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# THE RETIREMENT MIGRATION PUZZLE IN CHINA

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**The Retirement Migration Puzzle in China**

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**Abstract:** We examine whether and how retirement affects migration decisions in China. Using a regression discontinuity (RD) design approach combined with a nationally representative sample of 228,855 adults aged between 40 and 75, we find that retirement increases the probability of migration by 12.9 percentage points. Approximately 38% of the total migration effects can be attributed to inter-temporal substitution (delayed migration). Retirement-induced migrants are lower-educated and have restricted access to social security. Household-level migration decisions can reconcile different migration responses across gender. Retirees migrate for risk sharing and family protection mechnisms, reducing market production of their families in the receiving households.

**Keywords:** Retirement; Migration decision; Regression discontinuity design.

**JEL codes:** J14; J26; J61.

**Declarations of interest**: None

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## 1 Introduction

Due to strong reductions in fertility in the past, the economic challenges posed by population aging are particularly high in China. Approximately one-third of its population will be aged 60 and above in 2050 (UN Population Division, 2017 Revision), leading to more retirees and a shrinking workforce. While the statutory retirement age officially introduced in 1978 has not changed since then, China intends to progressively increase it in the future. This may have a profound impact on social and economic outcomes because retirement is a significant life event that is associated with decreasing income, increasing leisure time, and potentially changes in access to health care (Zhang, Salm, and van Soest 2018). For example, the prominent phenomenon that consumption expenditures drop sharply upon retirement, militating against the theory of consumption smoothing and known as the retirement consumption puzzle, has been examined by various studies over the past decades (Banks, Blundell, and Tanner 1998; Battistin et al. 2009; Luengo-Prado and Sevilla 2012; Li, Shi, and Wu 2015) . However, there is still scant scientific evidence on how retirement affects other older adult's behaviors that can lead to profound social and economic changes.

One potential behavioral change after retirement is migration. A long-standing theory considers migration as investment in human capital, which is costly but improves job opportunities (Schultz 1961; Sjaastad 1962; Bowles 1970). A number of studies reveal that a positive income shock facilitates migration by easing liquidity constraints (Bryan, Chowdhury, and Mobarak 2014; Angelucci 2015; Cai 2018). According to this line of argument we should witness a falling propensity to migrate when people exit the labor market upon retirement and therefore experience a reduction in income.[5] However,

[5] This is consistent with the old Chinese saying that falling leaves return to their roots.

recent studies also show that people may resort to migration as risk-sharing or shock coping strategies (Rosenzweig and Stark 1989; Gröger and Zylberberg 2016; Munshi and Rosenzweig 2016; Morten 2019). For example, when older people demand more health services upon retirement, and if public health services are inadequate, they may migrate for the reason of obtaining informal healthcare from their family members.[6] As a result, the impact of retirement on the propensity to migrate is uncertain from a theoretical point of view and pins down to an empirical question that we aim to answer in this article.

Understanding whether retirement will cause a higher geographic mobility of older adults is important for the following reasons. First, internal migration of older cohorts may lead to considerable demographic, social, cultural, and economic changes as the number of older adults increase over decades (Bean et al. 1994; Deller 1995). For example, it may have a negative impact on the financial stability of local social security systems through lower tax revenues and higher dependency ratios (Razin, Sadka, and Swagel 2002a, 2002b). It may also cause labor supply shocks in the receiving households/regions through reallocation of working time from market production to home production (Stancanelli and Van Soest 2012; Li, Shi, and Wu 2015). Second, high migration may lead to provincial-level heterogeneity in rates of population aging (Frey 1995; Rogerson 1996), which can have consequences for regional economic growth and income convergence between provinces (Barro and Sala-i-Martin 1992). Third, knowing the pattern of later-life migration provides the scientific foundation for

[6] Another reason could be that people move from areas with high living costs to areas with low living costs after retirement. Using housing costs as a proxy for living costs, we do not find evidence that average housing costs change significantly upon retirement (more details can be found in the appendix).

designing aging-related policies in the domains of retirement, regional infrastructure, healthcare, and long-term care. Finally, it is plausible that the migration behavior of older adults may be heterogeneous among subgroups defined by gender and educational attainment. Taking account of this variation may help policymakers in designing suitable policies for subgroups and thereby improve the health and well-being of the older population altogether.

While late-life migration has been addressed in earlier frameworks such as the lifecourse model (Rossi 1955; Walters 2002), most of them have methodological constraints and suffer from endogeneity issues (Bradley et al. 2008; Longino Jr et al. 2008; Sander and Bell 2014). Previous studies focus on the association between retirement and migration rather than on causality. However, workers who want to migrate for other reasons – e.g., because they experience declining health or the death of a spouse – are also more likely to retire. This raises problems related to reverse causality and implies the need for an accurate identification strategy. Furthermore, most of the previous studies use comparatively small datasets.

To address endogeneity issues, we use a regression discontinuity (RD) design to estimate the causal effect of retirement on migration in China. The focus on China implies three crucial advantages: i) it allows us to utilize a unique large-scale nationally representative population-based dataset of a 20% random sample of the China Population Census survey in 2005. The resulting sample accounts for 0.2% of the total population in China, which corresponds to 2.6 million people in all 31 provinces. Among other variables, the dataset includes information on age, gender, education level, marital status, self-reported health, retirement status, social security participation such as medical insurance and pension, migration status, and income. We keep those individuals aged between 40 and 75 years who have never quit the labor force before retirement, which amounts to a sample of 228,855 adults; ii) our RD framework exploits that the probability of retiring increases discontinuously at the statutory retirement age in China (i.e., 60 for males, 50 for female workers, and 55 for female civil servants). These thresholds are induced by mandatory retirement rules, which were officially established in 1978 and have not changed since then. The mandatory retirement rules are strictly enforced for urban workers (especially in public sectors) but less so for rural residents such as farmers or those who are self-employed. This is ideal for conducting a placebo test on the sample of the rural population; iii) the Chinese institutional setting offers an important advantage over studies focusing on other countries such as the United States, where individuals become eligible for the Medicare insurance program once they pass the age threshold of 65. It is therefore hard to disentangle the effects of retirement from those of Medicare insurance such that studies using the threshold of age 65 as an instrument for retirement (Insler 2014; Neuman 2008) run the risk of confounding their results with the effects of Medicare eligibility. This problem is avoided when focusing on China because it has a universal healthcare system, in which more than 95% of its population are insured via the Urban Employee Medical Insurance (UEMI) or the Urban Residence Medical Insurance (URMI) for urban residents, or via the New Cooperative Medical Scheme (NCMS) for rural residents. Retirees continue to enroll in their healthcare plans. Thus, the estimated effect of retirement will not be confounded by changes in health insurance.

To our best knowledge, this is the first study that estimates the causal effect of retirement on migration behavior under a RD framework, using a large-scale nationally representative population-based dataset. By exploring the heterogeneity in the effect of retirement across sub-groups (e.g., by gender, education groups, etc.), we expect that this study will elucidate the potential underlying mechanisms and thereby provide a scientific foundation for economic policies that address the challenges and opportunities induced by the migration of retirees.

The paper is organized as follows. In Section 2 we illustrate the institutional backgrounds of retirement policy and migration settings in China. In Section 3 we present the data and summary statistics. Section 4 contains our main results and various robustness and sensitivity analyses. In Section 5 we explore the heterogeneity in the effect of retirement across different sub-groups of the population. In Section 6 we discuss the potential causal mechanisms from retirement to migration in older adults. Finally, in Section 7 we summarize and draw our conclusions.

## 2 Institutional details

### 2.1 Statutory retirement ages in China

The current statutory retirement ages in China have been formally established on May 24th, 1978 when the retirement policy was approved at the Second Meeting of the Standing Committee of the Fifth National People's Congress. Policy-relevant documents include "The State Councils' Provisional Measures for Taking Care of the Aged, Physically Weak, Sick and Disabled Cadres" and "The State Council's Provisional Measures Concerning the Retirement and Resignation of Workers". According to the retirement policy, the general statutory retirement ages for men and women are 60 and 50, respectively. For female civil servants, the statutory retirement age is 55. The statutory retirement policy is more strictly enforced in urban areas, particularly for workers of the public sector. By contrast, workers in rural areas (e.g., farmers, workers who are self-employed, etc.) are more flexible to choose the timing of retirement. The mandatory retirement policy in urban China allows us to better cope with the causal impact of retirement. Thus, we restrict our analysis to urban residents and use the rural sample for placebo tests.

## 2.2 Migration policy in China

To regulate internal migration, China established the *Hukou* System in 1958. According to the *Hukou* System, everyone is born with a specific *Hukou* registered at his or her birthplace. Urban residents hold a non-agricultural *Hukou*, while rural residents hold an agricultural *Hukou*. Having a non-agricultural *Hukou* allows one to access local social welfare (e.g., medical insurance, pension, etc.), whereas agricultural *Hukou* holders have little access to social protection.[7] More importantly, migrants who are moving to an unregistered place cannot enjoy local social welfare as natives. In other words, social welfare is non-portable along with migration (Dong 2009; Q. Meng et al. 2015). For example, migrants who are covered by medical insurance in a registered place cannot enjoy the same healthcare services in another unregistered place. They have to pay more to obtain local public services such as medical care. Nevertheless, China witnessed unprecedented internal migration of the working age population regardless of the restrictive migration policy.[8] Additionally, due to limited access to local public services at the destination, these young migrants used to stay temporarily and return back home much earlier than the statutory retirement ages (X. Meng 2012; X. Meng, Xue, and Xue

[7] More details on the Hukou System can be found in Chan and Zhang (1999) and Chan and Buckingham (2008).

[8] According to the Population census in 2010, the total number of internal migrants was 261 million, which is about 81% higher than the number in 2000.

2016). Figure A1 in the appendix shows the relationship between age and the migration rate. We find that the average migration rate decreases gradually with increasing age for the working population, particularly for the working population from rural areas. By contrast, we find evidence that the average migration rate rebounds after retirement, particularly for the population from urban areas. Most of the economic studies on migration behavior are concerned with the younger working age population, and little is known on the migration behavior of retirees, who are getting more and more important.

