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Fertility cost, intergenerational labor division, and female employment

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Haiyue Yu, Jin Cao and Shulong Kang

Fertility cost, intergenerational labor
division, and female employment



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Haiyue Yu, Jin Cao and Shulong Kang

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Abstract

This paper considers the role of grandparental childcare in China's extraordinarily high female labor-market participation rate. Indeed, the high female labor-market participation and low labor-income penalty for childbirth is all the more remarkable given the lack of public subsidies for childcare. Using a novel and high-quality dataset, we find that childcare provided by retired grandparents significantly reduces the duration of career breaks for young women and helps women remain in the labor force. We further show that well-educated urban women benefit most from grandparental childcare, especially in the first three years of the child's life before there is a possibility to enter kindergarten.

JEL Codes: C24, J13, J22.

Keywords: intergenerational labor division, grandparental childcare, female employment, human capital accumulation.

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1 Introduction

Having children usually comes at an economic cost to the woman. Time devoted to childcare may disrupt her career path and depreciate her value in the labor market. To assure high female labor-market participation, advanced economies typically provide generous subsidies for childcare and back policies that support female employment. China, in contrast, provides little in the way of childcare spending or protections for female workers. Indeed, employer-provided daycare in the world's largest emerging market economy has largely vanished over the past three decades. Where the market has stepped in to provide such services, they are typically unaffordable to the average Chinese. Yet Chinese women perform surprisingly well internationally in terms of their labor-market participation rates. They are far higher than in other emerging market economies, and even exceed those of the Nordic countries, which are a traditional benchmark for gender equality in working life. Childbirth-induced interruptions to women's careers in China are shorter and the penalties in labor income are smaller than those experienced by women in advanced economies.

Have Chinese women somehow managed to resolve the conflict between employment and childcare? Mothers in advanced economies are usually the main caregivers for young children. The inherent tension between employment and childcare is eased through public subsidies and supportive employment policies. China offers little in the way of government-funded childcare or a private market that provides affordable childcare services, so women rely heavily on their parents or the parents of their spouse to share the burden of childcare. For many, this is the only practical way to avoid large breaks in their careers and remain in the labor force. This intra-family labor transfer from the old to young generation fills the public subsidy gap and reduces the opportunity cost for young females to work. It also partly explains China's high female employment rate and low childbirth-induced penalty on labor income.

Using novel and high-quality micro-level survey data and addressing the endogeneity issues, we investigate the effects of grandparental childcare on improving female labor-market participation and wage income, as well as effect heterogeneities depending on various characteristics of the mother. We find that the childcare provided by retired grandparents significantly increases the labor market participation rate of young women and reduces the childbearing-induced penalty in their labor income. Well-educated urban women with young children benefit the most from grandparental childcare, especially before the child's third birthday. This paper offers an explanation for the co-existence in China of high female employment and low childbearing-induced penalties on mothers. We also consider the underlying intra-family division of labor.

1.1 Background and literature review

The statutory retirement age in China was set in 1978. Men can retire at 60 and women at 50 (or 55 if they work in the public sector). These early retirement ages assure a large pool of retired people available to care for their grandchildren. In a 2007 survey conducted by the Shanghai Population and Family Planning Commission, 88.7% of grandparents were involved in caring for their grandchildren, with 53.3% of grandparents assuming major childcare duties on a regular basis. The China Health and Retirement Longitudinal Study (CHARLS) shows that 50% of grandparents regularly assumed major responsibilities in caring for grandchildren, a level much higher than in most countries. In the US and northern Europe, grandparent-provided childcare is less common, largely due to widely available daycare services provided by the market or public institutions. In the US, only 16% of grandparents were regularly involved in caring for grandchildren,¹ 15% in Germany and Austria, 30% in Italy and Spain, and 2% in Denmark and Sweden.² Private childcare services are available in China, but few households actually rely on them. For example, among 2,281 children below the age of three in the whole sample of China Family Panel Studies (CFPS) 2014, only three are fully taken care of by babysitters hired from the market during the daytime. Instead, assistance from grandparents is the standard solution for most families.

Such high involvement of the older generation in childcare has a huge impact on the labor market for the young generation, especially young women. It also reduces the opportunity cost of childbearing as a young woman establishes her career path. China's labor market thus has two outstanding qualities. First, China's labor-force participation rate for females is quite high. In 2017, it was 61%,³ which is among the world's highest levels of female participation in the labor force in the industrialized world. It is significantly higher than the US (55.7%) and the euro area (50%), and even exceeds that of countries famous for gender equality such as Denmark (59.2%), Norway (60.8%), and Sweden (60.8%). The other distinguishing feature is that the childbearing-induced labor-income penalty is surprisingly low for Chinese women, even in the absence of state-sponsored social protections. The childbearing-induced penalty in female employment (computed as the child-birth-induced drop in the employment rate) is only 5.6% for urban populations or 3.0% for rural

¹ See Health and Retirement Study, a.k.a. HRS, 2008; Lumsdaine and Vermeer, 2015.

² See Survey of Health, Ageing and Retirement in Europe, a.k.a. SHARE, 2004. It is worth noting that by definition grandparental childcare in the Chinese surveys is more intensive. Regular grandparental childcare is defined as grandparents being the *main* responsible persons on a *daily* basis (see e.g. CHARLS and the China Family Panel Survey, a.k.a. CPFS), while in the US HRS the threshold for a household's reliance on grandparental childcare on a regular basis requires that grandchildren are looked after by grandparents for more than 672 hours in a 12-month period (Lumsdaine and Vermeer, 2015). SHARE for Europe sets a threshold of "at least twice a week" (Arpino et al., 2014). Given China's stricter definition, the contrast between China and the US and Europe is even more striking.

³ Percentage of female population aged 15 or over, computed from International Labor Organization's ILOSTAT database. Data retrieved in March 2018.

populations (Zhang, 2011). Again, this is significantly lower than in the US (26.3%).⁴ Similarly, the penalty in labor income (computed as the childbirth-induced drop in wages) is merely 7% for China (Yu and Xie, 2014), compared to 18% for Germany, 10% for the UK, 9% for Spain (Gangl and Ziefle, 2009), and 16% for the US (Anderson et al., 2002).

