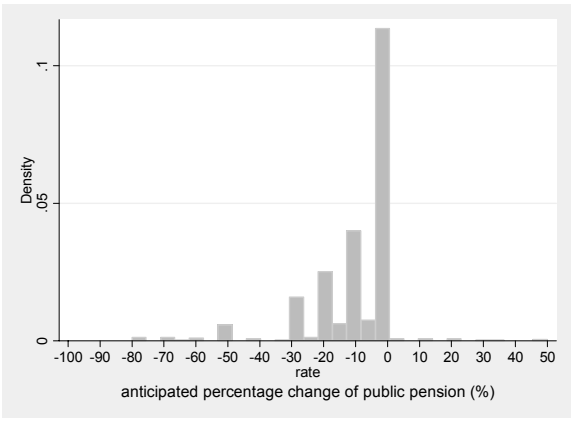
[5] Because there is no direct information in the survey to determine whether a respondent is a head-of-household, we treat subjects that meet any of the following two conditions as a household head: (1) total income (including unearned income) of the respondent accounts for 50% or more of household income; (2) the biggest component of total income for the household is the respondent's labor income.

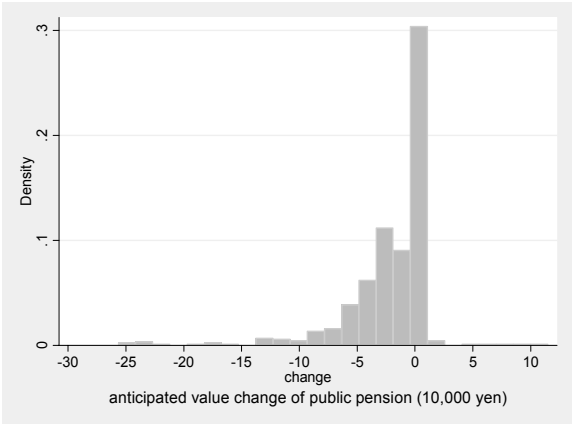
[6] Reflecting the recent trend of pension reforms, only 1.4% of respondents expected a rise in pension benefits, and 43.8% of respondents expected a drop.

[7] The ideal living expenses cover both the respondent and his/her spouse (if they have one).

Figure 2 Distribution of anticipated pension change

(APC) (AVC)





The distribution of the anticipated change in the public pension in terms of both percentage change and value change is shown in Figure 2. Although nearly half of the respondents expect "remain unchanged/unknown", the percentage of respondents (43.8%) expecting a drop is much larger than those expecting a rise (1.4%). The average anticipated percentage change is –9.3%, and the average anticipated value change is –21.9 thousand yen (see Table 3). In comparison with the government's presently planned pension percentage change (–4.8%) and value change (–11.7 thousand yen)[8], households' anticipated decline in pension benefits is much larger. This huge gap between households' anticipation and the government's planning reflects the fact that households are discounting future pension benefits much more heavily than the government's planned level. This household pessimism toward public pensions is very likely to induce households to practice excessive saving and wealth accumulation.

(ii) Measuring wealth

Three measures of wealth are used in our empirical analysis. The first measure (gross financial assets) is defined as the sum of all savings account balances.[9] The second measure (net financial assets 1) is calculated by deducting all debts from gross financial assets. The third measure (net financial assets 2) is computed by deducting all debts, except housing mortgages, from gross financial assets. Because most households with a mortgage should possess a comparable or higher value of housing assets than average, the third measure sounds more reasonable as an index of households' net financial assets.

Because the wealth-to-income ratio has such a wide distribution, and outliers can

[8] Both are simulation values computed by the authors. See Appendix II for details of the simulation.

[9] Because it is rare for Japanese household to hold bonds, stocks, and individual retirement annuities, saving accounts represent a major type of household financial assets.

significantly affect the estimates, we trimmed the distribution and excluded the top and bottom 2.5%. For the close-to-retirement households, the average wealth-to-income ratio is 163% according to the first measure, 50% according to the second measure, and 124% according to the third measure (see Table 3).

Because the SEWCEP contains no data on the specific values of housing assets or other real assets, we could not compute total household worth or net worth. As an alternative, we included an own-house dummy as an explanatory variable in our estimations, to control for the effect of real assets.