## 3 Data and summary statistics

### 3.1 Data source

Our data comprises a 20% random sample of the China Population Census survey in 2005, which accounts for 0.2% of the total population in China. The sample covers about 2.6 million people in all 31 provinces and equivalent administrative units of mainland China. The survey includes variables such as income, age, gender, education level, *Hukou* type, marital status, self-reported health, retirement status, migration status, and social security participation such as medical insurance and pension. Unique information on health and income imply that the census survey in 2005 is particularly valuable in our context as compared with census surveys in alternative years. See Xie and Zhou (2014) for more details of this dataset. Although there are alternative survey datasets such as RUMiC that can identify migrants, migrants included in these surveys are mostly from rural China and are therefore not as strongly affected by the mandatory retirement policy. By contrast, the census survey allows us to identify both migrants from rural and urban China.

### 3.2 Retirement definition and eligible sample

We keep those urban residents aged between 40 and 75 years who have never quit the labor force before retirement. Specifically, we use the following two questions in the questionnaire to determine retirement: First, did you engage in paid work in the past week? Second, why did you have no paid work? We define people as retired if they: 1) did not engage in paid work in the past week; and 2) self-reported retired. We drop observations for the following alternative reasons of having no paid work: i) being a student, ii) seeking no paid work voluntarily, and iii) being unemployed to allow for a precise comparison between workers and retirees.[9] Given that some retirees continue working after formal retirement, we resort to a third question in the questionnaire for an alternative way of defining retirement: what is your main source of living expenditures? According to this question, we define people as retired if they resort to pension payments as their main source for financing their living expenses. We use this alternative definition of retirement to perform a robustness check. The final sample consists of 228,855 individuals, of whom 133,422 are men and 95,433 are women.

According to the data, the average retirement rate of the whole sample is 42%, with 11% for the sample below the statutory retirement age and 87% for the remaining sample. Figure 1 shows the retirement rate by age and gender for urban residents. We observe that the retirement rate jumps significantly at ages 50 and 60 for women and men, respectively. For women, the retirement rate also increases slightly at age 55 but much less so than at age 50, which is consistent with the fact that civil servants account only for a small proportion of the female workforce (Zhang, Salm, and van Soest 2018).

[9] We also conduct robustness checks by including these observations as non-retirees and our main results are still robust.

Since our data do not contain detailed information about civil servants and other public sector employees, we proxy the statutory retirement age to age 50 for all women.

[Figure 1]


Figure 1 Retirement rate by age and gender

Notes: The general statutory retirement ages for men and women are 60 and 50, respectively. For female civil servants, the statutory retirement age is 55. Note that we only keep urban residents in the sample because the statutory retirement policy is more strictly enforced in urban areas, while rural residents have more flexibility to choose the timing of retirement.

To merge the different statutory retirement ages for men and women into one single variable, we construct the normalized age, which is equal to the actual age minus the retirement age. Thus, the normalized age variable equals zero for men and women at the respective statutory retirement age. Figure 2 shows that at the normalized age (i.e., the statutory retirement age for both men and women), the average retirement rate jumps from 44% to 68%, suggesting that there is a significant increase in the retirement rate immediately after reaching the statutory retirement age.

[Figure 2]


Figure 2 Retirement rate and normalized age

Notes: The normalized age equals to the actual age minus the statutory retirement age. We define people as retired if they: 1) did not engage in paid work in the past week; 2) self-reported as retired. Note that we drop observations for alternative reasons of having no paid work such as being a student, seeking no paid work voluntarily, and being unemployed to allow for a precise comparison between workers and retirees. The bin is selected based on the IMSE-optimal evenly-spaced method of Calonico, Cattaneo, and Titiunik 2014b.

### 3.3 Migration definition

We define a migrant as an individual who has lived away from his or her registered place.[10] Specifically, we use the following question in the questionnaire to determine migration: what is your current *Hukou* registration status? We define people as migrants if they did not live in their *Hukou* registered place. We also use an alternative definition of migration by excluding individuals who have lived away from their registered place but for less than 6 months for a robustness check. Specifically, we use an additional question in the questionnaire to determine migration duration: how long have you lived away from your *Hukou* registered place? Based on the answers, we define people as

[10] Due to data limitations, we cannot identify permanent migrants who changed their registered place. Since permanent migration was still very restrictive in 2005, we assume that the registered place is typically the same as the place of birth.

migrants if they (1) did not live in their *Hukou* registered place; 2) lived away from their *Hukou* registered place for more than 6 months. While the second definition of migration is consistent with the official definition of internal migration in China, it ignores the recent migrants who have just moved away from their registered place.

According to the data, the average migration rate is 17%, i.e., the percentage of the population that is classified as migrants is 17% in our sample. Different from previous studies that focus on migrants from rural China, more than 92% of migrants in our study come from urban China. This is consistent with the fact that the statutory retirement policy mainly applies to the urban population. We also find that the average migration rate is 17% in the sample below the statutory retirement age and 16% in the remaining sample, which is consistent with previous studies showing that the migration rate is negatively related to age (Zhao 1999). Figure 3 shows that at the statutory retirement age, the average migration rate increases from 16% to 18%, suggesting that there is a significant increase in the migration rate immediately after reaching the statutory retirement age. More details on the data description can be found in Tables A1-A2 in the appendix.

[Figure 3]

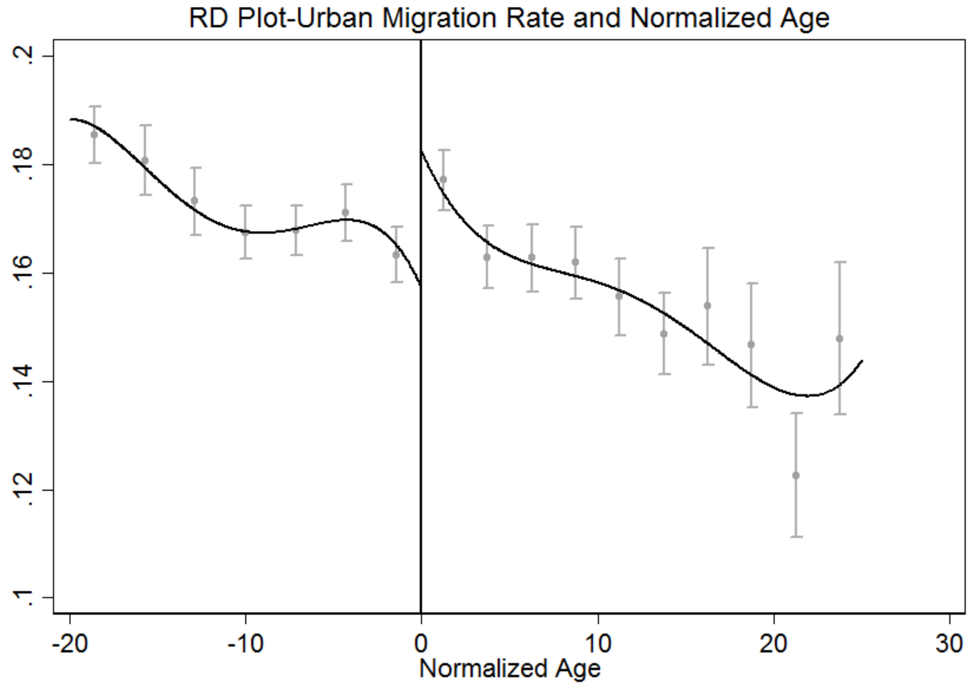


Figure 3 Urban migration rate and normalized age

Notes: we define people as migrants if they did not live in their *Hukou* registered place. Note that this definition of migration is a bit different from the official definition of migration in China, the latter of which excludes people who have lived away from their *Hukou* registered place for less than 6 months. The bin is selected based on the IMSE-optimal evenly-spaced method of Calonico, Cattaneo, and Titiunik 2014b.

## 4 Assessing the causal effects of retirement on migration

### 4.1 Simple regression model

Our aim is to estimate the causal effect of retirement on migration decisions, or the probability of moving away from one's registered place. To this end, we start with a Linear Probability Model:

$$M_i = \tau R_i + X_i' \mathrm{B} + \varepsilon_i, \ (1)$$

where $M_i$ is the migration status of individual i, which is equal to one for a migrant and zero otherwise, $R_i$ is the dummy variable for the retirement decision, and $\tau$ is the causal effect of retirement on the outcome variable. The vector $X_i'$ contains predetermined variables such as gender, age polynomials[11], education, marital status and ethnicity. Since retirement decisions might be endogenous to the propensity to migrate, the OLS estimates are biased which is the reason for following an RD design.

### 4.2 Regression discontinuity design

To address the potential endogeneity of retirement decisions, we use a nonparametric fuzzy RD design. The RD design exploits the statutory retirement age as a source of exogenous variation in retirement decisions (Battistin et al. 2009; Li, Shi, and Wu 2015; Heller-Sahlgren 2017; Fitzpatrick and Moore 2018).

The treatment effect can be estimated as the ratio of the jump in the probability of migration $M$ and the jump in the probability of retirement at the statutory retirement age, as shown in Eq. (2)

$$\tau_{FRD} = \frac{\lim_{\varepsilon \downarrow 0} E[M|a=0+\varepsilon] - \lim_{\varepsilon \uparrow 0} E[M|a=0-\varepsilon]}{\lim_{\varepsilon \downarrow 0} E[R|a=0+\varepsilon] - \lim_{\varepsilon \uparrow 0} E[R|a=0-\varepsilon]}. \quad (2)$$

Here $a$ is the normalized age, i.e., the actual age minus the retirement age and $\tau_{FRD}$ is the local average treatment effect on compliers at the threshold point. In our context, it is the average change in the probability of migration for those who are induced to retire as a result of the statutory retirement age.

To estimate the parameter $\tau_{FRD}$, we choose nonparametric estimation to avoid

[11] We use quadratic and cubic polynomials because there is still an ongoing debate on the correct polynomial order to be included (Lee and Lemieux 2010; Gelman and Imbens 2018).

assuming a particular functional form of the assignment variable. We use the triangular kernel function to construct the local-polynomial estimators and use a data driven method to choose the bandwidth of the kernel function based on one common MSE-optimal bandwidth selector method (Calonico, Cattaneo, and Titiunik 2014).

With age as the running variable, assignment to treatment is inevitable as all individuals would eventually reach retirement age (age 60 for men and age 50 for women in this case). This gives rise to an "anticipation effect" which means that individuals who anticipate the change may behave in a certain way before treatment is provided (Lee and Lemieux 2010). In particular, older adults may delay migration until after retirement, which may accentuate the size of the discontinuity. A common practice to address this problem is to conduct a donut-hole RD to reduce this concern (Barreca et al. 2011; Shigeoka 2014).

