On the Effectiveness of Insurance Mechanisms for the Elderly in China [*]

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Abstract

Does consumption smoothing across time and individuals indicate efficiency of insurance mechanisms? To address this question, we use China Health and Retirement Longitudinal Study (CHARLS) panel data covering 2011, 2013, 2015, and 2018 to examine effectiveness of market and non-market insurance mechanisms for the elderly in China. While the conventional tests support perfect consumption smoothing or full consumption insurance across time and individuals against health shocks particularly for essential consumption, our results show the welfare costs of such shocks are not necessarily small. This suggests that strengthened social safety nets can be welfare enhancing even when consumption is not very sensitive to shocks.

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1   Introduction

China has been aging at one of the fastest speeds around the globe (United Nations, 2019. World Population Prospects 2019. Department of Economic and Social Affairs, Population Division, United Nations). This trend can be attributed to few elements such as a sharp decline in mortality rate due to advancement in medical treatment and the low fertility rate due to the increased cost of raising a child as well as policy measures to control population, a.k.a. the one-child policy introduced in the 1970s (Asian Development Bank, 2020; cite Asia's Journey to Prosperity). Yet, long-term care (LTC) and pension systems in China, which play critical roles for the elderly to secure their wellbeing, are still developing -LTC in China relies heavily on informal care provided by family members because the formal care sector is still its infancy (Hu, 2019). As of the end of 2017, Chinese public pension schemes had more than 915 million participants, accounting for 65.8% of the total population, and the total public pension was about 5% of China's GDP. (Fang, Hanming and Jin Feng, 2020. The Chinese Pension System in Handbook of the Chinese Financial Markets, edited by M. Amstad, Guofeng Sun and Wei Xiong, Princeton University Press) but the average replacement rate of pension is China will still be around 20% in the nearest decade (CITATION). The number contrasts with that of around 45-55% in Europe. Under this circumstance, a recent study shows that the rapid aging without sufficient social insurance in China has been causing drastic impacts on elderly's physical and mental well-beings (Chen and Fang, 2021 https://cpb-us-w2.wpmucdn.com/web.sas.upenn.edu/dist/3/517/files/2021/01/202102_FPP-and-Parents_V2.pdf).

Generally speaking, elderly people both in developed and developing countries face a variety of downside risks disproportionately such as developing cancer and other diseases, loss of a loved one, and deterioration of essential health conditions (Fan, Hanming, 2014, Insurance Markets for the Elderly, in Handbook of Economics of Population Ageing, edited by John Piggott and Alan Woodland, Elsevier). China is not an exception. It is imperative to assess relative effectiveness of

existing formal and informal safety nets with which elderly people are currently managing their livelihood, albeit imperfectly, so that the government can design more effective social insurance programs in the future. On one hand, there has been a rich set of studies on China which estimate the future aggregate demand for home-based, public, and private LTC (Wittenberg et al., 2006; Zeng et al., 2015; Chung et al., 2009; Lou et al., 2014; Hu, 2019). Yet, to the best of our knowledge, there is no empirical micro-study so far which investigates individual-level risk-coping behavior against health shocks and its welfare consequences among the Chinese elderly.

This paper aims to bridge this important lacunae in the literature at least partly by uncovering people's responses to negative shocks using nationally-representative panel data of Chinese individuals ages 45 and above from the China Health and Retirement Longitudinal Study (CHARLS). The novelty of our study is to quantify relative welfare costs of different insurance mechanisms in addition to uncover heterogeneous risk-coping behaviors of the Chinese elderly against different health shocks. By doing so, we believe our study provides granular evidence for the government to design more effective LTC and social insurance systems.

To preview, there four findings emerge from our empirical analyses. First, the conventional tests support full consumption smoothing or insurance across time and households against health shocks for the essential consumption of foods. Second, we found the welfare costs of such shocks are not necessarily small because negative shocks due to death of spouse and hospitalization force people to dissaving and borrowing. Third, this leads to higher mental stress particularly in rural areas. Finally, based on the theoretical framework of Chetty and Looney (2006), we found substantial welfare losses arising from the use of borrowing and dissaving to cope with health shocks especially in rural areas. These empirical results highlight importance of effective social safety nets or social insurance to protect well-being of the elderly under rapidly progressing aging in China even when consumption is not very sensitive to health shocks.

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Related to our study, there are a number of existing studies in economics which investigate prevalence and consequences of various aspects of informal and social insurance among elderly population around the world such as: Various economic and social supports in China, Japan, and Korea (Ichimura et al 2007); family support from children and spouse in China (Chen and Fang, 2020, 2021); informal care givers and receivers in Japan (Yuda and Lee, 2016); and Universal Health Coverage (UHC) in Japan (Kondo and Shigeoka, 2013). Also, many existing papers examine the nexus between informal safety net and public social insurance programs such as Kim and Lim (2014) on LTC and informal care in Korea; the crowd-out effect of public insurance in the US (Finkelstein et al 2006, 2008, 2009, 2011); and the relationship between public and private transfers in the US (Cox, 1987), Peru (Cox et al 1998), Philippines (Hansen et al., 2004), and Vietnam (Cox et al. 1998).

Considering these predecessors, we believe our analysis make important contribution to the literature by unveiling the holes in the existing social insurance and quantify the potential welfare gains from forming formal social insurance programs even when we observe consumption smoothing across time and individuals.

The rest of the paper is organized as follows. Section 2 postulates the framework to be empirical implemented. In Section 3, we explain the data set and its descriptive statistics. Section 4 shows our main empirical results on consumption smoothing across time and households, people's risk coping behavior against negative health shocks, and its welfare consequences, addressing heterogeneities across location and income, which is followed by a set of robustness checks in section 5. The final section discusses policy implications of the empirical results obtained in this paper.

2 The Empirical Framework

Our empirical model is built on two canonical models of individual or household consumption smoothing decisions across time and households, i.e., the model of the life-cycle permanent income hypothesis (LC-PIH) and the consumption risk sharing model (Jappelli and Pistaferri, 2017), respectively.

2.1 The Life-Cycle Permanent Income Hypothesis

The LC-PIH model is a model of each individual's intertemporal utility maximization decisions under budget constraints and a set of the canonical assumptions such as time separability of utility function with constant interest rates and subjective discount rates. Such a model provides is the first-order necessary condition for optimal decisions which is known as the following consumption Euler equation:

$$u'(c_t) = \frac{1+r}{1+\delta} E_t(u'(c_{t+1})), \tag{1}$$

where c_t is consumption at period t, E_t is an expectation operator conditional on information set at time t, r is interest rate, and δ is a subjective discount rate. This condition indicates that the marginal utility at period t should be equal to the marginal discounted utility at period $t+1$, making consumption smoothed over time.