2.2 Empirical model

The theoretical predictions of the precautionary saving model can be summarized with reference to the following reduced-form equation, which has been employed by many empirical studies (e.g., Kazarosian 1997; Lusardi 1998; Murata 2003).

$$\frac{W_h}{Y_h^P} = a_0 AGE + a_1 \sigma_h + X_h' \beta + \varepsilon_h \qquad (1)$$

In the above model, a_0, a_1, β are coefficients, and ε is a normally distributed disturbance term. Wealth divided by the permanent income (W/Y^P) of household h is a function of AGE, household characteristics (X) that reflect the preferences parameters, and uncertainty about future income, as measured by the variance of σ. Uncertainty about future income, in this paper's context, is uncertainty about public pension benefits, because our sample is limited to close-to-retirement households. A supportive condition of the precautionary saving model is that uncertainty σ is positively related to the wealth-to-income ratio. In our context, because the values of our uncertainty proxies are inversely proportional to the degree of uncertainty, the estimated coefficient should be negative ($\hat{a}_1 < 0$) if the precautionary saving model is true.

As King and Dicks-Mireaux (1982) note, when preferences are nonhomothetic, X may include permanent income.[10] Specifically, X is a vector of the following variables: gender, four-scaled educational attainment, four-scaled health condition, marital status, having a family member in need of nursing care or not, having double income or not, coresiding with

[10] Some studies (e.g., Lusardi 1997; Bessho and Tobita 2008) assume homothetic preferences and use the log of W/Y^P as the dependent variable. In that case, all the observations with negative net wealth will be automatically excluded from the sample. Because negative net financial assets are quite common in real life, we use absolute value instead of the log value of W/Y^P as the dependent variable.

parents or not, number of family members, children's status[11] and residence (five-scaled city size and 11 districts). Including children's status in the estimations enables us to test the hypothesis of a bequest motive. The descriptive statistics of the major variables are presented in Table 3.

Table 3 Descriptive statistics of major variables

Variables	Mean	Std. Dev.	Min	Max
Gross financial assets (10,000 yen)	583.64	1219.76	0	10000
Net financial assets 1 (10,000 yen)	218.83	1527.42	-10000	10000
Net financial assets 2 (10,000 yen)	494.84	1333.67	-4000	10000
Permanent income (10,000 yen)	402.47	234.88	55.4	1322.0
Annual total income (10,000 yen)	482.91	438.38	10.8	7300.0
Annual labor income (10,000 yen)	445.45	409.21	10.8	7300.0
Permanent income (10,000 yen)	402.47	234.88	55.4	1322.0
Gross financial assets / Permanent income	1.63	3.80	0.0	47.7
Net financial assets 1 / Permanent income	0.52	5.03	-34.0	47.7
Net financial assets 2 / Permanent income	1.24	3.93	-22.7	29.6
Anticipated percentage change in pension (%)	-9.30	14.70	-80.00	50.00
Anticipated value change in pension (10,000 yen)	-2.19	3.81	-25.63	10.00
Planned percentage change in pension by the government (%)	-4.83	1.17	-7.65	-3.04
Planned value change in pension by the government (10,000	-1.17	2.21	-25.32	0.00
Age	58.53	2.66	55	69
$Age^2/100$	34.33	3.17	30.25	47.61
Male	0.691	0.462	0	1
Junior high school	0.164	0.370	0	1
High school	0.471	0.499	0	1
Junior college	0.124	0.329	0	1
College or graduate school	0.238	0.426	0	1
Excellent health	0.081	0.273	0	1
Good health	0.688	0.464	0	1
Poor health	0.209	0.407	0	1
Very poor health	0.019	0.136	0	1
Family member in need of nursing care	0.178	0.383	0	1
Double income	0.424	0.494	0	1
Extended family	0.655	0.476	0	1
No children	0.097	0.296	0	1
All children independent	0.519	0.500	0	1
Not all children independent	0.384	0.487	0	1
Married	0.839	0.368	0	1
Number of family members	3.252	1.554	1	11
Own house	0.854	0.353	0	1

Notes: (1) The maximum number of observations is 1,012. (2) Outliers of the distribution of the wealth-to-income ratio (the highest and lowest 2.5%) are excluded from the statistics.

[11] Children's status is defined as either one of the following three conditions: a) no child, b) all children independent, and c) not all children independent.

3. Empirical Results

Table 4 presents the correlation coefficients between the wealth-to-income ratio and public pension uncertainty. No matter what measures are used, the correlation coefficients are all negative, just as the precautionary saving model predicts. However, the relationship between the wealth-to-income ratio and pension uncertainty seems to be quite weak with respect to the magnitude of the coefficients (less than –0.2).

