

Income Uncertainty and Household Savings in China

Marcos Chamon, Kai Liu and Eswar Prasad^{*}

This draft: June 28, 2010

Abstract

In this paper, we use a panel of Chinese households covering the period 1989-2006 to analyze the evolution of household income. Over this period, there has been a strong upward trend in income across the board but income uncertainty has also increased substantially. While the permanent variance of household income remains stable, the transitory variance shows a sizable increase. A calibration of a buffer-stock savings model indicates that rising savings rates among younger households—despite the rapid anticipated income growth for these workers—are consistent with rising income uncertainty, and higher saving rates among older households are consistent with a decline in the pension replacement ratio for those retiring after 1997.

^{*} Chamon: Research Department, IMF; Liu: Johns Hopkins University; Prasad: Cornell University, Brookings Institution and NBER. The views expressed in this paper are those of the authors and do not necessarily reflect those of the IMF or IMF policy.

I. Introduction

The Chinese economy has been undergoing a marked transformation in recent decades—from a closed to an open economy, from an agricultural to an industrial economy, and from a socialist to a market-oriented economy. This set of transformations has resulted in a rapid growth in incomes but has also raised uncertainty as the economy undergoes massive structural shifts. Our objective in this paper is to evaluate the effects of these shifts on the degree of income uncertainty at the level of households and analyze the implications for household saving rates. We show that the rise in income uncertainty and the 1997 pension reform can explain much of the observed rise in saving rates.

We characterize the evolution of labor income in urban areas in China using a sample of urban households tracked by the China Health and Nutrition Survey (CHNS). We exploit the panel aspect of the dataset to characterize the rise in income uncertainty and decompose the variance of income into components attributable to permanent versus temporary income shocks, following the methodology in Moffitt and Gottschalk (1994, 1995) and Meghir and Pistaferri (2004).

The panel data shows a strong trend growth in earnings, which is stronger for the more educated households. The variance of permanent shocks to household income has remained stable, while the variance of transitory shocks trends upwards. This result suggests that while the transformation process did increase uncertainty, most shocks experienced to household income were temporary. Perhaps one of the main permanent shocks were changes in pension rules.

There is a growing body of research that attempts to explain the rising urban household saving rate in China at a time of high income growth. The urban saving rate increased from 17 percent in 1995 to 24 percent in 2005, a pattern that seems inconsistent with a simplistic version of the permanent income life cycle hypothesis (without shocks), which would imply that future high income growth should cause households to postpone their savings. Chamon and Prasad (2010) use disaggregated data from the National Bureau of

Statistics' Urban Household Survey to document an increase in saving rates across the board, but particularly pronounced among the younger and older households.¹

We conduct a simple calibration of a buffer-stock/life-cycle model of savings to evaluate the implications of rising uncertainty on household saving rates. We find that the rising transitory variance of income can help explain the rise in the savings of the young.

Saving rates increase by 3 percentage points for households in their 20s, although that effect declines with age (and amounts to less than 1 percentage points for households in their 40s). Since younger households have a lower buffer-stock of savings, an increase in the transitory variance causes them to save more in order to adjust their buffer-stock to the riskier environment. But older households, which have already accumulated significant savings, can more easily accommodate transitory shocks.

We also calibrate the model to match changes in pension rules. Prior to the pension reform, urban workers received pensions through their enterprises. These pensions had a replacement ratio of about 80 (relative to average earnings over the working life). Urban workers retiring after 1997 are covered under the reformed system. They receive a social pension corresponding to 20 percent of the average local wages, plus the amount accumulated from individual retirement accounts, plus a supplementary "transition pension."² Song and Yang (2010) documented a decline of the replacement ratio in China, from 85% in 1992 to 53% in 2007. The estimated replacement rate for the transition generation is estimated to be around 60 percent (Sin 2005).³ In our savings calibration we show that this change alone could explain a 3-5 percentage point increase in savings for households in their 50s. As expected, the effect is more muted for younger households (the increase is about 1½ percentage point for those in their 30s).

When both shocks are combined, a standard buffer-stock/life-cycle model of savings is

¹ Other recent contributions analyzing the determinants of household savings in China include studies using aggregate data (e.g., Modigliani and Cao, 2004; Kuijs, 2006), provincial-level data (e.g., Qian, 1998; Kraay, 2000; Horioka and Wan, 2007; Wei and Zhang, 2009) and micro data (e.g., Song and Yang, 2010).

² The social pension is financed by employer contributions of 17 percent of wages. The individual accounts are financed by employer and employee contributions of 3 and 8 percent of wages, respectively.

³ For more details on the pension reform, please refer to Sin (2005).

capable of explaining much of the rise in average savings, as well as the unusual pattern observed in the data whereby that rise was concentrated on the youngest and oldest households. Chamon and Prasad (2010) trace some of the increase in savings among the young to housing related motives, and those among the old to lumpy and uncertain health expenditures. In this paper, we show that the rise in income uncertainty and the pension reform alone can explain over half of the increase in saving rates.

II. Dataset

We use data from the China Health and Nutrition Survey (CHNS).⁴ The survey is based on a multistage, random cluster process that yields a sample of about 4400 households with a total of 19,000 individuals that are tracked over time. The sample covers nine provinces that vary substantially in terms of geography, economic development, and other socioeconomic indicators. This survey was conducted in 1989, 1991, 1993, 1997, 2000, 2004 and 2006.

The sample in each province is drawn from a multistage random cluster process. Counties are stratified by income and a weighted scheme is used to select four counties in each province, in addition to the capital or main city, and a lower income city. The 1991 wave only surveyed individuals belonging to the original 1989 sample. In the 1993 wave, all new households formed from households in the previous survey sample were added to the sample. From the 1997 wave onwards, the sample includes newly formed households from the original sample, as well as additional households and new communities added to the sample to replace those households and communities that were no longer participating in the survey.

We use both CHNS individual and household files.⁵ We focus on the urban sub-sample. The rural population exhibits much higher variance of earnings shocks (both permanent

⁴ For further details on this database, see <http://www.cpc.unc.edu/projects/china>

⁵ In the urban sample we are working with, labor earning comprises 97% of total individual income on average so these two measures are approximately equivalent. We retain labor earnings as our primary focus because it's a direct measure of the return to labor.

and transitory) relative to the urban population, which is probably due to the inherently more variable nature of agricultural incomes.