### 4.3 Validity tests

A valid fuzzy RD design relies on two main assumptions in our context. The first assumption requires a discontinuity in the probability of retirement at the threshold point. Figure 2 shows that the retirement rate increases significantly (by about 20 percentage points) at the statutory retirement ages for urban residents. As expected, there is no jump of the retirement rate at the threshold for rural residents (Figure A2). These results are consistent with the fact that the statutory retirement ages mainly apply to urban residents.

The second assumption requires continuity in potential outcomes as a function of the assignment variable around the threshold. This implies that in the absence of retirement, the probability of migration should not change at the threshold. In other words, “all other factors” driving migration must be continuous at the threshold point. Following Imbens and Lemieux (2008), we conduct several tests to check this assumption. First, we test the hypothesis that all covariates are continuous at the statutory retirement ages. Second, we test whether there is a discontinuity in the density of the assignment variable using the manipulation test proposed by Cattaneo, Jansson, and Ma (2018). All the test results justify the validity of the RD design. Details on these test results can be found in the appendix.

### 4.4 Main results

We start with OLS estimation using different model specifications. However, since OLS estimates are likely to be biased, we only report the results in the appendix. We find that the coefficient of retirement is close to zero, i. e., the OLS estimates do not reveal a significant relationship between retirement and migration. To address endogeneity concerns and isolate the causal effect of retirement, we next apply the described fuzzy RD design and report the results in Table 1. Columns 1 and 2 show the RD estimates using the optimal bandwidth. We find that the migration probability increases significantly after retirement. According to the bias-corrected RD estimates, retirement increases the probability of migration by 12.9 percentage points. Column 2 presents additional results by including covariates such as education and ethnicity. Including covariates is not necessary for unbiased inference under the assumptions of an RD design. However, adding covariates to the estimation is useful for: 1) eliminating small sample imbalances in observed variables that are correlated with the threshold; and 2) improving the precision of the causal RD estimates. Our main results are still robust when including covariates.

Columns 3-5 use alternative bandwidths to address concerns that data-driven criteria for an optimal choice of the bandwidth might be suboptimal or cannot be applied for categorical outcomes (Xu 2017). Taking 50%, 75%, 125%, and 150% of the bandwidth used in the benchmark model, we still find consistent evidence that retirement encourages migration. In addition, we find that the standard errors become larger when using smaller bandwidths, suggesting a bias-variance trade-off when selecting bandwidths. Reassuringly, the results of an alternative instrumental variable approach (see below) are consistent with the results based on the RD design.

[Table 1]

Table 1 Causal impact of retirement on migration decisions

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Conventional | 0.116 | 0.115 | 0.140 | 0.117 | 0.104 | 0.089 |
| | (0.032) | (0.032) | (0.055) | (0.041) | (0.028) | (0.026) |
| Robust | 0.129 | 0.129 | 0.165 | 0.143 | 0.132 | 0.134 |
| | (0.036) | (0.036) | (0.080) | (0.060) | (0.042) | (0.038) |
| Bandwidth | 4.6 | 4.6 | 2.3 | 3.4 | 5.7 | 6.9 |
| Covariates | NO | YES | YES | YES | YES | YES |
| Observations | 228,855 | 228,855 | 228,855 | 228,855 | 228,855 | 228,855 |

Notes: This table shows the impact of retirement on migration decisions using the RD design. Conventional outcomes refer to RD estimates with conventional variance estimator. Robust outcomes refer to RD estimates with robust variance estimator (Calonico, Cattaneo, and Titiunik 2014b, 2014a). Column 1 reports the baseline model results. Column 2 reports the RD estimates by controlling for covariates such as education, ethnicity and marriage status. Columns 1-2 select the bandwidth based on the MSE-optimal bandwidth selector (Calonico, Cattaneo, and Titiunik 2014b). Columns 3-6 take 50%, 75%, 125% and 150% of the optimal bandwidth, respectively. Standard errors are in parentheses.

As we discussed earlier, there is a potential bias in estimating the impact of retirement on migration decisions, largely due to the “anticipation effect”. To partially account for this effect, we run a donut-hole RD by excluding a few months of observations around the threshold (Barreca, Lindo, and Waddell 2016). There is no guideline for choosing the size of the “donut-hole” statistically or economically because it is often not clear what magnitude of delay is reasonable to expect. Thus, we first experiment with small “donut-hole” sizes ranging from zero to six months. As is shown in Table 2, the RD estimates are qualitatively unchanged though larger standard errors are observed as the donut-hole expands. When further increasing the size of the "donut-hole", shown in Figure 4, we find evidence that the point estimates are relatively stable up to 23 months. However, when the size of the "donut-hole" reaches 24 months and above, we find a reduction of the point estimates towards zero, likely due to the fact that too many observations (about 40% of the bandwidth) are excluded which will "undermine the virtue of the RD design" (Shigeoka 2014). Nonetheless, the "donut-hole" results show that the RD estimates are not sensitive to the "anticipation effect", which makes it unlikely that the increased migration after retirement can be attributed solely to the "anticipation effect".

[Table 2]

Table 2 Estimates from the donut-hole RD

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Conventional | 0.099 | 0.108 | 0.108 | 0.100 | 0.088 | 0.088 | 0.105 |
| | (0.031) | (0.034) | (0.034) | (0.035) | (0.063) | (0.063) | (0.082) |
| Robust | 0.110 | 0.120 | 0.120 | 0.112 | 0.086 | 0.086 | 0.100 |
| | (0.035) | (0.037) | (0.037) | (0.039) | (0.077) | (0.077) | (0.100) |
| Size of Donut-hole | zero month | one month | two months | three months | four months | five months | six months |
| Observations | 228,073 | 226,853 | 226,853 | 224,536 | 223,399 | 223,399 | 221,296 |

Notes: This table shows the estimates from the donut-hole RD design by excluding observations around the threshold. Column 1 shows estimates by removing observations at the threshold, or the statutory retirement age. Column 2 shows estimates by removing observations of one month around the threshold from either side of the statutory retirement age. Columns 3-7 each show the estimates by removing one more month around the threshold from either side of the statutory retirement age. Standard errors in parentheses.

[Figure 4]

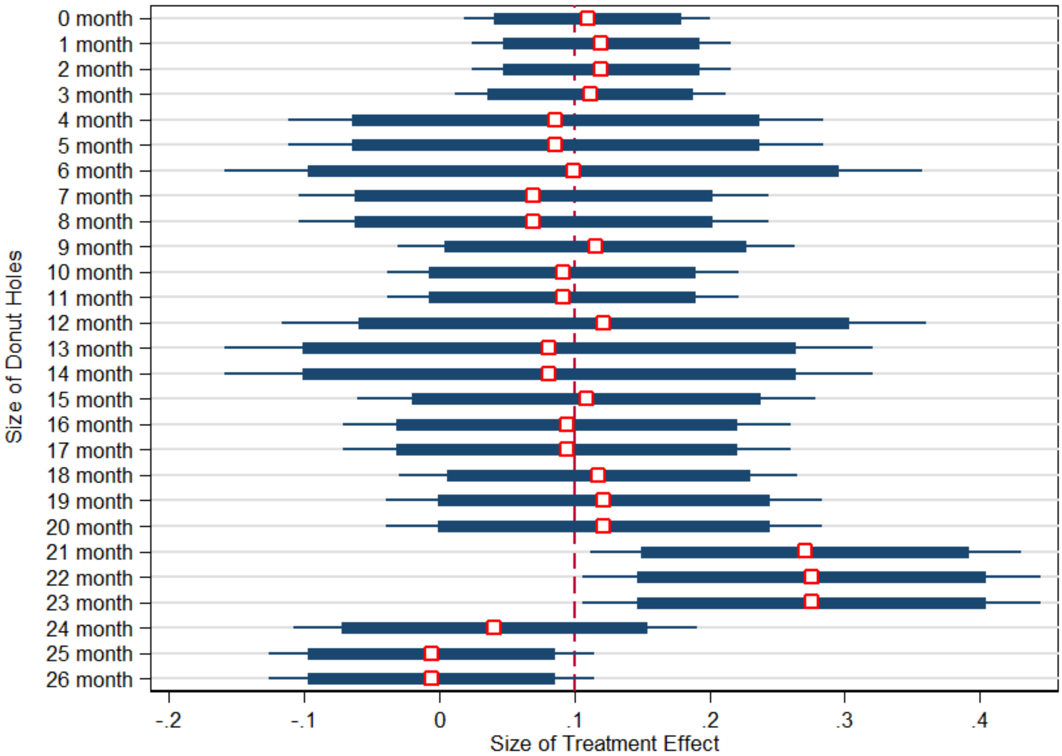


Figure 4 Donut-holes approach

Notes: The "donut-hole" sizes range from 0 to 26 months. The markers show the point estimates using different "donut-hole" sizes. Confidence spikes are reported for 99% and 95% confidence intervals. The vertical dash line refers to an average treatment effect of 10 percentage points.

Given the fact that the donut-hole RD approach does not rule out the possibility that there is some degree of inter-temporal substitution of migration, or "delayed migration" in our context, the extent to which we can interpret the local average treatment effect as the net effect of retirement is a priori uncertain. While the donut-hole RD estimate strengthens the causal interpretation of the average treatment effect, it cannot be used to decompose the overall treatment effect into the part of migration that is caused by inter-temporal substitution and the net effect of retirement on migration.

To decompose the overall effect by assessing the importance of inter-temporal substitution of migration, we resort to a bunching approach. In so doing, we follow Ehrlich and Seidel (2018) and compare the observed migration rate over the normalized age to a counterfactual distribution calculated as if there was no statutory retirement. This allows us to infer the extent to which people delay migration when approaching retirement.

We follow the conventional method, compute the migration rate over normalized age, assign observations to evenly spaced bins (Calonico, Cattaneo, and Titiunik 2015), and depict the local averages by bin against the distance from the treatment threshold. Figure 5 illustrates the idea, where the dots represent the observed migration rate in each bin. The dashed curve depicts the counterfactual distribution of the migration rate obtained by fitting a flexible polynomial to the observed distribution, excluding observations within a range of 24 months around the statutory retirement age, and extrapolating the fitted distribution.[12] We also fit the distribution of the observed migration rate on both side of the statutory retirement age separately as represented by the solid curves.