2.2 Consumption Risk Sharing

The second approach to model consumption decision is the model of consumption risk sharing in which consumption decisions are made under formal and informal insurance arrangements. The literature on consumption risk sharing are quite extensive (Mace 1991, Cochrane 1991, Townsend

1994, Hayashi et al 1996, Ogaki and Zhang 2001, Dubois et al 2008, Attanasio and Pavoni 2011, Laczo 2015, and Kinnan 2020). In the model of friction-less consumption insurance, full risk sharing in a formal and informal insurance network can achieve the Pareto optimal consumption allocation where the weighted marginal utilities are equalized across individuals. The first order necessary condition of the optimal allocation derived this problem is:

$$\lambda^i u'(c_{it}) = \lambda^j u'(c_{jt}),$$

where λ is the Negishi weight of a social welfare function to solve the social planner model in deriving the optimal conditions.

2.3 Testing Consumption Smoothing across Time and Households

In the first model, agents are trying to equate their discounted marginal value of consumption across time whereas in the second model they equate their marginal utility of consumption across individuals, This provides evidence of consumption smoothing across time or risk-sharing across households. It is important to note that in either model, we can derive a common consumption growth equation under a set of standard assumptions such as (log-linearized) concavity of utility function including a specific case of constant relative risk aversion (CRRA) utility, rational expectation, and common brief (Ligon, 1988; Jappelli and Pisterferri, 2017; Kinnan, 2020):

$$\Delta log(c_{it}) = b_0 + b_1 S_{it} + d_{city} + d_{year} + u_{it}$$

where S_{it} is a set of negative health shocks an individual i faces at time t. The LC-PIH or the complete consumption insurance hypothesis can be tested by checking whether $b_1 = 0$, which means that the agent is able to fully diversify away the negative shocks and achieve consumption smooth-

ing. This indicates strong effectiveness of different formal and informal insurance mechanisms to weather negative shocks.

2.4 Market and Non-Market Insurance Channels

To incorporate a variety of market insurance, self-insurance, and other non-market insurance mechanisms analyzed by Ehrlich and Becker (1972), we follow Fafchamps and Lund (1993) and consider an individual's intertemporal budget constraint at each period t as: $c_{it} = y_{it} - s_{it}, \forall t$ which is approximately equal to:

$$\Delta log(c_{it}) = \Delta log(y_{it}) - \Delta(s_{it}/y_{it}), \tag{4}$$

where y_{it} is income and s_{it} is the saving for agent i at time t where the right-hand side shows financing mechanisms of consumption by changing in private transfers, public transfers, dis-savings, and borrowings. Together with the consumption growth equation, this constraint, which shows that consumption can be financed different income sources as well as dis-savings and borrowings, motivates our empirical specification of $k - th$ risk-coping decisions as follows.

$$Y_{it}^k = \beta_0 + \beta_1 S_{it} + \beta_2 X_{it} + \delta_{city} + \delta_{year} + \epsilon_{it}, \tag{5}$$

where Y^k represents the use of $k - th$ financial coping mechanism of consumption under a variety of negative health shocks S_{it} at time t. An adoption decision of a particular coping channel is also driven by the household income, number of children, other demographics characteristics and individual unobserved heterogeneity captured by fixed effects, Here we are particularly interested in the coefficient β_1, which measures the extent of different negative shocks are affecting people's well-being.

2.5   Overall Welfare Impacts

To quantify and compare welfare impacts of different insurance mechanisms more directly, we introduced two outcome variables interchangeably: First, a subjective well-being measure, "life dissatisfaction," and a popular, clinically-validated depression measure, "CESD," named after the Center for Epidemiological Studies Depression.

To make use of this framework, we follow Chetty & Looney (2006) to assume each agent has utility over consumption $u(c)$ with disutility of obtaining each consumption level by utilizing particular insurance mechanisms. Here we consider two specific risk coping strategies or insurance mechanisms, i.e., dissaving and borrowing. Hence, welfare function, which is composed of utility and disutility, can be approximately specified as:

$$W(c, \Delta s, \Delta d) = \alpha_1 log(c^{food}) + \alpha_2 log(c^{nonfood}) + \alpha 3 log(c^{other}) + \eta_1 \Delta s + \eta_2 \Delta d + \epsilon, \quad (6)$$

where s is saving and d is borrowing or debt. Theoretically speaking, we can presume that $\eta_1 > 0$ and $\eta_2 < 0$. We capture utility revel directly by a subjective well-being measure, "life dissatisfaction," or a clinically-validated depression measure, "CESD." Note that both variables are inverse ones of utility level.

3   Data and Descriptive Statistics

In our analysis, we employ a nationally-repsesentative panel data, China Health and Retirement Longitudinal Study (CHARLS) data, restricting the age between 45-80, so the sample includes in total around 50,000 observations from each of 2011, 2013, 2015 and 2018.

The CHARLS's baseline survey includes one person per household aged 45 years of age

or older and their spouse, totaling 17,708 individuals, living in 10,257 households in 450 villages/urban communities (Zhao et al., 2013, 2014a). A stratified (by per capita GDP of urban districts and rural counties) multi-stage (county/district-village/community- household) PPS random sampling strategy was adopted.

CHARLS is a study of people aged 45 and over. As the study progresses, the sam- ple respondents get older, leaving the youngest ages unrepresented unless new sample members are recruited to fill the gap. Those aged 45-46 at any given wave will be 47-48 by the next wave. Therefore a refreshment sample of 45-46-year-olds will be needed the sample is to fully represent those aged 45+. Counting refresher samples and age-eligible respondents who failed to be found in the baseline but successfully contacted in the follow-up waves, the total number of individuals (main respondents plus spouses) has increased from 17,708 in wave 1 to 19,817 in wave 4.[1]

Table 1 shows general household Income, Consumption, Saving and Debt. An average pension has monthly pension of 3018 yuan and has about 16000 yuan in savings, while holding debt equal to 7892 yuan; the weekly consumption of food is around 287 yuan, while monthly nonfood goods equals 365 yuan, and annual consumption of other goods equals 11005 yuan, the total consumption of an average person is about 30530 Chinese yuan per year.

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[1]Zhao, Yaohui, John Strauss, Xinxin Chen, Yafeng Wang, Jinquan Gong, Qinqin Meng, Gewei Wang, Huali Wang. (2020). China Health and Retirement Longitudinal Study Wave 4 User's Guide, National School of Development, Peking University.

Table 1: Summary statistics: Income, Consumption, Saving and Debt

	Income, Consumption, Saving and Debt				
	count	mean	sd	min	max
pension (annually)	52810.0	3018.8	8623.2	0.0	300272.7
public and government transfer (annually)	54915.0	1247.6	25056.7	0.0	3481288.0
savings	43275.0	16067.9	87710.2	0.0	8233552.6
debt	49586.0	7892.6	64830.2	0.0	5221932.0
consumption of food (weekly)	47328.0	287.3	547.9	0.0	35074.0
consumption of nonfood goods (monthly)	48669.0	365.9	1647.3	0.0	329810.9
consumption of other goods (annually)	48372.0	11005.0	29810.1	0.0	1645460.5
total consumption	42519.0	30530.1	51845.3	0.0	3988115.1
N	54915				

Note: consumption of food includes purchased food and food from own production, meals eaten out, and alcohol and cigarettestobacco; consumption of monthly nonfood goods include communication fee (post, internet, cell phone), utilities (water and electricity), fuels (gas and coal), fee for housekeeper, local transportation, household items (toiletries and beauty treatments), and entertainment (books, newspaper, etc.); consumption of other goods annually include clothing and bedding, long distance traveling expenses, heating, furniture (durable goods and electronics), education (and training), medical expenditure, fitness expenditures, and beauty expenditure (make-up, facial and massages). The total consumption is 52 times weekly food consumption, plus 12 times monthly nonfood consumption, plus annual other consumption, deflated by the OECD yearly deflator.