Our baseline analysis involves a sample of households who are urban residents, with heads between the ages of 18 to 59, not a student, had complete information on age and education, and report positive and non-imputed annual labor earnings. We include households in every year in which they appear in the data and satisfy these requirements. We trim the top and bottom 1 percent of growth in income residuals by year and therefore the results capture earning risk for persons in the inner 98% of the distribution.⁶ Our final sample is an unbalanced panel consisting of 1689 households (with 3519 individual earners fitting the selection criteria described above).⁷

Table 1 shows the number of observations in each year and also presents some summary statistics for the analysis sample. From 1989 to 2006, mean annual labor earnings increase from 3390 to 14852 RMB at constant 2006 prices. Rising education levels in the population are reflected in the steadily increasing proportion of workers in our sample who have a high school degree (including a vocational training equivalent) or higher levels of education.

The state-owned and collective enterprise (SOE) sector—which refers to government units, state-owned enterprises, and large collective enterprise (owned by province or city)—still plays an important, although declining, role in the Chinese economy. In our sample, the proportion of workers employed in the state-owned and collective enterprise (SOE) sector falls from 81 percent in 1989 to 64 percent in 2006. Indeed, reflecting the pick-up in the pace of the shift towards a market-oriented economy in recent years, the probability of transition from SOE to private sector employment rises from 5.5 percent between the years 1989 and 1993 to 14 percent between the years 2000 and 2004 (Table 2). This shift could be due to employment shifts from the SOE to the private sector and also because SOE firms are being restructured and turned into non-SOE firms. We cannot

⁶ See Gottschalk and Moffitt (2009) for more discussion on why such trimming is necessary.

⁷ The sample is unbalanced because attrition, new respondents introduced into the survey, transitions into and out of employment, and aging affect households' and individuals' movement into and out of the sample in different years.

evaluate the relative importance of these two factors as the CHNS does not track job changes. Nevertheless, this is not a big concern from our perspective as either explanation could be consistent with changes in permanent income uncertainty.

The quality of the income information in the first wave of CHNS is questionable. The CHNS admitted problems in the 1989 wave of the CHNS, although they claim that “those problems have been corrected and the CHNS 1989 data are now of high quality”. In our selected sample, the standard deviation of individual earning is three times as large as that of the next wave in 1991. The variation of household income is also much larger in 1989, comparing with the next couple of waves of panel. This seems to go against the large literature documenting the rise in income inequality in China since 1980s.

Benjamin, Brandt, Loren and Fan (2003) raise similar concerns to the wage data collected in the first wave of CHNS. Therefore, we will not focus on results that rely on the 1989 data.

III. A Decomposition of Permanent and Transitory Shocks to Labor Income

In this section, we describe the methodology we use to decompose the variance in labor income into the components attributable to permanent and temporary shocks. We focus on household income (which is the relevant measure for basing consumption and saving decisions). First, we run Mincerian income regressions that allow us to control for year by year cross-sectional income variation attributable to economy-wide shifts in the returns to observed household characteristics. We regress log income on four region dummies (East, Northeast, Midwest and West), age, three education dummies for the head of household (middle school or less, high school, some college), dummies for the number of income earners in the household, household size, and dummies for whether the head is currently working and its marriage status. This regression is run separately for each year. Effectively, we are working with within-group variations in income that cannot be explained by these household characteristics⁸.

⁸ We do not report these regression results in detail here but note that they show rising returns to education. The pattern of returns to potential labor market experience is less clear. These results are inconsistent with

Our focus in this paper is on household-specific income uncertainty, so we will mostly work with the earnings residuals from the first-stage regressions. We use these residuals to estimate the permanent and transitory components of income:

$$y_{iat} = u_{iat} + v_{iat}$$

$$u_{iat} = u_{i,a-1t} + \omega_{iat}$$

where y_{iat} is the log earning residuals for household i aged a in year t from the Mincerian regression, u_{iat} is the permanent component, and v_{iat} is the transitory component. Since the Mincerian regressions are run separately for each year, the residuals correspond to within-group measures of log income, taking out the mean effects of region, education level, age and the other household characteristics controlled for. The permanent shocks ω and transitory shocks v to earnings have zero means and are mutually orthogonal. They are i.i.d across household, time and age⁹. We assume:

$$\text{var}(\omega_{iat}) = \sigma_{\omega t}^2$$

$$\text{var}(v_{iat}) = \sigma_{\xi t}^2$$

In other words, the variances of permanent and transitory shocks change by year but do not depend on age. This in effect amounts to averaging over households with different

findings of other authors using cross-section data sets (e.g., Song and Yang, 2010). We also tried the earning regression using various sets of covariates (e.g. adding a dummy of SOE employment; leaving constant as the only covariate), and the pattern of the estimated permanent earning uncertainty remain very similar.

⁹ A number of papers suggest that transitory shocks are serially correlated. We estimate the autocovariances of unexplained earning growth at lag 1 to 3, and they are (standard errors in parentheses): -0.101 (0.011), 0.007(0.014), -0.000(0.018). Autocovariances of order 2 or higher are not statistically significant. If we test the null hypothesis of zero autocovariances in income growth (allowing autocovariances to be different across years), we reject null at lag one but not for higher order lags. These evidence that the transitory shocks are either i.i.d or follow a MA(1) process. The latter is consistent with much of the literature (Abowd and Card, 1989, Meghir and Pistaferri, 2004, Blundell et al., 2008,). Because the gaps between years of observations in the data, it's not possible to further test the stochastic process of transitory shocks. As we discuss below, the permanent uncertainty identified from our model is consistent regardless whether the transitory shock follows an MA(1) process or is i.i.d.

ages (or in different cohorts) in each year.¹⁰ Later, we will examine how these variances differ across age groups. From here on, the subscript of a will be dropped. The parameters to estimate are: $\sigma_{\xi t}^2$ and $\sigma_{\omega t}^2$ for each survey wave:

$$t = \{89, 91, 93, 97, 00, 04, 06\} .$$

Suppose we observe household income in consecutive years. Identification hinges on the variance and covariance structure of one-year changes in income (see, e.g., Blundell, Pistaferri and Preston, 2008; and Meghir and Pistaferri, 2004):

$$\begin{aligned}\Delta y_{it} &= y_{it} - y_{it-1} = \omega_{it} + v_{it} - v_{it-1} \\ \Delta y_{it-1} &= y_{it-1} - y_{it-2} = \omega_{it-1} + v_{it-1} - v_{it-2} \\ \text{cov}(\Delta y_{it}, \Delta y_{it-1}) &= -\sigma_{\xi t-1}^2 \\ \text{var}(\Delta y_{it}) &= \sigma_{\omega t}^2 + \sigma_{\xi t}^2 + \sigma_{\xi t-1}^2\end{aligned}$$

So the one-period lag autocovariance of income changes identifies the variance of the transitory shock. With four years of data $\{t+1, t, t-1, t-2\}$, we would be able to identify $\sigma_{\omega t}^2, \sigma_{\omega t-1}^2, \sigma_{\xi t}^2$. Note that the parameters are identified nonparametrically without making any distributional assumption about the shocks. Nor does the identification involve any assumption about $\sigma_{u_0}^2$, the initial variance of permanent earnings. This is an important advantage over alternative identification strategies (e.g., moments using earning levels), particularly for a fast-growing economy where $\sigma_{u_0}^2$ is likely to be nonstationary.

