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RESEARCH PAPER

Happiness Under One Roof? The Intergenerational Co-residence and Subjective Well-Being of Elders in China

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Abstract
This study investigates the relationship between intergenerational co-residence and the subjective well-being (SWB) of elders based on the individual-level panel data collected from the Chinese Longitudinal Healthy Longevity Survey from 2002 to 2014. We use the endogenous treatment effect model to minimize selection bias and estimate the causal impacts of intergenerational co-residence on parental SWB. In addition, we employ the individual fixed-effect model for robustness checks. Results corroborate that elders who live with their adult–children are happier than those who do not undergo such a living arrangement. We also investigate heterogeneous effects across geographical regions and demographic groups. Older people in rural areas who co-reside with their adult–children gain a more substantial co-residence effect compared with those in urban areas. Moreover, results are robust according to different specifications. Our findings provide useful implications for policymakers in promoting the SWB of elders.

Keywords Subjective well-being · Living arrangements · Co-residence · Older people · China

1 Introduction

Research interest on the living arrangements of older people has recently been triggered by global demographic aging and social transition. In recent years, population aging has presented considerable social and economic challenges to many countries. According to the United Nations (UN), people aged 60 and above accounted for 13% of the global population in 2017 and are growing at a rate of roughly 3% per year. By contrast, populations in developing countries are aging at a much faster rate than those of their counterparts in developed nations (UN 2017a).

Living arrangements have changed dramatically over the past few decades. More than half of elders aged 60 co-resided with children who were born circa 2010 in Asia, Africa, Latin America, and the Caribbean, while only 20% of older people co-resided with their

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children in Europe and Northern America (UN 2017b). Recently, intergenerational living patterns transformed in response to the external economic constraints of young people in western countries. Given the labor income risk and challenges in housing markets, young adults tend to move back into their parents' home for parental support. Therefore, a trend of co-residence with parents has grown (Tosi and Grundy 2018). In certain Asian countries, intergenerational co-residence is honored as a common practice to express filial piety (Hsu 1998). However, dramatic changes in demographic structure, geographic mobility of labor, institutional arrangements, and social norms have occurred (Cong and Silverstein 2008). Thus, intergenerational co-residence has become less popular in some countries, such as China (Ren and Treiman 2015). In recent years, young adults have migrated to rapidly expanding cities, thereby leaving behind their parents. The popularity of multigenerational families is increasingly eroded by the rise of nuclear families.

Co-residence between older people and adult children has gained increasing attention due to its potential implications for individuals and societies. Generally, intergenerational co-residence involves mutual support between parents and children. Undoubtedly, this support is a crucial determinant of well-being in later life, in the form of welfare-state arrangements or family care services. In this case, family insurance serves as a substitute for public support in protecting the welfare of older people. Consequently, examining how intergenerational co-residence impacts the well-being of older people presents additional insights into the welfare of these people. In particular, the informal care systems for older people are undeveloped for developing countries.

This study investigates whether and to what extent intergenerational co-residence affects subjective well-being (SWB) in older people based on the individual-level panel data collected from the Chinese Longitudinal Healthy Longevity Survey (CLHLS). The research also examines the heterogeneous effects of intergenerational co-residence across geographical regions and demographic groups. Examining the degree of heterogeneity will help in elucidating the mechanism behind the co-residence effect and provide relevant implications for policymakers.

The effect of intergenerational co-residence on the Elderly's SWB is of particular interest in the Chinese background for several reasons. First, China has the world's largest population of older people. China is aging more rapidly compared with almost all other countries due to the rapid decline in fertility and dramatic increases in life expectancy (UN 2017a). China, which is distinguished by a particular cultural context and demographic policies,[1] provides an appealing testing ground for the relation between the living arrangement and SWB of the elderly. According to the National Statistics Bureau of China, the proportion of the country's population aged 65 and above reached 11.4% in 2017, which exceeds the international aging society standard of 7%. Furthermore, this finding corroborates that China has become an aging society. Figure 1 exhibits that the number of persons aged 65 and above increased consistently in the previous decades and is likely to escalate even further in the future.

Second, China is currently facing the prevailing social issues of senior care, as the proportion of empty-nest older people who live alone or with a spouse only is rapidly increasing to over 50% (Liu et al. 2014; Cheng et al. 2015). However, given the insufficient coverage of the social safety net, especially in rural areas, the elderly's SWB continues to depend heavily on family support. CHARLS (2013) affirmed that 88.7% of older people in need of support received it from family members. Moreover, changes in living arrangements in response to industrialization and urbanization have posed a threat to senior care issues. Therefore, the public policy intends to address the concern of empty-nest older people and improve their well-being to facilitate social stability and harmonious development.

[1] For instance, the "one-child policy" was introduced in 1979 and eliminated by the end of 2015.

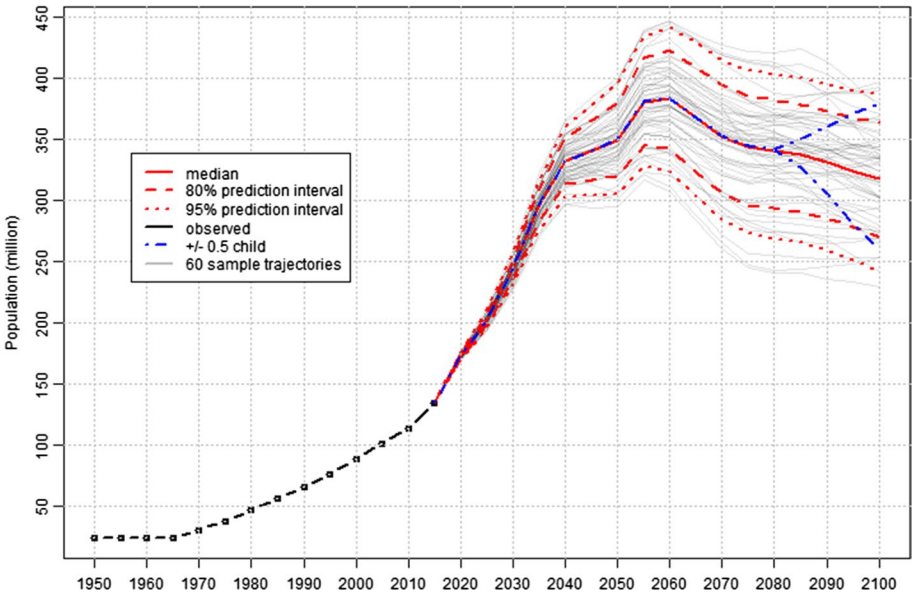

Fig. 1 Number of elderly people in China (aged 65+). *Note* The figure displays the estimates and probabilistic projections (Raftery et al. 2014) of China's population aged 65 and above. The population forecast is based on estimates of 2017 Revision of World Population Prospects (UN 2017a)

The remaining part is organized as follows: Sect. 2 summarizes the related literature; Sect. 3 provides a theoretical framework; Sects. 4 and 5 present the data description and identification strategy, respectively; Sect. 6 reports the empirical results and robustness check; and Sect. 7 concludes the paper.

2 Literature Review

Many studies have investigated the potential implications of living arrangements for the elders' well-being (Michael et al. 2001; Silverstein et al. 2006). According to empirical evidence, several studies have confirmed a positive relationship between the intergenerational co-residence and well-being of elders based on national datasets[2] (Aranda 2015; Courtin and Avendano 2016; Do and Malhotra 2012; Teerawichitchainan et al. 2015; Zunzunegui et al. 2001). Conversely, other studies have indicated a negative correlation[3] (Tosi and Grundy 2018; Johar and Maruyama 2014). Therefore, further research is required to rule out the mixed findings on this issue, which are partly due to diverse cultural traditions and institutional backgrounds across countries.

Several limitations exist in the abovementioned literature. First, other studies have failed to control for time-invariant individual characteristics. Therefore, we control for individual-level fixed effects, which enable us to examine changes at the individual level before and after intergenerational co-residence. Thereafter, we compare older people who experienced co-residence with those who did not experience such a living arrangement during the survey period.

[2] E.g., China, Europe, South Korea, Vietnam and Thailand, and Spain.

[3] E.g., Europe and Indonesia.

Second, whether the statistical correlation can be generalized into causality remains uncertain. The causal linkage between intergenerational co-residence and parental SWB is under-researched in previous literature. Such shortcoming is due partly to the unsolved endogeneity of intergenerational co-residence. The endogeneity may arise from reverse causality and non-random selection. On one hand, co-residence sometimes is an adaptive strategy in reaction to the deteriorated physical and mental status of older people, leading to reverse causality. For instance, Manacorda and Moretti (2011) found a high probability of co-residence for older people with high support needs. On the other hand, the choice of intergenerational co-residence is not randomly assigned. For instance, given the unavoidable conflicts in co-residence, older people who are good-tempered, considerate, and amiable are likely to co-reside with their children. However, these people are likely to be happy due to their positive attributes, which causes selection bias. Previous studies have employed several identifying strategies, such as instrumental variables and counterfactual framework, to address the abovementioned issues. For instance, Do and Malhotra (2012) instrumented co-residence with the number of sons, Johar and Maruyama (2014) adopted local traditions as instruments, and Maruyama (2012) used land prices and rurality as instruments.

This paper has filled the existing literature gap in the following manner. Primarily, we use the endogenous treatment effect model with instrumental variables to mitigate potential endogeneity issues such that we can infer the causality between intergenerational co-residence and the elderly's SWB. This alleviates bias caused by reverse causality and non-random selection, which are the main threat to the validity of causal inference. Secondly, we further examine the heterogeneous effects of intergenerational co-residence on parental SWB. The urban–rural divergence in the co-residence effect is explored. Additionally, we also investigate whether the gender asymmetry patterns in the co-residence effect exists. The heterogeneous analysis helps us better understand the causality between intergenerational co-residence and parental SWB.

3 Theoretical Background

The relationship between intergenerational co-residence and the elderly's SWB remains inconclusive due to the existence of two offsetting impacts. These two effects go in opposite directions. On one hand, older people may benefit from financial, physical, and emotional support provided by their adult children, which would enhance their SWB. On the other hand, they may suffer from intergenerational conflicts, the loss of privacy, and in some cases, overcrowding, which would adversely affect their SWB. However, in Chinese culture, they tend to prioritize emotional attachments and concerns for other family members in household behavior. The trajectories and well-being of adult children and elder parents are closely tied. In this case, the older parents tend to care for their adult children's feelings and internalize their distaste for co-residence and other potential conflicts out of altruism (Manacorda and Moretti 2011). Under these circumstances, the negative effect would be weakened, and the positive effect would take a dominant role. Therefore, we posit the following hypothesis.

Hypothesis 1 Intergeneration co-residence is positively associated with the elderly's SWB in China.

The traditional values for old-age security argue that parents provide parental investment for children. In turn, adult children reciprocate through financial and non-material

support. This motivation is pronounced in conventional societies which attach importance to family ties but lack a perfect social support arrangement (Johar and Maruyama 2014). Older people in Chinese rural areas fit well in these situations due to the deep-rooted traditions and incomplete public care system. Hence, the elders' SWB depends heavily on traditional home-based old-age support in rural areas. The following hypothesis can be established.

Hypothesis 2 The effect of intergenerational co-residence on the elderly's SWB is stronger in rural than urban areas.

Living with older parents is a demonstration of filial piety or the ethical commitment of adult children to reciprocate parents (Connelly et al. 2014). Previously, a patrilineal kinship system was predominant in Asia, which shaped particular family values and gender roles. Generally, traditional filial expectations are gender-biased (Teerawichitchainan et al. 2015). In a traditional Chinese family system (Xie and Zhu 2009), an adult daughter is considered to belong to her husband's extended family rather than the family-of-origin. Conversely, sons are permanent members of natal families. Consequently, a traditional perception ensues in China, where sons are deemed to shoulder major responsibilities for the care of the elderly in the family.

