Richer and healthier? Social pension and unhealthy behavior in China

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Richer and healthier? Social pensions and unhealthy consumption behaviour in China

Abstract

The unintended impact of social pensions on unhealthy consumption behaviours with consideration of life course utility has not been well studied. Based on a life course utility model that incorporate healthy and unhealthy, short run and long run consumption behavior of consumers, this study examines the impact of social pensions on smoking behaviours of the rural elderly and its underlying channels. Using China's New Rural Pension Scheme (NRPS) as a policy experiment, our empirical identification rests on nonparametric fuzzy regression discontinuity to address the endogeneity problem of receiving a pension. The data used in this study are from the China Health and Retirement Longitudinal Study, covering the four waves of 2011, 2013, 2015 and 2018. Overall, the results indicate that receiving a pension decreases the probability of smoking and the number of cigarettes smoked. We show that the most important channel is the increase in income following the pension transfer that make consumers value more the future utility, instead of substituting smoking by food, which is healthier. The positive health impact of social pension is more salient for elderly individuals who are relatively poor or who have a longer life expectancy.

Keywords: Social pensions; unhealthy consumption; nonparametric fuzzy regression discontinuity

1. Introduction

The impact of income shock on health is arousing extensive and continuous attention in the literature, because of the importance of this issue for the economy or and development of human capital (Acemoglu et al. 2013; Adda et al. 2009). Social pensions as an exogenous income shock for the elderly, fuel a long-running and controversial debate concerning their intended effects on social welfare or unintended effects on receivers' behaviour (Cuong 2021; Huang and Zhang 2021; Wilcox 1989). In the majority of high-income and middle-income countries, social pensions serve as the most important policy portfolio and target the elderly through additional income transfers (Dave et al. 2008; Nishiyama 2019; Wilcox 1989). Ideally, an increase in income means that individuals can afford healthier goods and services and enjoy more leisure activities, thus enhancing the overall welfare of individuals and their families (Duflo 2000; Huang and Zhang 2021; Nikolov and Adelman 2019; Ning et al. 2016). Yet, pension incomes might also have unintended effects that deviate from the original purpose of the policy design if they induce the engagement in and persistence of unhealthy behaviours, such as cigarette smoking (Apouey and Clark 2014). While much evidence focuses on the direct and intended effects of income shock, relatively little attention has been paid to its unintended effects.

Existing theory has provided various explanations for the causal relationship between income shock and unhealthy behaviour. According to the permanent income hypothesis, permanent and positive income transfers can relax budget constraints, allowing people to adjust their consumption behaviour (Browning and Collado 2001; Meng 2003; Zheng and Zhong 2016). For example, when income constraints play a pivotal role in consumption decisions, especially for those with low incomes, positive income shocks may also promote the consumption of unhealthy goods, resulting in worse and unpredictable health statuses. However, as highlighted in the *lifetime utility theory* of Binkley (2010), consumers who expect to have high incomes throughout their lifetimes tend to restrain from unhealthy behaviours that put their future survival at risk. Moreover, consumers with longer life expectancy may substitute more unhealthy consumption with healthy goods. Therefore, it would be premature to infer causation from positive income shock to unhealthy behaviour solely based on the aforementioned empirical regularity. In the context of social pension, that deems to improve the wellbeing of the eligible elderly, questions arise regarding whether the policy can lead to unintended unhealthy outcome and how the effect may differ across elderly with heterogeneous characteristics.

The objective of this paper is to investigate the unintended causal effect of social pensions on unhealthy consumption behaviour and to reveal the potential channels, with a particular focus on the elderly who are poorer and those who are more vulnerable to income shocks. We extend the lifetime utility theory to unify four effects, namely, the life-expectation effect, direct income effect, budget allocation effect and substitution effect, which are widely discussed in the literature but under separate settings (Hughes 1978; Binkley 2010; French et al. 2019). We show how the impact of an income shock on unhealthy consumption may vary across consumers who differ in terms of life expectancies

and income levels. Following the theoretical framework, we empirically estimate the causal effect and reveal the channels of social pensions on the unhealthy consumption behaviour of smoking.

The context of the New Rural Pension Scheme (NRPS) in China serves as a quasi-natural experiment for examining the consequences of positive and permanent income shocks on unhealthy behaviour, as it is an unprecedented welfare programme covering the largest population in human history (Huang and Zhang 2021). Our empirical estimations rely on nonparametric fuzzy regression discontinuity (RD) to address the endogeneity of receiving a pension. The data used in this study are from the China Health and Retirement Longitudinal Study (CHARLS), covering the four waves of 2011, 2013, 2015 and 2018. Overall, the results indicate that receiving a pension significantly decreases the probability of smoking among the elderly. In particular, for smokers' cigarette consumption has been reduced by nearly five cigarettes per day. Our results also suggest that the quality of cigarette consumption has improved. We show that the most important channel is the increase in income following the pension transfer that make consumers value more the future utility, instead of substituting smoking by food, which is healthier. In addition, the heterogenous analysis suggests that the positive health impact of social pensions is more salient for elderly individuals who are relatively poor or who have a longer life expectancy. These findings provide new evidence of the positive health impacts of social pensions for the rural old consumers in developing countires who are more volunerable in health and more sensitive to income shock.

The contribution of this study is fourfold. First, we contribute to the extensive discussion on the health effect of income shock by theoretically and empirically examining the causal effect of pension receiving on cigarette consumption behaviours. The challenge in empirically estimating the effect of positive income shocks on consumption is endogeneity due to reverse causality and omitted variables (Adda et al. 2009; Acemoglu et al. 2013; Lenhart 2019). For instance, reverse causality arises because poor consumption behaviours may also affect current and future incomes (e.g. Auld, 2005), while omitted variable bias occurs because it is difficult to control confounding factors, such as genetics and ability, which determine both income and consumption behaviours (Adda et al. 2009). We apply a nonparametric fuzzy RD by using eligible age as a source of exogenous variation in rural pension attainment. By this means, we can account for the endogeneity of obtaining a pension and derive the causal effect of this policy.

Second, this study contributes to the existing literature by identifying the heterogeneous effect of income shock on unhealthy consumption behaviours with respect to income distribution as budget constraints could play a significant role in unhealthy consumption, especially for the lower-income elderly. Additional income may result in a higher unintended effect for those with low incomes by enabling them to consume more unhealthy products, especially when the income change accounts for a larger proportion of the total budget or when the cost of adjusting one's consumption is trivial (Browning and Collado 2001; Jappelli and Pistaferri 2010). While the existing literature mainly

focuses on gender-specific effects (e.g. Schatz et al. 2012) or regional specific effects (e.g. Shu 2018), we focus on the elderly and find that the poorer elderly reduces their cigarette consumption more than the richer group following the positive income shock analysed. This result thus justifies the Chinese social pension programme, not only because of the positive role it playes in terms of increasing the elderly's income but also because of the associated effect on the aforementioned disadvantaged group's healthy consumption behaviour.

Third, this study speaks to the long-standing debate about the implications of expected lifetime for consumption behaviour by focusing on the heterogeneous effect of pension income on life expectancy. It suggests that one's expected lifetime may potentially affect one's consumption decision making (Browning and Crossley 2001). Evidence from the lifetime utility function indicates that elderly individuals with lower life expectancy prefer life to be short and sweet; thus, they like to spend more on consumption and purchase more unhealthy goods (Hughes 1978). Theoretically, elderly individuals with longer life expectancy are expected to care more about the future, save more and consume fewer unhealthy goods. Given the fact that little empirical research has directly examined whether and to what extent life expectancy may adjust consumer behaviour in a causal context, our study serves as a preliminary attempt to show the importance of life expectancy in terms of understanding the health effects of an income shock.

Finally, we also contribute to a better understanding of the channels through which the rural pension can affect the unhealthy consumption behaviour of smoking. The theory identifies two channels through which social pensions may reduce cigarette consumption: 1) by directly increasing income for consumers valuing more the future utility, i.e. the direct income effect and 2) by substituting cigarette consumption with that of healthy food, i.e. the substitution effect. As far as the direct income effect is concerned, the existing literature, however, reveals an ambiguous result as to whether social pensions can increase income, mainly because they may crowd out transfers from offspring (Nikolov and Adelman 2019). However, our empirical results show a positive relationship between social pensions and transferred income increases, hence justifying the direct income effect. As far as the substitution effect is concerned, empirical evidence has demonstrated that the elderly may be more positive with regard to the future and allocate higher budgets for their expenditure on food and services (Chen 2017; Huang and Zhang 2021; Zheng and Zhong 2016). Our results complements these works by investigating the budget allocation to unhealthy consumption. We find that following the pension reform, the number of cigarettes consumed has decreased while food expenditure hexibits no significant changes, suggesting the substitution effect does not exist in relation to the pensiont ransfer.

The rest of the paper is organized as follows. Section 2 introduces the institutional background of the rural pension programme in China and related literature. Section 3 presents the theoretical framework. Section 4 introduces our empirical models and the data used in the estimations. Section 5 provides a detailed discussion of empirical results. Finally, Section 6 offers concluding remarks.

2. The context of the rural pension programme in China

With the establishment of the People's Republic of China in 1949, China's first formal pension system was introduced in 1951, which was characterized as an enterprise-based, pay-as-you-go benefit scheme exclusively for state employees, civilians and the military. At this time, rural people did not have pensions and heavily depended on the low-level rural economic collective system for employment and income, and old age support was jointly provided by the collective (at the village level) and the family. In 1986, China introduced a rural pension scheme, which is often referred to as the Old Rural Pension Scheme, by first piloting the rollout among rural residents before expanding it to achieve wider coverage. This scheme was financed primarily through the personal contributions of rural participants and without subsidies from the central or local government. As a result, the programme had a poor enrolment rate and did not last for long (Ding 2017; Nikolov and Adelman 2019), because of unstable income sources, low savings and heavy reliance on family support in rural China (Cai et al. 2012; Cheng et al. 2018a; Lei et al. 2015; Zheng and Zhong 2016).

In July 2009, the government unveiled the "New Rural Pension Scheme" (NRPS) as a means of offering a basic social safety net to rural residents. The stylized facts of the NRPS define it as a voluntary risk-pooling pension programme that targets major rural residents by offering reimbursement at the cut-off age of 60. Following the broad pattern of economic and social reform in China, the system was first introduced in the pilot projects of 10% of the counties and then extended on an incremental, county-by-county basis. Buoyed by the success in the pilot counties, all 2,844 county-level administrative districts had launched the NRPS by the end of August 2012. Different from the old pilot schemes, the NRPS is heavily subsidized by the government. The programme is administered at the county level. County governments are given significant flexibility in many aspects of the design and management of their NRPS programmes, and hence, the schemes vary widely by locale.