The uneven spacing of the CHNS waves complicates the analysis since we need to use n -year rather one-year income changes:

¹⁰We focus on the year effect, and therefore the age and cohort effects cannot be separated. Given our sample size, we cannot allow variances to also vary by age (or cohort).

$$\text{cov}(\Delta 93 - 91, \Delta 91 - 89) = -\sigma_{\xi 91}^2$$

$$\text{cov}(\Delta 97 - 93, \Delta 93 - 91) = -\sigma_{\xi 93}^2$$

$$\text{cov}(\Delta 00 - 97, \Delta 97 - 93) = -\sigma_{\xi 97}^2$$

$$\text{cov}(\Delta 04 - 00, \Delta 00 - 97) = -\sigma_{\xi 00}^2$$

$$\text{cov}(\Delta 06 - 04, \Delta 04 - 00) = -\sigma_{\xi 04}^2$$

$$\text{var}(\Delta 93 - 91) = \sigma_{\omega 93}^2 + \sigma_{\omega 92}^2 + \sigma_{\xi 93}^2 + \sigma_{\xi 91}^2$$

$$= \sigma_{\omega 93}^2 + \sigma_{\omega 92}^2 - \text{cov}(\Delta 97 - 93, \Delta 93 - 91) - \text{cov}(\Delta 93 - 91, \Delta 91 - 89)$$

...

$$\text{var}(\Delta 04 - 00) = \sigma_{\omega 04}^2 + \sigma_{\omega 03}^2 + \sigma_{\omega 02}^2 + \sigma_{\omega 01}^2 + \sigma_{\xi 04}^2 + \sigma_{\xi 00}^2$$

$$\text{var}(\Delta 06 - 04) = \sigma_{\omega 06}^2 + \sigma_{\omega 05}^2 + \sigma_{\xi 06}^2 + \sigma_{\xi 04}^2$$

We are able to identify five years of the transitory income risk, all except 2006 and 1989. We do not make any assumption on the transitory variance in those two years and, hence, we are able to identify four permanent variances:

$$\sigma_{\omega 93}^2 + \sigma_{\omega 92}^2$$

$$\sigma_{\omega 97}^2 + \sigma_{\omega 96}^2 + \sigma_{\omega 95}^2 + \sigma_{\omega 94}^2$$

$$\sigma_{\omega 00}^2 + \sigma_{\omega 99}^2 + \sigma_{\omega 98}^2$$

$$\sigma_{\omega 04}^2 + \sigma_{\omega 03}^2 + \sigma_{\omega 02}^2 + \sigma_{\omega 01}^2$$

We estimate the model using an equally-weighted minimum distance estimator, a standard in the literature since Moffitt and Gottschalk (1992:25). The model is just identified.

Note that our estimated variance of transitory shocks is biased upwards, for two reasons. One is that in light of classical measurement errors (i.i.d), the estimated variance of transitory shocks will be inconsistent and biased upwards. Despite this, the trend in transitory variance may be less affected unless the variance of measurement errors has a trend. Second, transitory shocks may follow an MA(1) process, therefore the identified transitory variance also includes the transitory shocks from previous year. However, it's worth noting that since we are looking at n -year differences, $n \geq 2$ $v_{it} = \xi_{it} + \theta \xi_{it-1}$ (people take two years to recover from transitory shock), the estimates of variance of permanent shocks are still consistent (without additional assumptions, however, it is not feasible to identify the MA(1) process given the data availability in our sample):

$$\begin{aligned}
\text{cov}(\Delta 93 - 91, \Delta 91 - 89) &= -\sigma_{\xi 91}^2 - \theta^2 \sigma_{\xi 90}^2 \\
\text{cov}(\Delta 97 - 93, \Delta 93 - 91) &= -\sigma_{\xi 93}^2 - \theta^2 \sigma_{\xi 92}^2 \\
\text{var}(\Delta 93 - 91) &= \sigma_{\omega 93}^2 + \sigma_{\omega 92}^2 + (\sigma_{\xi 91}^2 + \theta^2 \sigma_{\xi 90}^2) + (\sigma_{\xi 93}^2 + \theta^2 \sigma_{\xi 92}^2) \\
&= \sigma_{\omega 93}^2 + \sigma_{\omega 92}^2 - \text{cov}(\Delta 93 - 91, \Delta 91 - 89) - \text{cov}(\Delta 97 - 93, \Delta 93 - 91)
\end{aligned}$$

In order to account for these two potential biases, when calibrating the savings model, we will assume that the true transitory uncertainty is 2/3 of the transitory variance identified from the model.

If we drop the 1989 wave of CHNS (due to the data concerns described in the previous section), we are no longer able to estimate the variance of transitory shock in 1991 and the variance of permanent shock in 1993. The model is still just identified. The rest of the estimated variances remain the same, since identification of these parameters do not hinge on the income information from 1989 (see the formulas above). While we present our estimates for the whole sample, the reader should be cautious when interpreting the transitory variance estimates in 1991 and the permanent variance estimates in 1993.

IV. Earnings Decomposition Results

Table 3 reports estimates for the variances of the permanent (panel 3A) and transitory shocks (panel 3B) to household income and earnings over time. Standard errors are computed following a block bootstrap procedure. The first column of the top panel in Table 3 shows that, for the urban sample, there is no clear trend in the variance of permanent shocks to income. The same is true if we turn to a sample of households whose head worked in the SOE sector.¹¹ The results are also similar if we consider household earnings instead of income (while the point estimates do suggest an upward trend for earnings in the SOE subsample, the standard errors are wide and we cannot reject a null hypothesis of no trend at a reasonable level of statistical significance). Moving to the transitory variance (Panel 3B), we do observe a clear upward trend, with

¹¹ The results are similar if we define the SOE subsample based on the employment as of the first wave in which the household appears (e.g. so as to include people that start in the SOE sector but later move to the non-SOE sector).

the point estimates steadily rising from 0.04 in 1991 to 0.162 by 2004. The results are similar in the SOE sample. When earnings are used instead of income, that trend seems to partially reverse in the last wave.