However, traditional gender patterns regarding the norm of providing support to parents have changed due to dramatic demographic shifts, economic development, and cultural and social transitions over the previous few decades in China (Lei 2013). In addition, changes in the institutional and structural contexts also undermine the normative concerns regarding gender divergences. For instance, the rise of public welfare-state arrangement has lessened parental dependence on financial transfers from adult children. Most importantly, intergenerational accompany and emotional exchanges, rather than the source of support, play a significant role in mediating the relationship between intergenerational co-residence and the current elderly's SWB (Tang et al. 2019). In this sense, daughters tend to excel at providing instrumental and emotional support, especially "hands-on" services, to parents compared with sons (Silverstein et al. 2006). Compared with living with daughters' families, there are more inevitable conflicts between daughters-in-law and mothers-in-law (Ren and Treiman 2015). Besides, it is common that the adult son's migrant from rural to urban for better job opportunities in China. The emotional bonds and filial piety contacts are eroded by the physical distance between older parents and sons. Therefore, we hypothesize the following:

Hypothesis 3 Older people living with daughters have higher SWB than those living with sons.

4 Data

4.1 Data Source

The panel data of this study were derived from five consecutive waves of the CLHLS (i.e. 2002, 2005, 2008, 2011, and 2014). The CLHLS gathered information on demographic characteristics, life evaluation and personality, mental state, lifestyle, the activity of daily living (ADL), personal background, and self-assessed health status. Moreover, the CLHLS adopted a multi-stage non-proportional random sampling method to survey a sufficiently

large portion of the elderly in need of care. The survey is representative and randomly selected approximately half of the counties, prefecture-level cities, or urban cities in selected provinces.

The longitudinal survey covered 16,064 older people aged 60 years or above in 22 Chinese provinces in 2002. The sample represents 85% of the total population in China. In follow-up surveys, 8175, 4191, 2514, and 1681 respondents were re-interviewed in 2005, 2008, 2011, and 2014, respectively.[4] Only valid respondents present in at least two waves are considered to avoid singleton groups in panel data analysis. Therefore, a non-balanced panel with 20,688 individual-year observations is responsible for the majority of our analysis.[5]

However, there are data limitations concerning adult children's demographic and socioeconomic characteristics as well as their motivations for intergenerational co-residence. We are unable to determine whether it was the child to move back to the parents' home or vice versa. Additionally, there is no available data regarding existing infrastructure in rural areas in analyzing urban–rural differences in co-residence effects. More detailed data in these fields would allow for better identification of co-residence effects. These data limitations leave room for future improvement.

4.2 Measurement of Intergenerational Co-residence and SWB

The variable of interest is intergenerational co-residence, which is a binary variable (equal to 1 if elder people lived with their adult children and 0 otherwise). The outcome was the self-evaluated SWB of the older people, which are measured in several methods. First, we considered positive dimensions of well-being. The respondents evaluated the extent of their perception of life satisfaction on a five-point rating scale, ranging from 1 (very bad) to 5 (very good). Thereafter, we take negative dimensions of well-being into account. We derived the elderly's depression from several dimensions that were available in the dataset. The depression index is measured by a subset from the Center for Epidemiologic Studies- Depression (CES-D) scale (Radloff 1977). Specifically, we select two items indicating positive feelings (feeling happy, looking on the bright side of things), one item indicating negative feelings (feeling lonely, feeling fearful or anxious), and one item indicating feelings of marginalization (feeling useless with age). We coded the frequency with which the participant had experienced each negative feeling as 0 (Rarely or none of the time), 1 (Some or a little of the time), 2 (Occasionally or a moderate amount of time), 3 (Most or all of the time). The coding of positive feelings is reversed to ensure consistency. Then the four items are summed, producing a depressive symptom score ranging from 0 to 12. A higher score means more depressive symptoms. It is widely accepted that the CES-D scale can assess the mental health of older adults, which has been validated for the literature of Chinse adults (Silverstein et al. 2006).

4.3 Descriptive Statistics

Table 1 reports the descriptive statistics for all variables. A simple comparison of means on SWB by living arrangement indicated that older people who live with their adult children

[4] The details of every survey are presented in Table 8 in the "Appendix".

[5] Given the availability and validity of data in questionnaires, the missing and invalid observations are excluded in the sample.

Table 1 Descriptive statistics

	Full sample			Intergenerational co-residence			
	N	Range	Mean	No	Yes	Diff	SD
SWB	21,001	1–5	3.68 (0.83)	3.63	3.73	−0.10***	(0.01)
Depression	21,001	0–12	2.48 (2.06)	2.51	2.46	0.05*	(0.03)
Loneliness	20,622	1–5	2.00 (1.00)	2.01	2.00	0.008	(0.01)
Coreside	21,001	No/yes	0.54 (0.50)	–	–	–	–
Age	21,001	63–117	82.71 (9.75)	80.83	84.34	−3.52***	(0.13)
63–79	21,001	0/1	0.42 (0.49)	0.50	0.35	0.15***	(0.01)
80–90	21,001	0/1	0.34 (0.47)	0.33	0.34	−0.01*	(0.01)
90 +	21,001	0/1	0.24 (0.43)	0.17	0.30	−0.13***	(0.01)
Male	21,001	0/1	0.47 (0.50)	0.53	0.42	0.11***	(0.01)
Urban	21,001	0/1	0.20 (0.40)	0.21	0.19	0.02***	(0.01)
Education (year)	20,958	0–25	2.46 (3.69)	2.82	2.15	0.66***	(0.05)
Married	20,984	0/1	0.41 (0.49)	0.57	0.26	0.31***	(0.01)
Health status							
Poor	20,979	0/1	0.17 (0.37)	0.17	0.16	0.02***	(0.01)
Fair	20,979	0/1	0.35 (0.48)	0.34	0.36	−0.02***	(0.01)
Good	20,979	0/1	0.49 (0.50)	0.49	0.48	0.00***	(0.01)
ADL limitation	20,909	0/1	0.16 (0.37)	0.12	0.20	−0.08***	(0.01)
Relative income							
Low	20,940	0/1	0.15 (0.36)	0.17	0.13	0.04***	(0.005)
Middle	20,940	0/1	0.67 (0.47)	0.66	0.68	-0.02***	(0.01)
High	20,940	0/1	0.17 (0.38)	0.16	0.18	−0.02***	(0.01)
Enough	20,985	0/1	0.79 (0.41)	0.78	0.80	−0.02***	(0.01)
Homeowner	20,895	0/1	0.44 (0.50)	0.60	0.30	0.31***	(0.01)
Social	20,989	0/1	0.17 (0.38)	0.20	0.15	0.05***	(0.01)
Medical	20,983	0/1	0.92 (0.27)	0.91	0.93	−0.01***	(0.004)
Pension	20,963	0/1	0.23 (0.42)	0.26	0.20	0.06***	(0.01)
Children	21,001	0/1	3.98 (1.75)	4.08	3.90	0.17***	(0.02)
Gender mix	21,001	0/1	0.46 (0.28)	0.46	0.46	0.00	(0.002)
Children age	20,963	1–92	51.23 (9.88)	49.68	52.56	−2.88***	(0.14)
Financial	20,989	0/1	0.57 (0.05)	0.45	0.67	−0.22***	(0.01)
GainSon	19,653	0–11.51	5.06 (2.99)	5.02	5.10	−0.07*	(0.04)
GainDaughter	20,004	0–11.51	4.28 (3.03)	4.37	4.20	0.16***	(0.04)
Emotional	20,990	0/1	0.53 (0.42)	0.35	0.69	−0.34***	(0.01)
Physical	20,948	0/1	0.64 (0.48)	0.45	0.81	−0.35***	(0.01)
Housing prices	19,546	6.17–9.83	7.81 (0.68)	7.85	7.78	0.07***	(0.01)
Family units	15,662	1–1.28	1.04 (0.05)	1.04	1.04	−0.001	(0.001)
Dialect Diversity	18,319	0–0.72	0.24 (0.21)	0.23	0.25	−0.02***	(0.004)

(1) *SWB*, self-assessed subjective well-being, *Coreside*, living with adult children; *ADL limitation*, activity limitation of daily living; *Enough*, having enough financial sources for expenses; *Homeowner*, current house/apartment is under elder's name; *Social*, taking part in social activities; *Medical*, access to public medical care; *Pension*, access to pension; *Children*, number of children; *Gender Mix*, proportion of daughters in all children; *Children Age*, average age of children alive; *Financial*, financial support from adult children; *GainSon/GainDaughter*, net financial support from sons/daughters; *Emotional*, intergenerational intimacy (talking, sharing, helping), *Physical,* physical support form adult children (taking care of elders); *Housing prices*, local real estate prices in logarithmic form; *Family units*, number of family unit in a house-

Table 1 (continued)

hold. *Dialect Diversity*, the dialect diversity index is measure by the number of dialects used in this city. Please refer to the detailed description of each variable in Table 7 in "Appendix"

(2) *, **, and *** denote differences in means between these two groups of older parents at the 10%, 5%, and 1% levels of significance, respectively. Standard deviation is reported in brackets

Table 2 Proportion distribution of living arrangements of the elderly

		Year distribution					Region distribution	
	Total (%)	2002 (%)	2005 (%)	2008 (%)	2011 (%)	2014 (%)	Rural (%)	Urban (%)
Panel A: living arrangement distribution								
(1) Children	39.87	37.55	41.88	40.04	40.00	40.56	40.77	36.30
(2) Spouse	23.81	24.37	22.78	25.20	24.16	22.01	23.29	25.87
(3) Children and Spouse	13.72	16.74	12.98	11.06	12.15	12.47	13.53	14.45
(4) Skip-generation	2.61	2.07	3.23	1.81	2.99	3.67	2.24	4.09
(5) Relatives	4.31	4.46	3.86	4.29	5.03	4.60	4.24	4.59
(6) Institution	1.50	1.58	1.71	1.32	1.22	1.00	1.01	3.41
(7) Alone	14.16	13.23	13.52	16.27	14.41	15.62	14.88	11.30
Panel B: parent–child coresidence by Children's Gender								
with daughters	7.11	7.29	7.34	7.07	6.20	6.74	5.62	13.01
with sons	45.30	45.77	46.47	42.96	44.56	44.90	47.63	36.08
with both	1.15	1.23	1.05	1.08	1.13	1.40	1.03	1.63

(i) In the Panel A, we classify the living arrangement into following categories: (1) Live with adult children, no spouse; (2) Live only with a spouse, no adult children; (3) Live both with spouse and children; (4) Living with grandchildren but not with adult children (skip-generational coresidence); (5) Live only with relatives who are not spouse, children or grandchildren (e.g. Living with siblings, spouse of child, spouse of grandchild, parent or parent-in-law, relatives, friends, roommates etc.); (6) Live in an institution; (7) Living alone. In the Panel B, intergenerational co-residence is classified into living with daughters, living with sons, living both with sons and daughters

Table 3 Parental SWB by living arrangement

Intergenerational co-residence	SWB			
	Bad	Fair	Good	Total
No	735 (7.54%)	3493 (35.84%)	5519 (56.62%)	9747
Yes	599 (5.32%)	3569 (31.71%)	7080 (62.96%)	11,254
Total	1334 (6.35%)	7062 (33.63%)	12,605 (60.02%)	21,001

Authors' calculation is based on the data from the CLHLS, 2002–2014

display consistently and significantly higher SWB compared with those who do not live with their adult children. Table 7 provides the relevant definitions of these variables. The proportion distribution of living arrangements of the elderly is presented in Table 2.

Table 3 compares the distribution of the elderly's SWB by living arrangement and reveals that older parents who live with their adult children are the most likely to evaluate their quality

of life as "good", whereas older parents without intergenerational co-residence are more likely to rate their quality of life as "bad", or "fair".

5 Identification Strategy

5.1 Average Treatment Effects of Intergenerational Co-residence on Parental SWB

We aim to investigate whether intergenerational co-residence play a crucial role in the betterment of parental subjective well-being. We employ ordered probit regressions and linear regressions, respectively. As our dependent variables are ordered discrete, the equation that describes parental SWB in a latent index setting is specified as follows:

$$SWB_i = \begin{cases} 1, \ if \ y_i^* < \mu_1 \\ k, \ if \ \mu_{k-1} < y_i^* < \mu_k, k = 2, 3 \\ 5, \ if \ y_i^* > \mu_4 \end{cases} \tag{1}$$

where μ_1, μ_2, μ_3, and μ_4 are cut-off parameters and y_i^* is the latent outcome variable that represents the elderly's SWB:

$$y_{i,t}^* = \beta_0 + Coreside_{i,t}\beta_1 + \mathbf{X'}_{i,t}\beta_2 + D_p + T_t + \varepsilon_{i,t} \tag{2}$$

The coefficient β_1 indicates the impact of co-residence on the elderly's SWB. Positive and significant β_1 suggests that co-residence exerts a positive effect on the elderly's SWB, whereas negative and significant β_1 indicates that co-residence decreases the elderly's SWB. Under Hypothesis 1, β_1 is expected to be significant and positive. D_p is a vector that reflects province-specific shocks, T_t represents the year fixed effects that account for year-specific trends in SWB. $\varepsilon_{i,t}$ is an error term that captures the unobservable factors that influence SWB.