Table 2: Summary statistics: Demographics

	Basic Demographics				
	count	mean	sd	min	max
age	54915.00	59.87	8.62	46.00	79.00
female	54915.00	0.51	0.50	0.00	1.00
couple (married or co-residence)	54915.00	0.84	0.37	0.00	1.00
number of children	54915.00	2.96	1.53	0.00	12.00
rural hukou	54014.00	0.79	0.41	0.00	1.00
education	54915.00	2.70	1.25	1.00	5.00
number of household members	54915.00	4.78	2.03	1.00	18.00
self-reported health (SRH)	49502.00	3.87	0.95	1.00	6.00
I(smoke)	51113.00	0.27	0.44	0.00	1.00
I(drink)	54803.00	0.34	0.48	0.00	1.00
N	54915				

The summary statistics give us a more panoramic view on people's demographics, from Table 2, age ranges from 46 to 79 with an average of 59.87 years old. In the sample, there are 51% of the observations are female, 84% are married, and 79% of them are holding a rural hukou. The average number of children is around 3, and the average category of education is 2.7[2], which is close to elementary level education. Average health score is 3.87[3] which is between good and fair. Around 27% of the people currently smoke and 34% of them currently drink.

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[2]Education categories: 1 no formal education, 2 some elementary level education but did not finish, 3 elementary level education, 4 middle school, 5 high school and above.

[3]Health score is: 1 excellent, 2 very good, 3 good, 4 fair, 5 poor.

Table 3: Summary statistics: Health Variables

	Health Variables				
	count	mean	sd	min	max
adl 6item	54394.00	0.36	0.98	0.00	6.00
mobility, lower body	54551.00	1.08	1.22	0.00	4.00
mobility, upper body	54546.00	0.28	0.63	0.00	3.00
CESD	51763.00	8.19	6.27	0.00	30.00
life satisfaction	50115.00	2.80	0.77	1.00	5.00
cancer	53453.00	0.01	0.12	0.00	1.00
memory(immediate word recalling)	50315.00	3.94	1.95	0.00	10.00
memory(delayed word recalling)	50207.00	3.12	2.27	0.00	10.00
memory(7 series)	51518.00	2.70	1.99	0.00	5.00
hospitalization	54741.00	0.13	0.34	0.00	1.00
N	54891				

Table 3 takes a closer look at different health variables, "adl_6item" records the number of difficulties in ADL[4] and the average of that is 0.36, while the average lower mobility difficulty is 1.08 and that of the upper mobility is 0.28. CESD[5] is a measurement for adult depression, the higher the more depressed, from Table 4, the average score of CESD is 8.19; life satisfaction ranges between 1 to 5, with 1 the most satisfied, the average life satisfaction score is 2.80. There are only 1% of the observations have been diagnosed with cancer in each survey year. For memory issue, we have three related variables: immediate word recalling, delayed word recalling, and deduction by 7, the higher the score is, the better memory the respondent has, in the sample the average scores are 3.94, 3.12, and 2.70 for them respectively. For medical use and in-hospitalization, there are on average 13% people had inpatient experience in the survey years.

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[4]Short for activities in daily living.

[5]The CES-D (Center for Epidemiological Studies Depression Scale) is a 20-item scale commonly used to evaluate current depressive symptom severity, with a score range of 0–60 (higher scores reflect increased symptom severity).

4   Estimation Results

4.1   Consumption Smoothing across Time and Households

Table 4 examines the impact of negative health shocks on consumption growth on food, non-food goods, and other annual expenditure, as well as inpatient out-of-pocket expense. Death of spouse significantly reduces the weekly consumption on food, monthly consumption on non-food goods, and other consumption possibly because there is one less person in the household.

As for food consumption growth, other than spouse death, no health shock variable affects the outcome at 5 percent level of significance, indicating empirical support of the necessary conditions of optimal intertemporal and cross-sectional consumption smoothing. As to non-food consumption growth, we also obtain qualitatively comparable result. These suggest overall effectiveness of market and non-market consumption insurance across time and households for the essential consumption items. [6]

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[6]In contrast, hospitalization shocks increase monthly consumption on other annual expenditure and inpatient out-of-pocket expense due to direct increases in medical expenses related to hospitalization. Memory issue increases spending on food and non-food goods, and mobility difficulty somewhat decreases food and non-food consumption.

Table 4: The effect of negative health shocks on growth in consumption

VARIABLES	(1) dlnconsumption_food	(2) dlnconsumption_nofood	(3) dlnconsumption_other	(4) dlnexp_inpatient_oop
death_spouse	-0.351***	-0.167**	-0.341**	0.130
	(0.112)	(0.0794)	(0.151)	(0.144)
inpatient	-0.0163	0.0365	0.491***	6.430***
	(0.0399)	(0.0243)	(0.0497)	(0.136)
dadl_6item	0.00808	0.0112	0.0292	0.121***
	(0.0184)	(0.0121)	(0.0239)	(0.0440)
dmobility_lower	0.00542	0.0102	0.0563***	-0.0494
	(0.0173)	(0.00839)	(0.0171)	(0.0465)
dmobility_upper	-0.0415	-0.0125	-0.0383	0.0539
	(0.0278)	(0.0146)	(0.0273)	(0.0448)
dmemory_iword	0.0332*	0.0178***	0.0338***	-0.0125
	(0.0184)	(0.00512)	(0.0119)	(0.0102)
dmemory_7serial	0.00118	0.00375	0.0160	-0.00257
	(0.00869)	(0.00408)	(0.0108)	(0.0135)
Constant	1.136***	0.553***	0.0353	0.645
	(0.245)	(0.109)	(0.229)	(0.451)
City&Year FE	✓	✓	✓	✓
Controls	✓	✓	✓	✓
Observations	21,720	23,459	23,266	28,693
R-squared	0.053	0.021	0.017	0.308