Violante (2002) shows that skill-neutral technological change could result in a rise in the variance of transitory earnings. In his model, workers learn vintage-specific skills and, when separating from their jobs, they can only partially transfer their skills across machines. Therefore, technological acceleration reduces skill transferability and increases wage losses upon separation, which can increase cross-sectional wage variability in an economy undergoing major technological shifts and/or significant labor market churning.

The rate of technological change in China since the 1990s has been even faster than in the U.S., due to the transition process and catching-up effects. This makes skill-biased technological change a promising candidate to help explain the increase in the variance of transitory income shocks. The transition from a centrally planned economy to a market economy may have accentuated this pattern through an increase in firm-level volatility related in part to SOE restructuring, an increase in the link between wages and firm-level performance, higher labor market turnover (both job-job transitions and transition into and out of unemployment), and more rural-urban migration.

V. Implications of the Shifts in Labor Income Variance for Precautionary Savings

This higher uncertainty in earnings at the microeconomic level can have a number of implications at the macroeconomic level. One important channel could be through an increase in precautionary savings. In the absence of a strong social safety net, this requires households to self-insure by increasing their individual savings. In order to quantify the effects of this rise in uncertainty on individual and aggregate savings, we now undertake a calibration of a precautionary savings model, building on the framework

of Carroll (1997) , Gourinchas and Parker (2002) and Fuchs-Schündeln (2008).¹² In this section we show that the increase in the variance of transitory shocks to household income can help explain the rise in savings among the younger households observed in the data, while changes in pension rules can help explain the savings of the older households.

To motivate this exercise, Figure 1 plots the saving rates as a function of the age of the head of household observed in the actual data for different years, based on the subsample of 10 provinces/municipalities used in Chamon and Prasad (2010).¹³ In the early 1990s, saving rates increased with age, leading up to retirement and then dropped (the results for the very youngest households are noisy due to the small number of observations based on which those averages were constructed). Over time, savings rates have increased across the board. But the increase is particularly pronounced for the younger (20s/early 30s) and older households (mid 50s onwards). By 2005 the age-profile has an unusual U-shaped pattern. Therefore, any empirically relevant explanation for the increase in saving rates must account not only for the substantial average increase, but also for the unusual way in which that increase was concentrated towards the younger and older households. Our calibration below is able to capture these empirically relevant features.

We assume an instantaneous CRRA utility function, with individuals maximizing the expected discounted flow of utility subject to a no-borrowing constraint:

$$\max \sum_t \beta^t \left(\prod_{j=0}^t s_j \right) E_t \left[\frac{C_t^{1-\gamma}}{1-\gamma} \right]$$

$$\text{s.t. } A_{t+1} = (1+r)(A_t + Y_t - C_t), \quad A_t \geq 0, \forall t$$

¹² Our calibration exercise of course sets only a lower bound on the degree of precautionary saving attributable to earnings uncertainty. We consider the variance of different shocks to earnings only for workers who report positive earnings in each period. For workers who in reality face unemployment and the prospect of zero earnings, the precautionary savings motive could be even stronger.

¹³ The sample is based on Anhui, Beijing, Chongqin, Ganshu, Guangdong, Hubei, Jiangsu, Liaoning, Shanxi, and Sichuan. Note that only 3 of these overlap with the CHNS sample.

where β is the discount factor, s is an age-dependent survival probability, C_t is the level of consumption in period t , γ is the coefficient of relative risk aversion, A_t is the level of assets, and Y_t represents income. We assume that income is based on the same process estimated in the previous section for the working years, but permanent income becomes deterministic in the retirement period R at a particular fraction of the pre-retirement permanent income. That is:

$$\begin{aligned} y_t &= u_t + v_t \\ u_t &= u_{t-1} + \omega_t \end{aligned} \quad \text{if } t \leq R$$

$$\begin{aligned} y_t &= \eta u_t \\ u_t &= u_{t-1} \end{aligned} \quad \text{if } t > R$$

The model is solved backwards starting from the last period of life using the endogenous grid point method developed in Carroll (2006). We calibrate the model assuming that working life begins at age 20, with an initial level of wealth of zero. The discount factor β is 0.97. The real interest rate is 1.4 percent, which matches the average real interest rate in China over the period 1989 to 2006. The coefficient of relative risk aversion γ is 4.5. We assume that people live with certainty until the retirement age of 60, but from then onwards have a survival probability¹⁴, and die with certainty if still alive at age 85, and there are no bequests (if people die prior to 85 with a positive level of assets, then those assets are “lost”).

Permanent income in the retirement period is initially set to $\eta=45$ percent of pre-retirement permanent income. This translates to a replacement ratio of 81 percent with respect to the average earnings over the working life. When we model the effects of the pension reform (which affects workers retiring after 1997), we will set $\eta=35$, which

¹⁴ For simplicity we assume a Poisson death process, calibrated to match the life expectancy of the Chinese in 2009 (73.47 years). This results in a constant survival probability of 0.925 between t and $t+1$.

implies a replacement ratio of 65 percent.¹⁵

To calibrate the income process, we use the deterministic life-cycle growth rate of earnings in the CHNS sample. We regress the log of family income on a set of cohort dummies, region dummies, household size, employment status of household head and a third degree polynomial in age. We calculate the marginal effect of age on household income at each age.¹⁶ Predicted annual earnings growth is about 9 (need to double check) percent for the young, and becomes negative at age 59.

We want to model how saving rates respond to the change in variance. We focus on family income, and assume that the permanent variance declines remains constant at 0.02, while the transitory variance increases from 0.04 to 0.08 (we assume that $\frac{1}{2}$ of the variance is due to measurement error, and hence lower than the values estimates).

Figure 2A plots the simulated age profile of the saving rate. We construct that profile by simulating the model for 5,000 households, and averaging their saving rates at each age. The dashed line corresponds to the profile of savings under the initial baseline variance of income. Consistent with this type of buffer-stock/life-cycle model, saving rates show a U-shaped pattern when plotted against age. Saving rates initially decline with age, since households with the youngest household heads typically start their working life cycle with no assets, and need to save more in order to quickly build an adequate buffer stock of savings. Once that buffer stock is built, savings remain relatively low until the late 30s/early 40s when earnings increase and life-cycle motives lead to a sharp increase in the savings rate.

¹⁵ The replacement rate should decline over time, given the nature of the pension formula. Sin (2005) projects the replacement rate for a male retiring at age 60 to decline to about 60, 55 and 50 percent by 2010, 2020 and 2030 respectively. Thus, our assumption for the decline in the replacement rate is a fairly conservative one, particularly for the younger workers.