$\mathbf{X'}_{i,t}$ is a vector of individual-level observable characteristics, including age, gender, education, residence type (rural or urban), marital status, self-rated health status, financial status, homeownership, relative income condition, pension and medical insurance, social participation, number of children, gender mix of children, average age of children, financial support, emotional support and physical support. Specifically, living with a spouse and participating in social activity can enhance SWB (Johar and Maruyama 2014). If older people are entitled to gain retirement pension and access to public medical insurance, then they are expected to have a high SWB. Moreover, health status, relative income, and financial status are expected to be positively associated with the elderly's SWB (Ren and Treiman 2015; Tosi and Grundy 2018).

5.2 Endogenous Treatment Effect Regression

Evaluating the causal relationship between intergenerational co-residence and the elderly's SWB is faced with certain challenges. The decision on co-residence cannot be regarded as an exogenous determinant of the elderly's SWB. Therefore, the occurrences of intergenerational co-residence are not randomly selected. To address the selection bias, we adopt the endogenous treatment effect model based on a two-stage estimation. Employing this model enables us to consider the probability that selection into intergenerational co-residence might be associated with the elderly's SWB.

The specification of the treatment effect model relies primarily on dealing with unobservables. Generally, a consistent estimation assumes that these unobservable confounders follow a bivariate normal distribution. However, once the premise of joint normality is violated, the results might be inconsistent. Aakvik et al. (2005) proposed a latent-factor (LF) structure to relax the assumption. Therefore, we follow the methodology proposed by Gregory (2015) to run the treatment-effect latent factor ordered probit regression. In this framework, we estimate a treatment equation at the first stage and the outcome Eq. (2) at the second stage.

In our setup, intergenerational co-residence between older people and adult children is considered the "treatment". The treatment group includes older people living with their adult children, whereas the control group incorporates those who do not co-reside with their adult children. In outcome Eq. (2), $Coreside_{i,t}$ is the endogenous treatment variable. The selection rule determined by treatment equation is specified as follows:

$$Coreside_{i,t} = \begin{cases} 1, & if \ Coreside^{*}_{i,t} > 0, \\ 0, & otherwise \end{cases} \tag{3}$$

$$Coreside^{*}_{i,t} = \bar{X}_i \sigma_1 + Z\sigma_2 + u_i \tag{4}$$

where $Coreside_{i,t} = 1$ denotes intergenerational co-residence and zero otherwise. Intergenerational co-residence is a strategic choice, which depends on objective demands and subjective willingness. $\bar{X}_i$ is a vector of observable variables, such as ADL limitation, age, gender, education, residence type (rural or urban), marital status, self-rated health status, financial status, homeownership, relative income condition, pension and medical insurance, social participation, number of children, gender mix of children, average age of children, financial support, emotional support and physical support which determine whether elders co-reside with adult children. u_i is an error term that captures the individual-level unobservable factors.

Z refers to instrumental variables that influence treatment assignment but have no direct impact on the elderly's SWB. We instrument intergenerational co-residence with the city-level family unit membership from historical data in the national census 1982 and a city-level dialect diversity index. A valid instrument can result in a source of exogenous variation in intergenerational co-residence. Meanwhile, the exclusion restrictions require the IV has no effect on elders' SWB, excepting its impact through intergenerational co-residence, conditional on the control variables.

The logic applied to the choice of family unit membership is as follows: it reflects the prevailing family composition and living arrangement under one roof at the city level in the past. More family units living in a household means more popular the co-residence culture is. The popularity of intergenerational co-residence may shape local social norms and then exert social pressure on people, which increases the probability of co-residence.

The rationale behind the city-level dialect diversity index[6] is based on the following premises. The local dialect is shaped and preserved through individual interactions in a particular community network. It reflects their shared beliefs, values and norms. In this sense, the local dialect is a crucial dimension of ethnic identity within a specific community (Pendakur and Pendakur 2002). Individuals are more willing to interact with those

[6] The dialect diversity index in city i is measure as follows: $Dialect\ Diversity_i = 1 - \sum_{k=1}^{N} W_{ki}^2$; where N denotes the number of dialects used in this city; W_{ki} indicates the proportion of people using dialect k in city i. The values of the dialect diversity index are between 0 and 1. This index can be interpreted as the possibility of speaking different dialects for two randomly selected persons in a particular city. The higher the value, the more diversity in dialects. The data source is from Xu et al. (2015).

who share an ethnic identity. However, distinct dialects may pose identity barriers in forming social ties. Individuals may have difficulties fitting into localized networks and feel like outsiders in areas with more dialectal variability. Their pursuit of homophily can largely foster family cohesion. It means individuals tend to place a high value on family ties rather than a social network. In this way, they tend to live with family members, resulting in a relatively high prevalence of intergenerational co-residence in these areas. Overall, areas with more diversified dialects feature a high prevalence of co-residence or vice versa.

We believe that these two IVs are unlikely to directly affect individual elders other than their impacts through intergenerational co-residence, as they are both at the city level. This implies that the exclusion restriction of IVs is plausible. They are expected to have a positive influence on the co-residence decision of older persons i living in city q without effects on his/her SWB. Following Gregory (2015), we estimate the abovementioned equations based on the maximum likelihood method.[7]

5.3 Robustness Check

Ferrer-i-Carbonell and Frijters (2004) argued that taking account of fixed individual effects in happiness studies is crucial. They also contended that empirical analysis on SWB is insensitive to the selection of ordinary least squares (OLS) or ordered probit/logit methods. Therefore, we assess the relationship between intergenerational co-residence and the elderly's SWB based on OLS estimation with fixed effects. The regression set-up is as follows:

$$SWB_{i,t} = \alpha_0 + \alpha_1 Coreside_{i,t} + \mathbf{X'}_{i,t}\gamma + \theta_i + \tau_t + \varepsilon_{i,t}, \tag{5}$$

where $SWB_{i,t}$ denote the subjective well-being of individual i in survey year t. We include fixed effects for each individual i denoted by θ_i, to capture time-invariant individual-level unobservable factors, thereby alleviating omitted variable bias. τ_t indicates the year fixed effects that account for year-specific trends in SWB, and $\varepsilon_{i,t}$ is an error term. Concerning standard errors, we use two-way clustering at the level of specific city at a specific year, which enables the correlation within certain cities over time (Correia 2016).[8]

6 Empirical Results

6.1 Endogenous Treatment Effect Regression Results

We employ the endogenous treatment effect model using instrumental variables in column (1)–(2) of Table 4 to estimate the local marginal treatment effect (LMTE)[9] of intergenerational co-residence. Additionally, Ferrer-i-Carbonell and Frijters (2004) argued that empirical analysis on SWB is insensitive to the selection of ordinary least squares (OLS)

[7] The procedure is implemented in Stata command "*treatoprobitsim*" as proposed by Gregory (2015).

[8] Twoway-clustering is allowed in Stata command "*reghdfe*". Thus, we indicate the interactions of city and year such that we can estimate consistent standard errors even when the observations are correlated within groups.

[9] The instrument can only identify those individuals living in areas with relatively prevalent co-residence culture and decide to live with their adult–children. Thus, IV estimation only identifies the effects of those who can be switched from not co-residence into co-residence, which is the local average treatment effect (LATE) rather than average treatment effect (ATE). Actually, the switchers are more likely to benefit from co-residence with adult children. The causal impact comes from a selected part of the population.

Table 4 Intergenerational co-residence and parental SWB

	Dependent variable: SWB			
	Two-stages endogenous treatment effect estimation with IVs		Average treatment effect estimation without IVs	
	(1)	(2)	(3)	(4)
	Linear	Ordered Probit	Linear	Ordered Probit
Coefficients of coreside	0.2728***	0.3842***	0.0591***	0.1032***
	(0.0638)	(0.1168)	(0.0108)	(0.0190)
Marginal effects of coreside on				
Lowest level of SWB		−0.0062***		−0.0014***
		(0.0085)		(0.0003)
Low level of SWB		−0.0297**		−0.0075***
		(0.0181)		(0.0014)
Medium level of SWB		−0.0780		−0.0222***
		(0.0336)		(0.0040)
High Level of SWB		0.0414		0.0113***
		(0.0446)		(0.0021)
Highest level of SWB		0.0725*		0.0196***
		(0.0304)		(0.0036)
Controls	Yes	Yes	Yes	Yes
Provincial dummies	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
Adjusted R^2/pseudo R^2	0.4258	0.4258	0.3229	0.1570
Observations	14,444	14,444	20,688	20,688

The linear endogenous treatment effect model with IVs is employed in the column (1). The dependent variable SWB is treated as a cardinal variable. The specification in column (2) is treatment-effect latent factor ordered probit regression and the estimation is based on 100 Halton sequence-based quasi-random draws per observation. The dependent variable SWB is treated as an ordinal variable. Only the empirical results of outcome equations in the two-stages endogenous treatment effect model are reported in Table 4. The results of treatment equations are presented in Table 13 in the "Appendix". For comparison, the estimations of the usual model without IVs are presented in column (3)–(4). The complete regression results are presented in Table 14

***, **, and * denote significant at the 1, 5, and 10% level respectively. Standard errors are given in parentheses. There are missing values in instrumental variables, ending up with a sample of 14,444 observations

[a]For more detail on controls, please refer to Tables 13 and 14 in the "Appendix"

or ordered probit/logit methods. Therefore, we also compare the linear specifications and ordered probit specifications. Estimations in column (1) are based on the linear specifications in which the dependent variable SWB is treated as a cardinal variable. In column (2), following Gregory (2015), we use the treatment-effect latent factor ordered probit regression where the dependent variable SWB is treated as an ordinal variable.

Generally, for the two-stages endogenous treatment effect estimations with IVs, we first estimate the possibility of the selection into intergenerational co-residence. The estimated results of treatment Eq. (4) are presented in Table 13 in the "Appendix". As expected, the instruments significantly increase the likelihood of parent–child co-residence at the 1% level, which statistically supports that IVs are correlated with the endogenous choice of

intergenerational co-residence. Specifically, the results of under-identification[10] and weak identification[11] tests provide additional evidences for this. Additionally, the results of the overidentification test[12] of these instrumental variables reveal that we cannot reject the null hypothesis: the instrument variable is uncorrelated with the error term. Therefore, the validity of the instrument variable is confirmed, and the overall result proves reliable and robust.

Secondly, the results of outcome equations after eliminating selection bias are presented in columns (1) and (2). In the linear model, the coefficient on co-residence is positive and significant at the 1% level. Intuitively, intergenerational co-residence can result in a 7.41% increase in parental SWB relative to the mean value. In the ordered probit model, we find that living with adult children can significantly increase the possibility of elder parents to report "very good" in self-evaluation of their SWB by 7.25% and decrease their possibility to rate "very bad" and "bad" by 0.62% and 2.97% respectively. Results reveal that intergenerational co-residence yields a remarkably positive causal impact on parental SWB in both linear and ordered probit specifications. It means the empirical analysis on SWB is robust to different specifications, which is consistent with previous findings (Ferrer-i-Carbonell and Frijters 2004).

We evaluate the independence between the treatment equation into the co-residence and outcome equation in the endogenous treatment effect model. If $Corr(\varepsilon_j, u_j) = \rho$, endogeneity means ρ is significantly different from zero. Results reject the null hypothesis that no association exists between treatment and outcome errors. It implies the unobserved variables determining intergenerational co-residence might simultaneously affect parental SWB. Hence, addressing endogeneity when inferring the causality between intergenerational co-residence and SWB of the elderly is crucial. Most importantly, the empirical results show that ρ is negative and significant at the 1% level. This implies endogenous issues lead to a downward bias in usual estimation.