Two insights can be derived from this analysis. First, the intersections of the solid and dashed curves provide an estimate of the overall time horizon for migration reallocation. From Figure 5, we can see that reallocation starts approximately 2 years prior to the statutory retirement age and reaches to approximately 4 years after the statutory retirement age, implying reallocation happens over a period of approximately 6 years. Second, the difference between the observed and the counterfactual distributions (areas between the dashed and solid lines) provides us with an estimate of the associated mass of reallocated migration (Ehrlich and Seidel, 2018). We find that the missing mass on

[12] Results with an even larger range (e.g. 4 years) are very similar and are presented as robustness checks in the appendix.

the left side of the statutory retirement age accounts for approximately 38% (with 90% confidence interval between 36% and 42%) of the additional mass on the right side of the statutory retirement age. We interpret these results as evidence for substantial inter-temporal substitution of migration. That being said, the net migration effect of retirement is still dominant and accounts for 62% of the migration effects.

[Figure 5]

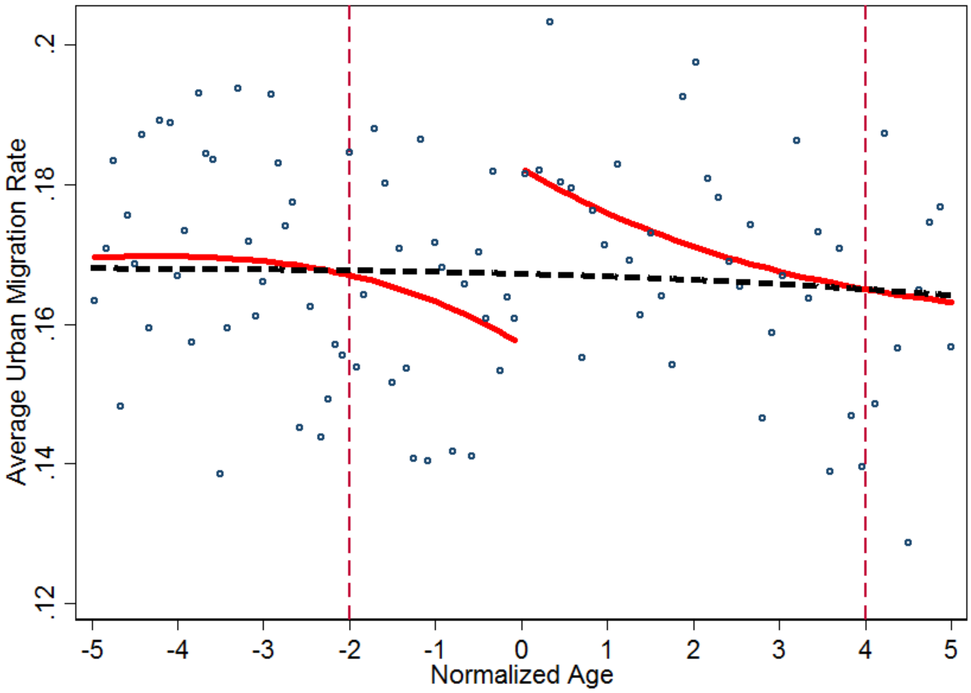


Figure 5 Bunching approach: average urban migration rate over normalized age

Notes: Observations are assigned to equally sized bins, where the dots illustrate local averages of the urban migration rate within bins. The bin is selected based on the IMSE-optimal evenly-spaced method of Calonico, Cattaneo, and Titiunik 2014b. The dashed line illustrates the estimated counterfactual distribution. The solid lines represent flexible polynomials fitted separately on both sides of the treatment threshold. Note that we drop observations in a range of 2 years around the treatment threshold to draw the counterfactual distribution of the urban migration rate.

## 4.5 Robustness checks

To further assess the robustness of our results, we considered the following changes. First, following Lee and Card (2008), we use standard errors clustered by the running variable to check whether our results are robust when allowing for a discrete running variable. We report the estimation results in Table 3. We do not find substantial changes, suggesting that our main results are robust even for a discrete running variable. Second, we use an instrumental variable approach to estimate the impact of retirement on migration decisions. We restrict the final sample based on the benchmark bandwidth and construct the instrumental variable based on whether an individual is eligible for retirement. The IV estimation results are shown in Table 4. We find that retirement increases the probability of migration by 11 percentage points, which is consistent using different model specifications. Therefore, our main results are robust with respect to the estimation approach adopted. Finally, we conduct two different placebo regressions. The first uses different placebo age thresholds, before and after the statutory retirement ages (shown in Table 5a). The second uses the sample of the rural population that is not affected by the statutory retirement ages (shown in Table 6a). Unsurprisingly, we do not find significant effects of retirement on migration decisions using both placebo analyses, further strengthening our main results that retirement is indeed an important causal driver of migration decisions. Given the fact that the denominator of the discontinuity estimand is nearly zero, making the point estimates largely imprecise, we also check the potential discontinuity at the artificial cut-offs without diving by the change in the probability of retirement (the reduced form), and our results are generally robust (Results are shown in Tables 5b and 6b.

[Tables 3-6]

Table 3 Impact of retirement on migration decisions by considering discrete running variable

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Conventional | 0.115 | 0.115 | 0.140 | 0.117 | 0.104 | 0.089 |
| | (0.033) | (0.034) | (0.060) | (0.044) | (0.031) | (0.028) |
| Robust | 0.129 | 0.129 | 0.165 | 0.143 | 0.132 | 0.134 |
| | (0.038) | (0.039) | (0.079) | (0.061) | (0.044) | (0.040) |
| Bandwidth | 4.6 | 4.6 | 2.3 | 3.4 | 5.7 | 6.9 |
| Covariates | NO | YES | YES | YES | YES | YES |
| Observations | 228,855 | 228,855 | 228,855 | 228,855 | 228,855 | 228,855 |

Notes: This table shows the impact of retirement on migration decisions using the RD design by considering the risks caused by a discrete running variable (Lee and Card 2008). Column 1 reports the baseline model results. Column 2 reports the RD estimates by controlling for covariates such as education and ethnicity. Columns 1-2 select the bandwidth based on the MSE-optimal bandwidth selector (Calonico, Cattaneo, and Titiunik 2014b). Columns 3-6 take 50%, 75%, 125% and 150% of optimal bandwidth, respectively. Standard errors are clustered by the age variable and are reported in parentheses.

Table 4 Impact of Retirement on migration decisions using the IV approach

| | (1) | (2) | (3) |
|---|---|---|---|
| | IV | IV | IV |
| Retirement | 0.114 | 0.116 | 0.113 |
| | (0.026) | (0.026) | (0.027) |
| Observations | 63823 | 63823 | 63823 |

Notes: This table shows the impact of retirement on migration decisions using the IV approach. The instrumental variable takes the value 1 when the normalized age is equal to zero and above, and takes the value 0 otherwise. Column 1 controls for variables such as age, gender, education, ethnicity, and marriage status. Column 2 further controls for $Age^2$ and Column 3 further controls for $Age^3$. Samples are restricted based on the benchmark bandwidth (-4.6 to 4.6). Standard errors are in parentheses.

Table 5a Impact of retirement on migration decisions using alternative age cut-offs

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Conventional | -2.896 | -0.039 | 0.249 | -0.279 | -0.369 | -0.049 |
| | (5.915) | (0.087) | (0.437) | (0.443) | (0.257) | (0.158) |
| Robust | 3.525 | -0.055 | 0.195 | -0.082 | -0.302 | -0.037 |
| | (6.368) | (0.096) | (0.506) | (0.472) | (0.273) | (0.171) |
| Age cut-offs | -0.5 | 0.5 | -1 | 1 | -2 | 2 |
| Observations | 228,855 | 228,855 | 228,855 | 228,855 | 228,855 | 228,855 |

Notes: This table conducts placebo analyses using alternative age cut-offs to estimate the impact of retirement on migration decisions. The age cut-off for the benchmark model is 0. Columns 1 and 2 use -0.5 and 0.5 to conduct placebo analyses, Columns 3 and 4 use -1 and 1 to conduct placebo analyses, and Columns 5 and 6 use -2 and 2 to conduct placebo analyses. We select the bandwidth based on one common MSE-optimal bandwidth selector. Covariates are excluded. Standard errors are in parentheses.

Table 5b Reduced form results using alternative age cut-offs (reduced form results)

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Conventional | 0.019 | 0.002 | 0.002 | 0.007 | 0.001 | -0.001 |
| | (0.007) | (0.005) | (0.007) | (0.005) | (0.007) | (0.006) |
| Robust | 0.021 | 0.001 | 0.001 | 0.008 | 0.001 | -0.000 |
| | (0.008) | (0.006) | (0.008) | (0.006) | (0.008) | (0.007) |
| Age cut-offs | -0.5 | 0.5 | -1 | 1 | -2 | 2 |
| Observations | 228,855 | 228,855 | 228,855 | 228,855 | 228,855 | 228,855 |

Notes: This table conducts placebo analyses on reduced form results using alternative age cut-offs. The age cut-off for the benchmark model is 0. Columns 1 and 2 use -0.5 and 0.5 to conduct placebo analyses, Columns 3 and 4 use -1 and 1 to conduct placebo analyses, and Columns 5 and 6 use -2 and 2 to conduct placebo analyses. We select the bandwidth based on one common MSE-optimal bandwidth selector. Covariates are excluded. Standard errors are in parentheses.

Table 6a Impact of retirement on migration decisions using the rural samples

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Conventional | 1.178 | 1.025 | -9.944 | 3.409 | 0.392 | 0.112 |
| | (3.694) | (2.651) | (76.294) | (12.075) | (1.385) | (0.583) |
| Robust | 2.270 | 1.870 | 20.520 | 17.626 | 1.891 | 0.293 |
| | (4.145) | (3.019) | (116.338) | (17.902) | (2.023) | (0.855) |
| Bandwidth | 2.4 | 2.4 | 1.2 | 1.8 | 3.1 | 5 |
| Covariates | NO | YES | YES | YES | YES | YES |
| Observations | 493,640 | 493,640 | 493,640 | 493,640 | 493,640 | 493,640 |

Notes: This table conducts the placebo analyses in the sample of rural people to estimate the impact of retirement on migration decisions using the RD design. Columns 1-2 select the bandwidth based on one common MSE-optimal bandwidth selector. Column 1 reports the benchmark model results. Column 2 reports the RD estimates by controlling for covariates such as education and ethnicity. Columns 3-6 take 50%, 75%, 125% and 150% of benchmark bandwidth, respectively. Standard errors are in parentheses.