The source of the pension for enrolees over 60 years old comes from an individual account and social pooling account. The individual account is composed of individual payments and subsidies from the government and collective, which are distributed over 139 months. The social pooling account is supported by government financial funds. The minimum payment standard stipulated by the country is 55 *yuan*/person/month and counties everywhere can adjust their standard according to the levels of economic development and institutional capacities. Once a county is covered, all enrolees aged 60 or over receive a fixed pension of 55 yuan per month (i.e. about $9 US or 15% of the median of the household income per capita in rural areas by the end of 2009) without any prepayments and their children who meet the requirements of the NRPS need to participate in it.[1]

[1]For those younger than 60 years old, the payments were categorized into five groups spanning 100–500 *yuan*/year, each with a range of 100 yuan. The pension received after an individual turns 60 years old heavily depends on

From 2014 onwards, China's government unified the NRPS with the Social Pension System for urban residents. When enrollees reach the age of 60, they are entitled to receive the pension, which is directly wired to their individual bank accounts monthly. The NRPS is based on public transfer payments (Huang and Zhang, 2021). According to the official statistics, NRPS pensioners received a basic monthly pension of, on average, 78.6 yuan in March 2013, which may not be adequate to cover all their living costs but can help to pay for their basic necessities (Cheng et al. 2018b). In 2019, 254 million people were aged over 60, accounting for 18.1% of China's total population; more than 60% of them lived in rural areas.[2] Statistics from the Ministry of Human Resources and Social Security show that NRPS programmes were available to nearly 532 million rural residents by the end of 2019, and that those over the age of 60/61 years old received the pension.[3]

The primary concern of existing literature on the NRPS is its intended economic and welfare impact. For instance, studies suggest that pension income has reduced rural elders' dependence on support from their adult children (Cheng et al. 2018b; Li et al. 2018) increased their capacity to live independently (Chen 2017; Cheng et al. 2018a), decreased their farm work (Li et al. 2018) and improved their subjective well-being (Ding 2017). However, there is a lack of studies on the unintended effects of the NRPS, especially from the perspective of consumption behaviours and taking lifetime utility into consideration.

3. Theoretical framework

We follow Binkley (2010) in assuming that the "lifetime" utility of a representative consumer is composed of a present utility and a future utility. As an extension, we introduce a normal good as a substitute for an unhealthy good so that the present utility is represented by $U(x,z) = \alpha \ln x + (1-\alpha)\ln z$, where x is the consumption quantity of the unhealthy good, and z is a representative normal good with its price normalized to 1. $\alpha \in [0,1]$ captures the degree of substitution between the unhealthy and normal goods. It also reflects the relative expenditure that the consumer intends to allocate to these two goods.[4] The future utility $V(I)$ depends on the future expected income, which is proportionate to the current income available for consumption I. As is discussed in Binkley (2010), the expected future income increases with the current income, either because of causality, such as the income resulting from current savings, or simply due to both being

one's payments. Enrollees in the age cohort of 45–59 need to pay an overdue fee, and the accumulative payment time cannot exceed 15 years. Enrollees under 45 years of age are able to voluntarily enrol, and the accumulative payment time can exceed 15 years.

[2] https://apps.who.int/iris/bitstream/handle/10665/194271/9789245509318-chi.pdf;jsessionid=53E6B9417D6474E6531E30AC603DA78E?sequence=5, accessed on 15 December, 2021.

[3] http://www.mohrss.gov.cn/wap/fw/rssj/202006/W020200608534647988832.pdf, accessed on 15 December, 2021.

[4] Without taking into account the future utility, the nature of the log-linear utility function suggests that the consumer allocates α proportion of the income to the consumption of the unhealthy good and $1-\alpha$ to that of the normal good. If the long-term effect is taken into account, from the first-order condition of problem (1), the relative expenditure on the healthy and normal goods is $\frac{px}{z} = \frac{\alpha - x\delta P'(x)V(I)}{1-\alpha}$, which also increases with α.

functions of the same factors. $V' > 0$ implies that the future utility increases with the future income. While the consumption of unhealthy products increases the current utility, it decreases the likelihood that the consumer will be alive in the future. Let $P(x)$ $(P' < 0)$ be the survival probability and δ be the discount factor. The consumer solves the following problem:

$$\max_{x,z} U(x,z) + \delta P(x)V(I)$$

$$s.t.\, p\, x + z \leq I \tag{1}$$

The Lagrangian function is written as $= \alpha \ln x + (1-\alpha)\ln z + \delta P(x)V(I) + \lambda(I - px - z)$, where λ is the Lagrangian multiplier capturing the direct income effect on the lifetime utility (i.e. $\lambda = \frac{\partial L}{\partial I}$). When the budget constraint is binding, $z = I - px$, so the first-order condition is derived as follows:

$$L_x(x;I) = \frac{\alpha}{x} - \frac{1-\alpha}{I-px}p + \delta P'(x)V(I) = 0 \tag{2}$$

To ensure the convexity of the problem, it must be $L_{xx} \equiv \frac{\partial^2 L}{\partial x^2} = -\frac{\alpha}{x^2} - \frac{(1-\alpha)p^2}{(I-px)^2} + \delta P''(x)V(I) < 0$. The first-order condition gives the demand for the unhealthy product, which can be represented as a function of income, $X(I)$, and that for the normal good, $Z(I) = 1 - pX(I)$. From the implicit function theorem, we derive the impact of a change in the current income I on the demand for the unhealthy product:

$$\frac{\partial X}{\partial I} = -\frac{L_{xI}}{L_{xx}} = sign(L_{xI}) = sign\left(\underbrace{\frac{(1-\alpha)p}{(I-px)^2}}_{>0} + \underbrace{\delta P'(x)V'}_{<0}\right), \tag{3}$$

where $L_{xI} \equiv \frac{\partial^2 L}{\partial x \partial I}$ is derived from condition (2). As is stated in Binkley (2010), an increase in income has two opposite effects: 1) it increases the utility of the short-term consumption, including the unhealthy product (captured by $\frac{(1-\alpha)p}{(I-px)^2} > 0$),[5] but 2) it decreases the future expected utility by reducing the survival rate ($\delta P'(x)V' < 0$). Therefore, the overall effect is ambiguous. Whether getting richer makes consumers purchase more healthily hinges on the trade-off between the short-term utility gain from unhealthy consumption and the long-term health concerns.

Intuitively, the overall effect depends on the consumer's life expectation (Hughes 1978), which can be captured by δ. From condition (3), if the consumer cares more about the future, the income effect

[5] More generally, the income effect on the marginal utility of the unhealthy good consumption is derived as $\frac{\partial^2 L}{\partial x \partial I} = \delta P'(x)V'(I) - \frac{\partial \lambda}{\partial I}p$, where $\frac{\partial \lambda}{\partial I} < 0$, suggesting that an increase in income relaxes the budget constraints and hence allows for the consumption of more goods. In our setting, $\lambda = \frac{\partial U}{\partial z} = \frac{1-\alpha}{z} = \frac{1-\alpha}{I-px}$. Thus, the positive income effect is $-\frac{\partial \lambda}{\partial I}p = \frac{(1-\alpha)p}{(I-px)^2} > 0$.

tends to be negative, leading to healthier consumption. We denote this the life expectation effect, which can be summarized by the following proposition:

Proposition 1 (**Life expectation effect):** A positive income shock is more likely to decrease the consumption of the unhealthy good for a consumer with longer life expectancy, i.e. $\frac{\partial^2 X}{\partial I \partial \delta} < 0$.

Proof: From condition (3), we obtain

$$\frac{\partial^2 X}{\partial I \partial \delta} = \frac{-L_{xI\delta} L_{xx} + L_{xI} L_{xx\delta}}{(L_{xx})^2} = sign\left(P'V'\left(\frac{\alpha}{x} + (1-\alpha)\left(\frac{p}{I-px}\right)^2\right) + \frac{P''V(1-\alpha)p}{(I-px)^2}\right) < 0, \quad (4)$$

where $L_{xI\delta} \equiv \frac{\partial L_{xI}}{\partial \delta}$ and $L_{xx\delta} \equiv \frac{\partial L_{xx}}{\partial \delta}$. The negativity holds true for a not too convex $P(x)$. It follows that consumers with a high level of δ will be affected more (or less) if $\frac{\partial X}{\partial I} < 0$ (or $\frac{\partial X}{\partial I} > 0$).

Q.E.D.

The income effect also depends on consumers' poverty levels. From condition (3), the positive effect $\frac{(1-\alpha)p}{(I-px)^2}$ is affected by the consumer's income level I. Proposition 2 summarizes the income effect for consumers with different income levels.

Proposition 2 (**Direct income effect):** Following a positive income shock, if the demand for the unhealthy good is reduced, the reduction is larger for higher-income consumers, i.e. if $\frac{\partial X}{\partial I} < 0$, then $\frac{\partial^2 X}{\partial I^2} < 0$.

Proof: From condition (3), it can be derived that $\frac{\partial^2 X}{\partial I^2} = \frac{-L_{xII} L_{xx} + L_{xI} L_{xxI}}{(L_{xx})^2}$, where $L_{xII} = -\frac{2(1-\alpha)p}{z^3} + \delta P'(x)V''(I) < 0$ for a not too concave $V(I)$ and $L_{xxI} = \frac{2(1-\alpha)p^2}{z^3} + \delta P''(x)V(I) > 0$ for a not too concave $P(x)$. Therefore, if the income effect is negative, i.e. $L_{xI} < 0$, we obtain $\frac{\partial^2 X}{\partial I^2} < 0$, suggesting that the negative income impact is strengthened for consumers with a higher income level.

Q.E.D.

Proposition 2 suggests that if a positive income shock leads to healthy consumption, richer consumers behave even healthier than poorer ones by reducing their consumption of the unhealthy good to a greater extent. This intuition mainly stems from the fact that the short-run satisfaction from consuming additional unhealthy goods is smaller for richer individuals than for poorer ones. Therefore, the long-term health concerns, i.e. the effect on future expected utility, are more likely to dominate the short-run unhealthy effect for richer consumers.

Another view of consumers' poverty heterogeneity may lie in the relative preference for unhealthy and normal goods. It is well documented in the literature that poor consumers tend to allocate a higher

budget to unhealthy goods compared to the rich (French et al. 2019). This argument, linked to our setting, implies that α in terms of the utility of poor consumers is larger than that of rich consumers. It follows that an income shock may lead to a bigger impact on poor consumers. We denote this as the budget allocation effect, which is summarized in Proposition 3:

Proposition 3 (Budget allocation effect): Following a positive income shock, if the demand for the unhealthy good is reduced, the decline is larger for consumers with relatively higher expenditure on the unhealthy good, i.e. if $\frac{\partial X}{\partial I} < 0$ and $px > z$, then $\frac{\partial^2 X}{\partial I \partial \alpha} < 0$.