For comparison, we also present the estimations of co-residence effects derived from the usual model without IVs in column (3)–(4) of Table 4. In column (3), we estimate the impact of intergenerational co-residence on parental SWB based on a linear regression model without IVs. Although results claim that living with adult children can substantially increase older parents' SWB, the magnitude of the impact is underestimated. In column (4), we adopt a random-effects ordered probit model without IVs. It reveals that intergenerational co-residence significantly increases elder's possibility to rate "good" and "very good" by 1.13% and 1.96% respectively and lower the probability to report "very bad", "bad" and "fair" by 0.14%, 0.75%, 2.22% respectively. Obviously, the usual models without dealing with endogeneity underestimate the actual impact of the intergenerational co-residence.

For the control variables, we find that male parents are inclined to denote lower SWB than their female counterparts. Furthermore, married older people who live with their spouses are more likely to report a high level of SWB. Moreover, enhanced self-rated health status is associated with high overall SWB. In addition, the elderly with sufficient financial support and high relative income tend to denote a high level of SWB. Other

[10] Underidentification test null hypothesis: the excluded instrument is uncorrelated with the endogenous variable. The Anderson canon. corr. LM statistic is 34.290; P value = 0.0000. The result shows that the null hypothesis is rejected at 1% level, which means the equation is identified.

[11] Weak identification test null hypothesis: the instruments are weak despite their correlation with the endogenous variable. The Cragg-Donald Wald F statistic is 17.158; the null hypothesis can be rejected according to the rules of thumb.

[12] Overidentification test of all instruments null hypothesis: the instruments are valid. The Sargan statistic is 2.558; P value = 0.1097. The null hypothesis cannot be rejected.

interesting associations show that emotional support and social participation are positively and significantly correlated with parental SWB (Kim et al. 2015; Glass et al. 2006; Miao et al. 2018). This finding implies that older people with weak social interaction either within or outside the family are inclined to report a low level of SWB, which is in line with the existing literature (Johar and Maruyama 2014).

6.2 Heterogenous Effects of Intergenerational Coresidence

Given the extensively recognized urban–rural inequality in China, households in different areas may respond differently to changes in housing prices and make distinct co-residence decisions.[13] We aim to identify which group of elderly people may benefit more from intergenerational co-residence. To address this issue, we further control for city-level housing prices and include the interaction term between intergenerational co-residence and residential type (urban or rural) to the endogenous treatment effect model in column (1) of Table 5. Our results in column (1) validate that the coefficient on $Coreside \times Urban$ is negative and significant at the 5% level. It implies, ceteris paribus, the intergenerational co-residence effect on elders is discounted in urban areas. Meanwhile, this finding suggests that intergenerational co-residence in rural areas results in a relatively larger increase in SWB compared with that in urban areas, which is in line with the hypothesis 2.

Certain reasons account for the heterogeneous effect of intergenerational co-residence between urban and rural areas. From a traditional perspective, being supported by adult children in the form of intergenerational co-residence might increase parents' social status, which enhances their SWB. This urban–rural disparity indicates that elders adhering to the traditional norms of filial piety benefit more in co-residence. Although the social norms and obligations regarding filial piety have been weakened by the advancement of modernization and urbanization in contemporary China, people in rural areas attach importance to traditional practices (Chen and Short 2008). Aranda (2015) proved that the positive co-residence effect is more significant in a more family-oriented environment where intergenerational households are much more prevalent. Chen and Silverstein (2000) affirmed that older adults with more traditional family values will benefit more from intergenerational support exchange than those with less conventional beliefs.

Moreover, older people in rural areas suffer from inadequate or absent formal support systems, public pensions, and retirement programs in contrast to elderly parents in urban areas who have access to a well-functioning social safety net. Primarily, elderly parents in rural areas continue to rely heavily on their adult children for material, physical, and emotional assistance (Silverstein et al. 2006). Consequently, they might be more in need of intergenerational co-residence as an alternative of support in their later lives.

Furthermore, housing unaffordability and high living costs in urban areas compel adult children to co-reside with their urban parents. This set-up involves insufficient living space and downstream financial transfers from older parents to adult children. In addition, it means that elderly parents receive less net financial support from their adult children. Thus, the positive effect of intergenerational co-residence in urban areas is jeopardized to a certain degree. Therefore, the effects of co-residence on rural elderly parents are larger than those on elderly parents in urban areas, which is in line with Hypothesis 2.

[13] In urban areas, rural immigrants may treat co-residence with older parents as an extra financial burden due to the high living costs and housing shortage. Conversely, higher housing prices may encourage urban parents to live with their adult child to reduce costs.

Table 5 Heterogenous effects of intergenerational co-residence

	Dependent Variable: SWB		
	(1)	(2)	(3)
Panel A: intergenerational co-residence by residential type:			
Coreside	0.2614***		
	(0.0637)		
Coreside × Urban	− 0.0599**		
	(0.0271)		
Panel B: Intergenerational Co-residence by offspring's gender:			
With daughters		0.2664***	
		(0.0770)	
With sons		0.2469***	
		(0.0522)	
With both		− 0.0708	
		(0.0948)	
Panel C: different living arrangements: (reference: living with adult children)			
Spouse			− 0.2598***
			(0.0743)
Children and spouse			− 0.1217*
			(0.0738)
Skip-generation			− 0.2488***
			(0.0680)
Relatives			− 0.1470
			(0.1045)
Institution			0.1567**
			(0.0705)
Alone			− 0.1811***
			(0.0427)
Pseudo R^2	0.4601	0.3711	0.3319
Observations	13,587	14,040	14,444

(i) All the heterogenous analysis are based on the linear endogenous treatment effect model specified in column (1) of Table 4. The dependent variable SWB is treated as a cardinal variable. Only the empirical results of outcome equations in the two-stages endogenous treatment effect model are reported in Table 5. The results of treatment equations are presented in Table 15 in the "Appendix". There are missing values in additional control variables (e.g. housing prices; financial transfers from sons and daughters), ending up with samples of different observations

(ii) In column (1), we control for the interaction term between intergenerational co-residence and residential type in the outcome equation. The city-level housing prices are also included in the treatment equations and outcome equation. The complete results are presented in Table 15 in the "Appendix". In column (2), the financial transfers from sons or daughters to elders are included in both stages of linear endogenous treatment effect model. The complete results are presented in Table 16 in the "Appendix". In column (3), i) Living Arrangements: (1) Live with adult children, no spouse;[Reference Group] (2) Live only with a spouse, no adult children; (3) Live both with spouse and children; (4) Living with grandchildren but not with adult children (skip-generational coresidence); (5) Live only with relatives who are not spouse, children or grandchildren (e.g. Living with siblings, spouse of child, spouse of grandchild, parent or parent-in-law, relatives, friends, roommates etc.); (6) Live in an institution; (7) Living alone. The complete results are presented in Table 17 in the "Appendix"

(iii) Standard errors are given in parentheses. ***, **, and * denote significant at the 1, 5, and 10% level respectively

We further examine whether the co-residence effects differ along with the gender of offspring caregivers and classify living arrangements according to the gender of adult children living with elderly parents. The single measure of co-residence is separated into three specific measures: *Coreside with daughter*, *Coreside with son* and *Coreside with both* indicate whether or not elderly parents live with their daughters, sons, or both of them, respectively. Two-stages endogenous multinomial treatment effect regression with IVs are exploited. The results are presented in column (2) of Table 5. It reveals that the estimated parameters on *Coreside with daughter, Coreside with son* are positive and statistically significant at the 1% level. Co-residing with daughters (sons) can significantly raise parental SWB by 7.23% (6.70%). The result is consistent with Hypothesis 3 and findings in Grundy and Murphy (2018), indicating that the elderly who are living with daughters have higher SWB than those living with sons. The primary explanation is that daughters can provide more psychological support, assistance with daily activities and have a lower potential for conflicts compared with sons.

We further classify the living arrangement into following categories: (1) Live with adult children, no spouse [Reference Group]; (2) Live only with a spouse, no adult children; (3) Live both with spouse and children; (4) Living with grandchildren but not with adult children (skip-generational coresidence); (5) Live only with relatives who are not spouse, children or grandchildren (e.g. Living with siblings, spouse of child, spouse of grandchild, parent or parent-in-law, relatives, friends, roommates etc.); (6) Live in an institution; (7) Live alone. The results in column (3) of Table 5 show that ceteris paribus, living only with spouses, living both with spouse and children, living alone or skip-generational coresidence can significantly decrease elders' SWB compared with living only with adult children. This result is consistent with our previous findings, supporting hypothesis 1 in the paper. It implies SWB increased not merely because of that companionship from spouse or others.

6.3 Robustness Check

To evaluate the credibility of previous results, we will provide a set of robustness checks on the identification of causal effects. First, we use the OLS approach instead of the maximum likelihood method. The panel nature of the data enables us to exploit both the cross-sectional and temporal variation in the living arrangement to identify the impact of intergenerational co-residence. The association between intergenerational co-residence and elder's SWB would vary depending on personal heterogeneity. The individual fixed-effects model in a robustness check considers the time-invariant characteristics at the individual level. This helps to overcome the shortcomings of previous empirical analysis on cross-sectional data. Table 6 reports the results.

In column (1), we control for the individual- and year-fixed effects. The result indicates a positive and statistically significant relationship between intergenerational co-residence and the elderly's SWB. Column (2) includes a set of control variables. Similarly, the result claims that co-residence improved the elderly's SWB after controlling for time-varying individual-level factors. It implies the coefficient on *Coreside* remains stable and significant regardless of diffident model specifications.

Second, we use the alternative dimensions of psychological well-being (i.e., depression and loneliness) to verify the effect of intergenerational co-residence. In Column (3) of Table 6, we use the depression index of specific older parents as the dependent variable estimated by ordinary least squares (OLS) method. As expected, the coefficient is negative

Table 6 Impact of intergenerational co-residence on parental SWB, depression and loneliness

	SWB		Depression	Loneliness
	(1)	(2)	(3)	(4)
Coreside	0.1015***	0.0749***	-0.1205**	-0.1324***
	(0.0199)	(0.0175)	(0.0484)	(0.0243)
Controls	Ye	Yes	Yes	Yes
Individual FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Adjust R^2	0.2195	0.3633	0.2934	0.2195
Observations	21,001	20,624	20,624	20,106

Standard errors are given in parentheses. The complete results are presented in the Table 18 in the "Appendix"

***, **, and * denote significant at the 1, 5, and 10% level respectively

and statistically significant, which denotes that intergenerational co-residence is negatively associated with parental depression, which supports our previous findings. Column (4) examines the association between intergenerational co-residence and parental loneliness. Our results infer that living with adult children can significantly decrease parental loneliness. Such findings reconcile with our theoretical framework. Parents can obtain effective emotional support provided by their adult children, which can improve their mental and emotional status. These results elucidate the mechanism behind the positive relationship between intergenerational co-residence and parental SWB.

In order to further address the omitted variable bias, we conduct the Oster (2019) approach to test the level of endogeneity that would invalidate our results. δ a value measures the degree of selections on unobservables relative to observables. Oster (2019) suggests $\delta = 1$ is an appropriate cutoff. It means the unobservables are as important as observables. R_{Max} indicates the R-squared value of a theoretical specification including both observed and unobserved control variables. $\tilde{R}^2$ denotes the regression specified in Eq. (2). Following Oster (2019), R_{Max} is set as follows: $R_{Max} = 1.3\tilde{R}^2$. Thus, the Oster (2019)'s bound estimation of coefficient β_1 in the Eq. (2) is $\beta_1^* = \beta_1^*(R_{Max}, \delta)$. Results show that $\beta_1^*(1.3\tilde{R}^2, 1) = 0.0442$. The identified set is [0.0442, 0.0591], which does not contain zero. It suggests that our results are not driven by unobservables. Alternatively, if $\delta = 3.14$, $\beta_1^*(1.3\tilde{R}^2, 1) = 0$. We find that selection-on-unobservables must be 3.14 times as strong as selection-on-observables to make the coefficient on intergenerational co-residence equal to 0. This implies the empirical results are unlikely to be severely influenced by the omitted variable bias.