It is well established in the literature that childbearing crowds out working hours for young women, thereby significantly reducing their employment rate (e.g. Cristia, 2008; Zhou, 2013; Xiong and Li, 2016) and the intensity in labor supply (e.g. Angrist and Evans, 1998; Entwisle and Chen, 2002; Zhang, 2011). Moreover, childbearing significantly reduces the wage rate for women, resulting in a wage penalty (Anderson et al., 2002; Yu and Xie 2014) from reduced productivity (Budig and England, 2001) and a depreciation in human capital due to career interruption (Polachek, 1981). Thus, women with parents or parents-in-law willing to provide an informal safety net and assume some of the burden of childcare are expected to experience less of a drop in their post-childbirth employment rate and labor income than women lacking such support.

Studies on the impacts of grandparental childcare on female employment mainly follow two strands.

The first strand directly investigates the impact of maternal and paternal parents intra-generational labor transfer on the mother's employment. Using data from European countries (SHARE), Dimova and Wolff (2011) find that grandparental childcare significantly improves the labor-force participation of young women, as well as the intensity in the labor supply. In a cross-country study, Aassve et al. (2012) find that this impact is significant and positive in some European countries (France, Germany, Bulgaria, and Hungary), but not significant in others (Georgia, Netherlands, and Russia). Using survey data from the US (NLSY79), Posadas and Vidal-Fernández (2013) find that grandparental childcare increases the labor-force participation of young women by 9%, and that this effect is particularly strong for ethnic minorities and single mothers. Arpino et al. (2014) document similar positive effect using Italian data with instrumental variables, and this effect is stronger for less-educated women and younger children.

The second strand focuses on quantifying the impact using proxies of grandparental childcare where direct measurements are unavailable. It has been documented (e.g. García-Morán and Kuehn, 2017; Compton and Pollak, 2014) that the labor-force participation rate is higher for young women who live close to their parents, thereby making grandparental childcare less of an effort. Based on a natural experiment from the Italian pension reform, Bratti et al. (2017) find that grandmothers' retirement increases the employment rate of young women by 13%, but that no similar

⁴ See Cristia (2008).

effect exists for grandfathers, suggesting unsurprisingly that childcare is more likely to be provided by grandmothers.

Compared with the US and Europe, the intra-family downward labor transfer for childcare in China is much more common and intensive, however, studies of its impact on employment of young mothers are still scarce. Although Shen et al. (2012) find that living with the older generation increases labor-force participation rate and working hours of women overall, it may be explained by increased feasibility of grandparental support for housework. The study does not address mothers with young children, and thereby fails to provide direct evidence on how the inter-generational labor transfer affects employment of childbearing women through grandparental childcare. Besides employment, there is also scant literature on how grandparental childcare affects the labor income of mothers, i.e., how grandparental support reduces interruptions to childbearing female's career path or path of human capital accumulation, as well as the negative shocks to post-natal income flow.

Our paper contributes to the literature in three ways. First, it investigates the direct impacts of grandparent-provided childcare on both employment and labor income of mothers with young children in the Chinese context. Our novel, high-quality dataset allows us to use Probit and Tobit models with instrumental variables to identify the heterogeneities in the affected females with respect to education level, residential area, age of children, as well as provide economic explanations. Second, using the lens of the intra-family intergenerational labor division, we tease out the factors that contribute to China's extremely high female labor-force participation and low childbearing-induced labor-income penalty. Third, our findings reveal the hidden costs in employment and human capital development encountered by women with young children when the statutory retirement age is raised. Our research suggests that policymakers face a clear tradeoff in increasing the labor supply by raising the retirement age at the expense of crowding out labor provided by women with young children. Higher retirement ages can permanently impair the career paths of childbearing women through the loss of access to grandparental support for childcare. This rationalizes the need for policies supporting childbearing and female employment as China moves to revise retirement policies, particularly with respect to the retirement age.

1.2 Structure of the paper

Section 2 presents the stylized facts on grandparental childcare and briefly describes the data. Section 3 sets forth the econometric models used in our analysis. Section 4 reports the results from estimating the models. This is followed by interpretation and discussion of the results. Section 5 presents several robustness checks using various model specifications. Section 6 outlines the policy implications and concludes.

2 Childcare and female employment

2.1 Data description

To analyze the impact of grandparental childcare on labor-force participation and labor income of young mothers, we combine the information for three generations of the same family, i.e. minor children, their parents and their grandparents. We extract such information and construct our cross-sectional dataset from the 2014 China Family Panel Studies (CFPS). This is a nationally representative, biannual longitudinal survey of Chinese communities, families, and individuals launched in 2010 by the Institute of Social Science Survey (ISSS) of Peking University. The project aims to provide a better understanding of the economic, as well as the non-economic, well-being of the contemporary Chinese population. It collects individual-, family-, and community-level longitudinal data across the country. The survey contains a wealth of information on such topics as economic activities, education outcomes, family dynamics and relationships, migration, and health. In the 2014 survey, the CFPS successfully interviewed almost 15,000 families across China and almost 30,000 individuals within these families. The response rate was about 79%.

Matching the information of children with adults in the same families, we get a sample of 4,277 females living with young children from CFPS 2014.⁵ Among the key variables we extract from the CFPS for our empirical analysis are the employment and labor-income data for women, grandparental childcare, characteristics of the mother, and characteristics of the child. Specifically, we consider the following variables:

Grandparental childcare (GPC). Dummy variable. For childbearing female i , if at least one of her children below the age 11 is cared for daily mainly by a grandparent or grandparents during the day.⁶ For a mother defined as receiving grandparental childcare, $GPC_i = 1$; otherwise her $GPC_i = 0$.

Employment status (WORK). Dummy variable. If female i is in the labor force (including maternity leave) at the time of survey, $WORK_i = 1$; otherwise $WORK_i = 0$.

⁵ Children in our sample are restricted to those below the age of 12. Children of 12 and over in the CFPS are assumed to take care of themselves during the daytime, so different parts of the questionnaire apply. Under these criteria, there are 4,251 females living with 5,658 small children in the survey. Women can retire at 50 or 55, so the conflicts retirees might encounter are usually not employment-related; for this reason, we dropped 24 females over 50 from our sample.

⁶ The CFPS distinguishes between daytime childcare and childcare at night. As people mostly work during the day when there greatest time conflict between childcare and jobs, we define GPC as grandparents' providing childcare during the daytime.

Log female's labor income ($\ln Y_i$). The logarithm of female i 's annual labor income in renminbi (CNY), including wage income and other income from agricultural and non-agricultural activities.⁷

Number of young children ($NCHILD_i$). The number of female i 's children between 0 and 2 years of age at the time of the survey.

Woman's education level (EDU_i). Dummy variable, equals 1 if female i 's highest degree is a college degree or higher; 0 otherwise.