Table 6b Reduced reform results using the rural samples

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Conventional | 0.000 | 0.000 | 0.003 | 0.002 | 0.001 | 0.000 |
| | (0.002) | (0.002) | (0.004) | (0.003) | (0.002) | (0.002) |
| Robust | 0.000 | 0.001 | 0.007 | 0.004 | 0.002 | 0.001 |
| | (0.003) | (0.003) | (0.006) | (0.005) | (0.003) | (0.003) |
| Bandwidth | 2.4 | 2.4 | 1.2 | 1.8 | 3.1 | 5 |
| Covariates | NO | YES | YES | YES | YES | YES |
| Observations | 493,640 | 493,640 | 493,640 | 493,640 | 493,640 | 493,640 |

Notes: This table conducts the placebo analyses on the reduced form results using the sample of rural people. Columns 1-2 select the bandwidth based on one common MSE-optimal bandwidth selector. Column 1 reports the benchmark model results. Column 2 reports the RD estimates by controlling for covariates such as education and ethnicity. Columns 3-6 take 50%, 75%, 125% and 150% of benchmark bandwidth, respectively. Standard errors are in parentheses.

## 5 Who is more likely to migrate after retirement?

### 5.1 Subgroups

We have shown that retirement increases migration significantly. This section explores further who is more likely to migrate after retirement. Specifically, we investigate the impact of retirement on migration decisions by gender, education groups, whether the individual has access to social security, and the type of registered place. The education level is categorized as low (highest degree achieved includes primary school, junior high school, and senior high school), or high (highest degree achieved includes vocational school, "two-/three-year college/associate degree", "four-year undergraduate/bachelor degree", master degree, or doctoral degree). In addition, we use the following questions to determine access to social security: "do you have medical insurance?" and "do you have pension?" If an individual answers with "yes" to either one of these questions, s/he will be categorized as having access to social security. Finally, we use the following question to determine the type of registered place: "what's your type of registered place?" If an individual answers with urban (rural), s/he will be a migrant registered in urban (rural) areas.

### 5.2 Main Results

Table 7 shows the results by subgroups. We find that the causal effects of retirement on migration vary significantly across gender. First, while retirement increases the probability of migration for men by 27 percentage points (Column 1), the increase is much smaller for women (Column 2). Second, retirement has a large and significant effect for the low-educated group, yet only a moderate and insignificant effect for the high-educated group (Columns 3 and 4) suggesting that migration after retirement mainly occurs among lower-educated people. Third, retirement has a larger effect on migration for people who do not have access to social security than for those who do (Columns 5-8). Specifically, retirement leads to an increase of 39 percentage points in the probability of migration for individuals with no access to pension. By contrast, we find a much smaller impact of retirement on the migration probability when retirees have access to pension. Finally, we find retirement results in a significant increase in the migration probability for individuals who are registered in urban areas (Column 9). We do not find significant evidence that retirement results in more migration from rural areas (Column 10). To summarize, retirement-induced migrants are mainly from urban areas, they are typically less well educated, and they are more likely to suffer from restricted access to social security.

[Table 7]

Table 7 Heterogeneous effects of retirement on migration

| VARIABLES | (1) Male | (2) Female | (3) College | (4) No College | (5) Pension | (6) No Pension | (7) Medical Insurance | (8) No Medical Insurance |
|---|---|---|---|---|---|---|---|---|
| Conventional | 0.242 | 0.075 | 0.050 | 0.134 | 0.079 | 0.346 | 0.086 | 0.218 |
| | (0.110) | (0.041) | (0.101) | (0.036) | (0.033) | (0.136) | (0.033) | (0.077) |
| Robust | 0.277 | 0.073 | 0.050 | 0.150 | 0.093 | 0.395 | 0.098 | 0.248 |
| | (0.127) | (0.049) | (0.123) | (0.040) | (0.039) | (0.156) | (0.038) | (0.085) |
| Observations | 133,422 | 95,433 | 43,470 | 185,385 | 166,779 | 62,076 | 166,990 | 61,865 |

| VARIABLES | (9) Urban migration | (10) Rural migration | (11) Labor migration | (12) Family migration | (13) Other migration | (14) Household migration | (15) Individual migration |
|---|---|---|---|---|---|---|---|
| Conventional | 0.108 | 0.008 | 0.003 | 0.101 | 0.002 | 0.160 | 0.015 |
| | (0.030) | (0.009) | (0.015) | (0.025) | (0.013) | (0.072) | (0.038) |
| Robust | 0.119 | 0.011 | 0.007 | 0.110 | 0.001 | 0.190 | 0.004 |
| | (0.034) | (0.010) | (0.016) | (0.029) | (0.016) | (0.080) | (0.046) |
| Observations | 228,855 | 228,855 | 228,855 | 228,855 | 228,855 | 152,004 | 152,004 |

Notes: This table shows the causal effects of retirement on migration by subgroups using the RD design. Conventional outcomes refer to RD estimates with conventional variance estimator. Robust outcomes refer to RD estimates with robust variance estimator (Calonico, Cattaneo, and Titiunik 2014b, 2014a). Columns 1 and 2 report the effects of retirement on migration for men and women, respectively. Columns 3 and 4 report the effects of retirement on migration for individuals with and without college degree (and above). Columns 5 and 6 report the effects of retirement on migration for individuals with and without pension. Columns 7 and 8 report the effects of retirement on migration for individuals with and without medical insurance. Column 9 reports the impact of retirement on migration from urban areas. Column 10 reports the impact of retirement on migration from rural areas. Column 11 reports the impact of retirement on work relevant migration. Column 12 reports the impact of retirement on family relevant migration. Column 13 reports the impact of retirement on other migration. Column 14 reports the impact of retirement on migration with partner. Column 15 reports the impact of retirement on migration without partner. We select the bandwidth based on MSE-optimal bandwidth selector. Covariates are excluded. Standard errors are in parentheses.

## 6 Why does migration rebound after retirement?

As we have discussed above, urban vulnerable people (e.g., the less well educated with restricted access to social security) are more likely to choose migration after retirement. However, it is still unclear why migration rebounds after retirement, a pattern we can see clearly in Figure A1 in the appendix. In particular, it is puzzling that men's migration decisions are more responsive to retirement as compared with women.

To shed more light on this, we investigate the migration motives after retirement in more detail. We resort to the following question in the questionnaire to define migration motives: why did you live away from your registered place? In general, there are three types of migrants categorized by migration motives: labor migrants, family migrants, and other migrants. We define labor migrants as individuals who migrate for work-related reasons (e.g., people migrate to another place to find a job). We define family migrants as individuals who migrate for family-related reasons (e.g., people migrate to another place to live with their children, spouse, relatives, etc.). When an individual migrates for neither work-related reasons nor family-related reasons, s/he is categorized as other migrant. We investigate which type of migration is actually induced by retirement. Table 7 shows the corresponding RD results. We find that retirement encourages migration for family-related reasons significantly (Column 11). By contrast, we do not find significant evidence that retirement affects migration for work-related reasons (Column 12) and for other reasons (Column 13). Therefore, retirement migration is largely driven by family-related motivations.

So why does migration rebound after retirement? One motivation for migration comes from the consideration of future incomes. For example, reductions in income and rising income uncertainty after retirement may encourage people to migrate to get better financial support from other family members or to reduce living expenses. Table 8 shows the RD estimates on the impact of retirement on income-related outcomes. The results show that both income and working time decrease strongly after retirement (Columns 1-6). We also find that retirement leads to a higher dependence on pension as the main source of living expenses (Columns 7-9). Moreover, we have shown before that the retirement impact on migration is larger for individuals with no access to pension. Therefore, these findings suggest that retirees migrate to insure against reductions in income after retirement.

[Table 8]

An alternative motivation is that people migrate to insure against their rising health risks after retirement. Existing studies suggest that retirement increases healthcare utilization in China (Zhang, Salm, and van Soest 2018). In the presence of inadequate public healthcare, people may resort to their family members for informal healthcare, particularly when retirement increases their demand for healthcare. This is consistent with our previous findings that vulnerable people who have limited access to public healthcare services are more likely to migrate upon retirement. To make these arguments more convincing, we explore the impact of retirement on self-reported health further, as shown in Table 8.[13] We find that retirement deteriorates health significantly (Columns 10-12). Specifically, retirement leads to a 0.11 unit change in heath on a 1-3 scale. The results are robust against using an alternative health indicator (Columns 13-

[13] The indicator of self-reported health takes the value of one for people in good health, the value of two for people with fair health, and the value of three for people with bad health.

15)[14] and the large health impact of retirement for men is consistent with previous findings (Lei, Tan, and Zhao 2011; Fitzpatrick and Moore 2018). Therefore, these findings suggest that increasing health risks after retirement induce retirees to migrate to live with their families.

While both reductions in income and increased health risks may partly explain the rebounding migration after retirement, it is still puzzling why retirement migration is stronger for men than for women. One possibility is that retirement results in larger reductions in income and higher health risks for men relative to women. While a larger negative health impact of retirement is indeed found for men relative to women (Columns 10-15), we failed to find significant differences in the impacts of retirement on income and the main sources of living expenses across gender (Columns 1-9). Therefore, the heterogeneous income and health impacts of retirement across gender cannot fully explain the larger migration impact of retirement for men.

An alternative explanation is that migration decisions of older individuals are made at the household level. With the large gap between retirement ages for men and women, even though a woman has reached her retirement age, her husband may not have reached his retirement age, and as a result, she may choose to wait to migrate until her husband can retire and migrate as well. To verify this argument, we restrict our sample to individuals who can be matched with their partners. To increase the sample size, we also include individuals who did not engage in paid work for reasons such as being

[14] When using an alternative indicator of good health, which equals to one for good health and zero otherwise, we find retirement decreases the probability of good health by 20 and 4 percentage points for men and women, respectively.

students, being unemployed, and other reasons. Our final sample size is 152,004. To examine the impact of retirement on migration decisions at the household level, we also redefine the retirement age as the one of the spouse with the later retirement date. We define household-level migration as the situation in which both partners migrate and individual-level migration as the situation in which one partner is left behind. The main results are reported in Columns 14-15 of Table 7. We find that retirement results in a significant 19 percentage points increase in the migration probability at the household level. By contrast, we do not find a significant impact of retirement on the migration propensity at the individual level. Therefore, the various migration responses after retirement across gender can be reconciled by migration decisions being made at the household level rather than at the individual level.