¹⁶ This assumes that there is no cohort effect on the growth rate of earnings. Cohorts only differ in the mean of earnings but not the growth rate over the life cycle. If we include interaction terms between age and cohort dummies in the RHS variables, the estimated coefficients on the interaction terms are statistically significant, implying that the age-profile of earnings is steeper for more recent cohort. This is at odds with Song and Yang (2010), who report a flattening of age-profile of earnings. The results may not be directly comparable as theirs are based on a set of repeated cross-sections rather than a panel.

The additional lines in this figure correspond to the saving profile after the change in the income process. Each line corresponds to the saving behavior that would result if the regime switch would occur starting at a given age (e.g. 20, 25, 30,..., 55), and after the initial jump we trace the behavior that would occur through the rest of the life-cycle under those parameters. That change is more easily illustrated in Figure 2B, which plots the change in the saving rate after the shock as a function of the age of the head of household. If a head household were to begin working life at age 20 already under the higher uncertainty regime, that household would save about 3 percentage points more to begin with. The difference in saving rates relative to the baseline regime declines rapidly with age. For example, the initial jump for a 30 year old household head is only about 1 percentage points. The reason for this pattern is the lower buffer stock of the youngest households (since they start life with no buffer stock). A lower buffer stock causes the younger to respond more strongly to the shock to the transitory variance (which will not be as harmful to a household that had already accumulated a large stock of savings, for example, those closer to retirement).

Figure 3 is analogous to Figure 2, but now the shock is to the pension replacement rate. The initial baseline profile in Figure 3A is the same as in Figure 2A. But the additional lines correspond to the saving behavior after the decline in the retirement replacement ratio. Figure 3B plots the change in saving rates relative to that baseline. The change in the replacement ratio induces a substantial increase in savings, particularly for the older households. After the pension reform, households need to save more in order to attain a same level of post-retirement consumption. But the older a household is, the less time it has to adjust its life-cycle savings to the lower replacement ratio (i.e., compensate for past savings that were not made because the individual was living in a more favorable pension environment). As a result, while the change in saving rate is only about 1 percentage point for a household in its early 20s, it can be as high as 4-5 percentage points for households close to the end of their life-cycle.

Finally, in Figure 4 we introduce both the rise in transitory uncertainty, and the change in the replacement ratio. As expected, savings respond more strongly once both shocks are

introduced. There is a marked increase in the saving rate of the younger and the older households (about 3 percentage points for the very young and 4-5 percentage points for the very old heads). In short, our calibration of a standard buffer-stock/life-cycle model based on parameters taken from our empirical estimation of the shifts in the variance of shocks to labor earnings plus the pension reform is capable of capturing a number of important stylized facts observed in the saving behavior of Chinese urban households.

The results from our calibrations suggest that the increase in earnings uncertainty can explain the rise in the savings, particularly among the younger households, and the pension reform can explain the rise in savings, particularly among the older households. While Chamon and Prasad (2010) trace much of the increase in the saving rates among the young to housing motives, and among the old to health expenditures, our calibration exercise suggests that shifts in earnings uncertainty (including pensions) had as important a role.¹⁷

V. Conclusion

To summarize, we have found that while the variance of shocks to household income has increased over time, that increase took place on its transitory component. This increase in uncertainty can help explain the rising saving rates among the younger households (who do not have had time to build adequate buffer stocks to handle these shocks). The pension reforms have led to a decline in the replacement income for workers retiring after 1997. This decline can also help explain rising saving rates, particularly for older households approaching retirement (which have less time to adjust, and must quickly build-up an adequate level of savings for that new environment).

Overall, our findings suggest that uncertainty over the provision of social benefits, such as pensions, is a more important channel to help explain savings than shocks to

¹⁷ Housing motives for saving are not included in the calibration above. If included, they would raise the saving rates of the younger individuals, which could further accentuate the U-shaped age-saving profile and bring it more in conformity with the pattern observed in the actual savings data for Chinese urban households. Lumpy and uncertain health expenditures can still play a role in explaining high savings among the elderly (particularly among those that have already retired).

income/earnings.

References

Abowd, J., and D. Card (1989): "On the covariance structure of earnings and hours changes," *Econometrica*, pp. 411-445.

Acemoglu, D. (1999), "Changes in Unemployment and Wage Inequality: An Alternative Theory and Some Evidence," *American Economic Review*, 89 (1999), pp. 1259-78.

Blundell, R., L. Pistaferri, and I. Preston (2008): "Consumption inequality and partial insurance," *American Economic Review*, 98(5), 1887-1921.

Buchinsky, M., and Hunt, J. (1999): "Wage Mobility in the United States," *Review of Economics and Statistics*, 81(3), 351-368.

Carroll, C (1997): "Buffer Stock Saving and the Life Cycle/Permanent Income Hypothesis." *Quarterly Journal of Economics*, CXII(1):1-56.

Carroll, C (2006): "The Method of Endogenous Gridpoints for Solving Dynamic Stochastic Optimization Problems." *Economics Letters*, 91(3), 312-320.

Chamon, M., and E. Prasad (2010): "Why are Saving Rates of Urban Households in China Rising?" *American Economic Journal: Macroeconomics*, 2(1), 93-130.

Dunway, Steven, and Vivek Arora (2007). "Pension Reform in China: The Need for a New Approach." IMF Working Paper No. 07/109.

Dwayne Benjamin, Loren Brandt, Loren and Jia-Zhueng Fan (2003), "Ceaseless Toil? Health and Labour Supply of the Elderly in Rural China," working paper, University of Toronto.

Fuchs-Schündeln, N. (2008): "The Response of Household Saving to the Large Shock of German Reunification," *American Economic Review*, 98(5), 1798-1828.

Gottschalk, P. and R. Moffitt (1994): "The Growth of Earnings Instability in the U.S. Labor Market." *Brookings Papers on Economic Activity* 2: 217-272.

Gottschalk, P. and R. Moffitt (2009): "The Rising Instability of U.S. Earnings," *Journal of Economic Perspectives*, 23(4), 3-24.

Gourinchas, P., and J. Parker (2002): "Consumption Over the Life Cycle," *Econometrica*, 70(1), 47-89.

Katz, L., and D. Autor (1999): "Changes in the wage structure and earnings inequality," *Handbook of Labor Economics*, Vol 3, 1463-1555.

Keane, M.P. and E.S. Prasad (2006): "Changes in the structure of earnings during the Polish transition," *Journal of Development Economics*, 80(2), 389-427.

Meghir, C., and L. Pistaferri (2004): "Income Variance Dynamics and Heterogeneity," *Econometrica*, 72(1), 1-32.

Moffitt, R., and P. Gottschalk (1995): "Trends in the Transitory Variance of Male Earnings in the U.S, 1970-1987," Manuscript, Johns Hopkins University.