Urban residency ($URBAN_i$). Dummy variable, equals 1 if the location of female i 's residence is classified as "urban" by the National Bureau of Statistics of China.

Log household's annual total net income, excluding the female's ($\ln Y_FAMILY_i$). The logarithm of female i 's household's annual total net income in CNY (including male's income and transfers, but excluding female i 's income).

Table 1 presents the summary statistics of the variables.

Table 1 Summary statistics

Variables	Obs.	Mean	Std. dev.	Min	Max
Intergenerational support, <i>GPC</i>	4,227	0.315	0.465	0	1
Employment, <i>WORK</i>	4,227	0.718	0.450	0	1
Log female's annual labor income, $\ln Y$	4,227	5.274	4.612	0	12.506
Number of children, 2 or younger, <i>NCHILD</i>	4,227	0.328	0.512	0	3
Age of youngest child, <i>AGE_CHILD</i>	4,227	4.862	3.310	0	11
Female's age, <i>AGE</i>	4,227	31.96	6.373	17	49
Education level of female, <i>EDU</i>	4,216	0.103	0.305	0	1
Years of education for female, <i>EDU_YEAR</i>	4,218	7.967	4.405	0	19
Urban residency (female), <i>URBAN</i>	4,201	0.424	0.494	0	1
Log household's total income* (excluding female's), $\ln Y_FAMILY$	4,227	9.145	3.445	0	15.220

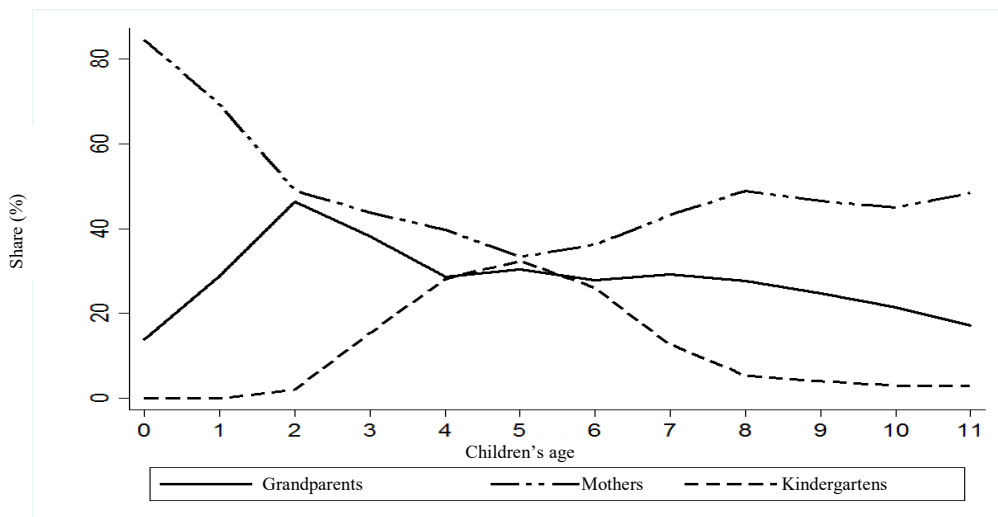
* The value is set to 0 if the household's total annual income (excluding the female's) is non-positive.

⁷ The value is set to 0 if her net income is 0 or negative (a few observations with negative net income in our sample are mostly self-employed women who incur losses in their businesses). As our income model (see section 3.2) is based on the Tobit model with a left truncation at 0, such setting does not affect our estimation.

2.2 Stylized facts of grandparental childcare and female employment

Using our dataset constructed from the CFPS, we characterize three stylized facts on grandparental childcare and its impact on female employment. The first stylized fact is that grandparental childcare is an indispensable complement to parental care. This can be directly seen from the CFPS survey, which asks for each child in the sample, “Who mainly looks after the child during the daytime?” Among all the options in the answer, over 90% of the respondents chose one of the following: (1) mother, (2) paternal grandparents, (3) maternal grandparents, or (4) kindergarten. These four options correspond well with the three major types of childcare in China, i.e. maternal care, non-maternal “non-institutional” care provided by grandparents, and “institutional” care provided by kindergartens and daycare facilities.

Figure 1 The main providers of daytime childcare in China change as the grows



In Figure 1, we combine childcare provided by paternal and maternal grandparents into a singly group “grandparents,” and present the share of each type of childcare used by families. In the first two years of life, the mother provides most of the care for the child. Maternal care is essential in the earliest years of life, and Chinese women often take maternity leave (usually 3–5 months). Grandparental care is almost the only practical care alternative available during this period, especially as the mother reenters working life after her maternity leave. Indeed, grandparents almost entirely fill the gap in this phase of the child’s life. The sum of maternal and grandparental care accounts for more than 98% of total childcare supply at this stage. The role of grandparental care peaks as the child approaches his or her third birthday, when the child becomes eligible for admission to kindergarten (*Regulation on the Administration of Kindergartens*, Ministry of Education of the People’s Republic of China, September 11, 1989). With the mother’s maternity leave long exhausted, reliance

on grandparental care before the child reaches kindergarten eligibility spikes, and the sum of grandparental and maternal care combined still exceeds 90%. Between the ages of 4 and 6, mothers, grandparents and kindergartens account for almost equal shares of childcare provision as most children go to kindergartens for part of the day.⁸ Between the ages of 7 and 11, the share of kindergarten care falls to almost zero as nearly all children enter primary school. The input of grandparents starts to fall, but still remains at a high level. While maternal care remains the predominant form of childcare during childhood overall, grandparents clearly play a crucial role in childcare. Especially in the years before the child enters kindergarten, care provided by grandparents is essentially the sole alternative to maternal care.

An interesting feature of Figure 1 is that sources of childcare other than the three major sources discussed above are negligible. Among the alternatives, government-sponsored daycare services for children aged 0–3, which are widely available in developed countries, are quite rare in China.⁹ Private childcare services are also scarce. Qualified childcare services are expensive, so they are only affordable for the rich. Moreover, China lack a credible mechanism for properly monitoring childcare workers. Thus, a full-time babysitter employed in the home has to be supervised by a family member (usually the grandparents and mostly for safety reasons). In our sample, among 2,281 children below the age of three, only three children are fully cared for by daytime babysitters (nannies) hired from the private market. Given the lack of practical alternatives, grandparents are heavily involved in the care of their young grandchildren.¹⁰

Table 2 Labor-market participation rate for females and males with (yes) and without (no) grandparental support

Labor-force participation rate		Females (%)			Males (%)		
		(1) Yes	(2) No	Difference	(3) Yes	(4) No	Difference
Full sample		82.2	66.9	15.3***	94.0	94.7	-0.7
Age of child	0-2	74.9	39.4	35.5***	92.8	93.5	-0.7
	3-6	86.0	72.8	13.2***	94.6	94.7	-0.1
	7-11	87.4	82.1	5.3**	94.7	95.5	-0.8

Note: *** / ** denote the difference is significant at the 1% / 5% level. Source of data: CFPS (2014).