Proof: From condition (3), it can be derived that $\frac{\partial^2 X}{\partial I \partial \alpha} = \frac{-L_{xI\alpha} L_{xx} + L_{xI} L_{xx\alpha}}{(L_{xx})^2}$, where $L_{xI\alpha} = -\frac{p}{z^2} < 0$, $L_{xx\alpha} = -\frac{1}{x^2} + \frac{p^2}{z^2} = \frac{1}{x^2}\left(\left(\frac{px}{z}\right)^2 - 1\right) > 0$ if $px > z$. Therefore, if $L_{xI} < 0$, providing that $L_{xx} < 0$, we obtain $\frac{\partial^2 X}{\partial I \partial \alpha} < 0$, suggesting that the negative income impact is strengthened for consumers with a higher level of α. It should be noted that $px > z$ is a sufficient but not necessary condition for $\frac{\partial^2 X}{\partial I \partial \alpha} < 0$. It suffices that the budget for the unhealthy good is large enough to ensure $\frac{\partial^2 X}{\partial I \partial \alpha} < 0$.

Q.E.D.

Proposition 3 suggests that from the consumption habit perspective, if poor consumers are used to allocating more of their income to unhealthy goods, they tend to reduce their expenditure on unhealthy goods consumption more than richer consumers following positive income transfers. An explanation for this result is that if a consumer already spends a lot more on unhealthy goods compared to normal goods, the additional consumption of unhealthy goods will not bring much satisfaction but instead entail disutility in the future. Therefore, following a positive income shock, such a consumer tends to allocate the income to normal good consumption, which generates a higher marginal utility.

As a consequence of Proposition 3, consumers tend to substitute unhealthy goods with healthier goods. Corollary 1 summarizes this substitution effect:

Corollary 1 (Substitution effect): Following a positive income shock, if demand for the unhealthy good is reduced, expenditure on the normal good will rise, and the increase will be higher for consumers who are used to spending more on the unhealthy good, i.e. if $\frac{\partial X}{\partial I} < 0$, then $\frac{\partial z}{\partial I} > 0$ and $\frac{\partial^2 Z}{\partial I \partial \alpha} > 0$.

Proof: The result is directly derived from $\frac{\partial z}{\partial I} = \frac{\partial (I - px)}{\partial I} = 1 - p\frac{\partial x}{\partial I} > 0$ if $\frac{\partial x}{\partial I} < 0$. Moreover, if $\frac{\partial^2 x}{\partial I \partial \alpha} < 0$, we obtain $\frac{\partial^2 z}{\partial I \partial \alpha} = -p\frac{\partial^2 x}{\partial I \partial \alpha} > 0$.

Q.E.D.

To sum up, getting rich does not necessarily induce consumers to reduce their unhealthy consumption as this depends on their long-run perspectives and actual income levels, as well as their consumption habits. In particular, Propositions 2 and 3 suggest that the impact of poverty on the income effects may exhibit very different results, depending on how we interpret poverty. In what follows, we shall test the theory in the context of the NRPS in China.

4. Empirical models and data

4.1 Empirical models

To evaluate the unintended impact of the NRPS, the endogeneity problem of the NRPS resulting from self-selection needs to be considered, since programme participation is voluntary and the outcomes of individuals cannot be observed if they have not participated in the programme. Unobserved individual characteristics could be the confounding factors that determine the probability of participation in the NRPS and affect one's unhealthy consumption behaviours. That is, participation in the NRPS is endogenous, and simply including it as an explanatory variable could cause biased estimations. The age criteria for social pensions are not very strict. Since the NRPS is a voluntary programme, some people aged 60 or above do not receive a social pension, suggesting non-trivial non-compliance among NRPS participants. This suggests that the NRPS satisfies the fuzzy regression discontinuity (RD) design, in which whether or not an individual is aged over 60 serves as an instrument for NRPS enrolment (Huang and Zhang 2021; Ning et al. 2016; Shu 2018). As argued by Ning et al. (2016), the attractiveness of such designs mainly relies upon their similarity with a formal randomized experiment and the consequent perception that the identifying assumptions are relatively weak and plausibly hold true in many circumstances.

Suppose P_i is no longer a deterministic function of the threshold and there is a jump in the probability of being treated at x_0:

$$\mathrm{P}(P_i = 1|x_i) = \begin{cases} g_1(x_i), & x_i \geq x_0 \\ g_0(x_i), & x_i < x_0 \end{cases}, \quad \text{where } g_1(x_0) \neq g_0(x_0) \tag{5}$$

Here, P_i is a binary variable that is equal to 1 if the household of individual *i* receives any kind of pension and 0 otherwise. x_i is a binary variable that is equal to 1 if the household of individual *i* is at or above the eligible age to qualify to receive the pension and 0 otherwise. When equation (5) is satisfied, the causal effect of the pension on the outcome variables can be expressed in the form of the fuzzy RD:

$$Y_i = \alpha + \beta P_i + f(x_i) + \varepsilon_i, \tag{6}$$

where $f(x_i)$ is a polynomial function of the assignment variable, age in our case. The control variables include individual characteristics, such as marital status and gender. In the fuzzy RD, we are interested in the Local average treatment effect (LATE), and τ_{FRD} is defined as follows:

$$\tau_{FRD} = \frac{\lim_{\varepsilon \downarrow 0} E(Y_i | age_i = 60.25 + \varepsilon) - \lim_{\varepsilon \uparrow 0} E(Y_i | age_i = 60.25 + \varepsilon)}{\lim_{\varepsilon \downarrow 0} E(D_i | age_i = 60.25 + \varepsilon) - \lim_{\varepsilon \uparrow 0} E(D_i | age_i = 60.25 + \varepsilon)} \quad (7)$$

τ_{FRD} can be estimated parametrically or nonparametrically (Imbens and Lemieux, 2008). In this study, we reported the results using nonparametric estimation. Gelman and Imbens (2019) showed that the parametric RD approach, which uses a polynomial function of the running variable as a control in the regression, tends to generate RD estimates that are sensitive to the order of the polynomial and have some other undesirable statistical properties. However, we present a series of additional robustness checks, including estimating nonparametric RD in different bandwidth and parametric RD estimations. Following Calonico et al. (2014) and adopting alternative bandwidth selectors, we also use the bias-corrected results to correct for the possible bias caused by the potential misspecification of the local linear regression with the limited sample size.

4.2 Data

4.2.1 Sampling

The main dataset used in this study was obtained from the CHARLS. This survey aims to collect a high-quality nationally representative sample of Chinese residents aged 45 and older to serve the needs of scientific research on the elderly. The baseline national wave of the CHARLS was fielded in 2011. The individuals are followed up on every two years. This study used the 2011, 2013,2015 and 2018 waves. In the baseline survey, the sample was drawn in four stages. County-level units (counties or urban districts) were sampled directly. All the county-level units in all the provinces except for Tibet were stratified by eight regions, based on whether they were urban districts or rural counties and on each county's Gross Domestic Product (GDP). After the county units were chosen, the National Bureau of Statistics helped the CHARLS team to sample villages and communities within the county units using recently updated village-level population data. The CHARLS sample used administrative villages in rural areas and neighbourhoods, which comprise one or more formal resident committees, in urban areas as primary sampling units (PSUs). The CHARLS then sampled three PSUs within each county-level unit, using probability proportional to size (PPS) sampling, for a total of 450 PSUs. In each PSU, the CHARLS team constructed a sampling frame using Google Earth base maps, and a CAPI (computer-assisted personal interview) program was then used to sample households and to conduct the interviews using laptops.[6] All age-eligible sample households who were willing to participate in the survey were interviewed. The final sample consists of 45,585 individuals from 29,184 households in 1,641 communities.

[6] The CHARLS is harmonized with the Health and Retirement Study (HRS), the English Longitudinal Study of Aging (ELSA), and the Survey of Health, Aging and Retirement in Europe (SHARE). For more details, see https://charls.charlsdata.com/pages/Data/2011-charls-wave1/zh-cn.html, accessed on 15 December, 2021.

4.2.2 Normalized age and pension

The running variable is the age that is constructed from information about one's birth year and month, and the treatment variable is whether the enrollee receives the pension. The CHARLS survey designed a block of questions to measure one's NRPS programme participation. Specifically, respondents were asked, "*Do you receive the New Rural Social Pension Insurance programme?*" Also, respondents were asked to report the timing of their NRPS benefits, as well as the monthly benefit amount (reported in *yuan*). Since the NRPS is a voluntary programme, non-participants were identified as eligible individuals who choose not to participate in the pension programme. The variation in participation could be due to supply, as the NRPS was developed county by county, which presents the temporally and geographically staggered variation in participation; this suggests that participation in the NRPS is not selective sorting. As presented in Table 1, of the eligible individuals (age $\geq$ 60), approximately 68.8% of the respondents participated in the NRPS programme, and the average pension received was $14.78 US (93.948 *yuan*).[7] The table reveals an increasing trend in the participation rate and pensions received over the survey years. Finally, the sample covers all the elderly in the age range of 50.25–70.25, as shown in Table 2; approximately 32% of the elderly had participated in the NRPS. Figure 1 shows a clear jump in the proportion of those receiving a pension from the age of 60.25, suggesting that the RD design of the study is proper.

Table 1. To be inserted here

Figure 1. To be inserted here

4.2.3 Outcome variables

Our main dependent variables are a set of variables concerning elderly individuals' cigarette consumption. The respondents were asked if they had ever smoked. If the answer was "Yes", they were asked the following questions: "*On average, how many cigarettes do you consume per day?*" "*How much do the cigarettes you smoke cost per pack (in yuan)?*" and *"How much do you spend on cigarette consumption per day (in yuan)?*" Based on these questions, we were able to obtain the variables to describe the smoking behaviours of the rural elderly, including whether they smoked (0/1), the number of cigarettes smoked per day, the price of cigarettes per pack and expenditure on cigarette consumption. To reduce the recall bias, the key dependent variables were recorded for the week before the survey, and all the value terms were based on the 2011 inflation and constant prices for each province. On average, nearly 29.8% of our observations were smokers of 3.9 cigarettes per day, who paid 5 *yuan* for each pack and had an expenditure of about 4.4 *yuan* per day on cigarette consumption. Significant differences exist in terms of cigarette consumption between pension participants and their counterparts, except with regard to expenditure on cigarette consumption. Precisely, pension participants were shown to have lower smoking ratios and numbers of cigarettes

[7] $1 US = 6.356 *yuan* in 2021.

consumed compared to non-participants, while participants smoked more expensive cigarettes than non-participants.

4.2.4 Channel variables

The CHARLS collects sufficient information on household wealth, income and consumption. According to the theoretical framework, we propose two main channels through which the NRPS can affect unhealthy consumption behaviours: the income effect and the substitution effect. The details regarding the variables for each channel are as follows: 1) an individual's transfer income is used to investigate the income effect of receiving a pension and 2) one's total expenditure on food consumption, food expenditure and expenditure on food away from home (excluding cigarette consumption here) is considered to reflect the substitution effect of receiving a pension. The descriptive statistics of these variables are presented in Table 2. The elderly receiving a pension are shown to have significant and higher individual transfer incomes and expenditure on food than those who did not receive a pension; this finding is constant for all aspects of food expenditure.