Moffitt, R. and P. Gottschalk (2009): "Trends in the Transitory Variance of Male Earnings in the U.S., 1970-2004." Mimeo, Johns Hopkins University

Sin, Yvonne (2005). "Pension Liabilities and Reform Options for Old Age Insurance." World Bank Working Paper No. 2005-1.

Song, M. , and D. Yang (2010): "Life Cycle Earnings and the Household Saving Puzzle in a Fast-Growing Economy" Manuscript, Chinese University of Hong Kong.

Violante, G. (2002): "Technological Acceleration, Skill Transferability, and The Rise in Residual Inequality," *Quarterly Journal of Economics*, 117(1), 297-338.

Wei, S. J. and X. Zhang (2009): "The Competitive Saving Motive: Evidence from Rising Sex Ratios and Savings Rates in China," *NBER Working Paper*.

Table 1. Summary Statistics

	Observations	Household Size	Labor Earnings (2006 RMB)		Income (2006 RMB)		Head Employed by SOE		At least some high school	
Wave	(Households)	Mean	Mean	S.d	Mean	S.d	Mean	S.d	Mean	S.d
1989	493	3.8	7356.1	7656.7	12830.5	9171.0	0.81	0.39	0.36	0.48
1991	464	3.6	7403.7	3852.9	11537.1	5935.2	0.84	0.37	0.43	0.50
1993	336	3.5	9115.1	6199.9	13336.0	11002.0	0.84	0.37	0.48	0.50
1997	406	3.4	11279.0	7535.0	14980.6	9230.9	0.80	0.40	0.57	0.50
2000	444	3.2	16529.6	17334.7	21293.9	18831.4	0.77	0.42	0.67	0.47
2004	467	2.9	21934.5	18867.4	28247.5	25645.7	0.73	0.45	0.72	0.45
2006	477	2.9	25683.7	32553.3	32042.5	34845.5	0.64	0.48	0.72	0.45

Notes: Based on an unbalanced panel of urban households, with heads aged 18-59, not a student, with complete age and education information, positive and non-imputed annual labor earnings.

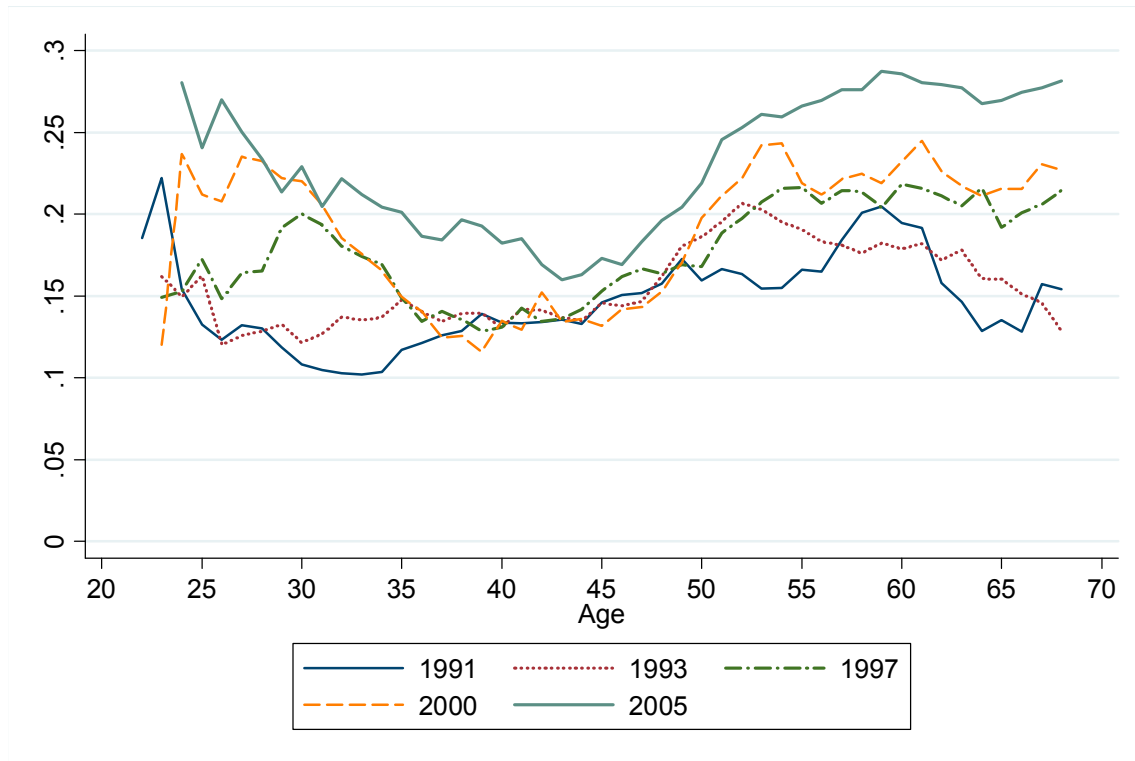
Table 2. Transition probabilities for SOE sector, employment, and unemployment						
Table 2.1. Transition probability from SOE to non-SOE sector (Year t1 to t2): employed workers						
	1989-1991	1991-1993	1993-1997	1997-2000	2000-2004	2004-2006
Transition probability	5.45	4.45	11.82	8.95	13.63	8.47
Table 2.2. Transition probability from employment to unemployment (Year t1 to t2)						
	1989-1991	1991-1993	1993-1997	1997-2000	2000-2004	2004-2006
All sample	4.09	4.6	8.57	7.53	13.03	7.88
SOE workers	2.98	3.08	8.67	6.68	11.97	5.05
Table 2.3. Transition probability from unemployment to employment (Year t1 to t2)						
	1989-1993	1993-1997	1997-2000	2000-2004		
All workers	23.53	32.56	28.57	27.69		
SOE workers	16	28.57	24.24	17.14		

Table 3. Permanent and Transitory Variance of Shocks to Urban Household Income and Earnings

3A. Permanent Variance				
	Family Income		Family Earnings	
Year	All	SOE	All	SOE
1993	0.023 (0.010)	0.017 (0.009)	0.020 (0.011)	0.017 (0.012)
1997	0.024 (0.010)	0.020 (0.008)	0.006 (0.011)	0.013 (0.011)
2000	0.009 (0.012)	0.023 (0.015)	0.021 (0.019)	0.029 (0.018)
2004	0.018 (0.009)	0.022 (0.012)	0.016 (0.011)	0.036 (0.012)
3B. Transitory variance				
	Family Income		Family Earnings	
Year	All	SOE	All	SOE
1991	0.040 (0.012)	0.027 (0.008)	0.074 (0.021)	0.028 (0.010)
1993	0.085 (0.017)	0.047 (0.018)	0.089 (0.020)	0.108 (0.033)
1997	0.090 (0.036)	0.048 (0.031)	0.126 (0.052)	0.054 (0.036)
2000	0.153 (0.026)	0.114 (0.031)	0.158 (0.042)	0.088 (0.024)
2004	0.162 (0.030)	0.121 (0.025)	0.091 (0.026)	0.059 (0.017)