⁸ As of 2016, China had more than 240,000 kindergartens across the country, and 77.4% of all preschool-aged children attended kindergarten. See “Dire shortage of daycare centers may impact China’s efforts to increase birth rate,” *Global Times*, November 14, 2017, available at <http://www.globaltimes.cn/content/1075165.shtml>.

⁹ The enrollment rate of 0- to 3-year-olds in daycare is only 4.1% in China, far lower than the 50% average for developed countries. Even in the most developed regions such as Shanghai, the enrollment rate does not exceed 14% (*Global Times*, November 14, 2017).

¹⁰ The strict definition of grandparental childcare under the CFPS is that grandparents must be the main responsible persons during daytime on a daily basis to be classified as childcare providers. This definition means that the contribution of grandparental childcare is underestimated. Many grandparents are involved in childcare to a lower degree.

The second stylized fact is that young childbearing women receiving support from the older generation are more likely to stay in the labor force than those without such support. This difference declines as the children grow up. Table 2 presents the difference in labor force participation rates, between childbearing females benefiting from grandparental childcare and those who do not. Among all 4,227 young females living with young children in the sample, 1,333 or 31.54%, get such support. Overall, females with support are 15.3% more likely to work, and the difference is significant at the 1% level. Such differences narrow for women with older children due to the lower required labor intensity of childcare and reduced crowding-out effect on the labor supply of women. Given the statutory ages for admission of three for kindergarten and seven for primary school, we divide our sample into three groups with respect to the age of each woman's youngest child: ages 0-2, 3-6, and 7-11. As shown in Figure 1, reliance on grandparental care declines as the child gets older.

In our sample, 37.97% of children aged 0-2 are looked after by grandparents, and the share falls to 33.51% and 23.35% for age groups 3-6 and 7-11, respectively. As reported in Table 2, within-group differences in females' likelihood of working are more striking when the children are younger. Mothers with support are 35.5%, 13.2%, and 5.3% more likely to work in each of the three groups, respectively. Table 2 also presents the labor-force participation rates for males in each of the same groups for comparison. It can be seen that either for the entire sample or for each of the children's age groups, there is no significant difference in employment among males.

To state the obvious, childcare requires substantial time input. As mothers assume the brunt of childcare duties, the burden of childcare may force them to reduce their labor supply, take a leave from their career or even exit the labor force (Entwisle and Chen, 2002). To reduce these adverse impacts, other sources of childcare are needed to share the burden with the young females, especially before their children are eligible to be admitted to kindergartens. Given the lack of alternative childcare providers, grandparental childcare reduces the burdens of maternity. This helps females return to labor force after giving birth, thus reducing the interruption to their career.

In Europe and the US, where grandparental care is not widely available, childbearing females mainly face a tradeoff between providing their own childcare via reducing their own labor supply and buying childcare services from the market. Thus, the market price of childcare largely reflects their opportunity cost of working. The higher the price is, the higher the wage threshold females need to earn from work, therefore, the more it deters females from working. For example, Connelly (1992) shows that the low labor force participation rate of the US females living with pre-school children can be much explained by the high prices in the childcare market. In China's dysfunctional market for childcare, the price (implicit and explicit) for such services is prohibitively high for most families. Should grandparental support be absent, most childbearing females must

choose not to work as the opportunity cost is too high. Thus, the widely-used grandparent-provided (basically free to the mother) care in China effectively fills the gap in the market and significantly reduces the opportunity cost of working for young females receiving such support. This is well reflected in China's high female labor-force participation rate.

The third stylized fact is that childbearing females receiving grandparental support earn higher labor income, and the positive effect of grandparental childcare on their labor income persists even as children grow up. In Table 3, we compare the average labor income for childbearing females with and without support. In our sample, 2,465 young females involved in childcare receive non-zero labor income at the time of survey, with 36.51% of them receiving support from the older generation. As is shown in Panel A, those receiving support earn on average 45.83% higher annual income, and the difference is significant at the 1% level. If we include observations with zero labor income, the difference is more striking as childbearing females without grandparental support are more likely to drop out of the labor force and earn zero income. In this case, as shown in Panel B, females with grandparental support on average receive 81.09% higher annual income.

Table 3 Average annual income for childbearing females/males with (yes) or without (no) intergenerational support.

Panel A: Observations with non-zero labor income							
		Females (CNY thousand)			Males (CNY thousand)		
		(1) Yes	(2) No	Difference (%)	(3) Yes	(4) No	Difference (%)
Full sample		22.56	15.55	45.08***	31.87	29.78	7.02
Children's age	0-2	21.24	12.13	75.10***	31.64	32.21	-1.77
	3-6	22.47	16.69	34.63***	32.38	30.29	6.90
	7-11	24.35	16.01	52.09***	31.43	28.91	8.72
Panel B: Full sample, including observations with zero labor income							
		Females (CNY thousand)			Males (CNY thousand)		
		(1) Yes	(2) No	Difference (%)	(3) Yes	(4) No	Difference (%)
Full sample		15.23	8.41	81.09***	23.50	22.70	3.52
Children's age	0-2	13.16	4.34	203.2***	23.45	24.31	-3.54
	3-6	15.43	9.62	59.70***	23.84	22.95	3.88
	7-11	18.06	10.32	74.92***	23.06	22.34	3.22