Table 2. To be inserted here

4.2.5 Control variables

We control for predetermined variables, such as individuals gender, and whether they live with or without a partner. Fuzzy RD requires that there are no discrete changes in the predetermined variables at the cut-off age of 60; this will be discussed in Section 5.4.

5. Estimation results

In this section, we start with the presentation of the baseline results and then identify the heterogeneous effect of the NRPS on poverty status and life expectancy. Afterwards, the potential channel underlying the effect of the NRPS is examined from the perspectives of income and substitution effects. Finally, we provide a discussion on potential threats to the identification strategy of fuzzy RD.

5.1 Baseline result

Using the pooled sample, the nonparametric estimation results for the impact of the NRPS on smoking are presented in Table 3, and the results using parametric RD estimation are presented in Table A1. Since the main estimates are largely consistent, our interpretation rests on the results being nonparametric. In Table 3, we present both of the estimates from the fuzzy RD using conventional, bias-corrected and robust estimation, with robust standard errors clustered at the community level in the bandwidth of optimal bandwidth and three bandwidths of three, four and fives years. The RD plots of the outcome variables for the pooled sample are presented in Figure 2. The results suggest that, on average, receiving a pension reduces the probability of cigarette smoking by 38% and decreases the number of cigarettes smoked by 2.8 cigarettes per day, suggesting that the positive effect of income

shock on healthier consumption dominates the negative impact (identified in equation (3)). This result implies that the elderly people in China tend to place more value on their future lives than on their short-run satisfaction following the increase in income due to the NRPS. The results are largely robust regardless of which bandwidth is applied.

Table 3. To be inserted here

Figure 2. To be inserted here

Regarding the results for the smoker sample, we find that receiving a pension reduces the number of cigarettes smoked by 4.7 cigarettes per day (as shown in Figure 3), but increases the price of the cigarettes bought by 3.4 *yuan* when the bandwidth of three years is applied. Similar to the results for the pooled sample, no significant effect of receiving a pension on expenditure is observed. It should be noted that expenditure on cigarette consumption is not affected by the NRPS, suggesting that elderly smokers maintain the amount they spend on cigarette consumption but adjust their smoking behaviours to consume a lower number of more highly-priced cigarettes. Our result is contradictory to the results from Cheng et al. (2018b), which reveal that receiving a pension has no significant effect on smoking. One possible reason is that Cheng et al. (2018b) only use CHARLS data from 2011 and 2013, which might result in relatively low participation rates with regard to the NRPS. When using RD estimation, this will reduce the sample size dramatically. In our estimation, we also consider more recent waves of the survey from 2015 and 2018, which provide more observations within the band considered.

Figure 3. To be inserted here

5.2 Heterogeneous effects

Considering that the effect of receiving a pension might be highly related to the income levels and life expectancies of the rural elderly, we conduct estimations for subsamples divided based on poverty status and life expectancy.[8] Before moving on to the discussion of the estimation results, we present the descriptive statistics of cigarette consumption according to poverty status and life expectancy in Table 4. Statistically significant differences exist in terms of smoking behaviours based on both poverty status and life expectancy. Relatively poor elderly individuals are less likely to smoke and tend to smoke less compared to the non-poor, and significant difference in expenditure on cigarette consumption can be observed. Regarding life expectancy, we find that there is no significant difference in the ratio and number of cigarettes consumed, but significant disparities are observed with

[8] The question used in the survey was as follows (see table A3). Suppose there are 5 steps, where the lowest step represents the smallest chance and the highest step denotes the biggest chance of living, which step do you think depicts your chance of reaching the age of X? (If the age of the respondent is lower than 65, X = 75; If the age of the respondent is between 65 and 69, X = 80; If the age of the respondent is between 70 and 74, X = 85; If the age of the respondent is between 75 and 79, X = 90; If the age of the respondent is between 80 and 84, X = 95; If the age of the respondent is between 85 and 89, X = 100; If the age of the respondent is between 90 and 94, X = 105; If the age of the respondent is between 95 and 99, X = 110; If the age of the respondent is higher than 100, X = 115). If the respondent answered "Almost impossible", we identify them as having a low life expectancy, and otherwise we identify them as having a long life expectancy.

regard to cigarette prices and expenditure. Elderly Individuals who have longer life expectancies tend to smoke cigarettes with higher prices and have higher expenditures. To further examine whether these significant differences are driven by receiving a pension, the RD estimation method is applied to subsamples classified by poverty status and life expectancy.

Table 4. To be inserted here

5.2.1 Heterogeneous effects based on poverty status

As shown in Table 5, we observe significantly heterogeneous effects of receiving a pension based on poverty status. Receiving a pension has significantly reduced effect on the smoking ratio and the number of cigarettes consumed by both poor and non-poor individuals. The poor elderly reduced their consumption by nearly five cigarettes per day and the non-poor elderly by almost four cigarettes per day because of pension income, suggesting the poor experience a larger reduction than the non-poor. Similar to the evidence in Table 3, we find that receiving a pension increases the price of cigarettes consumed by the non-poor, while this result does not hold true for the poor. In addition, it indicates that there is a significant effect of receiving a pension on expenditure on cigarette consumption for the poor samples. One possible reason could be that for the poor elderly, the pension income accounts for a higher proportion of their total income than for the richer elderly; thus, their smoking behaviours are likely to be changed to a larger degree. The poor elderly spend less on cigarette consumption by consuming fewer cigarettes, and the non-poor elderly maintain the amount they spend on cigarette consumption but adjust their smoking behaviours by consuming fewer, and more highly-priced cigarettes. Thus, to some extent, we can conclude that the poor elderly can benefit more from the NRPS in terms of reducing their cigarette consumption.

Table 5. To be inserted here

5.2.2 Heterogeneous effects based on life expectancy

Regarding life expectancy, as discussed in our theoretical framework, the elderly with a longer life expectancy tend to have a higher future utility; thus, they significantly decrease their unhealthy consumption behaviours with the pension income. Our estimation results are largely consistent with the theoretical hypothesis, as shown in Table 6. For the rural elderly who have a long life expectancy, the smoking ratio and the number of cigarettes consumed are significantly reduced as a result of pension receiving. For those with a short life expectancy, the pension income drives a higher expenditure on cigarette consumption. Our results suggest that the elderly with long life expectancies value their future utility more and use the additional income to change their smoking behaviours to head in a healthy direction, while those with short life expectancies value their current consumption habits more, and thus, the additional income stimulates their cigarette smoking dramatically.

Table 6. To be inserted here

5.3 Channel analysis

The estimations regarding the effect of receiving a pension on the channel variables are presented in Table 7, and the RD plots of the channel variables are shown in Table A1. First, the results imply a significant and positive income effect of receiving a pension; it increases one's transfer income by roughly 1,000 *yuan*. Our finding is in line with previous study on income (Huang and Zhang 2021). Unlike previous studies (Nikolov and Adelman 2019; Ning et al. 2019), we do not find a crowd-out effect of receiving a pension on transfer income. Second, it is a caveat that our empirical results using the whole sample do not support Corollary 1, in which a significant substitution effect of receiving a pension on food consumption may exist. This also makes it necessary to check Corollary 1 using the subsamples of smokers and non-smokers. The above findings also suggest that the NRPS can improve the welfare of rural residents by improving their incomes, as these elderly individuals do not spend more on cigarette consumption when they receive additional income.

Table 7. To be inserted here

We further check the income and expenditure effects of receiving a pension for the smoking and non-smoking samples, as shown in Table 8. Receiving a pension has a higher effect on the incomes of non-smokers than on those of smokers. Regarding the substitute effect of receiving a pension, we do not find that a significant difference in the effect of receiving a pension on food consumption between smokers and non-smokers. Overall, the results suggest that receiving a pension because of the NRPS significantly changes the income levels and consumption behaviours of smokers. Thus, we can conluded that the increased income following the pension transfer serves as the most important channel, making consumers value more the future utility, instead of substituting smoking by food, which is healthier.

Table 8. To be inserted here

Tables 9 and 10 present the income and expenditure effects of the NRPS based on poverty status and life expectancy. They show that the NRPS improves the income levels for both the poor and the non-poor elderly, while it has a higher income effect on the poor elderly compared to the non-poor. The reason is that the poor elderly in our sample have very low incomes, so the pension income substantially improves their income levels. We do not find that there is a significant effect of the NRPS on food consumption for different samples by poverty status. Regarding the heterogeneous effect of life expectancy, the NRPS improves the incomes of both the long and short life expectancy groups, but the income of the elderly with a long life expectancy is increased to a larger extent. There is no significant effect of the NRPS on food consumption for different samples based on life expectancy.

Table 9. To be inserted here

Table 10. To be inserted here

5.4 Threats to identification

5.4.1 Manipulation of the assignment variable

It is necessary to investigate whether the cut-off age is actively affected by the sample itself. If there is a significant difference in the number of observations around the cut-off value, these observation points may affect the cut-off age and the accuracy of the estimations. If the age can be manipulated, for example, insured persons can lie about their age to decide when they receive their pensions, resulting in biased estimates. Considering this potential problem, we need to check whether the age is manipulated. The most commonly used method is McCracy's (2008) density test. Figure A5 shows the density test of the assignment variable is continuous and the T-statistic is 1.5, which implies that there is no significant discontinuity in the density distribution of the assignment variable at the cut-off point and that the government cannot fully manipulate who receives their pension. The assignment variable selected in this paper cannot be fully manipulated, which helps to confirm the validity of the conclusions.

5.4.2 Composition check

Since programme participation is voluntary and the outcomes of individuals cannot be observed if they have not participated in the programme, the self-selection bias should be addressed (Cuong 2021; Huang and Zhang 2021). A second quantitative check regarding the manipulation of the assignment variable suggested by Lee and Lemieux (2010) involves directly examining whether individuals' and households' predetermined socioeconomic characteristics are smooth at the cut-off point. If full manipulation existed in our research setting, we would find discontinuities in these predetermined characteristics at the cut-off point. To this end, we first check the predetermined variables that can be identified in the CHARLS: gender and marriage status. Figures A3 and A4 show that none of the predetermined variables exhibits discontinuities at the cut-off point. The regression results are reported in Table A2, further confirming that there are no statistically or economically significant discontinuities.

6. Conclusion and discussion

The introduction of the NRPS in July 2009 put the rural pension programme back on the national agenda after a 60-year absence, contrary to its urban counterpart. As with other significant reforms in China, the implementation of the NRPS has been both gradual and experimental and as expected, it was operating in all rural Chinese counties by 2012. As a result, fundamental characteristics of the NRPS programme, such as its participation rates and increases in the pensions received over time, vary dramatically from one county to the next. Using the NRPS as a policy experiment, this study estimates the causal effect of receiving a pension on unhealthy consumption behaviours of the elderly and investigates its underlying channels based on exploiting the income change induced by the launch of the NRPS.