Finally, we test a competing explanation that retirees may migrate to the receiving households (e.g. their children's households) to support their families (e.g. looking after grandchildren etc.). The main hypothesis here is that labor supply of the receving households would increase if retirees migrate to support their families, due to re-allocation of working time from home production to market production. By contrast, we should witness decreasing labor supply of workers in the receiving households if retirees' migration decisions are driven by risk sharing and family protection mechanisms because families in the receiving households will take more time for home production (e.g. look after the older adults).

We restrict our sample to individuasl who can be matched with their children or children-in-law. The final sample size is 133,914. We resort to two indicators for our main analyses: the labor market participation decision and working hours per week.

The main results are reported in Table 9. We find that parental retirement does not have any significant impact on the labor market participation decision of their children (-in-law). However, parental retirement significantly decreases (weekly) working hours of their children (-in-law) in the labor market. Specifically, parental retirement decreases working hours of their children (-in-law) by 16%. We also find a larger impact of parental retirement on labor supply of daughters (-in-law), suggesting that daughters (-in-law) may take on more responsibilities related to care for older adults which is consistent with social norms in China. All these results strengthen our argument that retirees migrate for risk sharing and family protection rather than to support their families such as looking after grandchildren.

[Table 9]

Overall, reductions in future incomes and increased health risks are two possible explanations for rebounding migration after retirement. The heterogeneous retirement effects on migration across gender can be well reconciled with the household-level migration decisions after retirement. To summarize, unlike labor migration, which is usually related to income motives among people from rural China, retirement-induced migration seems to take place predominantly among people from urban China to insure against both reductions in income and increased health risks, at the expense of reducing market production of their families in the receiving households.

Table 8 Impact of retirement on other outcomes

| VARIABLES | (1) Income | (2) Male | (3) Female | (4) Working Hours | (5) Male | (6) Female | (7) Pension as main sources of living | (8) Male | (9) Female |
|---|---|---|---|---|---|---|---|---|---|
| Conventional | -6.769 | -7.149 | -6.678 | -3.631 | -3.628 | -3.656 | 1.061 | 1.121 | 1.016 |
| | (0.056) | (0.181) | (0.092) | (0.030) | (0.132) | (0.064) | (0.015) | (0.049) | (0.021) |
| Robust | -6.800 | -7.145 | -6.725 | -3.632 | -3.634 | -3.657 | 1.058 | 1.135 | 1.009 |
| | (0.068) | (0.198) | (0.105) | (0.036) | (0.145) | (0.069) | (0.018) | (0.059) | (0.023) |
| Observations | 228,855 | 133,422 | 95,433 | 228,855 | 133,422 | 95,433 | 228,855 | 133,422 | 95,433 |

| VARIABLES | (10) Self-report Health | (11) Male | (12) Female | (13) Good Health | (14) Male | (15) Female |
|---|---|---|---|---|---|---|
| Conventional | 0.105 | 0.253 | 0.040 | -0.079 | -0.195 | -0.036 |
| | (0.034) | (0.123) | (0.020) | (0.022) | (0.102) | (0.023) |
| Robust | 0.115 | 0.263 | 0.049 | -0.092 | -0.206 | -0.041 |
| | (0.038) | (0.136) | (0.024) | (0.027) | (0.112) | (0.026) |
| Observations | 228,855 | 133,422 | 95,433 | 228,855 | 133,422 | 95,433 |

Notes: This table shows the impact of retirement on other outcomes using the RD design. Conventional outcomes refer to RD estimates with conventional variance estimator. Robust outcomes refer to RD estimates with robust variance estimator (Calonico, Cattaneo, and Titiunik 2014b, 2014a). Columns 1-3 report the impact of retirement on income in log using full, male only, and female only sample, respectively. Columns 4-6 report the impact of retirement on working hours in log using full, male only, and female only sample. Columns 7-9 report the impact of retirement on the probability of resorting to pension as main sources of living expenditures using full, male only, and female only sample. Columns 10-12 report the impact of retirement on self-reported health using full, male only, and female only sample. Columns 13-15 report the impact of retirement on the probability of having a good health using full, male only, and female only sample. We select the bandwidth based on MSE-optimal bandwidth selector. Covariates are excluded. Standard errors are in parentheses

Table 9 Impact of parental retirement on children (in-law)'s labor market outcomes

| VARIABLES | (1)<br>Parental migration decisions | (2)<br>Labor market participation decision | (3)<br>Weekly working hours | (4)<br>Son (in-law)'s weekly working hours | (5)<br>Daughter (-in-law)'s weekly working hours |
|---|---|---|---|---|---|
| Conventional | 0.144 | 0.031 | -0.151 | -0.139 | -0.169 |
| | (0.045) | (0.059) | (0.067) | (0.085) | (0.114) |
| Robust | 0.162 | 0.007 | -0.166 | -0.133 | -0.223 |
| | (0.048) | (0.071) | (0.075) | (0.103) | (0.137) |
| Observations | 133,914 | 133,914 | 57,033 | 30,932 | 26,101 |

Notes: This table shows the impact of parental retirement on children's labor market outcomes using the RD design. We use the same Census Survey data to conduct this analysis by restricting our samples to individuals who can be matched with their children (-in-law). Column 1 uses the restricted sample to estimate the impact of retirement on individuals' migration decisions. Column 2 shows the impact of retirement on children (in-law)'s labor market participation decision. Column 3 shows the impact of retirement on children (-in-law)'s weekly working hours. Column 4 shows the impact of retirement on son (in-law)'s weekly working hours. Column 4 shows the impact of retirement on daughter (in-law)'s weekly working hours. We select the bandwidth based on MSE-optimal bandwidth selector. Covariates are excluded. Standard errors are in parentheses.

## 7 Conclusion

To the best of our knowledge, this is the first study to examine the causal effects of retirement on migration decisions in China and in other low- and middle-income countries. In contrast to labor migration that decreases with increasing age, our findings suggest that the migration probability increases significantly upon retirement, especially for men. We also find that approximately 38% of the total migration effects are caused by intertemporal substitution (delayed migration). More importantly, the rebounding migration is dominated by vulnerable people who are less well educated and have less access to social security. While both reductions in future income and increasing health risks are possible explanations for rebounding migration after retirement, it is the household-level migration decision that can reconcile the various migration responses to retirement across gender. Unlike labor migration that is related predominantly to income motives among people from rural China, retirement-induced migration seems to take place among people from urban China to insure against both income and health shocks through better access to financial and healthcare support from family members.

Our finding that migration rebounds after retirement contrasts with the conventional wisdom that the migration propensity decreases as people get older. An important lesson to be taken from our study is that retirees are coping with reductions in future income and increased health risks through migration because migration increases their access to financial and healthcare support from family members, particularly when access to social security such as pension and healthcare are restricted. In addition, our study sheds light on the important interactions between retirement and migration policies, which have been largely ignored in the literature. According to our findings, restrictive migration policies would deteriorate the welfare of retirees, particularly for the vulnerable. By contrast, lower migration costs improve the welfare of retirees through better access to informal financial support and healthcare provided by family members, which is complementary to social security in coping with income and health risks upon retirement. Finally, our study sheds light on the labor market consequences of retirement-induced migration on receiving households. According to our findings, parental retirement significantly reduces market production of their children (-in-law) in the receiving households by 16%, even more so for daughters (-in-law). In other words, retirement-induced migration also acts as an important channel to impact labor supply decisions of the young population (Börsch-Supan 2013).

There are several limitations of this study. First, we cannot rule out the possibility that migration affects health, which may weaken the mechanisms discussed above. For example, when there is poor portability of social security such as medical insurance, migrants are subject to higher medical costs at the destination. These higher medical costs discourage healthcare utilization and in turn affect migrants' health negatively. These effects tend to be relatively large for migrants who have been previously covered by medical insurance in the origin region. However, we think that this issue is less problematic in our context because migration effects after retirement are more pronounced for those vulnerable people who have no access to social security to begin with. Second, we cannot simply extend our findings to rural China, which witnesses a more prominent internal migration but is hardly affected by the mandatory retirement policy.