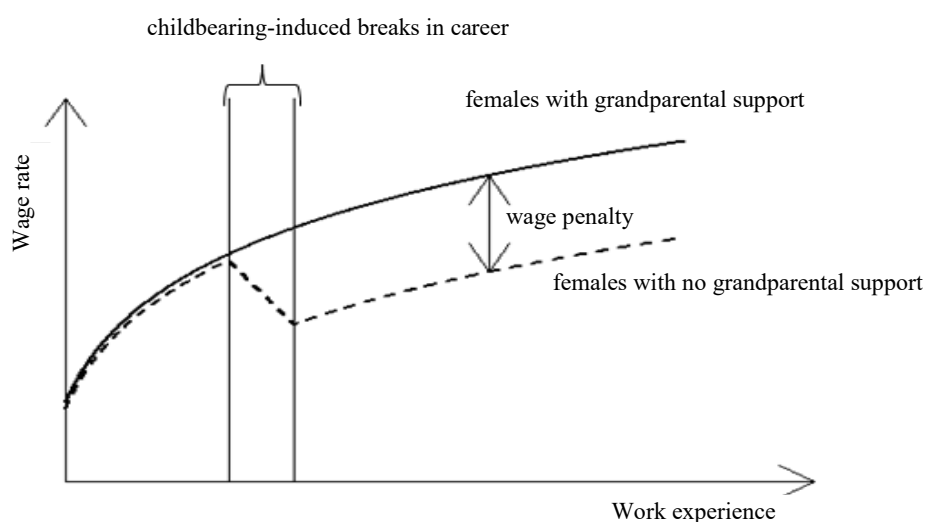
Note: *** denotes the difference is significant at the 1% level. Data source is CFPS (2014).

The impact of grandparental support on female labor income also varies with the age of the children. The impact is strongest when children are youngest: For females with non-zero labor income, as in

Panel A, the mean annual labor income for those with support is about CNY 9,110, or 75.10% higher than those without support that have a child in the age group 0-2. Such difference becomes 5,780 (34.63%) and 8,340 (52.09%) for age groups 3-6 and 7-11, respectively, i.e. *persistently high even for females with older children*. All these differences widen after we include observations with zero income. Again, the data do not exhibit any significant difference among the males in the same sample.

It is widely known that fertility and childcare discourage female participation in the labor force and reduce their labor income over time, a phenomenon referred to as the childbearing-induced “wage penalty.” As Mincer (1974) shows, theory dictates that work experience increases a worker’s human capital, and the worker’s labor income rises. However, fertility and childcare activities often lead female workers to drop out of the labor force temporarily or permanently, causing a break in their accumulation of work experience and human capital. Even if a woman manages to remain in the labor force, the need for childcare may force her to switch to a less-demanding, more flexible, part-time job with lower pay. Either way, the labor income of childbearing females drops in the short run, as the dashed line shows in Figure 2. Furthermore, the short-run adverse shock to human capital accumulation generates a downward shift in the wage growth path, ensuring that the wage penalty persists over the long run.

Figure 2 Intergenerational childcare support, fertility-induced breaks in career, and wage penalty (inspired by Yu and Xie 2014).



When grandparental childcare support is feasible, the mother can share the burden of childcare with the older generation. This reduces childbearing-induced breaks in young females’ career paths, as

well as interruptions to their work experience accumulation and human capital, alleviating the adverse shock to their labor income flow. Such a mechanism is captured by the solid curve in Figure 2. Grandparental support helps reduce the woman's time away from the labor force, and hence the depreciation in their human capital caused by the absence. This, in turn, increases their feasible working hours, i.e. labor supply intensity, and raises their wage rate and as labor income. Thus, the childbearing-induced wage penalty is reduced in both the short and long run.

3 Model specification

The stylized facts in section 2.2 show that childbearing mothers with grandparental childcare support are more likely to stay in the labor force and achieve higher labor income relative to mothers without similar support systems. In this section, we construct econometric models to further investigate how grandparental support affects female employment and labor income.

3.1 Model explaining employment

For our econometric model explaining female employment, we choose $WORK_i$ as the dependent variable, a binary variable that follows the specification from Dimova and Wolff (2011) and Aassve et al. (2012). We then take a Probit model to analyze the impact of grandparental support on female employment:

$$Pr(WORK_i | GPC_i, X_i) = \Phi(\alpha + \tau GPC_i + X_i \beta),$$

where $WORK_i$ denotes whether female i is employed at the time of survey, independent variable GPC_i denotes whether she receives support from the older generation, and vector X_i contains other control variables. $\Phi(\cdot)$ is the cumulative distribution function of a standard normal distribution.

Following the literature (Dimova and Wolff, 2011; Aassve et al., 2012; Posadas and Vidal-Fernández, 2013; Arpino et al., 2014), vector X_i in our model contains three types of control variables:

- (1) Characteristics of female i , including age (AGE_i), squared age (AGE_i^2), level of education (or, whether she has at least a college degree, EDU_i), and urban residency ($URBAN_i$);
- (2) Characteristics of her children, including the number of children, 2 or younger ($NCHILD_i$), the age of the youngest child (AGE_CHILD_i); and
- (3) Household characteristics, including the logarithm of the household's total net income, excluding the female's net income (Y_FAMILY_i).

3.2 Model explaining labor income

Although current literature focuses mainly on the effects of grandparental childcare on a childbearing woman's employment choice, our data allows us to further investigate the impact on her labor income as well. Our labor income model is an augmented version of Mincer earnings function (Mincer, 1974) that includes our variable for grandparental childcare (GPC_i), so that

$$\ln Y_i = \begin{cases} \alpha + \gamma_1 AGE_i + \gamma_2 AGE_i^2 + \gamma_3 EDU_YEAR_i + \tau GPC_i + X_i \beta + \epsilon_i & \text{if } \ln Y_i > 0 \\ 0 & \text{otherwise} \end{cases}$$

where $\ln Y_i$ is the logarithm of female i 's annual income, AGE_i , AGE_i^2 and EDU_YEAR_i are her age, squared age, and years of schooling, respectively.

In the classical Mincer model, the logarithm of wage income is a function of work experience, squared work experience, and years of schooling. Our data do not include information on the female's work experience, so we use her age instead. Previous studies measure the work experience variable in several ways. These include taking the difference between current age and the age when the first job starts after completing education (Xie and Hannum, 1996), or taking the age minus years of schooling minus six (Luo, 2007). The latter approach assumes everyone in the sample started primary school at 6 and joined the labor force right after finishing their education. They also assume no break in one's career prior to childbearing, which is often not the case in reality and leads to measurement errors. Without a precise measurement of work experience, we use age as a proxy instead in the model, based on the regularity that has been documented by Mincer (1974) such that labor income fits well a quadratic function of age. The same approach has been used by Zhao (2006) and Yin and Gan (2010).