Table 4 Correlations between wealth-to-income ratio and public pension uncertainty

	Anticipated pension change (percentage)	Anticipated pension change (value)
Gross financial assets / Permanent income	-0.079	-0.104
Net financial assets 1 / Permanent income	-0.079	-0.139
Net financial assets 2 / Permanent income	-0.104	-0.123

When controlling for the other covariates, however, the estimation results show more supportive evidence for the precautionary saving model. Table 5 presents estimates of the wealth-to-income equation by using the APC as a proxy for uncertainty. Table 6, however, uses the alternative proxy, AVC. Both tables present estimation results when either gross financial assets, net financial assets 1, or net financial assets 2 are used as the measure of wealth.

In accordance with the precautionary saving model, the sign of pension uncertainty is negative and statistically significant in five of the six cases, indicating that when people feel greater uncertainty about the public pension, they will save more and accumulate more wealth.

Table 7 presents our estimate of the magnitude of precautionary saving for public pension uncertainty by calculating what our results imply about the share of precautionary wealth in total wealth accumulation. We can calculate the share of precautionary saving (λ) in total wealth (W) from a_1, the estimated coefficient of σ , as follows:

$$\lambda = \frac{\overline{W}^P}{\overline{W}} = \frac{\overline{W}^P / \overline{Y}^P}{\overline{W} / \overline{Y}^P} = \frac{OD \times a_1}{\overline{W} / \overline{Y}^P}. \quad (2)$$

Here, $\overline{W}^P$ is the average precautionary wealth accumulation against public pension uncertainty. OD is the over-discounting of future pension benefits, defined as the difference between households' anticipated percentage change (or value change) of the pension benefit and the government's planned percentage change (or value change). λ is predicted to be 9.87–9.91% when net financial assets 2 are employed as the wealth index, which means that precautionary saving accounts for about 10% of the net financial assets of close-to-retirement

households (see Table 7). λ is predicted to be 5.46–5.78% or 20.32–28.07% when either gross financial assets or net financial assets 1, respectively, are used as the index of wealth.

Table 5 Estimation results of wealth-to-income ratio (pension uncertainty=APC)

	Gross FA/Yp			Net FA1/Yp			Net FA 2/Yp		
	Coef.	Std. Err.		Coef.	Std. Err.		Coef.	Std. Err.	
Permanent income (Yp)	-0.002	0.001	**	0.001	0.001		-0.001	0.001	
Anticipated percentage change of pension	-0.020	0.012	*	-0.024	0.015		-0.028	0.013	**
Age	1.668	1.676		0.932	1.995		0.211	1.685	
$Age^2/100$	-1.321	1.370		-0.701	1.633		-0.114	1.382	
Male	-1.278	0.495	***	-1.228	0.684	*	-1.172	0.547	**
High school	1.019	0.270	***	0.970	0.573	*	0.883	0.334	***
Junior college	1.935	0.825	**	2.065	1.177	*	0.979	0.737	
College or graduate school	2.518	0.520	***	2.249	0.709	***	2.105	0.602	***
Excellent health	1.622	0.909	*	0.788	0.986		1.289	0.953	
Good health	1.155	0.588	**	0.303	0.752		0.713	0.617	
Poor health	0.971	0.652		-0.068	0.868		0.441	0.705	
Family member in need of nursing care	0.791	0.567		1.140	0.690	*	0.386	0.461	
Double income	0.476	0.345		0.527	0.473		0.369	0.387	
Extended family	-0.182	0.435		0.247	0.660		0.026	0.526	
All children independent	-0.430	0.682		-0.998	0.846		-0.780	0.752	
Not all children independent	-1.031	0.679		-2.031	0.880	**	-1.257	0.732	*
Married	0.349	0.462		1.324	0.780	*	0.530	0.536	
Number of family members	-0.144	0.108		-0.666	0.262	**	-0.449	0.209	**
Own house	1.397	0.328	***	0.397	0.417		1.471	0.370	***
Constant	-51.2	51.1		-28.9	60.6		-6.1	51.0	
Number of observations	619			586				576	
Adjusted R^2	0.1391			0.1187				0.1285	

Notes: (1) The estimation method is OLS with robust standard errors. (2) City size dummies and district dummies are included in the covariates, but their coefficients are abbreviated to save space. (3) "***", "**", and "*" indicate that the coefficient is statistically significant at the 1, 5, and 10% level, respectively.