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

4.2 Dissaving and Borrowing as Insurance Mechanisms

In Tables 5 reports impact of health shocks on saving, borrowing, and receiving public transfers. A set of health shock variables, i.e., the death of spouse, hospitalization, and upper body mobility difficulty, has a tendency to decrease the amount of one's savings. Savings may function as an

important risk coping mechanism against these shocks. Memory difficulty, on the other hand, increases cash savings, suggesting that while memory lost does not place a pressure on saving reduction, it may also increases precautionary savings.
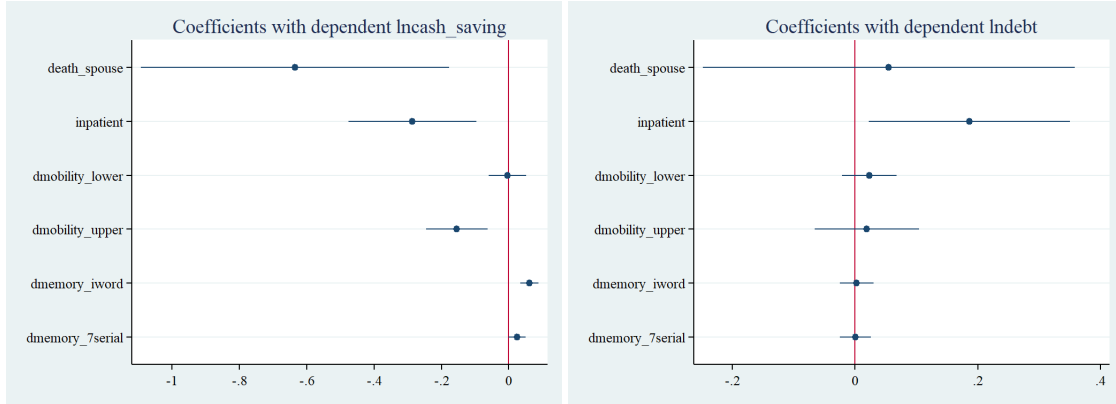
While ADL difficulty and memory difficulty are likely to earn more government and public transfers for agents, hospitalization put inpatient in higher debt, suggesting that due to low reimbursement or less coverage of health insurance, people need to borrow money to cover their inpatient fee, which increases their debt amount after all.

Table 5: The effect of negative health shocks on savings, borrowing, and public transfers

	(1)	(2)	(3)
VARIABLES	lncash_saving	lndebt	lnhhgovpub
death_spouse	-0.635***	0.0550	0.481**
	(0.232)	(0.153)	(0.194)
inpatient	-0.286***	0.186**	0.0185
	(0.0958)	(0.0828)	(0.0811)
dadl_6item	-0.0578	0.0163	0.0740**
	(0.0363)	(0.0235)	(0.0368)
dmobility_lower	-0.00382	0.0231	-0.0532
	(0.0284)	(0.0224)	(0.0398)
dmobility_upper	-0.154***	0.0191	-0.0294
	(0.0458)	(0.0430)	(0.0601)
dmemory_iword	0.0611***	0.00247	0.0405***
	(0.0137)	(0.0139)	(0.0153)
dmemory_7serial	0.0253**	0.000549	0.0320*
	(0.0128)	(0.0128)	(0.0183)
Constant	11.57***	3.413***	0.494
	(0.427)	(0.430)	(0.453)
City&Year FE	✓	✓	✓
Controls	✓	✓	✓
Observations	23,450	27,251	29,084
R-squared	0.191	0.103	0.133

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

	Coefficients with dependent lncash_saving	Coefficients with dependent lndebt
death_spouse		
inpatient		
dmobility_lower		
dmobility_upper		
dmemory_iword		
dmemory_7serial		

4.3 Overall Welfare Impacts

Based on the approximated welfare function specification of equation (6), we can examine validity of our framework empirically. To capture welfare levels directly, we employ a subjective well-being measure, "life dissatisfaction," and a clinically-validated depression measure, "CESD," interchangeably, both of which are an inverse measure of welfare. Table 6 shows the estimated effect of consumption and coping strategies on life satisfaction[7] and CESD depression score, controlling for the levels of consumption on the three categories, i.e., food, nonfood, and other consumption items.

In general, the level of food and non-food consumption are negatively correlated with life dissatisfaction level and CESD depression score, the increase in consumption decreases life dissatisfaction and depression level (Table 6), which are consistent with our presumption of utility function.

Notice that higher consumption of other goods and services are positively correlated with people's dissatisfaction of life and CESD. A possible explanation is that these consumption includes, for example, hospitalization fees, which are unwanted expenses greatly induced by negative health

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[7]Life dissatisfaction ranges from 1-5, which 1 stands for "satisfied", and 5 "extremely not satisfied".
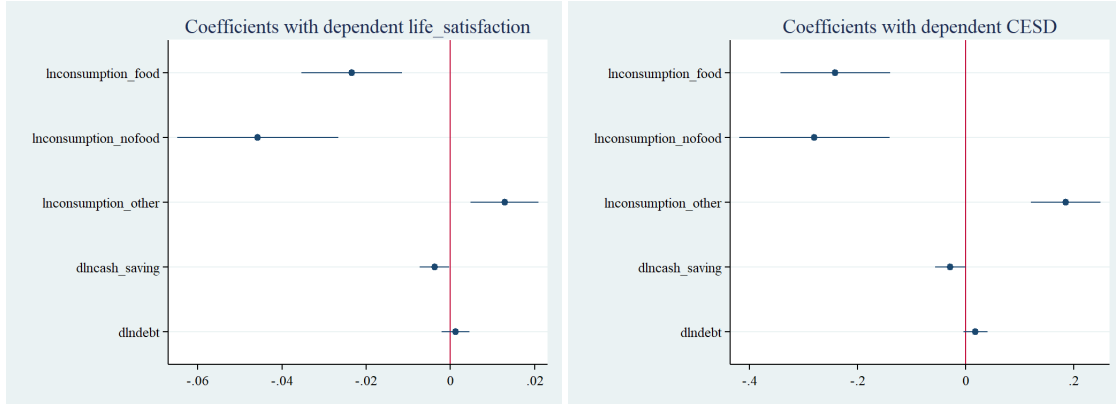
shocks or bad life events, and may give people higher debt burden, thus these consumption does not give people more utility.

An increase in cash savings leads to lower life dissatisfaction level and depression level (Table 6). This result suggests that with higher amount of savings, one is more likely to feel satisfied and secured. On the other hand, as theoretically formualted by Chetty and Looney (2006), the use of dissaving to achieve a certain level of consumption seems to incur disutility.

While savings is a major consumption smoothing instrument among the senior in China, higher savings growth is negatively correlated with life-dissatisfaction level and CESD score. Debt is positively correlated with these outcome variables, indicating that borrowing and incurring debt would be stressful, although we observe only marginal statistical significance.

Table 6: Welfare impacts of consumption, saving, and borrowing
(without or with control variables)

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	life_dissatisfaction	life_dissatisfaction	life_dissatisfaction	CESD	CESD	CESD
lnconsumption_food	-0.021***	-0.020***	-0.023***	-0.309***	-0.303***	-0.241***
	(0.006)	(0.006)	(0.006)	(0.052)	(0.052)	(0.051)
lnconsumption_nofood	-0.037***	-0.037***	-0.046***	-0.385***	-0.384***	-0.280***
	(0.009)	(0.009)	(0.010)	(0.071)	(0.071)	(0.070)
lnconsumption_other	0.013***	0.013***	0.013***	0.145***	0.147***	0.185***
	(0.004)	(0.004)	(0.004)	(0.033)	(0.033)	(0.033)
dlncash_saving		-0.004**	-0.004**		-0.043***	-0.029**
		(0.002)	(0.002)		(0.014)	(0.014)
dlndebt		0.001	0.001		0.018	0.018
		(0.002)	(0.002)		(0.012)	(0.011)
City&Year FE	✓	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓
Observations	15,880	15,880	15,880	15,880	15,880	15,880
R-squared	0.076	0.077	0.082	0.095	0.096	0.139

| Coefficients with dependent life_satisfaction | Coefficients with dependent CESD |

4.4 Heterogeneous Impacts: Rural vs. Urban Households

In this section, we compare rural and urban residents in terms of effects of negative health shocks on coping behavior, i.e., savings and borrowings, as well as welfare.