Using data from the CHARLS covering the years 2011, 2013, 2015 and 2018, the results indicate that the NRPS decreases the ratio and number of cigarettes consumed, especially among smokers, but it increases the prices of the cigarettes consumed, resulting in an unchanged expenditure on cigarette consumption. Our findings demonstrate that a positive income shock does have an unintended effect on elderly individuals' unhealthy consumption behaviours. Importantly, we also reveal that after receiving a pension due to the NRPS, relatively poor elderly individuals are likely to reduce their cigarette consumption to a greater extent compared to the non-poor. Compared to the elderly individuals with a shorter life expectancy, thoese with a longer one have a lower probability of smoking and tend to smoke less. In addition, we find that the income effect serve as important channels to interpret the effect of the NRPS receiving on unhealthy consumption behaviours.

Pensions, as one of the important means of improving the welfare of disadvantaged people, might have an ambiguous and unintended effect on the people they target. This study provides causality that the NRPS can improve the welfare of the elderly through its unintended effect, especially for those with lower incomes and longer life expectancies. Caution should be exerted for those elderly persons with short life expectancies because they may be negatively affected by increases in smoking ratios and the number of cigarettes consumed as a result of their NRPS receiving.

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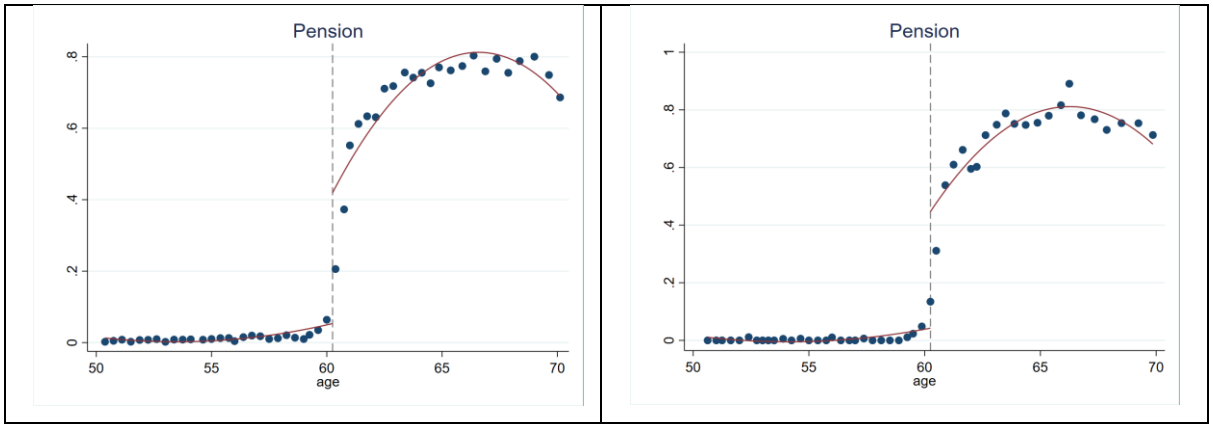
Figures:



a. Pooled sample b. Smoker sample

Figure 1. Age and pension participation

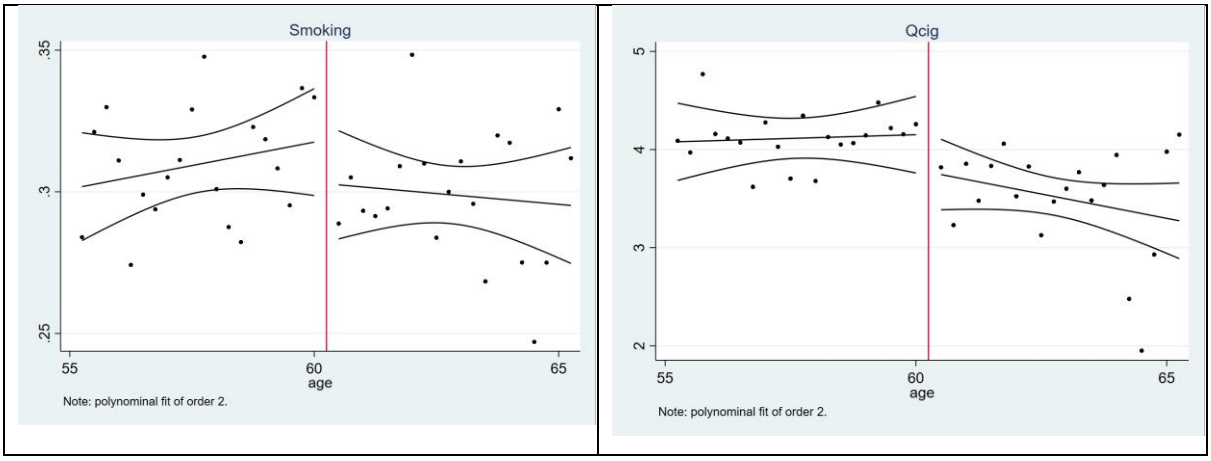


Figure 2. RD plot of outcome variables for the pooled sample

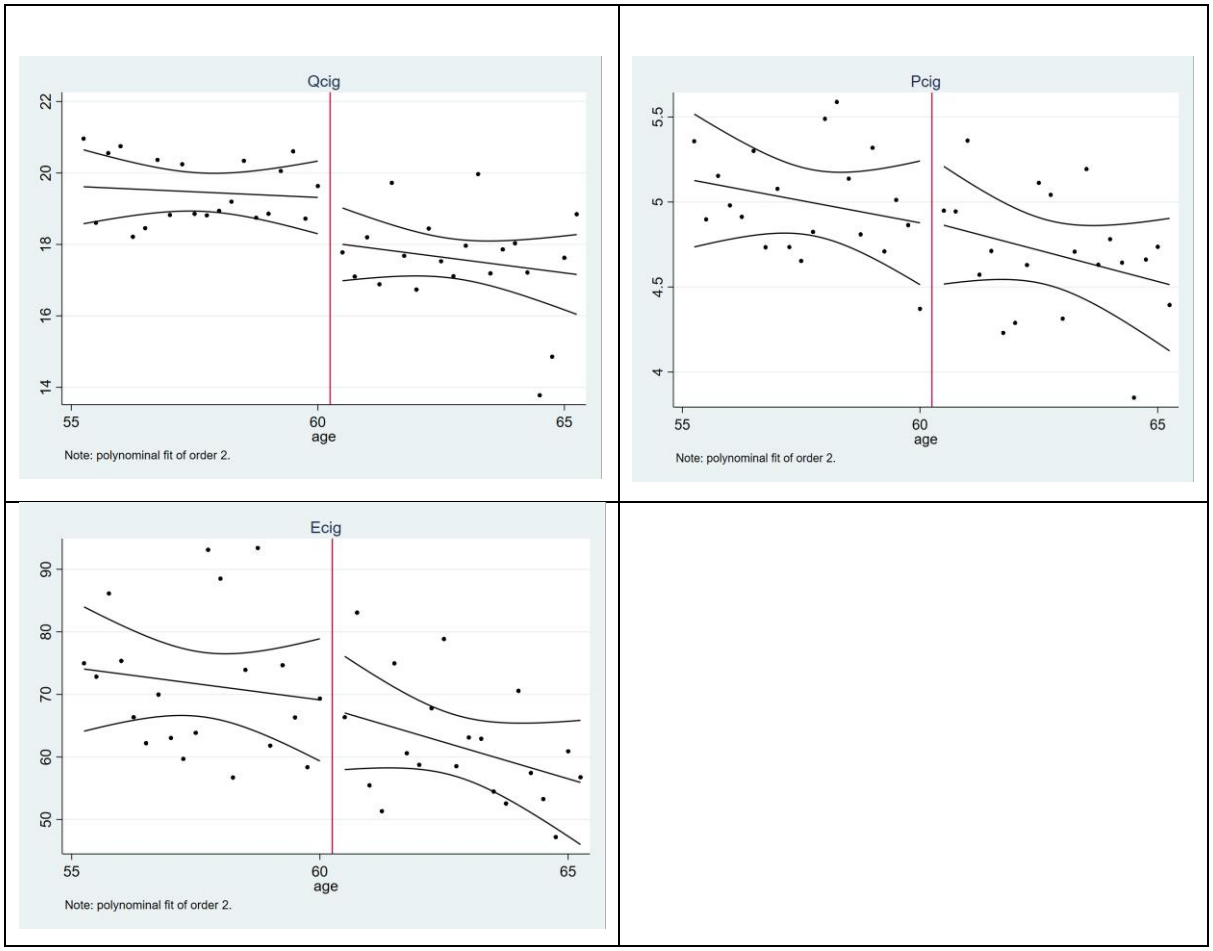


Figure 3. RD plot of outcome variables for the smoker sample

Table 1. The descriptive statistics of the participation and the amount of pension in NRPS

	Participation rate of NRPS (%)		Participation rate of NRPS (age>60)		The amount of pension [a] (yuan/year)[a]	
	Mean	(Std. Dev.)	Mean	(Std. Dev.)	Mean	(Std. Dev.)
All the years	32.105	(0.467)	68.765	(0.463)	93.948	(112.366)
2011	8.875	(0.283)	20.691	(0.405)	69.687	(42.784)
2013	33.537	(0.472)	75.837	(0.428)	78.717	(97.745)
2015	38.541	(0.487)	79.917	(0.401)	92.708	(107.243)
2018	46.439	(0.499)	88.821	(0.315)	129.480	(179.155)

Note: a. it is calculated on the conditional of those participants in NRPS.
Source: authors' own calculation based on the data from CHARLS.

Table 2. The descriptive statistics of variables

Variables	Definition	Pooled sample		Participants		Non- Participants		Difference
		Obs.	Mean (Std. Dev.)	Obs.	Mean (Std. Dev.)	Obs.	Mean (Std. Dev.)	(t test)
Treatment								
Pension	Pension participation (Yes=1; No=0)	30,232	0.321 (0.467)	21966	0.442 (0.497)	8266	0 (0.000)	0.442***
Outcome variables								
Smoking	Whether the individual is a smoker (Yes=1; No=0)	30,232	0.298 (0.458)	21966	0.290 (0.454)	8266	0.320 (0.005)	-0.030**
Qcig	Number of cigarettes smoked per day (no./day)	30,232	3.856 (9.115)	21966	3.810 (9.074)	8266	3.977 (9.223)	-0.167
Pcig [a]	Price of cigarettes per pack (20 cigarettes) (yuan/pack)	4,624	5.099 (3.721)	3010	5.317 (3.503)	1614	4.692 (5.317)	0.625***
Ecig	Expenditure on cigarette consumption per day (yuan/day)	30,232	0.717 (2.575)	21966	0.663 (2.457)	8266	0.861 (2.457)	-0.198***
Channel variables								
Transfer	Total transfer (yuan)	30232	465.555 (1652.840)	21966	558.873 (1632.576)	8266	217.571 (1680.623)	341.301***
Expenditure								
Total food expense [b]	Total food expenditure last week per capita (Yuan)	30232	74.096 (107.931)	21966	80.779 (115.940)	8266	56.337 (80.321)	24.441***
Food expense	Total expenditure on food bought per capita (Yuan)	30232	70.259 (102.686)	21966	76.621 (111.469)	8266	53.354 (71.788)	23.267***
Food away home	Total expenditure on food away from home per capita (Yuan)	30232	3.836 (23.564)	21966	4.156 (23.4806)	8266	2.983 (23.764)	1.174***

Control variables								
Gender	1=Male, 0=Female	23813	0.470	21966	0.462	8266	0.489	-0.027***
			(0.499)		(0.499)		(0.500)	
Marriage	If the individual is married (1=Yes, 0=No)	23813	0.898	21966	0.899	8266	0.895	0.003
			(0.303)		(0.302)		(0.306)	

Source: Authors' own calculation based on the data from CHARLS. The sample covers all individuals whose age ranges 50.25-70.25. Standard deviations are presented in parentheses. ∗ significant at 10%, ∗∗ significant at 5%, ∗∗∗ significant at 1%.