Table 6 Estimation results of wealth-to-income ratio (pension uncertainty=AVC)

	Gross FA/Yp			Net FA1/Yp			Net FA 2/Yp		
	Coef.	Std. Err.		Coef.	Std. Err.		Coef.	Std. Err.	
Permanent income (Yp)	-0.001	0.001	*	0.001	0.001		0.000	0.001	
Anticipated value change of pension	-0.092	0.049	*	-0.142	0.062	**	-0.119	0.055	**
Age	1.540	1.841		1.498	2.287		0.366	2.187	
$Age^2/100$	-1.145	1.529		-1.158	1.895		-0.154	1.822	
Male	-1.668	0.554	***	-1.410	0.789	*	-1.676	0.659	**
High school	1.083	0.341	***	0.784	0.700		0.871	0.438	**
Junior college	1.392	0.700	**	0.953	1.229		0.941	0.929	
College or graduate school	2.256	0.550	***	1.754	0.791	**	1.814	0.661	***
Excellent health	1.038	0.807		0.649	1.050		0.665	0.896	
Good health	0.801	0.745		0.142	0.990		0.415	0.809	
Poor health	0.516	0.769		-0.187	1.002		-0.151	0.856	
Family member in need of nursing care	0.308	0.466		0.635	0.637		0.296	0.553	
Double income	0.236	0.380		0.485	0.556		0.458	0.487	
Extended family	-0.638	0.527		-0.352	0.809		-0.294	0.665	
All children independent	-0.569	0.856		-1.045	1.063		-0.970	0.955	
Not all children independent	-0.928	0.818		-1.596	1.061		-1.323	0.939	
Married	0.452	0.586		1.544	0.983		0.750	0.676	
Number of family members	-0.102	0.149		-0.735	0.332	**	-0.480	0.273	*
Own house	1.480	0.395	***	0.388	0.525		1.468	0.441	***
Constant	-47.7	55.0		-44.3	68.4		-11.7	65.3	
Number of observations	458			444			437		
Adjusted R^2	0.1891			0.1591			0.1729		

Note: The notes of Table 5 apply.

Table 7 Ratio of precautionary saving to close-to-retirement households' wealth

	Over-discounting of future pension benefit (OD)	Estimate of uncertainty (a1)	Precautionary component of W/YP	Average W/YP	Share of precautionary saving to W (Lambda)
W/Yp=Gross financial assets / Yp					
Pension uncertainty=APC	-4.465	-0.020	0.089	1.634	5.46%
Pension uncertainty=AVC	-1.027	-0.092	0.094	1.634	5.78%
W/Yp=Net financial assets 1 / Yp					
Pension uncertainty=APC	-4.465	-0.024	0.106	0.520	20.32% #
Pension uncertainty=AVC	-1.027	-0.142	0.146	0.520	28.07%
W/Yp=Net financial assets 2 /Yp					
Pension uncertainty=APC	-4.465	-0.028	0.123	1.240	9.91%
Pension uncertainty=AVC	-1.027	-0.119	0.122	1.240	9.87%

Note: "#" indicates that the estimate utilized is not statistically significant.

Precaution against future public pension uncertainty may not be the sole incentive for

excessive wealth accumulation. The elderly may also be holding excessive wealth for the bequest motive (Dekle 1990). The estimation results in Tables 5 and 6, however, provide little supportive evidence for the bequest motive hypothesis. Wealth holding by households is not changed significantly by the existence of children. Rather, households with economically independent children have a significantly lower wealth-to-income ratio in comparison with the households without children.

Estimates of household characteristics are in general consistent with intuition. For example, households headed by a female or a more highly educated individual, households that own their residences, and households with fewer family members have a relatively higher wealth-to-income ratio than their counterparts.

4. Concluding Remarks

Using a representative and unique Japanese elderly household survey, this paper investigated the impact of public pension uncertainty on wealth accumulation by close-to-retirement Japanese households. Households' anticipated percentage/value changes in pension and future public pension benefits with respect to the present benefit level were used to proxy pension uncertainty. Our principle econometric finding is that households' financial wealth holdings are positively and significantly related to public pension uncertainty for various measures of wealth and both uncertainty proxies.

We also found that households discount future pension benefits much more heavily than the government's planned pension cut. We use this discrepancy as an index of households' over-discounting rate on future pension benefits and combine this information with the estimation result to predict the magnitude of precautionary saving. Our simulations suggest that approximately 10% of net financial assets and 5% of gross financial assets of the close-to-retirement households are held as a precaution against public pension uncertainty. Hence, our findings are in accordance with the precautionary saving model and provide supportive evidence for the hypothesis of excessive saving and wealth accumulation by elderly Japanese households.