Table 7 reports how people respond to a variety of health shocks. The death of spouse as well as hospitalization are affecting rural residents saving and/or borrowing but not urban ones. While mobility difficulties affect both rural and urban respondents by decreasing saving, rural residents are more likely to have higher debt level than urban residents because of hospitalization. Cognitive capacity problems captured by memory difficulty do not seem harmful for urban people but these problems are likely to stimulate more savings for rural residents probably as precautionary saving for future use.

In Table 8, we examine welfare impacts of different consumption items, saving, and borrowing. Among other consumption categories, food consumption and other consumption plays a role of affecting overall welfare in positive and negative directions, respectively, for both urban and rural residents. Nofood iteams also affect rural households positively. In addition, if we take CESD measure as a welfare outcome, rural residents' welfare are affected, respectively, by saving and borrowing.

In sum, the above heterogeneous analyses indicate the effects of health shocks on coping responses and welfare are more pronounced among rural households. These findings may be a reflection of the relative lack of formal insurance mechanisms in rural areas.[8]

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[8]We also conducted heterogeneous impact assessments for high income vs. low income respondents. The empirical results, which are available from the corresponding author, show that, largely speaking, low income individuals are constrained from the lack of insurance mechanisms and therefore rely on costly risk coping instruments such as dissaving and borrowing.

Table 7: The effect of negative health shocks on savings, debt, and public transfers (Urban vs. Rural)

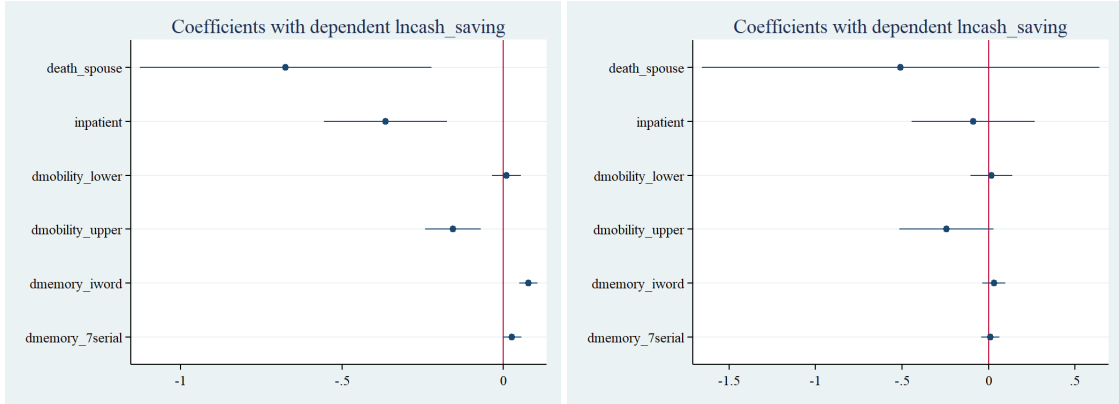| VARIABLES	(1) lncash_saving	(2) lndebt	(3) lnhhgovpub
	URBAN		
death_spouse	-0.509	-0.152	0.0723
	(0.581)	(0.267)	(0.444)
inpatient	-0.0895	0.201	-0.00366
	(0.179)	(0.175)	(0.158)
dadl_6item	-0.165	0.0286	0.160
	(0.104)	(0.0552)	(0.134)
dmobility_lower	0.0163	0.00236	-0.129
	(0.0616)	(0.0469)	(0.116)
dmobility_upper	-0.244*	0.0609	0.127
	(0.137)	(0.0927)	(0.144)
dmemory_iword	0.0304	0.0211	0.0772**
	(0.0339)	(0.0450)	(0.0344)
dmemory_7serial	0.00887	0.0283	0.0573
	(0.0267)	(0.0274)	(0.0430)
	RURAL		
death_spouse	-0.675***	0.134	0.545**
	(0.228)	(0.178)	(0.216)
inpatient	-0.365***	0.207**	-0.00155
	(0.0960)	(0.0884)	(0.0921)
dadl_6item	-0.0290	0.00896	0.0605**
	(0.0368)	(0.0261)	(0.0292)
dmobility_lower	0.00937	0.0262	-0.0198
	(0.0223)	(0.0254)	(0.0260)
dmobility_upper	-0.157***	-0.00168	-0.0741
	(0.0434)	(0.0478)	(0.0521)
dmemory_iword	0.0775***	-0.000768	0.0164
	(0.0140)	(0.0142)	(0.0155)
dmemory_7serial	0.0265*	-0.0155	0.0162
	(0.0145)	(0.0144)	(0.0144)

Figure 1: Rural (left) vs. urban (right): The effects of negative health shocks on savings
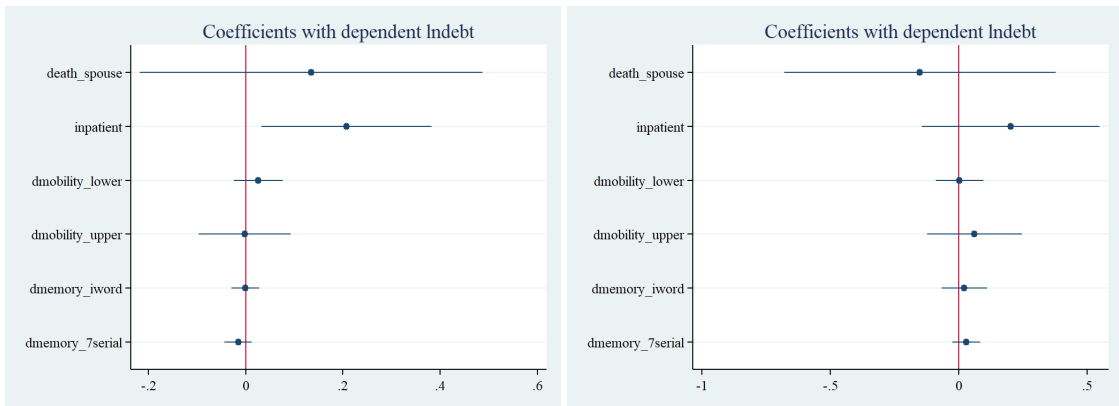

Figure 2: Rural (left) vs. urban (right): The effects of negative health shocks on debts

Table 8: Welfare impacts of consumption, saving, and borrowing
(without or with control variables)