Since labor income is usually only observable when an individual's income is positive, the variable Y_i is truncated. Applying linear models such as OLS would thus lead to a bias in estimation. Since labor income in principle is an outcome of employment selection, we let $Y_i = 0$ when the individual is unemployed and $Y_i > 0$ otherwise. Theoretically, the Heckman selection model would be a good candidate for analyzing such questions featured by selections, but employment and labor income are not perfectly matched in our sample. Some females are self-employed in agricultural or non-agricultural sectors and receive negative net income (their $\ln Y_i$ is thus set to 0) for the year of the survey. In such cases, a Heckman selection model would mistakenly interpret these individuals as unemployed. Moreover, being employed according to the survey does not necessarily mean receiving positive income for the year of the survey. For instance, some employed individuals receive zero income during maternity leave, and for the year of survey some unemployed continue to receive

positive income before they drop out of the labor force. Thus, the selection mechanism of the Heckman model does not work for such observations. Instead, we use a Tobit model for labor income analysis. Under the Tobit model, the fact that an individual's labor income is zero does not necessarily correlate with employment status.

For comparison, we also investigate the impact of grandparental childcare on employment and labor income for "males," i.e. the spouses of the females in the same household, using the same model setup.

3.3 Exploring heterogeneities

Since the stylized facts in the previous section suggest micro-level heterogeneities in the impacts of grandparental childcare on employment and labor income, we further use models with interacting terms to quantify such heterogeneities.

First, heterogeneities may relate to the child's age, so in the baseline employment and labor income models we add the interaction between grandparental childcare GPC_i and the age of the youngest child AGE_CHILD_i . If the coefficient of this interaction term in the estimated model is significantly different from zero, we are able to say that the impact of grandparental childcare on female employment and labor income varies with the age of youngest child.

Second, we account for the heterogeneities with respect to where the childbearing female lives. Females in urban and rural areas confront very different job markets. Unlike women in rural areas, urban females are far more likely to hold non-agricultural jobs and more rigid working hours. Thus, the tension between job and childcare in the urban contexts may be more severe and grandparental support may have a stronger positive impact on female employment and labor income. To examine this issue, we augment the baseline employment and income models with the interaction between grandparental support GPC_i and urban residency $URBAN_i$. The coefficient of this interaction term reflects the heterogeneities coming from urban or rural residency.

Finally, childcare support from the older generation may affect females depending on education levels. Females with higher education are more likely to take full-time jobs, or jobs with less flexibility in working hours. For them, grandparental childcare may help ease the conflict between job and childcare, generating a higher positive impact on employment and labor income. Previous studies, such as Anderson et al. (2003), Yu and Xie (2014), find that a break in career leads to higher human capital depreciation for females with higher education. They suffer more from the childbearing-induced wage penalty. For this reason, we also introduce the interaction between grandparental support GPC_i and female's education level EDU_i in the augmented models. As the baseline income model already includes years of schooling (EDU_YEAR_i) as a control variable, we

avoid multicollinearity by only taking the interaction term using grandparental support and “years of schooling,” i.e. omitting “level of education” (EDU_i).

3.4 Endogeneity and instrumental variable

Endogeneity looms as a potential problem in our model specification. It may arise, for example, from reverse causality, i.e. the choice of young females to stay in the labor force may force grandparents to provide childcare support. In such case, the impact of grandparental childcare on female employment may be overestimated (Posadas and Vidal-Fernández, 2013). Endogeneity may also come from missing variables. Aassve et al. (2012) suggest that unobservable household preferences such as the work preferences of young and old generations, the strength of family bonds, or the household’s preference for childcare labor input may simultaneously affect the grandparents’ decision regarding providing childcare *and* the childbearing female’s decisions regarding employment.

We use an instrumental variable to correct the potential bias caused by endogeneity. In the literature, instrumental variables for grandparental childcare are often constructed from family structure such as information on the childbearing female’s siblings and characteristics of grandparents. Here, we use “paternal grandmother still living” (PGM_i) as an instrumental variable. Although instrumental variables have been constructed using the information of both paternal and maternal grandparents (Arpino et al., 2014), or the information of maternal grandmothers only (Aassve et al. 2012, Posadas and Vidal-Fernández 2013), we choose paternal grandmothers’ characteristics. CFPS 2014 shows that paternal grandparents are much more involved in day time childcare than maternal grandparents. Moreover, paternal grandmothers generally claim a far larger share of childcare than paternal grandfathers, especially when the grandchildren are young. Therefore, the variable “paternal grandmother still living” has a strong correlation with the instrumented variable “grandparental childcare.” On the other hand, the fact that the paternal grandmother is living or not is normally orthogonal and exogenous to female’s employment status and income (Chen, 2012), so reverse causality from dependent variables is avoided and justifies PGM_i as a valid instrumental variable.

The exogeneity of the instrument may be weakened by the fact that it is likely to be correlated with the other variables that affect a woman’s employment and income. For example, the fact that the paternal grandmother is living is not correlated with the female’s age, an independent variable in our models. The higher the age, the less likely the paternal grandmother is still living. Age also correlates with the woman’s employment status and income. Finally, “paternal grandmother still living” may not always positively correlate with grandparental childcare. For instance, a paternal grandmother in poor health may not contribute to grandparental childcare (and could even require care from the childbearing female, sometimes known as a “sandwich” situation), generating

an adverse effect on the female's employment and income. To take such concerns into account in the robustness check, we include households' input on old-age support in the regression and see whether the upward labor transfer to the older generation affects the validity of the instrumental variable.

4 Results

4.1 Results from the employment model

The results from the employment model are presented in Table 4. Columns (1) to (3) are the estimates from a series of Probit regressions with various control variables. It can be seen that grandparental childcare significantly boosts the likelihood of working of childbearing females. Columns (4) to (6) report the estimates from the employment model using an IV-Probit estimator, with the instrumental variable "paternal grandmother still living." Column (4) shows the results using a maximum likelihood estimation, and the results reach qualitatively similar conclusion as an OLS estimation. Columns (5) and (6) report the first- and second-stage results from a Newey two-step estimator of the IV-Probit regression, and the results confirm that grandparental childcare significantly increases the likelihood of working of childbearing females. Additionally, a Wald endogeneity test suggests that the null hypothesis on the non-existence of endogeneities cannot be rejected, showing it is proper to adopt the Probit model rather than the IV-Probit model.

As Probit is a non-linear model, we cannot implement a test for weak instrumental variable directly using an F -statistic from the first-stage regression. Instead, we test weak instrumental variables in an IV-2SLS regression, i.e. the linear probability model (see Table 7 in Section 5). As the IV-Probit model has the same first-stage estimation as the linear probability model, the F -statistic of the IV-linear probability regression can also test for weak instrumental variables in the IV-Probit regression. The F -statistic in Table 7 implies that the weak instrumental variable test cannot reject the null hypothesis that the instrumental variable is not weak.