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## Appendix

A1. Additional figures

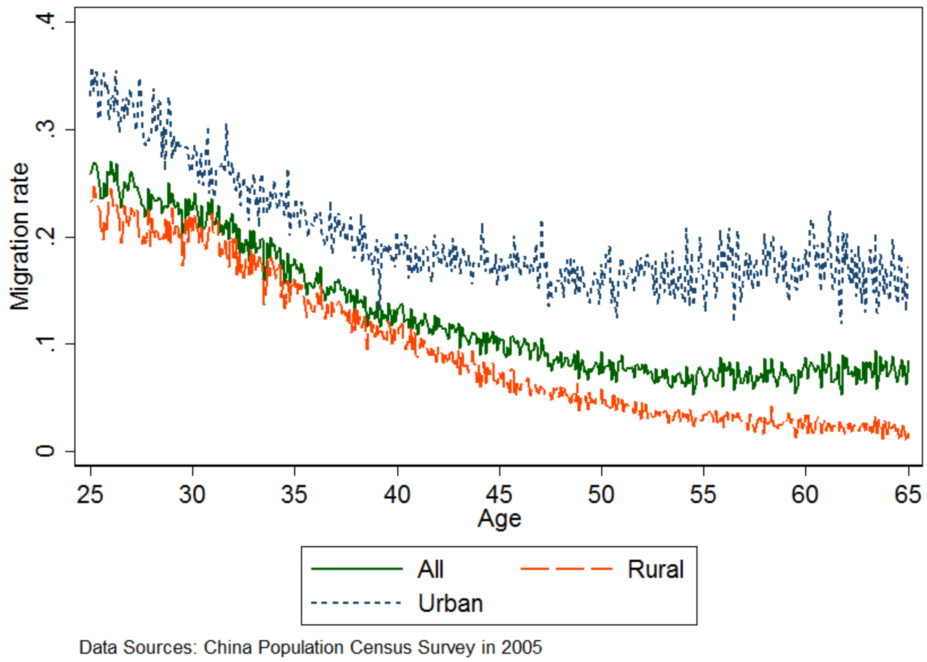


Figure A1 Age and migration rate by cohorts

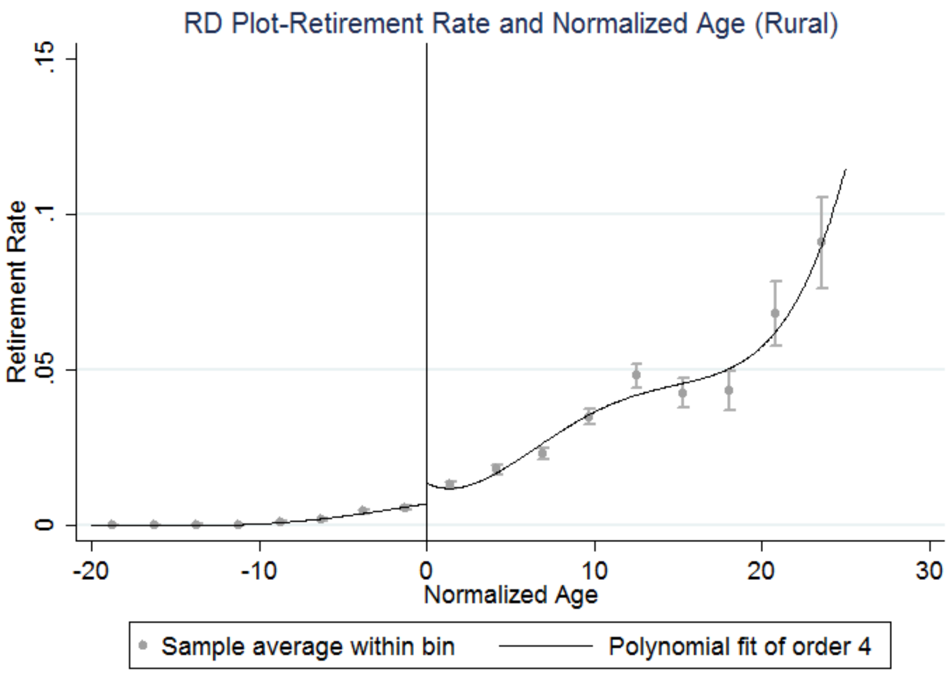


Figure A2 Retirement and age for rural people

Notes: The bin is selected based on IMSE-optimal evenly-spaced method based on (Calonico, Cattaneo, and Titiunik 2014b).

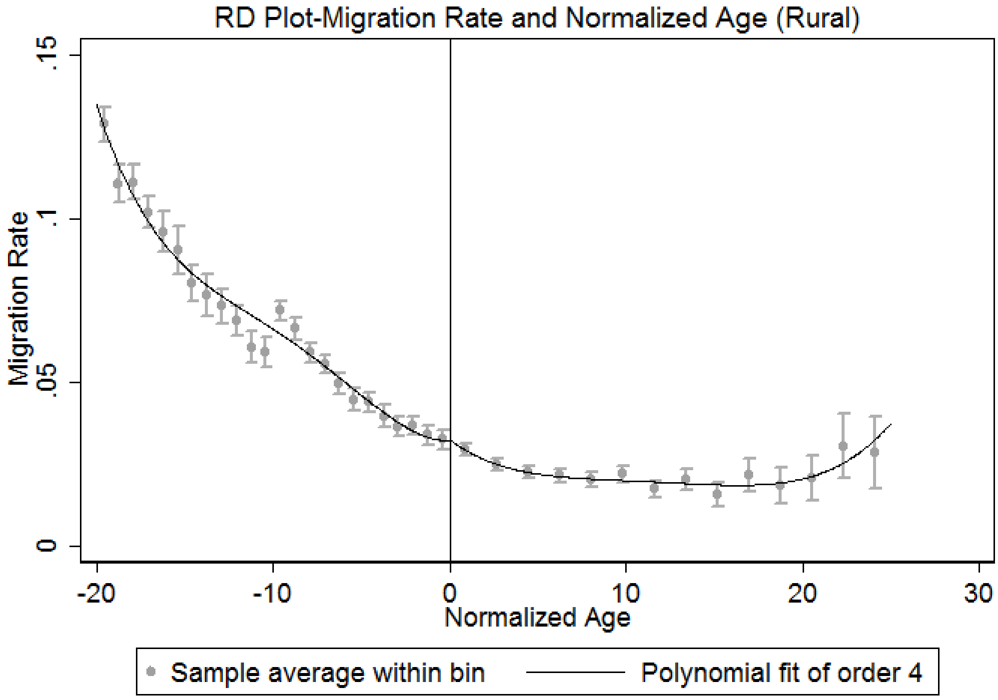


Figure A3 Retirement and migration for rural people

Notes: The bin is selected based on IMSE-optimal evenly-spaced method based on (Calonico, Cattaneo, and Titiunik 2014b).

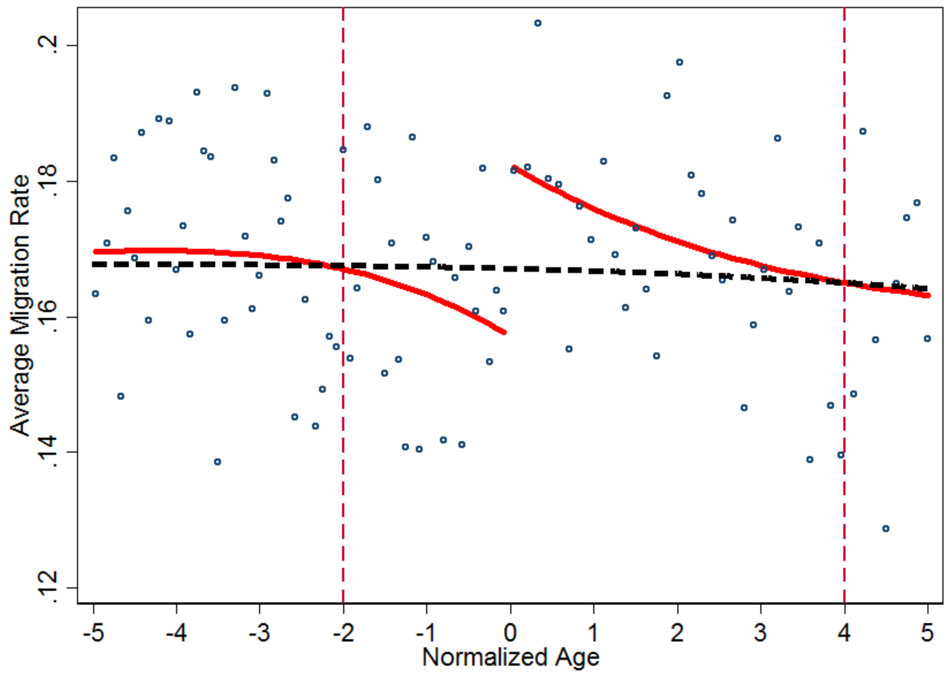


Figure A4 Bunching approach: average migration rate over normalized age

Notes: Observations are assigned to equally sized bins, where the dots illustrate local averages of the migration rate within bins. The bin is selected based on the IMSE-optimal evenly-spaced method of Calonico, Cattaneo, and Titiunik 2014b. The dashed line illustrates the estimated counterfactual distribution. The solid lines represent flexible polynomials fitted separately on both sides of the treatment threshold. Note that we drop observations in a range of 4 years around the treatment threshold to draw the counterfactual distribution of the migration rate.

## A2. Summary Statistics

Table A1 Summary Statistics

| VARIABLES | (1)<br>N | (2)<br>mean | (3)<br>min | (4)<br>max |
|---|---|---|---|---|
| Age | 228,855.00 | 53.46 | 40.00 | 75.00 |
| Normalized Age | 228,855.00 | -2.37 | -20.00 | 25.00 |
| Retirement(=0,1) | 228,855.00 | 0.42 | 0.00 | 1.00 |
| [0]Not retired | 228,855.00 | 0.58 | 0.00 | 1.00 |
| [1]Retired | 228,855.00 | 0.42 | 0.00 | 1.00 |
| Self-report health(=1,2,3,4) | 228,855.00 | 1.10 | 1.00 | 4.00 |
| [1]Good health | 228,855.00 | 0.91 | 0.00 | 1.00 |
| [2]Fair | 228,855.00 | 0.08 | 0.00 | 1.00 |
| [3]Bad | 228,855.00 | 0.01 | 0.00 | 1.00 |
| [4]Uncertain | 228,855.00 | 0.00 | 0.00 | 1.00 |
| Male(=0,1) | 228,855.00 | 0.58 | 0.00 | 1.00 |
| [0]Female | 228,855.00 | 0.42 | 0.00 | 1.00 |
| [1]Male | 228,855.00 | 0.58 | 0.00 | 1.00 |
| Education Degree(=1,2,3,4,5,6,7) | 228,855.00 | 3.54 | 1.00 | 7.00 |
| [1]No school | 228,855.00 | 0.03 | 0.00 | 1.00 |
| [2]Primary school | 228,855.00 | 0.15 | 0.00 | 1.00 |
| [3]Junior high school | 228,855.00 | 0.34 | 0.00 | 1.00 |
| [4]Senior high school | 228,855.00 | 0.29 | 0.00 | 1.00 |
| [5]Two-/three-year college/associate degree | 228,855.00 | 0.12 | 0.00 | 1.00 |
| [6]Undergraduate | 228,855.00 | 0.06 | 0.00 | 1.00 |
| [7]Master and above | 228,855.00 | 0.00 | 0.00 | 1.00 |
| Marriage Status(=1,2,3,4,5) | 228,855.00 | 2.20 | 1.00 | 5.00 |
| [1]Single | 228,855.00 | 0.01 | 0.00 | 1.00 |
| [2]Married | 228,855.00 | 0.89 | 0.00 | 1.00 |
| [3]Remarried | 228,855.00 | 0.03 | 0.00 | 1.00 |
| [4]Divorced | 228,855.00 | 0.02 | 0.00 | 1.00 |
| [5]Widowed | 228,855.00 | 0.04 | 0.00 | 1.00 |
| Medical Insurance(=0,1) | 228,855.00 | 0.73 | 0.00 | 1.00 |
| [0]No Medical Insurance | 228,855.00 | 0.27 | 0.00 | 1.00 |
| [1]With Medical Insurance | 228,855.00 | 0.73 | 0.00 | 1.00 |
| Pension(=0,1) | 228,855.00 | 0.73 | 0.00 | 1.00 |
| [0]No Pension | 228,855.00 | 0.27 | 0.00 | 1.00 |
| [1]With pension | 228,855.00 | 0.73 | 0.00 | 1.00 |
| Migrant(=0,1) | 228,855.00 | 0.17 | 0.00 | 1.00 |
| [0]Non-migrant | 228,855.00 | 0.83 | 0.00 | 1.00 |
| [1]Migrant | 228,855.00 | 0.17 | 0.00 | 1.00 |