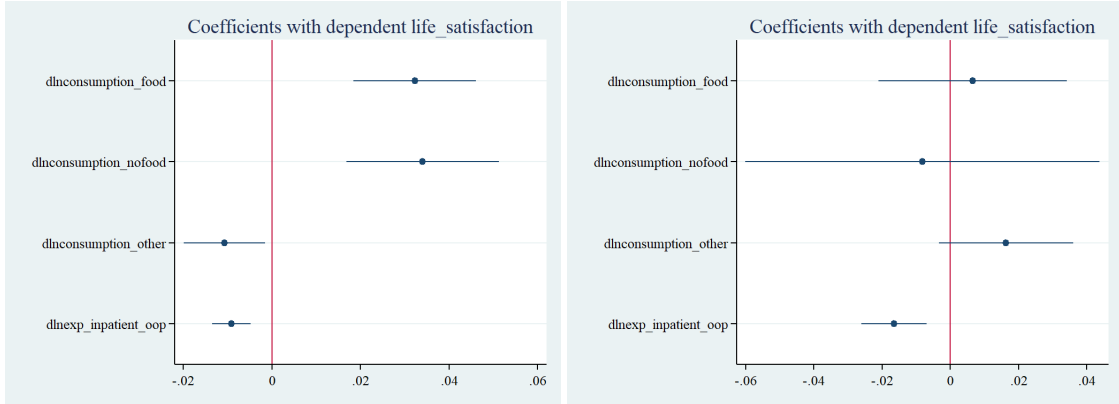| VARIABLES	(1) life_satisfaction	(2) life_satisfaction	(3) life_satisfaction	(4) CESD	(5) CESD	(6) CESD
			URBAN			
lnconsumption_food	-0.058***	-0.056***	-0.055***	-0.357***	-0.350***	-0.272**
	(0.019)	(0.018)	(0.018)	(0.122)	(0.123)	(0.116)
lnconsumption_nofood	-0.012	-0.012	-0.015	-0.317**	-0.317**	-0.152
	(0.022)	(0.022)	(0.022)	(0.159)	(0.159)	(0.147)
lnconsumption_other	0.026**	0.026**	0.026**	0.186**	0.186**	0.202**
	(0.010)	(0.010)	(0.010)	(0.074)	(0.074)	(0.079)
dlncash_saving		-0.008**	-0.007*		-0.025	-0.019
		(0.004)	(0.004)		(0.033)	(0.031)
dlndebt		-0.002	-0.002		-0.007	-0.004
		(0.003)	(0.003)		(0.022)	(0.021)
			RURAL			
lnconsumption_food	-0.013**	-0.013**	-0.017***	-0.288***	-0.284***	-0.247***
	(0.006)	(0.006)	(0.006)	(0.061)	(0.061)	(0.062)
lnconsumption_nofood	-0.044***	-0.043***	-0.052***	-0.326***	-0.322***	-0.263***
	(0.009)	(0.009)	(0.009)	(0.077)	(0.077)	(0.077)
lnconsumption_other	0.012**	0.012**	0.011**	0.168***	0.169***	0.196***
	(0.004)	(0.004)	(0.004)	(0.037)	(0.036)	(0.036)
dlncash_saving		-0.003	-0.003		-0.046***	-0.033**
		(0.002)	(0.002)		(0.015)	(0.015)
dlndebt		0.002	0.002		0.032**	0.032**
		(0.002)	(0.002)		(0.014)	(0.013)

Figure 3: Rural (left) vs. urban (right) negative shocks on life dissatisfaction (consumption)
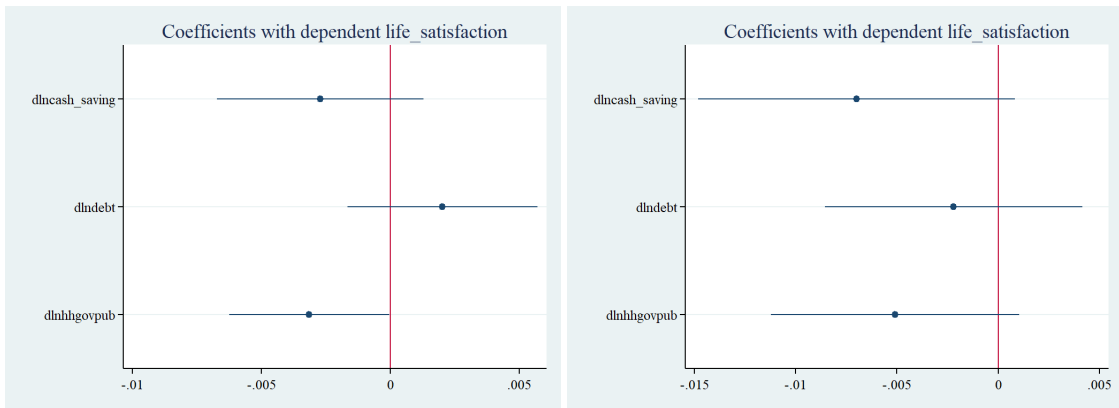

Figure 4: Rural (left) vs. urban (right) negative shocks on life dissatisfaction (savings)
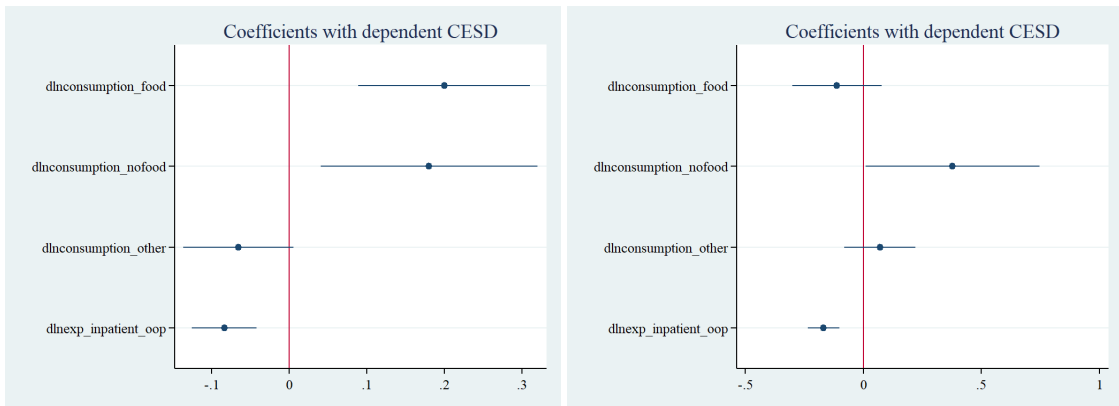