7 Conclusion

This study investigates whether and to what extent intergenerational co-residence influences the SWB among elders. Our major empirical results corroborate that elderly parents who live with their adult children would be happier than those who do not. Specifically, the intergenerational co-residence serves as buffers for elders who are handling depression and loneliness, which leads to better SWB than their counterparts who did not undergo such a

living arrangement. Moreover, our findings raise several intriguing issues concerning the heterogeneous effect of intergenerational co-residence. The co-residence effect is more pronounced in rural areas than in urban areas. Additionally, a gender asymmetry in the co-residence effect exists and those living with daughters reported themselves as happier than those living with sons.

Our results reveal a positive relationship between intergenerational co-residence and elders' SWB, which is consistent with the majority of existing literature in the Asian context (Teerawichitchainan et al. 2015; Silverstein et al. 2006), but contrasts some findings on western countries (Tosi and Grundy 2018). The inconclusive findings may be ascribed to different co-residence motivations and cultural norms. Our findings highlight the role of cultural norms plays in moderating co-residence effect, which chimes with existing research (Connelly et al. 2014; Wang et al. 2019).

There are several limitations needs further improvement. The motivation of intergenerational co-residence needs to be clearly identified. The intergenerational co-residence can be either a mutual strategic choice between older and younger generations or an adaptive expedient in response to neediness from one party. Some elders living with adult children out of the purpose of reciprocal exchange. Some adult children of elders choose parent–child co-residence to fulfil their obligations to express filial piety, which is deeply rooted in Eastern Asian cultures. However, some younger generations regard intergenerational co-residence as an adaptive strategy in response to financial hardship and economic insecurity. Therefore, it means intergenerational co-residence with diversified motivation has different impacts on elders' SWB. Adult children's demographic and socioeconomic characteristics could be included to further quantitatively analyse this issue. It is also necessary to identify which party is the mover in parent–child co-residence. More detailed data in these fields would allow for better identification of co-residence effects.

The results present clear implications for public policy meant to improve the welfare of older people. By emphasizing the improvement in the subjective well-being of the elderly living with adult children, our findings support that home-based elderly support may complement the public old-age support. Policymakers, as well as elder care providers, should recognize the positive role of family care in promoting the SWB of older adults. There are unexpected changes in the macroeconomic environment and the housing affordability issues create barriers that hinder the intergenerational co-residence. Therefore, the authorities need to design welfare policies by means of housing policies and economic incentives. For example, providing housing subsidies and public rental housing with priority for intergenerational co-residence purposes. In addition, the government can implement tax deductions for the working population to encourage intergenerational co-residence. Besides, they can also offer subsidies for economically disadvantaged elders and households with financial constraints to alleviate the burden of old-age support providers. Moreover, policy-oriented welfare-state arrangements can exert a subtle influence on socially shared values and family attitudes. Thus, individual-based solutions can be accepted by more and more households.

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Appendix

See Tables 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17 and 18.

Table 7 Definition of variables

Variable	Definition
Dependent variables	
SWB	Self-reported quality of life (1 = very bad; 2 = bad; 3 = fair; 4 = good; 5 = very good)
Loneliness	"How often do they feel lonely and isolated?" (1 = never; 2 = seldom; 3 = sometimes; 4 = often; 5 = always)
Depression	Sum score across dimensions: "1. feel fearful or anxious; 2. feel useless with age; 3. look on the bright side of things. 4. be as happy as when younger"
Explanatory variables	
Coreside	= 1 if respondents live with adult children; 0 otherwise
Gender	= 1 if male; 0 otherwise
Age	Age
Married	= 1 if respondent currently married and living with the spouse; = 0 if single, widowed, divorced, or separated
Urban	= 1 if respondents live in urban areas; 0 otherwise
Education	Years of education received by respondents
Health	Self-reported health status (1 = very bad; 2 = bad; 3 = fair; 4 = good; 5 = very good)
ADL limitation	= 1 if the respondents are unable to deal with ADL (dressing, bathing or showering, eating, getting in or out of bed, using the toilet, and controlling urination and defecation); 0 otherwise
Enough	= 1 if answer for "Are all financial sources enough for your expenses?" is "Yes"; 0 otherwise
Relative income	"How is your life compared with other local people?" (1 = very poor; 2 = poor; 3 = fair; 4 = rich; 5 = very rich)
Homeowner	= 1 if current house/apartment is under the name of elders; 0 otherwise
Children	Number of alive children of respondents
Children Age	The average age of adult children
Gender Mix	The proportion of daughters in all children
Pension	= 1 if respondents have pension; 0 otherwise
Medical	= 1 if respondents have access to public medical care; 0 otherwise
Social	= 1 if respondents take part in certain social activities; 0 otherwise
Financial	= 1 if main financial source is from adult children; 0 otherwise
GainSon	Net financial support from sons
GainDaughter	Net financial support from daughters
Emotional	= 1 if intergenerational relation is closed (i.e., frequent chat/communicate/confide/asking help); 0 otherwise
Physical	= 1 if physical support form adult children (taking care of elders)
Instrumental variables	
Dialect	The dialect diversity index is measure by the number of dialects used in this city
Family units	The number of the family unit in a household in 1982

Data source: CLHLS, 2002–2014

Table 8 Respondents in Every Survey

Respondents	2002	2005	2008	2011	2014
Lost to follow-up between two waves	–	2015	1464	494	115
Died between two waves	–	5874	2520	1183	718
Interviewed	16,064	8175	4191	2514	1681

Table 9 Characteristics of Elders Who Were Lost to Follow-up or Died between Two Waves

	2002–2005		2005–2008		2008–2011		2011–2014	
	Lost	Died	Lost	Died	Lost	Died	Lost	Died
SWB	3.740	3.663	3.736	3.636	3.654	3.642	3.706	3.677
	(0.820)	(0.825)	(0.834)	(0.826)	(0.824)	(0.830)	(0.810)	(0.806)
Loneliness	2.101	2.177	1.972	2.099	1.955	2.106	1.865	2.043
	(1.048)	(1.031)	(1.014)	(1.020)	(1.038)	(1.019)	(1.015)	(1.001)
Depression	2.562	2.719	2.358	2.700	2.723	2.743	2.331	2.587
	(2.101)	(2.053)	(2.042)	(2.117)	(2.169)	(2.069)	(2.110)	(2.004)
Coreside	0.523	0.670	0.543	0.629	0.493	0.577	0.397	0.556
	(0.500)	(0.470)	(0.498)	(0.483)	(0.500)	(0.494)	(0.490)	(0.497)
Male	0.436	0.416	0.457	0.454	0.431	0.492	0.434	0.484
	(0.496)	(0.493)	(0.498)	(0.498)	(0.495)	(0.500)	(0.496)	(0.500)
Urban	0.432	0.193	0.342	0.184	0.421	0.151	0.395	0.152
	(0.495)	(0.394)	(0.475)	(0.388)	(0.494)	(0.358)	(0.489)	(0.359)
Education(year)	2.819	1.673	3.016	1.855	3.130	1.974	4.047	2.106
	(4.219)	(3.196)	(4.268)	(3.187)	(4.240)	(3.290)	(4.852)	(3.329)
Married	0.359	0.183	0.404	0.266	0.410	0.329	0.542	0.374
	(0.480)	(0.386)	(0.491)	(0.442)	(0.492)	(0.470)	(0.499)	(0.484)
Age	83.81	92.43	83.14	89.44	81.35	85.49	79.35	83.22
	(11.62)	(9.597)	(10.53)	(10.13)	(9.266)	(9.838)	(8.552)	(8.767)
63–79	0.394	0.105	0.422	0.181	0.475	0.303	0.566	0.365
	(0.489)	(0.306)	(0.494)	(0.385)	(0.500)	(0.460)	(0.496)	(0.481)
80–90	0.261	0.242	0.289	0.316	0.322	0.350	0.306	0.405
	(0.439)	(0.428)	(0.453)	(0.465)	(0.467)	(0.477)	(0.462)	(0.491)
90+	0.345	0.653	0.289	0.503	0.203	0.347	0.127	0.230
	(0.476)	(0.476)	(0.454)	(0.500)	(0.402)	(0.476)	(0.334)	(0.421)
Health status								
Poor	0.163	0.204	0.147	0.193	0.154	0.181	0.140	0.177
	(0.370)	(0.403)	(0.354)	(0.395)	(0.361)	(0.385)	(0.347)	(0.381)
Fair	0.379	0.374	0.350	0.348	0.378	0.340	0.373	0.356
	(0.485)	(0.484)	(0.477)	(0.476)	(0.485)	(0.474)	(0.484)	(0.479)
Good	0.458	0.422	0.503	0.459	0.468	0.479	0.488	0.467
	(0.498)	(0.494)	(0.500)	(0.498)	(0.499)	(0.500)	(0.500)	(0.499)
ADL limitation	0.288	0.437	0.193	0.294	0.142	0.183	0.123	0.155
	(0.453)	(0.496)	(0.395)	(0.456)	(0.349)	(0.387)	(0.328)	(0.362)

Table 9 (continued)

	2002–2005		2005–2008		2008–2011		2011–2014	
	Lost	Died	Lost	Died	Lost	Died	Lost	Died
Relative income								
Low	0.113	0.163	0.142	0.163	0.138	0.166	0.140	0.166
	(0.316)	(0.369)	(0.349)	(0.370)	(0.345)	(0.372)	(0.347)	(0.372)
Fair	0.698	0.658	0.664	0.667	0.691	0.670	0.681	0.669
	(0.459)	(0.475)	(0.473)	(0.471)	(0.462)	(0.470)	(0.467)	(0.471)
Good	0.189	0.180	0.194	0.170	0.171	0.165	0.179	0.165
	(0.392)	(0.384)	(0.396)	(0.375)	(0.376)	(0.371)	(0.384)	(0.371)
Enough	0.868	0.807	0.828	0.791	0.818	0.785	0.841	0.778
	(0.339)	(0.395)	(0.377)	(0.407)	(0.386)	(0.411)	(0.366)	(0.416)
Homeowner	0.346	0.195	0.424	0.303	0.515	0.389	0.596	0.417
	(0.476)	(0.396)	(0.494)	(0.460)	(0.500)	(0.488)	(0.491)	(0.493)
Social	0.207	0.0797	0.231	0.109	0.201	0.124	0.238	0.143
	(0.405)	(0.271)	(0.422)	(0.312)	(0.401)	(0.329)	(0.426)	(0.350)
Medical	0.921	0.880	0.914	0.886	0.909	0.898	0.939	0.926
	(0.270)	(0.325)	(0.280)	(0.318)	(0.288)	(0.302)	(0.240)	(0.262)
Pension	0.354	0.145	0.315	0.171	0.377	0.161	0.417	0.191
	(0.478)	(0.352)	(0.465)	(0.377)	(0.485)	(0.368)	(0.494)	(0.393)
Children	3.596	3.427	3.749	3.733	3.758	3.985	4.167	4.032
	(1.750)	(1.842)	(1.827)	(1.849)	(1.675)	(1.784)	(1.834)	(1.768)
Gender mix	0.476	0.495	0.474	0.465	0.493	0.463	0.453	0.450
	(0.304)	(0.332)	(0.291)	(0.304)	(0.280)	(0.287)	(0.252)	(0.278)
Children age	53.02	60.02	52.10	56.98	50.81	53.53	47.69	51.32
	(11.82)	(10.56)	(10.63)	(10.61)	(9.748)	(10.03)	(8.704)	(9.024)
Financial	0.483	0.701	0.519	0.666	0.448	0.672	0.392	0.628
	(0.500)	(0.458)	(0.500)	(0.472)	(0.498)	(0.470)	(0.489)	(0.484)
Emotional	0.479	0.620	0.517	0.606	0.531	0.577	0.434	0.568
	(0.406)	(0.392)	(0.428)	(0.404)	(0.424)	(0.408)	(0.409)	(0.414)
Physical	0.598	0.735	0.614	0.714	0.614	0.695	0.578	0.678
	(0.490)	(0.441)	(0.487)	(0.452)	(0.487)	(0.461)	(0.494)	(0.467)
N	2015	5874	1464	2520	494	1183	115	718