The price level of a certain year (2011) as the benchmark, all income and consumption variables have been deflated

[a] Price of cigarettes is only available in 2011 and 2015.

[b] Total food expenditure includes expenditure on food and food away from home.

Table 3. Non-parametric RD estimation for unhealthy consumption behaviors

		Pooled sample				Smoker			
Smoking	Conventional	-0.382**	-0.078	-0.067	-0.039				
		(0.181)	(0.058)	(0.044)	(0.036)				
	Bias-corrected	-0.468***	-0.279***	-0.154***	-0.111***				
		(0.181)	(0.058)	(0.044)	(0.036)				
	Robust	-0.468**	-0.279***	-0.154***	-0.111**				
		(0.188)	(0.089)	(0.060)	(0.048)				
	Bandwidth	1.574	3	4	5				
	Obs.	5553	10279	13535	16577				
Qcig	Conventional	-2.832*	-2.725*	-1.644	-1.160	-4.222*	-4.865	-4.222*	-2.366
		(1.688)	(1.416)	(1.018)	(0.783)	(2.299)	(3.058)	(2.300)	(1.844)
	Bias-corrected	-4.033**	-4.961***	-4.059***	-2.742***	-4.704**	-7.001**	-5.474**	-5.056***
		(1.688)	(1.416)	(1.018)	(0.783)	(2.299)	(3.058)	(2.300)	(1.844)
	Robust	-4.033**	-4.961**	-4.059***	-2.742**	-4.704*	-7.001	-5.474	-5.056*
		(1.918)	(2.010)	(1.440)	(1.190)	(2.474)	(4.558)	(3.346)	(2.760)
	Bandwidth	2.724	3	4	5	4.234	3	4	5
	Obs.	8741	10279	13535	16577	2780	2119	2780	3399
Pcig	Conventional					-0.013	0.426	0.045	0.088
						(0.736)	(1.137)	(0.866)	(0.702)
	Bias-corrected					-0.179	3.399***	1.520*	0.680
						(0.736)	(1.137)	(0.866)	(0.702)
	Robust					-0.179	3.399**	1.520	0.680
						(0.802)	(1.675)	(1.261)	(1.002)
	Bandwidth					4.919	3	4	5
	Obs.					2467	1672	2146	2577
Ecig	Conventional					-1.244	-1.292	-2.035**	-1.829**
						(1.259)	(1.184)	(0.927)	(0.728)
	Bias-corrected					-1.316	-0.893	-0.858	-1.732**
						(1.259)	(1.184)	(0.927)	(0.728)
	Robust					-1.316	-0.893	-0.858	-1.732
						(1.390)	(1.589)	(1.244)	(1.178)
	Bandwidth					2.818	3	4	5
	Obs.					1974	2119	2780	3399

Notes: All estimates are from bias-corrected RD estimation; Covariates include gender and marital status; Standard errors clustered at the community level are presented in parentheses; ∗ significant at 10%, ∗∗ significant at 5%, ∗∗∗ significant at 1%.

Source: authors' own estimation based on the data from CHARLS.

Table 4. Descriptive statistics of unhealthy consumption behaviors across poverty status and life expectancy

Variables	Relative poverty=1		Relative poverty=0		
	Obs	Mean	Obs	Mean	T-test
Smoking	15116	0.260	15116	0.337	-0.077***
		(0.439)		(0.004)	
Qcig	15116	3.271	15116	4.441	-1.170***
		(0.069)		(0.078)	
Pcig	2190	5.050	2434	5.142	-0.091
		(3.766)		(0.075)	
Ecig	15116	0.675	15116	0.760	-0.057**
		(2.372)		(2.372)	
	Long life expectancy		Short life expectancy		
	Obs	Mean	Obs	Mean	T-test
Smoking	20309	0.315	3197	0.311	0.004
		(0.465)		(0.463)	
Qcig	20309	4.133	3197	4.025	0.108
		(9.383)		(9.116)	
Pcig	3371	5.178	490	4.334	0.844***
		(3.885)		(2.749)	
Ecig	20309	0.789	3197	0.616	0.173***
		(0.020)		(0.037)	

Notes: All estimates are from bias-corrected RD estimation; Covariates include gender and marital status; Standard errors are presented in parentheses.

Table 5. Non-parametric RD estimation for unhealthy consumption behaviors by poverty status

		Relative poverty=1				Relative poverty=0			
Smoking	Bias-corrected	-0.180	-0.391***	-0.204***	-0.156***	-0.289*	-0.202***	-0.117**	-0.078*
		(0.121)	(0.099)	(0.072)	(0.058)	(0.152)	(0.071)	(0.051)	(0.041)
	Bandwidth	2.533	3	4	5	1.762	3	4	5
	Obs.	4483	5274	6816	8297	3104	5005	6719	8280
Qcig	Bias-corrected	-4.969**	-3.225	-3.861**	-3.009**	-4.021*	-6.325***	-4.222***	-2.620***
		(1.982)	(2.215)	(1.514)	(1.180)	(2.147)	(1.784)	(1.276)	(0.986)
	Bandwidth	3.340	3	4	5	2.708	3	4	5
	Obs.	5402	5274	6816	8297	4258	5005	6719	8280
Pcig	Bias-corrected	-0.630	-0.647	-1.286	-1.413	7.813***	6.131***	3.558***	2.302**
		(3.297)	(1.843)	(1.330)	(1.103)	(2.846)	(1.442)	(1.124)	(0.920)
	Bandwidth	1.771	3	4	5	1.798	3	4	5
	Obs.	535	807	1022	1233	518	865	1124	1344
Ecig	Bias-corrected	-1.097	-1.327**	-1.340***	-1.128***	-0.573	-0.457	-0.275	-0.420*
		(0.753)	(0.603)	(0.414)	(0.321)	(0.885)	(0.457)	(0.338)	(0.253)
	Bandwidth	2.515	3	4	5	1.754	3	4	5
	Obs.	4483	5274	6816	8297	3104	5005	6719	8280

Notes: All estimates are from bias-corrected RD estimation; Covariates include gender and marital status; Standard errors clustered at the community level are presented in parentheses; $*$ significant at 10%, $**$ significant at 5%, $***$ significant at 1%.

Source: authors' own estimation based on the data from CHARLS.

Table 6. Non-parametric RD estimation for unhealthy consumption behaviors by life expectancy

		Long life expectancy				Short life expectancy			
Smoking	Bias-corrected	-0.483**	-0.296***	-0.157***	-0.096**	0.078	0.133	0.078	0.067
		(0.203)	(0.066)	(0.051)	(0.042)	(0.160)	(0.207)	(0.161)	(0.116)
	Bandwidth	1.551	3	4	5	4.105	3	4	5
	Obs.	3793	7034	9259	11276	1153	878	1153	1492
Qcig	Bias-corrected	-6.565***	-6.054***	-4.659***	-3.137***	4.478	14.443***	9.419***	5.698**
		(2.234)	(1.601)	(1.177)	(0.924)	(3.549)	(4.798)	(3.298)	(2.406)
	Bandwidth	2.366	3	4	5	3.941	3	4	5
	Obs.	5415	7034	9259	11276	1095	878	1153	1492
Pcig	Bias-corrected	6.709**	4.877***	2.551***	1.439*	0.488	-9.629	-0.972	2.718
		(2.616)	(1.278)	(0.985)	(0.850)	(8.622)	(9.349)	(8.135)	(3.592)
	Bandwidth	1.832	3	4	5	2.225	3	4	5
	Obs.	763	1220	1581	1885	109	164	195	254
Ecig	Bias-corrected	-1.037*	-1.043**	-0.899***	-0.867***	2.943*	2.190	2.308**	1.532**
		(0.578)	(0.415)	(0.308)	(0.251)	(1.527)	(1.443)	(1.054)	(0.752)
	Bandwidth	2.368	3	4	5	2.961	878	1153	1492
	Obs.	5415	7034	9259	11276	818	3	4	5

Notes: All estimates are from bias-corrected RD estimation; Covariates include gender and marital status; Standard errors clustered at the community level are presented in parentheses; $*$ significant at 10%, $**$ significant at 5%, $***$ significant at 1%.

Source: authors' own estimation based on the data from CHARLS.

Table 7. The potential channels through which pension affects the unhealthy consumption behaviors.

	Pooled Sample			
Bandwidth		3	4	5
Income effect				
Transfer	1017.576***	889.170***	966.820***	973.072***
	(117.802)	(184.277)	(137.745)	(125.770)
Bandwidth	5.338	3	4	5
Obs.	17263	10279	13535	16577
Substitution effect				
Total food expense	7.808	9.130	1.820	3.056
	(13.703)	(17.012)	(12.776)	(10.487)
Bandwidth	3.893	3	4	5
Obs.	12774	10279	13535	16577
Food expense	5.402	7.607	1.451	3.965
	(13.118)	(16.137)	(12.311)	(10.117)
Bandwidth	3.822	3	4	5
Obs.	12774	10279	13535	16577
Food away home	1.911	1.523	0.370	-0.914
	(2.406)	(3.431)	(2.554)	(2.139)
Bandwidth	4.437	3	4	5
Obs.	14346	10279	13535	16577

Notes: All estimates are from bias-corrected RD estimation; Covariates include gender and marital status; Standard errors clustered at the community level are presented in parentheses; $*$ significant at 10%, $**$ significant at 5%, $***$ significant at 1%.
Source: authors' own estimation based on the data from CHARLS.