The results of both the Probit and IV-Probit regressions show that grandparental childcare has no significant effect on the likelihood whether the male (spouse) in the family works. Effects of grandparental childcare on childbearing couples' labor force participation reported in Table 4 are consistent with the stylized facts in Table 2, which provides strong support in our conjecture that grandparental childcare lowers the opportunity cost of young females and increases their labor-force participation rate.

Table 4 Employment model results

Employment	Female						Male
	Probit			IV-Probit			Probit
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Grandparental childcare	0.485*** (0.050)	0.629*** (0.054)	0.674*** (0.055)	0.824** (0.307)		0.826** (0.322)	-0.044 (0.068)
Number of children below age 2		-0.342*** (0.066)	-0.356*** (0.067)	-0.353*** (0.067)	-0.002 (0.022)	-0.354*** (0.064)	-0.082 (0.084)
Age of youngest child		0.089*** (0.011)	0.052*** (0.013)	0.053*** (0.013)	-0.003 (0.004)	0.053*** (0.012)	0.010 (0.016)
Age of female/male			0.034*** (0.005)	0.036*** (0.006)	-0.009*** (0.002)	0.036*** (0.006)	4.4e-4 (0.007)
Education level of female/male			0.559*** (0.084)	0.548*** (0.087)	0.076*** (0.025)	0.550*** (0.088)	0.240* (0.114)
Urban residency (female/ male)			-0.252*** (0.048)	-0.251*** (0.048)	0.015 (0.015)	-0.252*** (0.048)	-0.112* (0.068)
Log household's total income (excluding that of female/male)			-0.066*** (0.015)	-0.067** (0.016)	0.001 (0.004)	-0.067*** (0.015)	-0.003 (0.009)
Paternal grandmother still living					0.154*** (0.015)		
Constant	0.460*** (0.025)	0.140* (0.075)	-0.046 (0.221)	-0.145 (0.301)	0.500*** (0.065)	-0.145 (0.298)	1.619*** (0.241)
Significance test	93.96 (P=0.0000)	390.09 (P=0.0000)	503.20 (P=0.0000)	425.66 (P=0.0000)	34.63 (P=0.0000)	413.70 (P=0.0000)	11.76 (P=0.1087)
Log likelihood	-2187.52	-1997.97	-1930.76	-4272.73			-871.30
Wald endogeneity test				0.24 (P=0.6264)		0.23 (P=0.6328)	
Pseudo R ²	0.0218	0.1066	0.1366				0.0063
Number of obs.	3,795	3,795	3,795	3,795	3,795	3,795	4,089

Note: This table presents the estimates from the employment model in section 3.1. ***, **, and * denote the result is significant at the 1%, 5%, and 10% level, respectively. Values in parentheses are standard errors, except those specified as *P* values. Regarding model significance tests, the *F*-statistic is reported for the Tobit regression as well as the first-step regression in Newey's two-step estimator. The Wald χ^2 -statistic is reported for the other regressions. The Wald endogeneity test is based on the χ^2 -statistic.

To quantify the impact of grandparental childcare on females' employment, we take a Logit model and regress females' employment status on grandparental childcare. The likelihood of being employed is 3.15 times higher for female's with grandparental childcare than for those without such support.¹¹

¹¹ In the Logit model, let the likelihood of being employed for female *i* with grandparental childcare be $p = Pr(WORK_i = 1|GPC_i = 1, X_i)$, then $P = \frac{p}{1-p}$ denotes the odds that females with grandparental childcare are employed. Let the likelihood of being employed for female *j* without grandparental childcare be $q = Pr(WORK_j = 1|GPC_j = 0, X_j)$, then $Q = \frac{q}{1-q}$ denotes the odds that females without grandparental childcare are employed. The odds ratio for females with grandparental childcare versus females without grandparental childcare is defined as $\frac{P}{Q}$.

The estimates for the coefficients of the other control variables also have strong economic implications. First, for a childbearing female, the more young children (under the age of 2) she has, the less likely she has a job. This is consistent with previous studies which find that females with more young children must invest more time in childcare, which this leads to a fall in their labor supply. Second, the female's likelihood of being employed increases with the age of her youngest child. Older children need less care, so the crowding-out effect of childcare on the female's labor supply declines. Third, the likelihood of working is higher for females with better education, which usually implies greater potential for higher labor income. Hence, the opportunity cost of exiting the labor force rises. Fourth, females living in urban areas (most likely holding non-agricultural jobs) have a lower likelihood of working as the crowding-out effect of childcare on non-agricultural labor (usually less flexible) is possibly stronger than on agricultural labor (usually more flexible). Finally, the higher the household's total income (excluding the female's), the lower the probability she is employed. This implies that the rest of the household's income has a substitution effect on the female's labor force participation as documented by Ashenfelter and Heckman (1974), Yao and Tan (2005), Blau and Kahn (2007), and Posadas and Vidal-Fernández (2013). When a household's income is high, the young female faces low pressure to work and support the household's expenditure, so that she tends to be more likely to quit the labor force after giving birth to devote her full time to childrearing.

For comparison, we also investigate the impact of grandparental childcare on the male's employment using a Tobit model. The results are reported in column (7) of Table 4. Unlike females, the likelihood of the male working is unaffected by grandparental childcare, age of the youngest child, or number of young children. This clearly shows the division of labor within typical couples. Females generally take much more responsibility for housework and childcare. They are almost indispensable for looking after young children. The male typically contributes more to household income. Their jobs then to be less flexible regarding working hours. As a result, childcare and intra-family downward labor transfer do not usually affect the labor supply of males.

4.2 Results from the income model

We further explore the impact of grandparental childcare on young female's labor income through the income model. The results are reported in Table 5. Columns (1) and (2) are based on Tobit regressions with various sets of control variables. In our sample, grandparental childcare significantly improves the labor income of females. Column (3) to (5) are based on IV-Tobit estimators. Column (3) presents results from a maximum likelihood estimation, column (4) reports the first-step results from a Newey two-step regression, and column (5) reports the results from the second

step. In column (4), the estimated coefficient for the instrumental variable “paternal grandmother still living” is significant at the 1% level, with the correct sign, and free of the weak instrument problem. The Wald endogeneity tests for the IV-Tobit models cannot reject the null hypothesis that the explanatory variables are exogenous. Thus, Tobit is preferred to the IV-Tobit estimator.