Table 10 Changing characteristics of the existing sample

	2002	2005	2008	2011	2014
SWB	3.684	3.671	3.641	3.741	3.822
	(0.816)	(0.834)	(0.804)	(0.864)	(0.815)
Loneliness	2.051	2.027	2.042	1.987	1.988
	(1.008)	(1.019)	(1.026)	(0.993)	(0.982)
Depression	2.478	2.565	2.961	2.296	2.303
	(2.039)	(2.048)	(2.061)	(2.092)	(2.015)
Coreside	0.583	0.552	0.517	0.523	0.530
	(0.493)	(0.497)	(0.500)	(0.500)	(0.499)
Male	0.444	0.465	0.475	0.483	0.480
	(0.497)	(0.499)	(0.499)	(0.500)	(0.500)
Urban	0.237	0.217	0.190	0.167	0.158
	(0.425)	(0.412)	(0.392)	(0.373)	(0.365)
Education (year)	2.220	2.408	2.484	2.622	2.642
	(3.634)	(3.694)	(3.668)	(3.723)	(3.649)
Married	0.344	0.375	0.394	0.411	0.408
	(0.475)	(0.484)	(0.489)	(0.492)	(0.492)
Age	85.05	84.00	82.98	83.45	84.73
	(11.63)	(10.56)	(8.756)	(7.358)	(6.232)
63–79	0.354	0.400	0.425	0.365	0.223
	(0.478)	(0.490)	(0.494)	(0.481)	(0.417)
80–90	0.265	0.301	0.348	0.437	0.577
	(0.441)	(0.459)	(0.476)	(0.496)	(0.494)
90+	0.381	0.299	0.227	0.199	0.200
	(0.486)	(0.458)	(0.419)	(0.399)	(0.400)
Health status					
Poor	0.155	0.177	0.172	0.203	0.179
	(0.362)	(0.381)	(0.378)	(0.403)	(0.383)
Fair	0.357	0.342	0.363	0.350	0.398
	(0.479)	(0.475)	(0.481)	(0.477)	(0.490)
Good	0.488	0.481	0.465	0.447	0.423
	(0.500)	(0.500)	(0.499)	(0.497)	(0.494)
ADL limitation	0.256	0.189	0.108	0.192	0.202
	(0.436)	(0.391)	(0.310)	(0.394)	(0.402)
Relative income					
Low	0.141	0.164	0.161	0.165	0.119
	(0.348)	(0.370)	(0.368)	(0.371)	(0.324)
Fair	0.675	0.663	0.702	0.626	0.675
	(0.468)	(0.473)	(0.457)	(0.484)	(0.468)
Good	0.184	0.173	0.137	0.209	0.206
	(0.387)	(0.378)	(0.344)	(0.407)	(0.405)

Table 10 (continued)

	2002	2005	2008	2011	2014
Enough	0.821	0.775	0.786	0.775	0.802
	(0.383)	(0.417)	(0.410)	(0.417)	(0.398)
Homeowner	0.316	0.454	0.517	0.438	0.440
	(0.465)	(0.498)	(0.500)	(0.496)	(0.497)
Social	0.150	0.175	0.135	0.176	0.183
	(0.358)	(0.380)	(0.341)	(0.381)	(0.387)
Medical	0.904	0.897	0.932	0.953	0.965
	(0.294)	(0.303)	(0.252)	(0.211)	(0.185)
Pension	0.221	0.220	0.210	0.250	0.220
	(0.415)	(0.414)	(0.407)	(0.433)	(0.414)
Children	3.713	3.917	4.034	4.093	4.005
	(1.821)	(1.781)	(1.712)	(1.688)	(1.644)
Gender mix	0.482	0.455	0.456	0.451	0.452
	(0.308)	(0.281)	(0.270)	(0.264)	(0.273)
Children age	53.39	52.51	52.18	49.77	54.07
	(11.80)	(10.36)	(9.045)	(7.581)	(7.565)
Financial	0.594	0.580	0.605	0.538	0.506
	(0.491)	(0.494)	(0.489)	(0.499)	(0.500)
Emotional	0.527	0.565	0.555	0.528	0.563
	(0.399)	(0.431)	(0.431)	(0.420)	(0.420)
Physical	0.652	0.645	0.646	0.667	0.751
	(0.476)	(0.479)	(0.478)	(0.471)	(0.433)
N	16,064	8175	4191	2514	1681

Table 11 Transition matrices of living arrangements across waves

	(1) Children	(2) Spouse only	(3) Children & Spouse	(4) Skip-generation	(5) Relatives only	(6) Institution	(7) Alone
Panel A: wave 2002–2005 (%)							
(1) Children only	81.81	2.14	2.14	1.65	3.23	0.52	8.51
(2) Spouse only	8.82	67.14	11.28	3.14	0.62	0.25	8.75
(3) Children and spouse	16.74	22.50	52.66	3.33	2.07	0.00	2.70
(4) Skip-generation	17.52	37.96	9.49	21.17	2.19	0.73	10.95
(5) Relatives only	24.14	12.07	7.24	9.66	38.28	0.34	8.28
(6) Institution	9.71	0.97	0.00	0.00	0.00	86.41	2.91
(7) Alone	32.84	4.68	1.25	3.53	2.96	0.80	53.93
Panel B: wave 2005–2008 (%)							
(1) Children only	77.45	3.19	2.33	1.01	3.50	0.54	11.98
(2) Spouse only	10.63	68.32	8.81	1.92	1.82	0.20	8.30
(3) Children and spouse	17.84	26.77	49.07	1.12	1.86	0.19	3.16
(4) Skip-generation	24.22	24.22	5.47	15.62	10.16	0.78	19.53
(5) Relatives only	33.00	5.00	6.00	1.00	41.00	1.00	13.00
(6) Institution	2.86	0.00	0.00	0.00	0.00	82.86	14.29
(7) Alone	31.03	4.55	0.79	1.58	4.15	0.20	57.71
Panel C: wave 2008–2011 (%)							
(1) Children only	79.08	1.96	3.53	1.18	6.54	0.39	7.32
(2) Spouse only	8.31	65.88	11.72	4.30	1.34	0.59	7.86
(3) Children and Spouse	20.77	19.01	51.41	3.52	2.46	0.00	2.82
(4) Skip-generation	27.66	19.15	6.38	19.15	6.38	0.00	21.28
(5) Relatives only	30.00	10.00	5.00	5.00	35.00	1.25	13.75
(6) Institution	10.00	0.00	5.00	5.00	5.00	75.00	0.00
(7) Alone	36.10	4.81	2.14	1.60	3.48	1.07	50.80
Panel D: wave 2011–2014 (%)							
(1) Children only	82.14	0.74	1.66	0.92	5.16	0.37	9.02
(2) Spouse only	6.82	65.91	10.61	7.32	1.01	0.76	7.58
(3) Children & Spouse	14.57	19.10	58.29	3.52	2.51	0.00	2.01
(4) Skip-generation	20.00	22.22	22.22	20.00	4.44	0.00	11.11
(5) Relatives only	34.00	10.00	8.00	2.00	32.00	4.00	10.00
(6) Institution	10.00	10.00	0.00	0.00	10.00	70.00	0.00
(7) Alone	28.88	3.02	2.16	1.29	4.31	0.00	60.34

Table 11 demonstrates the changes in the living arrangements for the elderly between two subsequent waves (2002–2005, 2005–2008, 2008–2011 and 2011–2014). The proportions of older people who switch from a particular living arrangement to another arrangement are presented in the table. The sum of each row is 100%. It describes how much flow there is from a category to another over time. Generally, most living arrangements are largely stable over time except (4) Skip-generation and (5) Relatives only

Table 12 Transition of Living Arrangements across Waves for the Elderly in Urban and Rural Areas

	Living arrangement													
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Panel A: Wave 2002–2005 in Urban Areas (%)							Panel B: Wave 2002-2005 in Rural Areas (%)						
(1)	84.91	1.51	1.29	1.72	2.37	1.72	6.47	81.10	2.28	2.33	1.64	3.42	0.25	8.98
(2)	7.08	65.94	10.63	5.45	0.27	0.54	10.08	9.32	67.49	11.47	2.47	0.72	0.16	8.37
(3)	14.34	26.10	51.47	4.41	1.47	0.00	2.21	17.52	21.33	53.04	2.98	2.26	0.00	2.86
(4)	16.33	38.78	12.24	22.45	4.08	2.04	4.08	18.18	37.50	7.95	20.45	1.14	0.00	14.77
(5)	14.71	7.35	2.94	26.47	33.82	0.00	14.71	27.03	13.51	8.56	4.50	39.64	0.45	6.31
(6)	3.77	0.00	0.00	0.00	0.00	94.34	1.89	16.00	2.00	0.00	0.00	0.00	78.00	4.00
(7)	34.42	4.55	0.65	9.74	0.65	0.65	49.35	32.50	4.70	1.38	2.21	3.46	0.83	54.91
	Panel C: Wave 2005–2008 in Urban Areas (%)							Panel D: Wave 2005-2008 in Rural Areas (%)						
(1)	83.83	2.55	1.70	0.43	2.98	0.85	7.66	76.02	3.33	2.47	1.14	3.62	0.48	12.94
(2)	8.59	70.71	10.10	2.53	2.53	0.51	5.05	11.14	67.72	8.48	1.77	1.65	0.13	9.11
(3)	10.10	28.28	53.54	2.02	4.04	0.00	2.02	19.59	26.42	48.06	0.91	1.37	0.23	3.42
(4)	27.50	22.50	2.50	15.00	17.50	0.00	15.00	22.73	25.00	6.82	15.91	6.82	1.14	21.59
(5)	26.67	6.67	0.00	0.00	46.67	6.67	13.33	34.12	4.71	7.06	1.18	40.00	0.00	12.94
(6)	8.33	0.00	0.00	0.00	0.00	83.33	8.33	0.00	0.00	0.00	0.00	0.00	82.61	17.39
(7)	32.18	5.75	1.15	1.15	9.20	0.00	50.57	30.79	4.30	0.72	1.67	3.10	0.24	59.19
	Panel E: Wave 2008–2011 in Urban Areas (%)							Panel F: Wave 2008-2011 in Rural Areas (%)						
(1)	76.02	3.33	2.47	1.14	3.62	0.48	12.94	79.10	1.87	4.06	1.09	6.86	0.16	6.86
(2)	11.14	67.72	8.48	1.77	1.65	0.13	9.11	8.86	64.20	13.02	4.16	1.45	0.36	7.96
(3)	19.59	26.42	48.06	0.91	1.37	0.23	3.42	21.34	17.99	51.88	2.93	2.51	0.00	3.35
(4)	22.73	25.00	6.82	15.91	6.82	1.14	21.59	32.43	13.51	8.11	18.92	5.41	0.00	21.62
(5)	34.12	4.71	7.06	1.18	40.00	0.00	12.94	31.75	9.52	6.35	4.76	31.75	0.00	15.87
(6)	0.00	0.00	0.00	0.00	0.00	82.61	17.39	13.33	0.00	6.67	0.00	6.67	73.33	0.00
(7)	30.79	4.30	0.72	1.67	3.10	0.24	59.19	36.70	4.59	2.14	1.83	1.83	1.22	51.68

Table 12 (continued)

	Living arrangement													
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Panel G: Wave 2011–2014 in Urban Areas (%)							Panel H: Wave 2011-2014 in Rural Areas (%)						
(1)	79.03	2.42	0.81	1.61	4.84	1.61	9.68	79.10	1.87	4.06	1.09	6.86	0.16	6.86
(2)	5.79	73.55	5.79	4.96	0.83	1.65	7.44	8.86	64.20	13.02	4.16	1.45	0.36	7.96
(3)	17.78	24.44	48.89	6.67	2.22	0.00	0.00	21.34	17.99	51.88	2.93	2.51	0.00	3.35
(4)	10.00	40.00	0.00	20.00	10.00	0.00	20.00	32.43	13.51	8.11	18.92	5.41	0.00	21.62
(5)	23.53	11.76	0.00	5.88	47.06	5.88	5.88	31.75	9.52	6.35	4.76	31.75	0.00	15.87
(6)	0.00	0.00	0.00	20.00	0.00	80.00	0.00	13.33	0.00	6.67	0.00	6.67	73.33	0.00
(7)	31.91	6.38	2.13	0.00	14.89	0.00	44.68	36.70	4.59	2.14	1.83	1.83	1.22	51.68