How to alleviate the public pension uncertainty of elderly households effectively, however, remains an open question. Major possible reasons for public pension uncertainty include (a) nationals' distrustfulness toward the pension system management (e.g., missing pension records, poor management of the pension fund), (b) anxiety about the sustainability of the public pension system because of population aging, and (c) irrational panic and gossip because of nationals' lack of knowledge concerning the complicated public pension system and pension reforms. Therefore, effective strategies for easing pension uncertainty could be to provide a reliable, easy-to-understand reform plan to nationals and to improve the

transparency and efficiency of the pension management system.

Although encouraging dissaving by elderly households or encouraging inter vivos transfers is a potentially efficient antirecession approach, there are some side-effects that we should consider. A large decline in elderly households' wealth holdings is likely to weaken the domestic affordability of government bonds and then drive up the long-term interest rate. A dramatic rise in the interest rate will not only have a negative impact on the economy by crowding out equipment investment of private companies but also drive up the interest rate burden of government debt. To avoid debt default, the government would have to print more money, which may cause hyperinflation, raise tax rates, which will be harmful to economic growth, or cut public spending, which is extremely painful and politically difficult. In sum, expecting elderly households to spend more to save the Japanese economy has limited effectiveness.

An important limitation of our approach is that the subjective proxies for public pension uncertainty we used may suffer from endogeneity. Because we could not control households' risk aversion and time preference rates because of lack of information, estimates of uncertainty may be upward biased if these two unobservable preference variables affect both households' subjective uncertainty perceptions and wealth accumulation.

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Appendix I: Estimation of Permanent Income

We use the predicted labor income of the head-of-household from his/her income function as a proxy for his/her permanent income. This income function uses explanatory variables such as age, tenure, education, health condition, marriage status, occupation, industry, scale of workplace, size of city of residence, and district of residence. We also include the square of the person's age and tenure as explanatory variables to measure age or tenure based upon an inverted-U earning profile. A typical Mincerian wage function is employed, in which the dependent variable is the log of annual labor income. The estimation result is outlined in Table A.1.

Table A.1 Estimation result of Mincerian wage function

	Coef.	Std. Err.	
Age	0.098	0.245	
$Age^2/100$	-0.098	0.205	
Tenure	0.028	0.007	***
$Tenure^2/100$	-0.031	0.015	**
Male	0.527	0.060	***
High school	0.044	0.064	
Junior college	-0.009	0.087	
College or graduate school	0.235	0.079	***
Excellent health	0.025	0.161	
Good health	0.034	0.147	
Poor health	-0.107	0.152	
Married	0.052	0.059	
Constant	2.149	7.314	
Occupation dummies	Yes		
Industry dummies	Yes		
Scale of workplace dummies	Yes		
City size dummies	Yes		
District dummies	Yes		
Number of observations	727		
Adjusted R^2	0.5205		

Note: The estimation method is OLS with robust standard errors. "***", "**", and "*" indicate that the coefficient is statistically significant at the 1, 5, and 10% level, respectively.

Appendix II: Simulation of the Government's Planned Pension Benefit Change

The government's planned pension benefit change is simulated by estimating the extent to which lifetime pension benefits will decline within the system of macroeconomic slide (MES) functions. We use the standard scenario used by the government in 2007, which assumed the following conditions.[12]

Nominal wage increase rate per year (w): 2.1%
Inflation rate per year (π): 1.0%
Nominal interest rate (r): 3.2%
MES rate per year (k): 0.9%

Because it is planned that the MES will be functioning between 2009 and 2023, we assume that pension benefits in other years are unchanged. Then for people aged 55 in the JILPT 2009 survey, for instance, the MES will be applicable after they reach 65 years of age (2019) and end when they reach 69 years of age (2023). For people aged 65, however, the applicable period will be the longest (14 years). The pension benefit for people aged 55, for instance, in 2023 (while MES applies) will be as follows (where the pension benefit of people aged 69 in 2009=100):

$$PB_{MES} = 100 \times \frac{(1+w-\pi-k)^{(69-65)}}{(1+r-\pi)^{(2023-2009)}}. \quad (3)$$

We assume that each person lives until age 85, and we sum up their lifetime public pension benefit and compare it with the level when MES is absent to obtain the percentage change in the government planned public pension. We then multiply this percentage with the ideal retirement pension benefit obtained in the survey to get the value change in the government planned public pension. These two variables are employed to estimate the ratio of precautionary saving to total household wealth.

[12] Source: MHLW Pension Bureau "A Simulation of Impact on Pension Finance by the 2004 Reform". URL: http://www.mhlw.go.jp/topics/nenkin/zaisei/zaisei/04/index.html

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