Table 8. The potential channels through which pension affects the unhealthy consumption behaviors by smoking status

	Smoker				**Non-Smoker**			
Income effect								
Transfer	644.697**	849.235***	798.457***	754.944***	941.997***	885.833***	1015.504***	1039.763***
	(322.753)	(290.406)	(243.028)	(212.207)	(355.014)	(219.779)	(157.646)	(146.370)
Bandwidth	2.724	3	4	5	2.102	3	4	5
Obs.	1817	2119	2780	3399	5690	8160	10755	13178
Substitute effect								
Total food expense	-4.139	9.980	-0.525	14.988	18.149	12.115	4.929	0.771
	(60.405)	(32.328)	(25.330)	(19.193)	(37.878)	(18.585)	(13.623)	(11.227)
Bandwidth	1.880	3	4	5	1.977	3	4	5
Obs.	1339	2119	2780	3399	5070	8160	10755	13178
Food expense	-5.923	16.262	2.798	16.696	16.974	8.035	3.410	1.475
	(42.385)	(30.897)	(24.430)	(18.511)	(35.854)	(17.614)	(12.990)	(10.712)

Bandwidth	2.056	3	4	5	1.916	3	4	5
Obs.	1505	2119	2780	3399	5070	8160	10755	13178
Food away home	-6.014	-6.282	-3.323	-1.709	0.019	4.080	1.518	-0.704
	(9.600)	(6.497)	(4.885)	(3.875)	(3.199)	(3.959)	(2.913)	(2.439)
Bandwidth	2.016	3	4	5	3.779	3	4	5
Obs.	1505	2119	2780	3399	10134	8160	10755	13178

Notes: All estimates are from bias-corrected RD estimation; Covariates include gender and marital status; Standard errors clustered at the community level are presented in parentheses; $*$ significant at 10%, $**$ significant at 5%, $***$ significant at 1%.
Source: authors' own estimation based on the data from CHARLS.

Table 9. The potential channels through which pension affects the unhealthy consumption behaviors by poverty status and life expectancy

	Relative poverty=1				Relative poverty=0			
Income effect								
Transfer	734.445***	813.862***	763.914***	762.395***	662.521	808.379*	755.667**	937.652***
	(37.069)	(37.073)	(26.704)	(21.177)	(613.946)	(446.335)	(313.578)	(254.109)
Bandwidth	3.116	3	4	5	2.354	3	4	5
Obs.	5274	5274	6816	8297	3891	4629	6302	7932
Substitute effect								
Total food	-82.332	-16.660	-1.997	5.834	9.158	65.338**	49.561**	34.208**
expense	(53.182)	(25.221)	(17.980)	(14.152)	(128.496)	(31.488)	(21.974)	(17.416)
Bandwidth	1.788	3	4	5	1.192	3	4	5
Obs.	3305	5274	6816	8297	1853	4629	6302	7932
Food expense	-79.972	-15.861	-3.772	2.532	63.339	64.368**	47.509**	32.734**
	(51.191)	(24.101)	(17.323)	(13.495)	(103.384)	(29.399)	(20.583)	(16.471)
Bandwidth	1.785	3	4	5	1.436	3	4	5
Obs.	3305	5274	6816	8297	2257	4629	6302	7932
Food away	-1.722	-2.457	-1.783	-22.055	-5.934	0.970	2.052	1.474
home	(3.396)	(6.093)	(4.228)	(13.495)	(21.758)	(5.958)	(4.173)	(3.327)
Bandwidth	2.130	3	4	5	1.223	3	4	5
Obs.	3678	5274	6816	8297	1853	4629	6302	7932

Notes: All estimates are from bias-corrected RD estimation; Covariates include gender and marital status; Standard errors clustered at the community level are presented in parentheses; $*$ significant at 10%, $**$ significant at 5%, $***$ significant at 1%.

Source: authors' own estimation based on the data from CHARLS.

Table 10. The potential channels through which pension affects the unhealthy consumption behaviors by life expectancy

	Long life expectancy				Short life expectancy			
Income effect								
Transfer	972.054***	898.024***	888.747***	1018.003***	901.684***	488.163	821.904***	1068.298***
	(180.249)	(331.341)	(228.232)	(183.320)	(305.197)	(322.579)	(264.814)	(219.440)
Bandwidth	5.092	3	4	5	3.175	3	4	5
Obs.	11276	6511	8737	10837	878	818	1095	1400
Substitute effect								
Total food	-0.932	-20.321	-9.929	-2.482	63.528	91.876	46.312	22.245
expense	(14.370)	(26.641)	(18.919)	(14.934)	(105.785)	(99.876)	(71.147)	(54.020)
Bandwidth	5.209	3	4	5	2.850	3	4	5
Obs.	11276	6511	8737	10837	818	818	1095	1400
Food	-5.266	-20.644	-10.322	-2.937	88.847	106.546	61.900	33.723
expense	(15.619)	(25.412)	(18.159)	(14.382)	(104.356)	(94.280)	(67.065)	(51.162)
Bandwidth	4.587	3	4	5	2.773	3	4	5
Obs.	10331	6511	8737	10837	818	818	1095	1400
Food away	-0.155	-2.466	-0.987	-0.094	-16.649	-14.670	-15.588	-11.478
home	(3.421)	(5.428)	(3.734)	(3.016)	(14.408)	(18.836)	(13.031)	(9.486)
Bandwidth	4.342	3	4	5	3.704	3	4	5
Obs.	9818	6511	8737	10837	1020	818	1095	1400

Notes: All estimates are from bias-corrected RD estimation; Covariates include gender and marital status; Standard errors clustered at the community level are presented in parentheses; $*$ significant at 10%, $**$ significant at 5%, $***$ significant at 1%.

Source: authors' own estimation based on the data from CHARLS.

Appendix:
Figures:

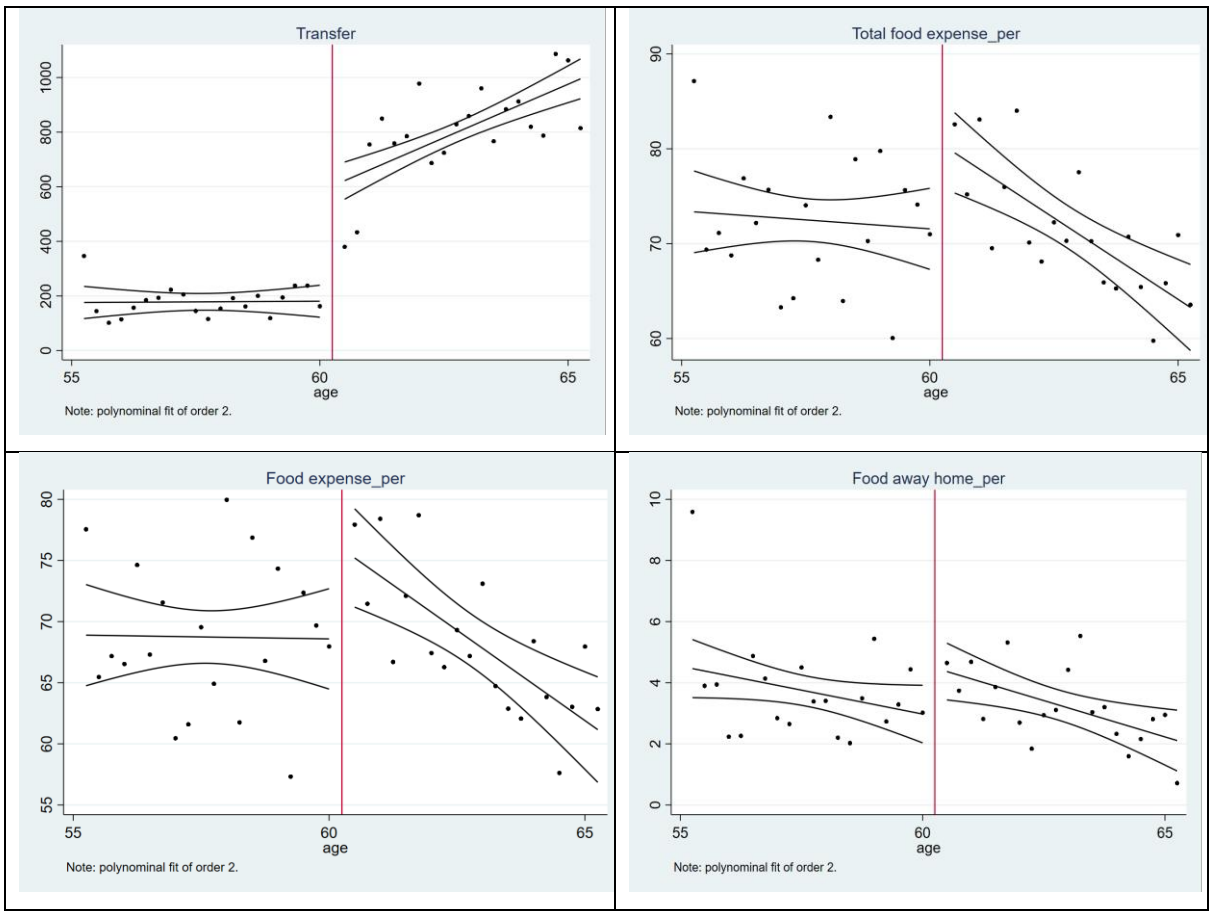
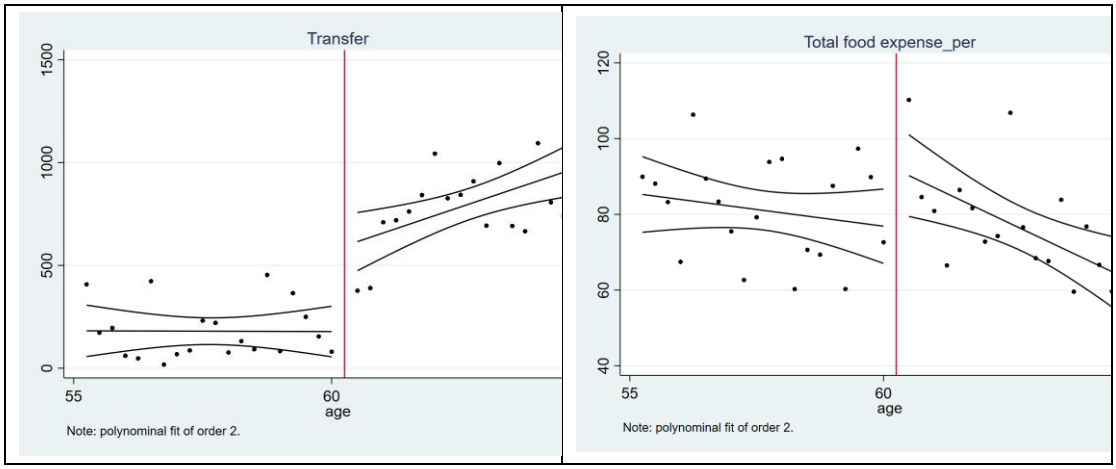