(i) The living arrangement is categorized into (1) Live with adult children, no spouse; (2) Live only with a spouse, no adult children; (3) Live both with spouse and children; (4) Living with grandchildren but not with adult children (skip-generational coresidence); (5) Live only with relatives who are not spouse, children or grandchildren (e.g. Living with siblings, spouse of child, spouse of grandchild, parent or parent-in-law, relatives, friends, roommates etc.); (6) Live in an institution; (7) Living alone

(ii) Table 12 demonstrates the changes in the living arrangements for the elderly in urban and rural areas between two subsequent waves (2002–2005, 2005–2008, 2008–2011 and 2011–2014). The proportions of older people who switch from a particular living arrangement to another arrangement are presented in the table. The sum of each row in each panel is 100%. It describes how much flow there is from a category to another over time

Table 13 Two-stages endogenous treatment effect regression with IVs

Dependent variable	Linear Treatment Effect Model		Ordered-Probit Treatment Effect Model	
	(1) Treatment equation	(2) Outcome Equation	(1) Treatment equation	(2) Outcome Equation
	Coreside	SWB	Coreside	SWB
Coreside		0.2728***		0.3842***
		(0.0638)		(0.1168)
Instruments				
Family units	0.8025***		1.6230***	
	(0.2468)		(0.4911)	
Dialect diversity index	0.2822***		0.5696***	
	(0.0590)		(0.1190)	
Controls				
ADL limitation	0.2704***		0.5284***	
	(0.0333)		(0.0646)	
Homeowner	-0.5075***		-1.0049***	
	(0.0252)		(0.0497)	
Male	0.0099	-0.0273**	0.0162	-0.0464**
	(0.0268)	(0.0136)	(0.0527)	(0.0224)
Urban	0.0831***	0.0045	0.1644***	0.0090
	(0.0320)	(0.0168)	(0.0631)	(0.0283)
Education level	-0.0000	0.0057***	-0.0001	0.0098***
	(0.0036)	(0.0019)	(0.0073)	(0.0032)
Married	0.0396	0.0784***	0.0845	0.1270***
	(0.0342)	(0.0177)	(0.0671)	(0.0299)
Age: 80–89	0.0501	-0.0125	0.1005	-0.0184
	(0.0314)	(0.0163)	(0.0616)	(0.0273)
Age: 90+	0.3044***	0.0133	0.6019***	0.0306
	(0.0469)	(0.0252)	(0.0931)	(0.0416)

Table 13 (continued)

Dependent variable	Linear Treatment Effect Model		Ordered-Probit Treatment Effect Model	
	(1) Treatment equation	(2) Outcome Equation	(1) Treatment equation	(2) Outcome Equation
	Coreside	SWB	Coreside	SWB
Health status: poor	-0.0344	-0.6024***	-0.0675	-0.9797***
	(0.0347)	(0.0174)	(0.0685)	(0.0342)
Health status: fair	0.0388	-0.3861***	0.0775	-0.6352***
	(0.0256)	(0.0131)	(0.0508)	(0.0238)
Low relative income	-0.0694*	-0.3701***	-0.1382*	-0.5971***
	(0.0402)	(0.0206)	(0.0801)	(0.0369)
High relative income	0.0687**	0.3382***	0.1361**	0.5744***
	(0.0313)	(0.0160)	(0.0612)	(0.0266)
Enough	-0.0415	0.2007***	-0.0799	0.3226***
	(0.0359)	(0.0185)	(0.0714)	(0.0317)
Social	0.0098	0.0958***	0.0202	0.1628***
	(0.0313)	(0.0162)	(0.0631)	(0.0271)
Medical	-0.0072	0.2309***	-0.0146	0.3601***
	(0.0474)	(0.0243)	(0.0950)	(0.0421)
Pension	0.2338***	0.0364*	0.4653***	0.0658*
	(0.0385)	(0.0202)	(0.0780)	(0.0342)
Children	-0.0611***	0.0069*	-0.1221***	0.0102
	(0.0068)	(0.0037)	(0.0135)	(0.0063)
Gender mix	0.0268	0.0297	0.0552	0.0514
	(0.0412)	(0.0209)	(0.0818)	(0.0347)

Table 13 (continued)

Dependent variable	Linear Treatment Effect Model		Ordered-Probit Treatment Effect Model	
	(1) Treatment equation	(2) Outcome Equation	(1) Treatment equation	(2) Outcome Equation
	Coreside	SWB	Coreside	SWB
Children age	-0.0149***	0.0035***	-0.0294***	0.0055***
	(0.0019)	(0.0010)	(0.0038)	(0.0017)
Financial	0.2618***	-0.0028	0.5181***	0.0012
	(0.0301)	(0.0169)	(0.0602)	(0.0283)
Emotional	0.8198***	-0.0049	1.6110***	0.0106
	(0.0389)	(0.0276)	(0.0760)	(0.0473)
Physical	0.4893***	-0.0337*	0.9615***	-0.0451
	(0.0299)	(0.0196)	(0.0588)	(0.0337)
Pseudo R^2: 0.4258	Observations: 14,444		Observations: 14,444	

Standard errors are given in parentheses. There are missing values in instrumental variables, ending up with a sample with 14,444 observations. This specification employs the latent-factor structure and is based on 100 Halton sequence-based quasi-random draws per observation. For the linear specification, the test of independent equations statistic: 13.50 ($p=0.00$). For the ordered probit model, the the test of independent equations statistic: 7.6 ($p=0.01$). The regional fixed effects and year fixed effects are all included in the outcome equations in two-stages endogenous treatment effect models

***, **, and * denote significant at the 1, 5, and 10% level respectively

Table 14 Liner and ordered-probit regression without IVs

	Dependent variable:SWB			
	(1)		(2)	
	Linear		Ordered-probit	
Coresidence	0.0591***	(0.0108)	0.1032***	(0.0190)
Male	−0.0352***	(0.0113)	−0.0590***	(0.0205)
Urban	0.0087	(0.0149)	0.0190	(0.0273)
Education level	0.0037**	(0.0016)	0.0071**	(0.0030)
Married	0.0749***	(0.0145)	0.1273***	(0.0250)
Age: 80–89	0.0031	(0.0135)	0.0061	(0.0232)
Age: 90 +	0.0314	(0.0195)	0.0514	(0.0339)
Health status: poor	−0.6037***	(0.0159)	−1.0085***	(0.0276)
Health status: Fair	−0.3829***	(0.0106)	−0.6487***	(0.0191)
Low relative income	−0.3911***	(0.0182)	−0.6264***	(0.0307)
High relative income	0.3511***	(0.0126)	0.5992***	(0.0229)
Enough	0.2016***	(0.0150)	0.3276***	(0.0248)
Social	0.0994***	(0.0136)	0.1713***	(0.0236)
Medical	0.2121***	(0.0213)	0.3315***	(0.0343)
Pension	0.0568***	(0.0170)	0.0956***	(0.0298)
Children	0.0020	(0.0029)	0.0035	(0.0051)
Gender mix	0.0282	(0.0173)	0.0476	(0.0306)
Children age	0.0029***	(0.0008)	0.0050***	(0.0014)
Financial	0.0135	(0.0129)	0.0174	(0.0224)
Emotional	0.0477***	(0.0172)	0.0778***	(0.0293)
Physical	0.0023	(0.0134)	0.0070	(0.0227)
Provincial dummies	Yes			
Year dummies	Yes			
Adjuested R^2/pseudo R^2	0.3229			
Observations	20,688			

Standard errors are given in parentheses. ***, **, and * denote significant at the 1, 5, and 10% level respectively

Table 15 Heterogenous effects of intergenerational co-residence by residential type (Urban/Rural)

	Two-stages Endogenous Treatment Effect Regression with IVs	
	(1) Treatment equation	(2) Outcome equation
Dependent variable	Coreside	SWB
Coreside		0.2614***
		(0.0637)
Coreside × Urban		− 0.0599**
		(0.0271)
Family units	0.6893***	
	(0.2538)	
Dialect diversity index	0.3226***	
	(0.0631)	
ADL limitation	0.2673***	
	(0.0345)	
Homeowner	-0.5250***	
	(0.0261)	
Male	0.0077	− 0.0335**
	(0.0276)	(0.0140)
Urban	0.1074***	0.0349
	(0.0328)	(0.0226)
Housing Price	-0.0215	− 0.0185
	(0.0193)	(0.0206)
Education level	0.0014	0.0059***
	(0.0037)	(0.0019)
Married	0.0372	0.0798***
	(0.0355)	(0.0184)
AGE: 80–89	0.0629*	− 0.0079
	(0.0323)	(0.0167)
AGE: 90+	0.3021***	0.0286
	(0.0482)	(0.0257)
Health status: Poor	-0.0074	− 0.6162***
	(0.0361)	(0.0180)
Health status: Fair	0.0450*	-0.3932***
	(0.0264)	(0.0134)
Low relative income	-0.0823**	− 0.3696***
	(0.0415)	(0.0212)
High relative income	0.0704**	0.3444***
	(0.0322)	(0.0164)
Enough	-0.0327	0.2061***
	(0.0371)	(0.0190)
Social	0.0089	0.0989***
	(0.0321)	(0.0165)
Medical	-0.0253	0.2500***
	(0.0499)	(0.0254)
Pension	0.2384***	0.0327
	(0.0395)	(0.0207)

Table 15 (continued)

	Two-stages Endogenous Treatment Effect Regression with IVs	
	(1) Treatment equation	(2) Outcome equation
Dependent variable	Coreside	SWB
Children	-0.0565***	0.0051
	(0.0070)	(0.0038)
Gender mix	0.0097	0.0389*
	(0.0427)	(0.0216)
Children age	-0.0151***	0.0029***
	(0.0020)	(0.0010)
Financial	0.2614***	-0.0132
	(0.0310)	(0.0173)
Emotional	0.8268***	0.0038
	(0.0403)	(0.0282)
Physical	0.4673***	-0.0243
	(0.0308)	(0.0197)

There are missing values in instrumental variables and housing prices, ending up with a sample with 13,587 observations (Pseudo $R^2 = 0.46$). Standard errors are given in parentheses. ***, **, and * denote significant at the 1, 5, and 10% level respectively

Table 16 Heterogenous effects of intergenerational co-residence by offspring's gender

	Two-stages endogenous multinomial treatment effect regression with IVs			
	(1) Treatment equation			(2) Outcome Equation
	Coreside with daughters	Coreside with sons	Coreside with both	SWB
Coreside with daughters				0.2664***
				(0.0770)
Coreside with sons				0.2469***
				(0.0522)
Coreside with both				−0.0708
				(0.0948)
Family units	−1.1118	1.6292**	1.1113	
	(1.1045)	(0.7658)	(1.6565)	
ADL limitation	0.7043***	0.4862***	0.8675***	
	(0.1145)	(0.0747)	(0.2131)	
Homeowner	−0.6713***	−1.0708***	−0.2485	
	(0.1206)	(0.0887)	(0.1637)	
Male	−0.1953**	0.1072*	−0.1821	−0.0273*
	(0.0973)	(0.0615)	(0.1631)	(0.0146)
Urban	0.8710***	0.0182	0.4761*	0.0079
	(0.1191)	(0.0937)	(0.2464)	(0.0200)
Education level	0.0262*	−0.0047	0.0200	0.0054**
	(0.0135)	(0.0091)	(0.0277)	(0.0022)

Table 16 (continued)