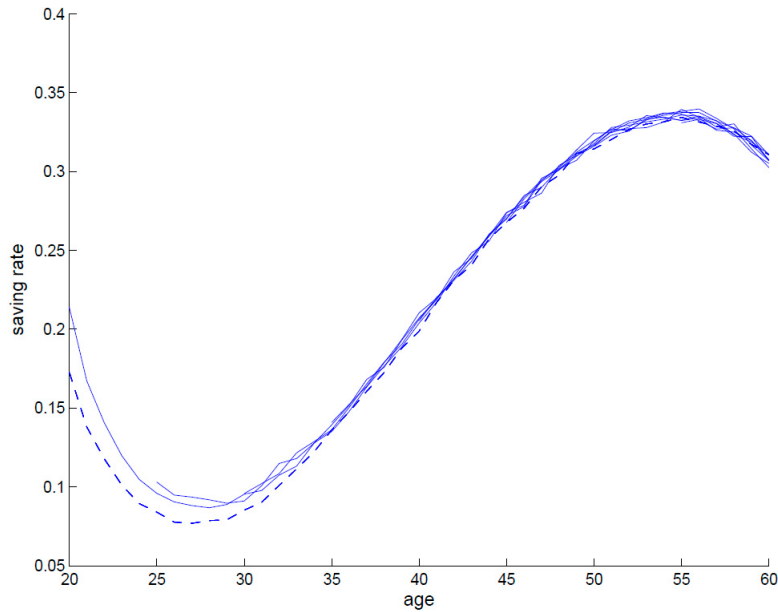
Notes: Variance estimates based on the decomposition described in Section III. All refers to all urban households fitting our selection criteria (described in Section II). SOE subsample restricted to those where head was an SOE employee throughout the sample. Results are similar if SOE subsample assigned based on initial employment.

Figure 1. Urban Household Saving Rates by Age of Head



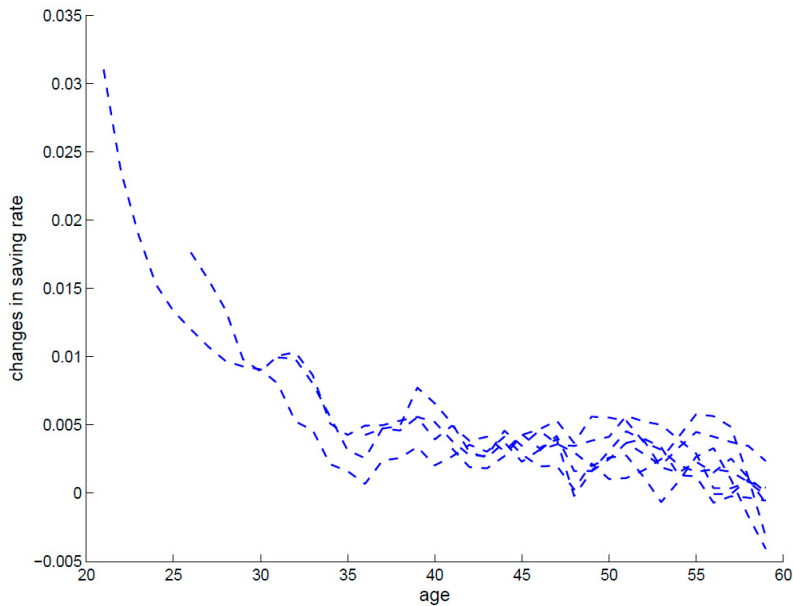
Notes: Based on a 10 province/municipality subsample of the National Bureau of Statistics Urban Household Survey. Saving rates smoothed by a moving average with 4 neighboring age averages. For details on the data, and how saving rates are defined, please refer to Chamon and Prasad (2010).

Figure 2A. Estimated Age Profile of Saving Rates Before and After Rise in Variance of Income



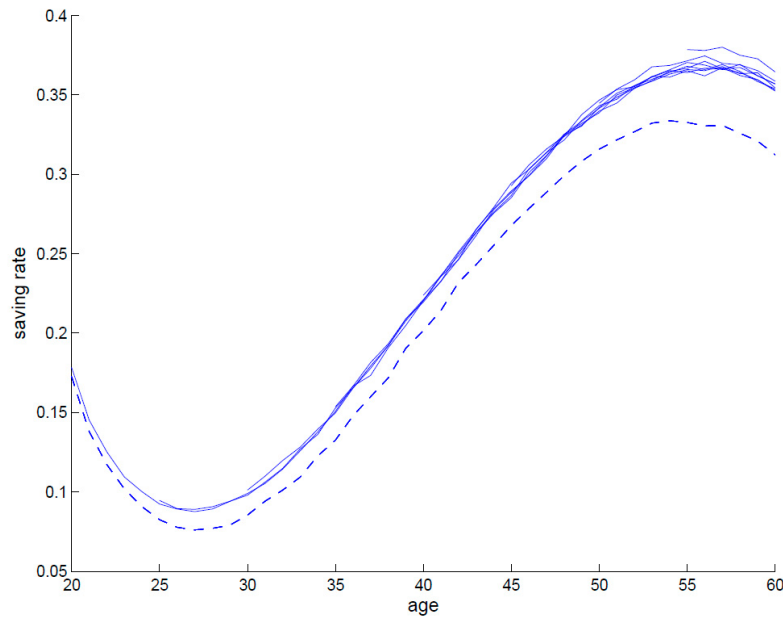
Notes: Dashed line corresponds to the saving behavior when the variance of transitory income is 0.04. Other lines indicate the saving behavior when that variance is 0.08 if the change were to occur when the individual was at that respective age.