Figure A1. RD plot of channel variables for the pooled sample



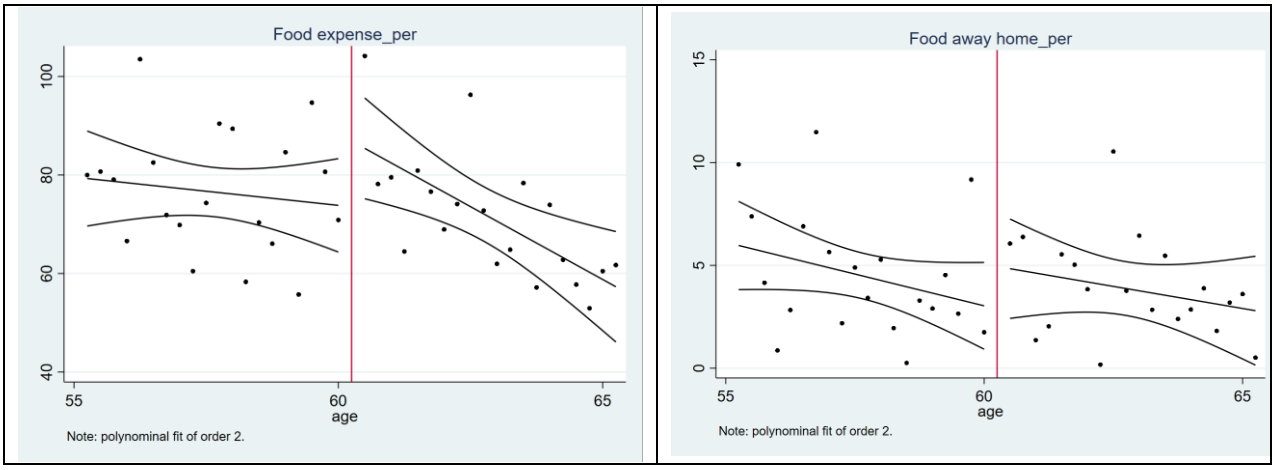


Figure A2. RD plot of channel variables for the smoker sample

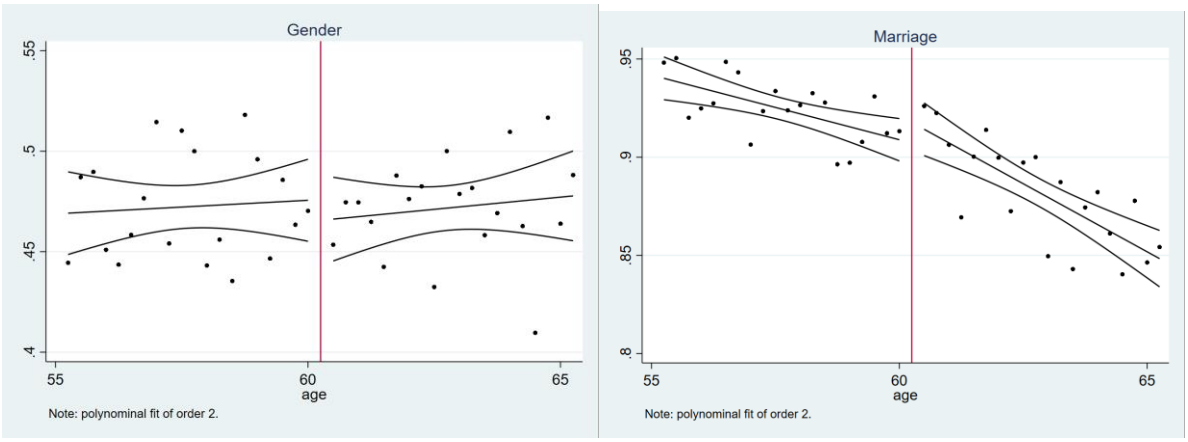


Figure A3. RD plot of control variables for the pooled sample

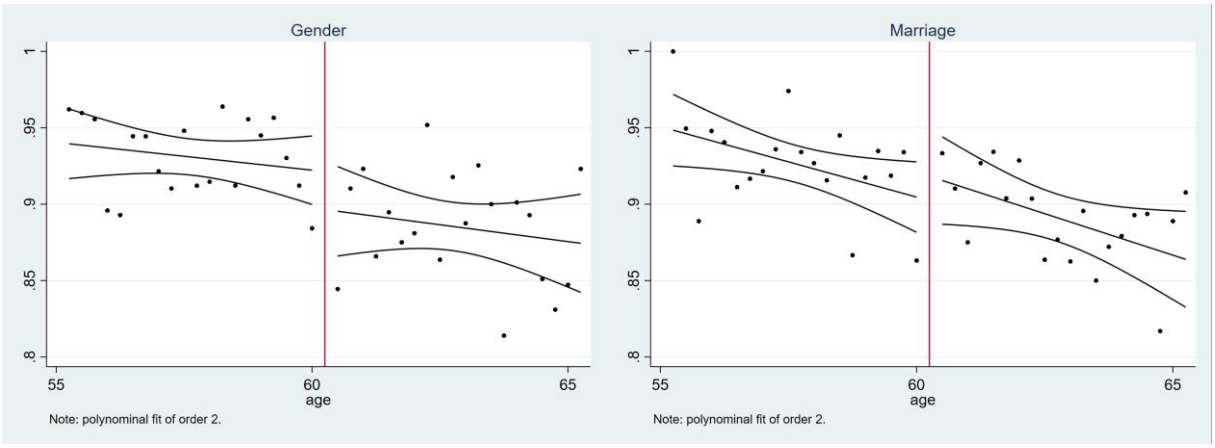


Figure A4. RD plot of control variables for the smoker sample

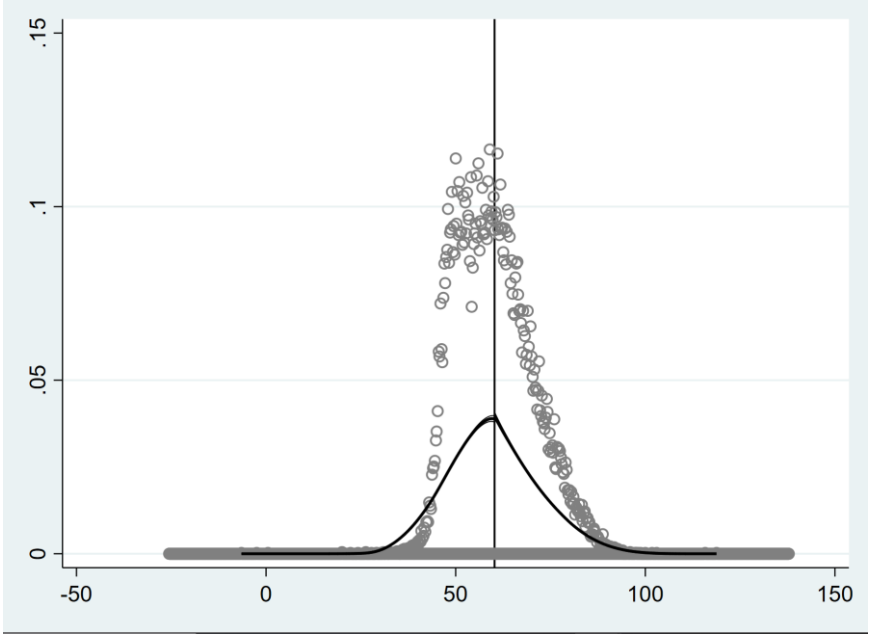


Figure A5. The density test of assignment variable

Tables:

Table A1 Parametric RD estimation for unhealthy consumption behaviors

	Pooled sample				Smoker			
Smoking	-0.859*	-0.092	-0.068*	-0.040				
	(0.494)	(0.062)	(0.040)	(0.030)				
Bandwidth	1.574	3	4	5				
Obs.	5553	10279	13535	16577				
Qcig	-3.991**	-3.417**	-2.102**	-1.654**	-4.717**	-5.539*	-4.717**	-2.856*
	(2.001)	(1.526)	(0.931)	(0.680)	(2.194)	(3.185)	(2.194)	(1.704)
Bandwidth	2.724	3	4	5	4.234	3	4	5
Obs.	8741	10279	13535	16577	2780	2119	2780	3399
Pcig					-0.117	0.228	-0.012	-0.042
					(0.676)	(1.116)	(0.807)	(0.636)
Bandwidth					4.919	3	4	5
Obs.					2467	1672	2146	2577
Ecig					-0.695	-1.002	-1.169	-0.677
					(1.121)	(1.025)	(0.785)	(0.588)
Bandwidth					2.818	3	4	5
Obs.					1974	2119	2780	3399

Notes: Covariates include gender and marital status; Standard errors clustered at the community level are presented in parentheses; ∗ significant at 10%, ∗∗ significant at 5%, ∗∗∗ significant at 1%.

Source: authors' own estimation based on the data from CHARLS.

Table A2 Non-parametric RD estimation for control variables

	Bandwidth	**Pooled sample**			**Smoker sample**		
		3	4	5	3	4	5
Gender	Conventional	-0.026	-0.028	-0.025	-0.113	-0.112	-0.099
		(0.060)	(0.042)	(0.032)	(0.134)	(0.093)	(0.072)
	Bias-corrected	-0.022	0.002	-0.010	-0.033	-0.101	-0.124*
		(0.060)	(0.042)	(0.032)	(0.134)	(0.093)	(0.072)
	Robust	-0.022	0.002	-0.010	-0.033	-0.101	-0.124
		(0.110)	(0.069)	(0.054)	(0.210)	(0.142)	(0.108)
	Obs.	10279	13535	16577	2119	2780	3399
Marriage	Conventional	0.032	0.026	0.021	0.084	0.038	0.030
		(0.040)	(0.028)	(0.024)	(0.078)	(0.055)	(0.044)
	Bias-corrected	0.015	0.027	0.026	0.085	0.101*	0.063
		(0.040)	(0.028)	(0.024)	(0.078)	(0.055)	(0.044)
	Robust	0.015	0.027	0.026	0.085	0.101	0.063
		(0.061)	(0.042)	(0.032)	(0.126)	(0.094)	(0.069)
	Obs.	10279	13535	16577	2119	2780	3399

Notes: Standard errors clustered at the community level are presented in parentheses;
$*$ significant at 10%, $**$ significant at 5%, $***$ significant at 1%.
Source: authors' own estimation based on the data from CHARLS.

Table A3 The life expectation question in questionnaire

INTERVIEWER CHECK AGE OF RESPONDENT?	**1. < 65 YEAR → COLUMN A** **2. 65 - 69 YEAR → COLUMN B** **3. 70 - 74 YEAR → COLUMN C** **4. 75 - 79 YEAR → COLUMN D** **5. 80 - 84 YEAR → COLUMN E** **6. 85 - 89 YEAR → COLUMN F** **7. 90 - 94 YEAR → COLUMN G** **8. 95 - 99 YEAR → COLUMN H** **9. ≥ 100 YEAR → COLUMN I**								
	A	B	C	D	E	F	G	H	I
DA081 Suppose there are 5 steps, where the lowest step represents the smallest chance and the highest step represents the highest chance, on what step do you think is your chance in reaching the age of [...]?	75 years	80 years	85 years	90 years	95 years	100 years	105 years	110 years	115 years
1 Almost impossible	1	1	1	1	1	1	1	1	1
2 Not very likely	2	2	2	2	2	2	2	2	2
3 Maybe	3	3	3	3	3	3	3	3	3
4 Very likely	4	4	4	4	4	4	4	4	4
5 Almost certain	5	5	5	5	5	5	5	5	5