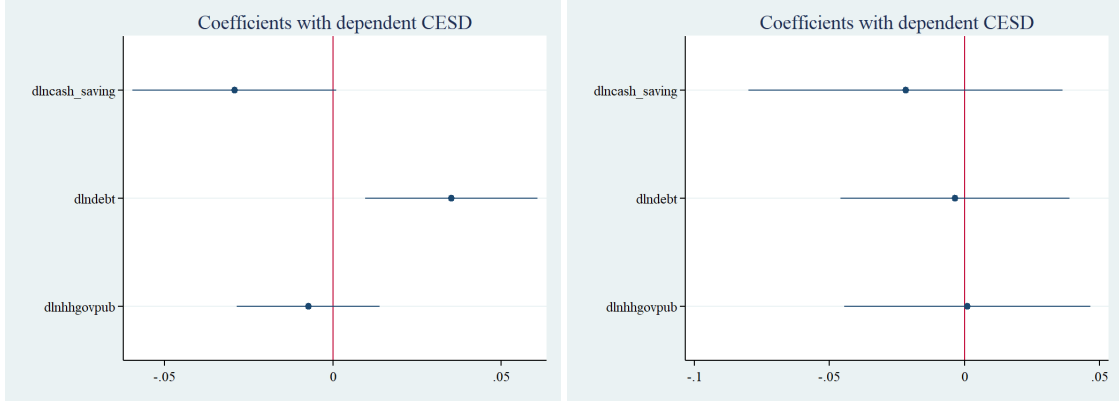Figure 5: Rural (left) vs. urban (right) negative shocks on CESD (consumption)

Figure 6: Rural (left) vs. urban (right) negative shocks on CESD (savings)

5 Normative Analysis

5.1 Optimality of Social Insurance

Following Chetty and Rooney (2007), we can quantify marginal welfare gain from getting access to formal insurance mechanism by a formula: $\Delta W = \gamma \Delta c / c$ where γ is the coefficient of relative risk aversion (RRA). To allow commonly-observed systematic differences in the RRA coefficients between the rich and the poor, we follow Ogaki and Zang (2001) and employ a decreasing relative risk aversion (DRR) utility function: $\frac{(c-a)^{1-\alpha}}{1-\alpha}$, where parameter a is the minimum subsistence level of consumption. With this utility function, note that $\gamma = \alpha \frac{c^{1-\alpha}}{c-a}$, indicating that rich people can be less risk averse when their consumption level becomes well-above the "minimum-subsistence level" of consumption.[9]

Under these assumptions, we can specify welfare function of an individual who employ saving and borrowing to respond to the health shocks as follows: $W(c, \Delta s, \Delta d) = \frac{(c-a)^{1-\alpha}}{1-\alpha} + \eta_1 \Delta s +$

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[9]Where c is the consumption level and a is the subsistence level of consumption, which could be seen as the minimum level of consumption one has to spend on living. Here we use the government standard for "low-income" households for rural and urban family separately from 2011-2018 as our parameters for "subsistence level" a. `http://files2.mca.gov.cn/www/201512/20151202084401543.htm`

$\eta_2 \Delta d$, $\eta_1 > 0, \eta_2 < 0$, $\alpha \geq 1$. Following the optimal consumption decisions formulated by Chetty and Rooney (2006), we can show that, theoretically speaking, each individual will select the following optimal consumption growth path when encountering a health shock: $\Delta c/c = 1 - \frac{\theta+a}{1+a}$ where $\theta = -\eta_1^{-1/\alpha}$ or $\theta = \eta_2^{-1/\alpha}$. Based on this equation, observed consumption smoothing against a health shock can be attributed to large value of θ which can be caused either by small welfare cost of utilizing risk coping via dissaving or borrowing, respectively, with small η_1 or η_2. Alternatively, large α or large RRA (γ) can also make smaller consumption growth. In the latter case, the marginal welfare gain from getting access to formal insurance mechanism, i.e., $\Delta W = \gamma \Delta c/c = \gamma(1 - \frac{\theta+a}{1+a})$ can still be substantial despite small consumption growth.

5.2 Quantitative Assessments of Social Insurance

In the individual welfare function, $W(c, \Delta s, \Delta d) = \frac{(c-a)^{1-\alpha}}{1-\alpha} + \eta_1 \Delta s + \eta_2 \Delta d$, we assume α = 1, 1.5, or 2, for both life (dis)satisfaction and CESD to estimate disutility parameters, η_1 and η_2 separately for urban and rural residents. Table 9 shows the estimated disutility parameters for (dis)saving and borrowing. While these estimated parameters are largely insignificant in the case of urban residents, the estimated disutility coefficients are all consistent with the theoretical prediction and statistically significant for rural residents especially when we use CESD as a welfare measure. Dissaving and borrowing both increase depression or decrease overall welfare.

With these estimated disutility parameters, we can compute the optimal consumption drop due to health shocks. We show this drop for rural and urban residents separately with borrowing (debt) or dissaving to weather negative health shocks (Figure 7 and 8). These figures show that rural residents have been disproportionately affected by consumption drop due to health shocks.

Table 9: Welfare assessments: urban vs rural, by risk aversion level

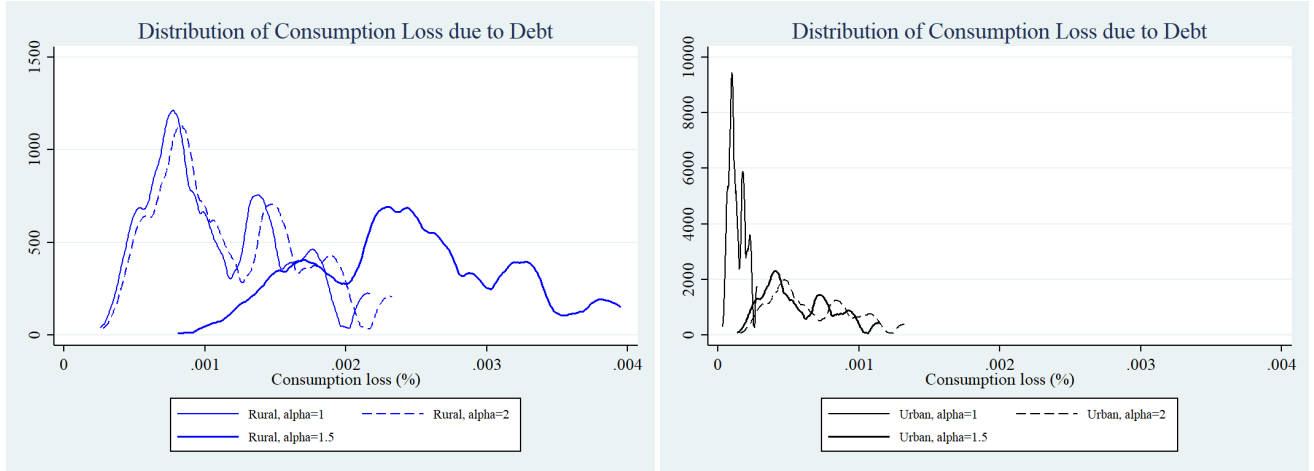| VARIABLES	life_satisfaction	life_satisfaction	CESD	CESD
		URBAN		
		$\alpha = 1$		
dlncash_saving	-0.008**	-0.007*	-0.025	-0.019
	(0.004)	(0.004)	(0.033)	(0.031)
dlndebt	-0.002	-0.002	-0.007	-0.004
	(0.003)	(0.003)	(0.022)	(0.021)
		$\alpha = 1.5$		
cl_dcash_saving	-0.025	-0.027	-0.194	-0.053
	(0.038)	(0.036)	(0.284)	(0.328)
cl_ddebt	-0.005	-0.009	-0.045	-0.025
	(0.013)	(0.013)	(0.076)	(0.080)
		$\alpha = 2$		
cl_dcash_saving	-0.017	-0.017	-0.142	-0.080
	(0.021)	(0.021)	(0.180)	(0.212)
cl_ddebt	-0.000	-0.002	0.010	0.039
	(0.004)	(0.004)	(0.041)	(0.042)
		RURAL		
		$\alpha = 1$		
dlncash_saving	-0.003	-0.003	-0.046***	-0.033**
	(0.002)	(0.002)	(0.015)	(0.015)
dlndebt	0.002	0.002	0.032**	0.032**
	(0.002)	(0.002)	(0.014)	(0.013)
		$\alpha = 1.5$		
cl_dcash_saving	-0.025*	-0.028**	-0.346***	-0.274**
	(0.014)	(0.014)	(0.113)	(0.114)
cl_ddebt	0.020***	0.015**	0.137***	0.166***
	(0.007)	(0.007)	(0.049)	(0.050)
		$\alpha = 2$		
cl_dcash_saving	-0.009	-0.010	-0.155**	-0.117*
	(0.008)	(0.008)	(0.065)	(0.064)
cl_ddebt	0.011***	0.010***	0.044**	0.070***
	(0.002)	(0.002)	(0.018)	(0.019)
Controls		✓		✓
Wave and city FE	✓	✓	✓	✓