Notes: Normalized age=age-60 for men and Normalized age=age-50 for women

Table A2 Summary statistics around the cut-off

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | -1<=age<0 | | 0<=age<1 | |
| VARIABLES | N | mean | N | mean |
| Age | 6,555.00 | 53.93 | 7,503.00 | 54.68 |
| Normalized Age | 6,555.00 | -0.55 | 7,503.00 | 0.45 |
| Retirement(=0,1) | 6,555.00 | 0.44 | 7,503.00 | 0.68 |
| [0]Not retired | 6,555.00 | 0.56 | 7,503.00 | 0.32 |
| [1]Retired | 6,555.00 | 0.44 | 7,503.00 | 0.68 |
| Self-report health(=1,2,3,4) | 6,555.00 | 1.06 | 7,503.00 | 1.09 |
| [1]Good health | 6,555.00 | 0.94 | 7,503.00 | 0.92 |
| [2]Fair | 6,555.00 | 0.05 | 7,503.00 | 0.07 |
| [3]Bad | 6,555.00 | 0.00 | 7,503.00 | 0.01 |
| [4]Uncertain | 6,555.00 | 0.00 | 7,503.00 | 0.00 |
| Male(=0,1) | 6,555.00 | 0.45 | 7,503.00 | 0.42 |
| [0]Female | 6,555.00 | 0.55 | 7,503.00 | 0.58 |
| [1]Male | 6,555.00 | 0.45 | 7,503.00 | 0.42 |
| Education Degree(=1,2,3,4,5,6,7) | 6,555.00 | 3.51 | 7,503.00 | 3.43 |
| [1]No school | 6,555.00 | 0.02 | 7,503.00 | 0.02 |
| [2]Primary school | 6,555.00 | 0.16 | 7,503.00 | 0.16 |
| [3]Junior high school | 6,555.00 | 0.35 | 7,503.00 | 0.40 |
| [4]Senior high school | 6,555.00 | 0.31 | 7,503.00 | 0.27 |
| [5]Two-/three-year college/associate degree | 6,555.00 | 0.11 | 7,503.00 | 0.10 |
| [6]Undergraduate | 6,555.00 | 0.05 | 7,503.00 | 0.05 |
| [7]Master and above | 6,555.00 | 0.00 | 7,503.00 | 0.00 |
| Marriage Status(=1,2,3,4,5) | 6,555.00 | 2.16 | 7,503.00 | 2.17 |
| [1]Single | 6,555.00 | 0.01 | 7,503.00 | 0.01 |
| [2]Married | 6,555.00 | 0.91 | 7,503.00 | 0.90 |
| [3]Remarried | 6,555.00 | 0.03 | 7,503.00 | 0.04 |
| [4]Divorced | 6,555.00 | 0.02 | 7,503.00 | 0.02 |
| [5]Widowed | 6,555.00 | 0.03 | 7,503.00 | 0.03 |
| Medical Insurance(=0,1) | 6,555.00 | 0.73 | 7,503.00 | 0.76 |
| [0]No Medical Insurance | 6,555.00 | 0.27 | 7,503.00 | 0.24 |
| [1]With Medical Insurance | 6,555.00 | 0.73 | 7,503.00 | 0.76 |
| Pension(=0,1) | 6,555.00 | 0.73 | 7,503.00 | 0.76 |
| [0]No Pension | 6,555.00 | 0.27 | 7,503.00 | 0.24 |
| [1]With pension | 6,555.00 | 0.73 | 7,503.00 | 0.76 |
| Migrant(=0,1) | 6,555.00 | 0.16 | 7,503.00 | 0.18 |
| [0]Non-migrant | 6,555.00 | 0.84 | 7,503.00 | 0.82 |
| [1]Migrant | 6,555.00 | 0.16 | 7,503.00 | 0.18 |

Notes: Normalized age=age-60 for men and Normalized age=age-50 for women

## A3. Alternative estimation results

Table A3 Impact of Retirement on migration decisions using the regression approach

| | (1)<br>OLS | (2)<br>OLS | (3)<br>OLS | (4)<br>OLS | (5)<br>OLS | (6)<br>Probit | (7)<br>Logit |
|---|---|---|---|---|---|---|---|
| Retirement | -0.009 | 0.004 | 0.004 | 0.001 | 0.006 | 0.006 | 0.006 |
| | (0.002) | (0.002) | (0.002) | (0.002) | (0.003) | (0.003) | (0.003) |
| Observations | 228855 | 228855 | 228855 | 228855 | 228855 | 228855 | 228855 |

Notes: This table estimates the impact of retirement on migration using different regression models. Column 1 shows the OLS estimate without control variables. Column 2 controls for age variables. Column 3 controls for quadratic polynomials of age. Column 4 controls for cubic polynomials of age. Column 5 further controls for other individual characteristics such as gender, education, ethnicity, and marriage status. Column 5 uses a Probit model and Column 6 uses a Logit model, with all variables controlled for. Standard errors are in parentheses.

## A4. Validity tests

### A4.1 Continuity tests

Table A4 Continuity tests for covariates

| | (1)<br>Primary | (2)<br>Non-primary | (3)<br>Han | (4)<br>Non-Han | (5)<br>Married | (6)<br>Unmarried |
|---|---|---|---|---|---|---|
| Conventional | 0.004 | 0.005 | -0.000 | -0.009 | -0.004 | 0.003 |
| | (0.036) | (0.032) | (0.029) | (0.024) | (0.018) | (0.018) |
| Robust | 0.016 | -0.009 | -0.002 | -0.007 | -0.004 | 0.003 |
| | (0.038) | (0.035) | (0.031) | (0.028) | (0.022) | (0.022) |
| Bandwidth | Data driven | Data driven | Data driven | Data driven | Data driven | Data driven |
| Observations | 228,855 | 228,855 | 228,855 | 228,855 | 228,855 | 228,855 |

Notes: This table shows continuity tests for covariates. Primary refers to people who did not attend junior high school and above. Non-primary refers to people who attended junior high school or above. Han refers to people with ethnicity of Han. Married refers to people in a marriage. Unmarried refers to people who are single, divorced or widowed. Standard errors are in parentheses.

### A4.2 Manipulation tests

We conduct the manipulation tests using the STATA command *rddensity* proposed by Cattaneo et al. (2018). The p-value of the final manipulation test is 0.3755. Therefore, there is no statistical evidence of systematic manipulation of the running variable.

## A5. Retirement and housing arrangements

Table A5 Retirement and housing arrangements

| | (1) | (2) | (3) |
|---|---|---|---|
| Conventional | 0.001 | 0.016 | 0.064 |
| | (0.031) | (0.118) | (0.187) |
| Robust | 0.004 | -0.015 | 0.056 |
| | (0.035) | (0.140) | (0.205) |
| Observations | 228,855 | 136,585 | 31,350 |

Notes: This table shows the impact of retirement on housing arrangements. We distinguish between people with house ownership and without house ownership (e.g. rent). Column 1 shows the impact of retirement on the probability of living in a house with ownership. Column 2 shows the impact of retirement on the costs of purchasing the house among people with house ownership. Column 3 shows the impact of retirement on the costs of renting the house among people without house ownership. Standard errors are in parentheses

## A6. Alternative definition of retirement

Table A6 Causal impact of retirement on migration decisions using an alternative definition of retirement

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Conventional | 0.116 | 0.115 | 0.140 | 0.117 | 0.104 | 0.089 |
| | (0.032) | (0.032) | (0.055) | (0.041) | (0.028) | (0.026) |
| Conventional | 0.109 | 0.109 | 0.134 | 0.110 | 0.098 | 0.083 |
| | (0.030) | (0.031) | (0.053) | (0.039) | (0.027) | (0.024) |
| Bandwidth | 4.6 | 4.6 | 2.3 | 3.4 | 5.7 | 6.9 |
| Covariates | NO | YES | YES | YES | YES | YES |
| Observations | 228,855 | 228,855 | 228,855 | 228,855 | 228,855 | 228,855 |

Notes: This table shows the impact of retirement on migration decisions using an alternative definition of retirement. We redefine retirees as individuals who resort to pension as the main source of living expenditures. Conventional outcomes refer to RD estimates with conventional variance estimator. Robust outcomes refer to RD estimates with robust variance estimator (Calonico, Cattaneo, and Titiunik 2014b, 2014a). Column 1 reports the baseline model results. Column 2 reports the RD estimates by controlling for covariates such as education, ethnicity and marriage status. Columns 1-2 select the bandwidth based on the MSE-optimal bandwidth selector (Calonico, Cattaneo, and Titiunik 2014b). Columns 3-6 take 50%, 75%, 125% and 150% of optimal bandwidth, respectively. Standard errors are in parentheses.

## A7. Alternative definition of migration

Table A7 Causal impact of retirement on migration decisions using an alternative definition of migration

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Conventional | 0.108 | 0.107 | 0.125 | 0.106 | 0.098 | 0.084 |
| | (0.032) | (0.032) | (0.055) | (0.041) | (0.028) | (0.026) |
| Robust | 0.119 | 0.119 | 0.148 | 0.127 | 0.119 | 0.123 |
| | (0.035) | (0.035) | (0.081) | (0.060) | (0.042) | (0.038) |
| Bandwidth | 4.6 | 4.6 | 2.3 | 3.4 | 5.7 | 6.9 |
| Covariates | NO | YES | YES | YES | YES | YES |
| Observations | 227,931 | 227,931 | 227,931 | 227,931 | 227,931 | 227,931 |

Notes: This table shows the impact of retirement on migration decisions using an alternative definition of migration. We redefine migrants as individuals who have lived away from their registered place for more than 6 months. Conventional outcomes refer to RD estimates with conventional variance estimator. Robust outcomes refer to RD estimates with robust variance estimator (Calonico, Cattaneo, and Titiunik 2014b, 2014a). Column 1 reports the baseline model results. Column 2 reports the RD estimates by controlling for covariates such as education, ethnicity and marriage status. Columns 1-2 select the bandwidth based on the MSE-optimal bandwidth selector (Calonico, Cattaneo, and Titiunik 2014b). Columns 3-6 take 50%, 75%, 125% and 150% of optimal bandwidth, respectively. Standard errors are in parentheses.

## A8. Alternative range selection for bunching approach

In the main analysis, we fit a flexible polynomial to the observed distribution, excluding observations in a range of 2 years around the treatment threshold, and extrapolate the fitted distribution. We use an alternative range of 4 years around the treatment threshold to conduct robustness checks and find that approximately 36% of total migration effects are due to inter-temporal substitution (delayed migration), with the 90 percent confidence interval for the missing mass ranging between 34% and 42%.

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