Figure 2B. Jump in Saving Rate Following Rise in Variance of Income



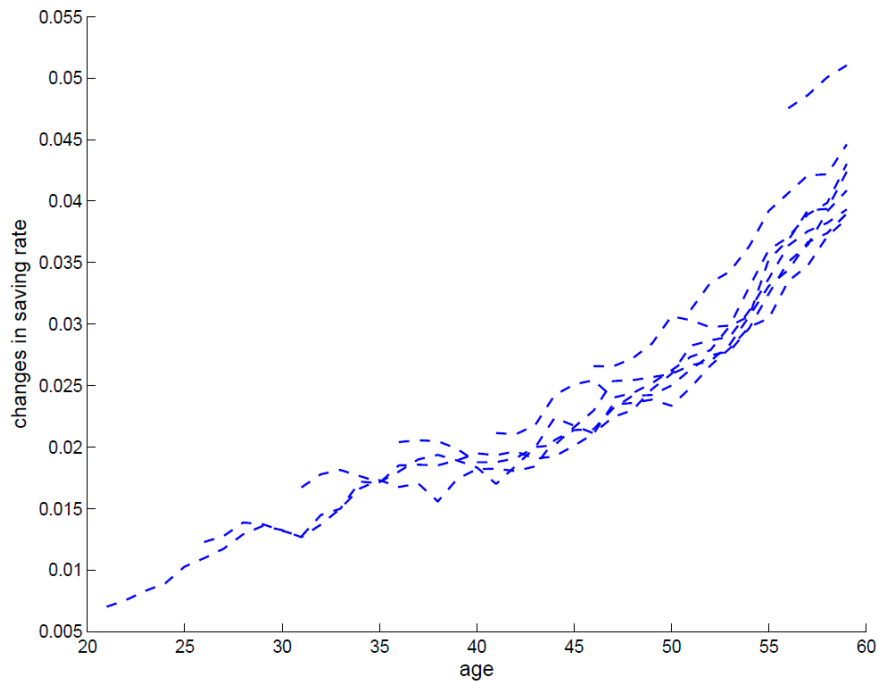
Notes: Each line corresponds to the jump in the saving rate in Figure 2A after the increase in the variance of permanent income for an individual at that age.

Figure 3A. Estimated Age Profile of Saving Rates Before and After Pension Reform



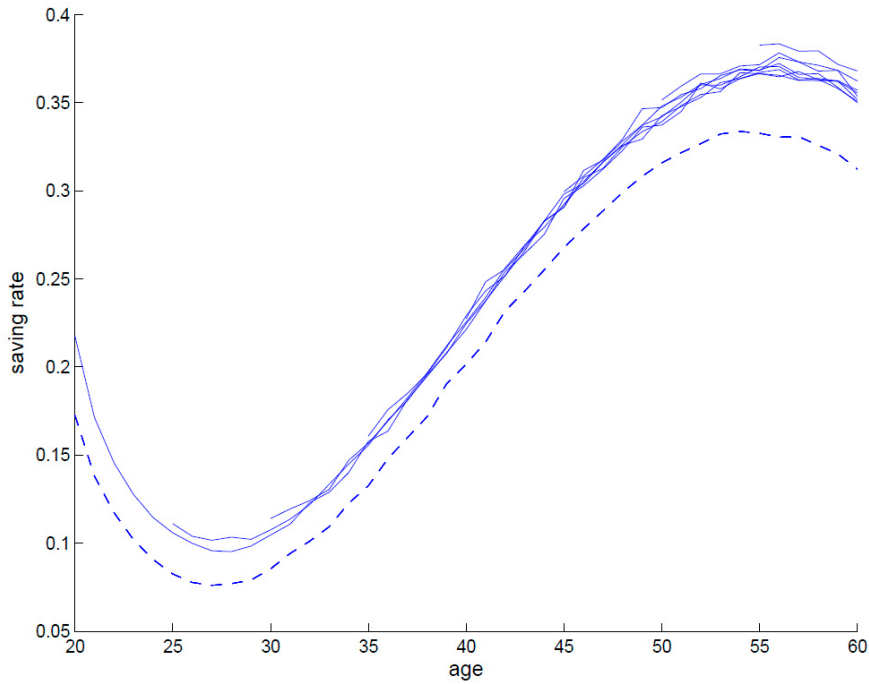
Notes: Dashed line corresponds to the saving behavior when $\eta=0.45$. Other lines indicate the saving behavior when $\eta=0.35$ if the change in pension replacement were to occur when the individual was at that respective age.

Figure 3B. Jump in Saving Rate Following Pension Reform



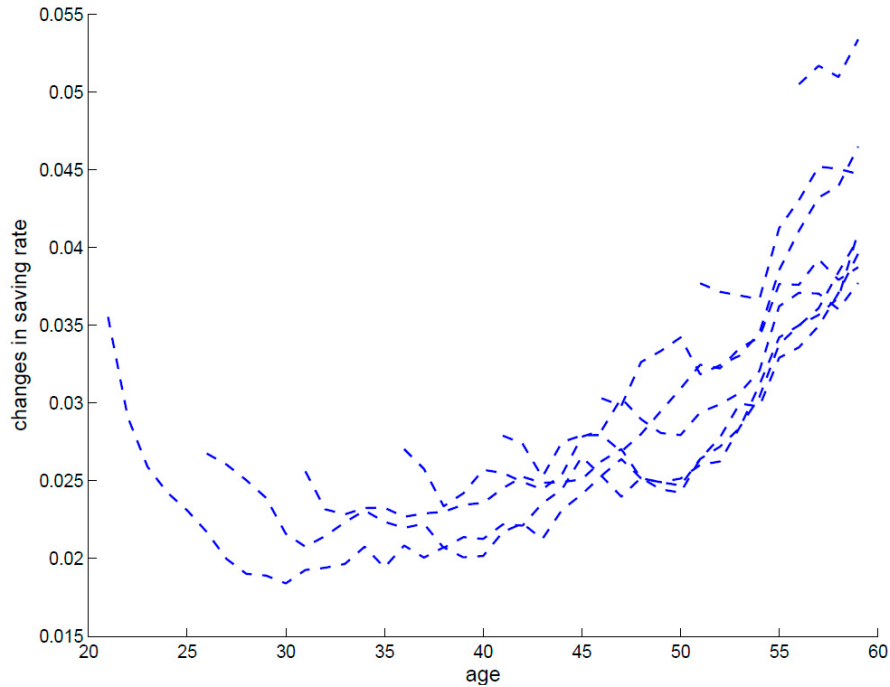
Notes: Each line corresponds to the jump in the saving rate in Figure 2A after pension reform for an individual at that age.

Figure 4A. Estimated Age Profile of Saving Rates Before and After Rise in Variance of Income and Pension Reform



Notes: Dashed line corresponds to the saving behavior when the variance of transitory income is 0.04 and $\eta=0.45$. Other lines correspond to saving behavior when the variance of transitory income is 0.08 and $\eta=0.35$ if the change were to occur when the individual was at that respective age.

Figure 4B. Jump in Saving Rate Following Rise in Variance of Income



Notes: Each line corresponds to the jump in the saving rate in Figure 4A after the shock occurs for an individual at that age.