Figure 7: Consumption loss due to the use of borrowing (debt) to cope with health shocks:
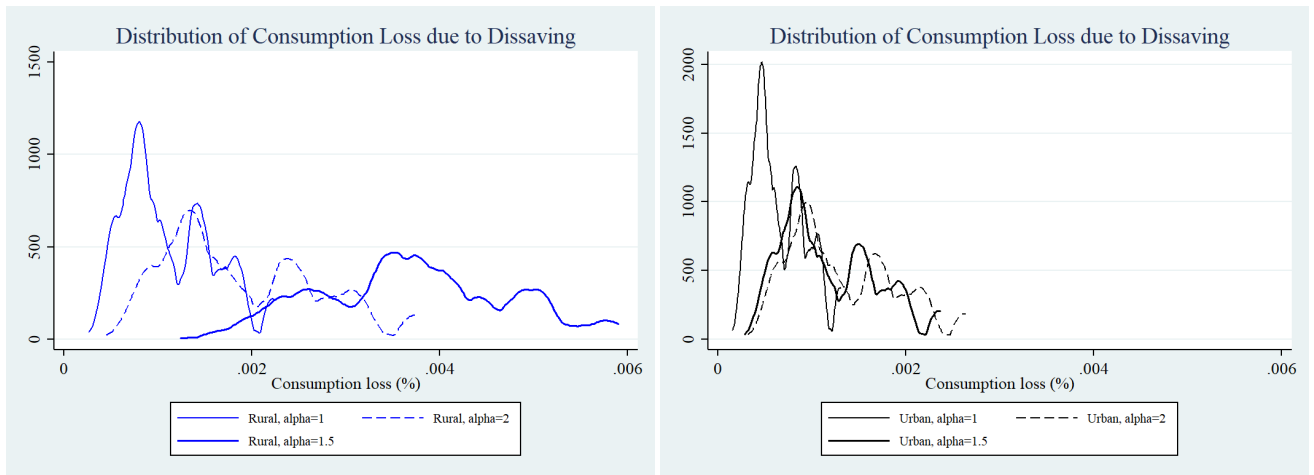Rural (left) vs. urban (right)

Figure 8: Consumption loss due to the use of dissaving to cope with health shocks:
Rural (left) vs. urban (right)

Using the formula of Chetty and Looney under the DRRA utility, $\Delta W = \gamma \Delta c/c = \gamma(1 - \frac{\theta+a}{1+a})$, where $\theta = -\eta_1^{-1/\alpha}$ or $--\eta_2^{-1/\alpha}$. we can quantify overall welfare loss arising from borrowing (debt) and dissaving. The computation results are reported in Figure 9. We can observe that overall welfare loss has been more salient among urban residents and for the use of dissaving as risk
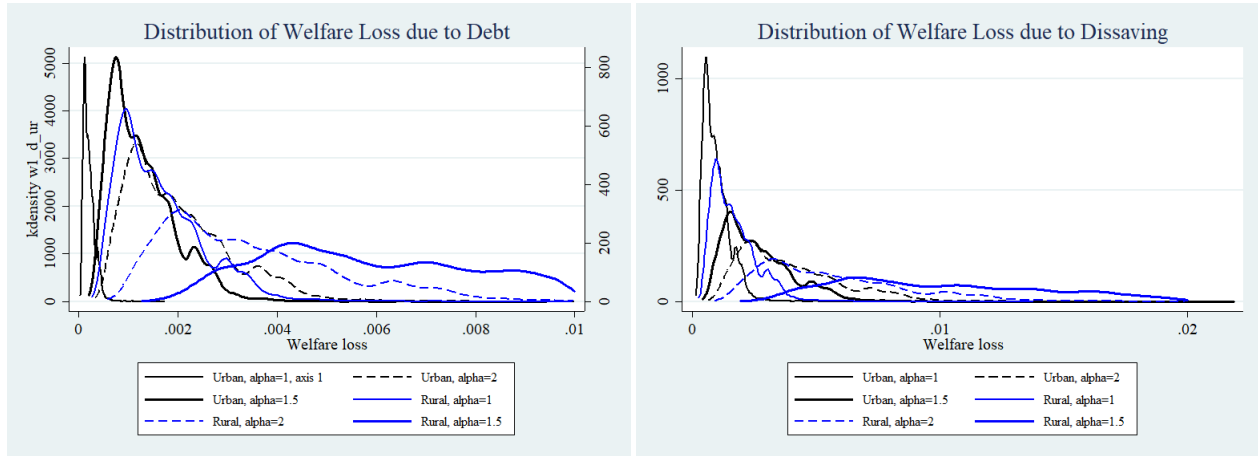
coping measures.

Figure 9: Welfare loss due to the use of debt (left) and dissavings (right) to cope with health shocks

6 Concluding Remarks

In this paper, using four waves of China Health and Retirement Longitudinal Study (CHARLS) panel data, we examine effectiveness of market and non-market insurance mechanisms for the elderly in China. There are three key messages from our empirical findings. First, we found reasonable consumption smoothing against health shocks: The conventional tests supports full consumption insurance across time and individuals for essential consumption items by our data. Second, the coping measures used by the individuals are associated with mental stress outcomes. Third, our results show the welfare costs of weathering health shocks are not necessarily small especially in rural areas because of the use of high-cost risk coping measures of borrowing and dissaving. This suggests that strengthened social safety nets can be welfare enhancing even when consumption is not very sensitive to shocks.

It would be worth noting that We also found new evidence of heterogeneity in insurance mech-

anisms: while urban residents enjoy better living standard and earn higher income, they are less risk avers than their rural counterparts, leading to less welfare gains from strengthened social insurance programs. This provides important policy implications that special attention should be paid to rural and low-income people since they are more vulnerable with a higher risk aversion parameter, making them suffer much more to achieve consumption smoothing by high-cost coping meausres.

Reference) To be added