	Two-stages endogenous multinomial treatment effect regression with IVs			
	(1) Treatment equation			(2) Outcome Equation
	Coreside with daughters	Coreside with sons	Coreside with both	SWB
Married	0.5646***	0.0086	0.2538	0.0685***
	(0.1297)	(0.0829)	(0.2378)	(0.0186)
Age: 80–89	0.1882*	0.0853	0.0580	−0.0097
	(0.1105)	(0.0653)	(0.2034)	(0.0174)
Age: 90+	0.7389***	0.4815***	1.1337***	0.0184
	(0.1466)	(0.0957)	(0.3190)	(0.0245)
Health status: Poor	−0.0332	−0.0751	−0.0118	−0.6088***
	(0.1432)	(0.0757)	(0.2339)	(0.0232)
Health status: Fair	0.1383	0.0773	−0.1199	−0.3893***
	(0.1010)	(0.0577)	(0.2012)	(0.0169)
Low relative income	−0.2063	−0.1989**	0.1137	−0.3607***
	(0.1546)	(0.0900)	(0.2861)	(0.0232)
High relative income	0.4319***	0.1021	−0.2097	0.3378***
	(0.1093)	(0.0755)	(0.2561)	(0.0170)
Enough	−0.1122	−0.0071	−0.1697	0.1957***
	(0.1352)	(0.0782)	(0.2791)	(0.0187)
Social	0.0154	−0.0196	0.5640**	0.0894***
	(0.1247)	(0.0827)	(0.2286)	(0.0165)
Medical	0.3891*	−0.1517	0.8675*	0.2306***
	(0.2072)	(0.1067)	(0.4588)	(0.0309)
Pension	0.5739***	0.3391***	0.1189	0.0443**
	(0.1672)	(0.0826)	(0.2942)	(0.0210)
Children	−0.1549***	−0.0635***	−0.0185	0.0045
	(0.0277)	(0.0170)	(0.0512)	(0.0039)
Gender mix	2.7974***	−0.5136***	0.9104***	0.0213
	(0.2157)	(0.1067)	(0.3018)	(0.0314)
Children age	−0.0106	−0.0286***	−0.0632***	0.0033***
	(0.0067)	(0.0040)	(0.0154)	(0.0010)
Financial	0.4130***	0.5948***	0.0636	−0.0095
	(0.1229)	(0.0736)	(0.2349)	(0.0177)
Emotional	2.2638***	1.5076***	1.6108***	−0.0081
	(0.1523)	(0.0955)	(0.3428)	(0.0217)
Physical	0.9229***	0.9276***	0.5961**	−0.0274
	(0.1437)	(0.0618)	(0.2599)	(0.0188)
GainSon	−0.1870***	0.0189*	−0.0279	0.0055*
	(0.0181)	(0.0115)	(0.0369)	(0.0031)
GainGirl	0.1260***	−0.0573***	−0.0279	0.0047
	(0.0202)	(0.0106)	(0.0321)	(0.0030)

(i) The measure of co-residence is separated into three specific categories: Coreside with daughter, Coreside with son and Coreside with both. ii) Standard errors are given in parentheses. There are missing values in instrumental variables, GainSon and GainGirl, ending up with a sample with 14,040 observations. (Pseudo $R^2 = 0.37$); ***, **, and * denote significant at the 1, 5, and 10% level respectively

Table 17 Different Living Arrangements and Parental SWB

VARIABLES	Two-stages endogenous multinomial treatment effect regression with IVs						
	(1) Treatment equation						(2) Outcome
	Spouse	Children & Spouse	Skip-generation	Relatives	Institution	Alone	SWB
Spouse							−0.2598***
							(0.0743)
Children and spouse							−0.1217*
							(0.0738)
Skip-generation							−0.2488***
							(0.0680)
Relatives							−0.1470
							(0.1045)
Institution							0.1567**
							(0.0705)
Alone							−0.1811***
							(0.0427)
Family units	0.6659	1.2390	−2.5980*	0.3703	−12.8741***	−2.3470**	
	(1.5662)	(1.3939)	(1.5352)	(1.5077)	(3.8956)	(1.1850)	
Dialect diversity	−0.8744**	−0.1989	0.4147	0.2798	−1.0988	−0.8392***	
	(0.4053)	(0.3576)	(0.4059)	(0.3018)	(0.8223)	(0.2817)	
ADL limitation	−0.1756	0.2344	0.0624	−0.0862	0.2900	−0.8726***	
	(0.1848)	(0.1880)	(0.1820)	(0.1365)	(0.2831)	(0.1170)	
Homeowner	1.6400***	0.1501	1.1264***	0.3949***	−46.3259***	0.9705***	
	(0.1608)	(0.1530)	(0.1575)	(0.1372)	(0.3059)	(0.1478)	
Male	−0.0962	0.1194	−0.4829***	0.0387	0.0087	0.2006***	−0.0266*
	(0.1394)	(0.1353)	(0.1516)	(0.1120)	(0.2502)	(0.0774)	(0.0145)

Table 17 (continued)

VARIABLES	Two-stages endogenous multinomial treatment effect regression with IVs						
	(1) Treatment equation						(2) Outcome
	Spouse	Children & Spouse	Skip-generation	Relatives	Institution	Alone	SWB
Urban	−0.0023	0.1351	0.4374**	0.0604	1.0955***	−0.4080***	0.0046
	(0.1913)	(0.2076)	(0.1826)	(0.1578)	(0.2306)	(0.1145)	(0.0181)
Education Level	0.0188	0.0190	0.0409**	0.0129	0.0395	−0.0097	0.0056**
	(0.0211)	(0.0200)	(0.0190)	(0.0172)	(0.0331)	(0.0114)	(0.0022)
Married	8.1882***	8.4219***	2.9232***	2.4492***	−0.6494	−1.3980***	0.1806***
	(0.2550)	(0.2671)	(0.2162)	(0.2167)	(0.5122)	(0.2996)	(0.0612)
Age: 80–89	−0.2591	−0.1902	−0.0932	0.0650	0.3967	−0.2812***	−0.0109
	(0.1657)	(0.1598)	(0.1920)	(0.1616)	(0.4757)	(0.0874)	(0.0166)
Age: 90+	−0.7613***	0.2289	−0.0686	0.5716***	−0.4654	−0.7620***	0.0256
	(0.2519)	(0.2528)	(0.2815)	(0.2049)	(0.6005)	(0.1274)	(0.0242)
Health: poor	−0.1461	−0.1520	−0.1203	−0.2598	0.0931	0.1733*	−0.6009***
	(0.1825)	(0.1943)	(0.2082)	(0.1801)	(0.3057)	(0.1030)	(0.0229)
Health: fair	−0.1677	−0.0106	−0.0700	−0.0514	0.0007	−0.0328	−0.3845***
	(0.1527)	(0.1575)	(0.1611)	(0.1136)	(0.2355)	(0.0769)	(0.0164)
Low relative income	0.1688	0.1003	0.0651	−0.1292	−0.1544	0.2909**	−0.3731***
	(0.2315)	(0.2340)	(0.2318)	(0.1918)	(0.4973)	(0.1143)	(0.0237)
High relative income	−0.2280	−0.1817	−0.2233	0.0358	−0.0606	−0.3020***	0.3399***
	(0.1679)	(0.1665)	(0.1989)	(0.1299)	(0.2831)	(0.0983)	(0.0169)
Enough	0.0697	0.0013	0.0184	−0.0612	0.7990**	0.1363	0.1976***
	(0.1922)	(0.1993)	(0.2036)	(0.1712)	(0.3880)	(0.1015)	(0.0193)
Social	0.0644	0.2195	−0.0163	−0.0464	1.3316***	0.0362	0.0905***
	(0.1963)	(0.1900)	(0.1894)	(0.1625)	(0.2696)	(0.1068)	(0.0161)

Table 17 (continued)

VARIABLES	Two-stages endogenous multinomial treatment effect regression with IVs						
	(1) Treatment equation						(2) Outcome
	Spouse	Children & Spouse	Skip-generation	Relatives	Institution	Alone	SWB
Medical	0.5520*	0.3660	0.3376	0.4274**	1.0889**	−0.1907	0.2265***
	(0.2826)	(0.2730)	(0.2918)	(0.1942)	(0.5464)	(0.1221)	(0.0303)
Pension	−0.2991	0.2526	0.1846	−0.5787***	−0.0906	−0.4051***	0.0485**
	(0.2101)	(0.2200)	(0.2081)	(0.1846)	(0.2964)	(0.1146)	(0.0214)
Children	0.0813**	−0.0480	0.0400	−0.1645***	−0.0533	0.1929***	0.0053
	(0.0368)	(0.0362)	(0.0438)	(0.0347)	(0.0694)	(0.0198)	(0.0038)
Gender mix	0.3750	0.7178***	0.1877	0.7150***	0.4986	−0.2098*	0.0294
	(0.2345)	(0.2516)	(0.2292)	(0.1797)	(0.3522)	(0.1254)	(0.0196)
children age	0.0160	−0.0408***	−0.0157	0.0209***	0.0237	0.0110**	0.0027***
	(0.0101)	(0.0110)	(0.0128)	(0.0077)	(0.0191)	(0.0049)	(0.0010)
Financial	−0.3093*	0.1711	−0.1063	−0.8330***	−0.3744	−0.4331***	0.0108
	(0.1786)	(0.1804)	(0.1946)	(0.1485)	(0.2453)	(0.1033)	(0.0170)
Emotional	−2.2396***	−1.3058***	−2.4283***	−1.5113***	−2.6271***	−1.6214***	0.0338*
	(0.2247)	(0.2437)	(0.2439)	(0.1704)	(0.3329)	(0.1238)	(0.0196)
Physical	−1.8832***	−1.1179***	−1.9301***	−1.9717***	−3.6067***	−0.8268***	−0.0025
	(0.1773)	(0.1778)	(0.1887)	(0.1491)	(0.2776)	(0.1140)	(0.0199)

(i) Living Arrangements: (1) Live with adult children, no spouse;[Reference Group] (2) Live only with a spouse, no adult children; (3) Live both with spouse and children; (4) Living with grandchildren but not with adult children (skip-generational coresidence); (5) Live only with relatives who are not spouse, children or grandchildren (e.g. Living with siblings, spouse of child, spouse of grandchild, parent or parent-in-law, relatives, friends, roommates etc.); (6) Live in an institution; (7) Living alone

(ii) Standard errors are given in parentheses. There are missing values in instrumental variables, ending up with a sample with 14,444 observations (Pseudo $R^2 = 0.33$); ***, **, and * denote significant at the 1, 5, and 10% level respectively

Table 18 Impact of Intergenerational Co-residence on Parental SWB, Depression and Loneliness

	(1) SWB	(2) SWB	(3) Depression	(4) Loneliness
Coresidence	0.1015***	0.0749***	−0.1205**	−0.1324***
	(0.0199)	(0.0175)	(0.0484)	(0.0243)
Married		0.0619**	−0.0287	−0.4199***
		(0.0242)	(0.0638)	(0.0379)
Age: 80–89		−0.0027	0.1059*	−0.0246
		(0.0235)	(0.0595)	(0.0292)
Age: 90+		0.0276	0.1050	−0.0296
		(0.0403)	(0.1066)	(0.0514)
Health status: poor		−0.6085***	1.4439***	0.3790***
		(0.0219)	(0.0601)	(0.0314)
Health status: Fair		−0.3789***	0.6638***	0.1792***
		(0.0157)	(0.0387)	(0.0215)
Low relative income		−0.3221***	0.3822***	0.1787***
		(0.0224)	(0.0603)	(0.0304)
High relative income		0.2685***	−0.2363***	−0.0840***
		(0.0174)	(0.0463)	(0.0250)
Enough		0.1645***	−0.3264***	−0.0959***
		(0.0183)	(0.0533)	(0.0289)
Social		0.0886***	−0.1732***	0.0242
		(0.0189)	(0.0497)	(0.0251)
Medical		0.1642***	−0.5178***	−0.1182***
		(0.0267)	(0.0786)	(0.0414)
Pension		0.0163	−0.0993	0.0327
		(0.0324)	(0.0796)	(0.0422)
Children		−0.0131*	−0.0040	−0.0302***
		(0.0074)	(0.0222)	(0.0104)
Gender mix		0.0428	−0.1830	−0.0434
		(0.0369)	(0.1251)	(0.0611)
Children age		0.0045**	0.0109**	0.0029
		(0.0018)	(0.0049)	(0.0025)
Financial		−0.0013	0.0514	0.0235
		(0.0179)	(0.0480)	(0.0235)
Emotional		0.0388*	0.1599**	0.0620*
		(0.0213)	(0.0646)	(0.0327)
Physical		0.0242	−0.0335	−0.0285
		(0.0173)	(0.0409)	(0.0218)
Individual FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Adjust R^2	0.2195	0.3633	0.2934	0.2195
Observations	21,001	20,624	20,624	20,106

Standard errors are given in parentheses. The complete results are presented in the Table 18 in the "Appendix"

***, **, and * denote significant at the 1, 5, and 10% level respectively

References

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