Table 5 Income model results

Log annual income	Female					Male
	Tobit		IV-Tobit			Tobit
	(1)	(2)	(3)	(4)	(5)	(6)
Grandparental child-care	2.560*** (0.246)	3.033*** (0.247)	4.145** (1.623)		4.145** (1.629)	-0.255 (0.200)
Years of schooling, female/ male		0.181*** (0.029)	0.174*** (0.031)	0.006*** (0.002)	0.174*** (0.031)	0.092*** (0.024)
Age of the female/male		0.702*** (0.180)	0.653*** (0.194)	0.039*** (0.010)	0.653*** (0.193)	0.289*** (0.113)
Squared age of female/male, divided by 100		-0.829*** (0.262)	-0.736** (0.294)	-0.070*** (0.016)	-0.736** (0.297)	-0.403*** (0.153)
Number of children below age 2		-1.279*** (0.359)	-1.291*** (0.360)	0.020 (0.020)	-1.291*** (0.343)	0.004 (0.263)
Age of youngest child		0.182*** (0.058)	0.186*** (0.058)	-0.003 (0.004)	0.186*** (0.059)	0.011 (0.044)
Urban residency (female/male)		-0.265 (0.255)	-0.253 (0.256)	0.003 (0.015)	-0.253 (0.254)	-0.110 (0.197)
Paternal grandmother still living				0.151*** (0.015)		
Constant	2.444*** (0.180)	-13.135*** (3.003)	-12.856*** (3.033)	-0.311* (0.171)	-12.856*** (2.987)	0.950 (2.032)
Significance test for the model	108.40 (P=0.0000)	55.29 (P=0.0000)	241.76 (P=0.0000)	43.86 (P=0.0000)	244.53 (P=0.0000)	3.72 (P=0.0000)
Log likelihood	-9825.00	-9688.43	-12273.29			-10849.47
Wald endogeneity test			0.48 (P=0.4887)		0.48 (P=0.4883)	
Pseudo R ²	0.0050	0.0189				0.0013
Number of obs.	4,192	4,192	4,192	4,192	4,192	4,089

Note: This table presents the estimates from the labor income model in section 3.2. ***, **, and * denote the result is significant at the 1%, 5% and 10% level, respectively. Values in parentheses are standard errors, except those specified as *P* values. Regarding our model significance tests, the *F*-statistic is reported for the Tobit regression and the first-step regression in Newey’s two-step estimator. A Wald χ^2 -statistic is reported for the other regressions. The Wald endogeneity test is based on the χ^2 -statistic.

In Table 5, the results from various specifications consistently show that grandparental care significantly increases young females' labor income. Such positive effect may come through the channels of *labor supply intensity* or *changes in the females' wage rate or productivity*.

It is well established that childcare reduces females' labor supply intensity. Zhang (2011), for example, finds that a higher number of children leads to lower working hours for both urban and rural females. Therefore, grandparental care frees up a part of the female's labor input to childcare, increasing her labor-supply intensity and thereby boosting her labor income.

Regarding wage rate and productivity, we note that childbearing females may switch to more child-friendly jobs that are flexible, less labor-intensive, and less productive. This translates to lower pay (Yu and Xie 2014). Polachek (1981) finds that after a childbearing-induced break in the careers, females become less likely to be involved in typically well-paid professional/managerial jobs and more likely to take low-skill jobs that pay low wages. However, if females are able to receive support for childcare from the older generation, the disruptions to their career paths or human capital accumulation are less significant, so they may not have to switch to a less productive job. The possibility of remaining on the career track alleviates some of the adverse shocks related to having children, and thereby reduces the wage penalty.

For the results of the Tobit regression reported in column (2) of Table 5, all the signs of the estimated coefficients are as expected. The female's labor income increases significantly with years of schooling, while the signs for coefficients for the female's age and squared age are positive and negative, respectively, which again is in line with the classical Mincer equation. The more young children (under the age of 2) a woman has, the lower her income. This finding is also consistent with the literature, i.e., the childbearing-related wage penalty increases with the number of young children. The female's income increases with the age of her youngest children, because older children demand less looking-after and her labor supply is freed up. Females with older children may have reentered the labor force years earlier, giving them time to again accumulate human capital and increase their labor income.

For comparison, we explore the impact of grandparental care on the labor income of the male. These results are reported in column 6 of Table 5. Although coefficients of years of schooling, age, squared age are significant (consistent with the Mincer equation), grandparental care and number/age of children have no significant impact on the male's labor income.

4.3 Heterogeneities in the impacts of grandparental childcare

The descriptive statistics in Tables 1 and 2, as well as the empirical evidence from Tables 4 and 5 suggest that the impact of grandparental care on female employment and labor income may vary

vis-à-vis children's ages, whether the young mother lives in the city or countryside, education level, etc. In this section, we use interaction terms to further explore such heterogeneities. The results are reported in Table 6. Columns (1) to (3) contain the results from the employment model, and (4) to (6) contain the results from the income model. As we showed in the previous section that the Wald endogeneity tests do not reject the null hypothesis that control variables are exogenous, we implement here all regressions without using instrumental variables.

From columns (1) and (4), one can see that the coefficient for the interaction term (grandparental childcare * age of the youngest child), i.e., $GPC_i * AGE_CHILD_i$, is significant and negative, implying that the positive effects of grandparental care on the female's employment and income are stronger if they have younger children. This is due to the fact that younger children require more care. Childcare crowds out the female's labor supply, so grandparental care has a greater impact on improving the female's employment and income by alleviating this crowding-out effect.

Columns (2) and (5) suggest that grandparental care has a more positive impact on employment and income for young females living in urban areas, compared with those in rural areas. This may be explained by the difference in their jobs. In our sample, of the 1,770 employed females in rural areas, 983, or 55.54%, are involved in agricultural production. For the 1,245 employed females from urban areas, 1,044, or 83.86%, are engaged in non-agricultural jobs. Unlike farm jobs, non-agricultural jobs tend to have more set working hours, so urban females likely face greater tension between childcare and working. This tension is eased through grandparental support, i.e., grandparental childcare has a more positive impact on employment and income for urban females.

It can also be seen from column (4) that grandparental childcare has a more positive impact for better-educated females. In our sample, only 38.84% employed females without higher education (college degree or above) are involved in non-agricultural jobs, while this share becomes 85.84% for employed females with higher education. This implies that females with higher education are more likely to take inflexible jobs. Grandparental care reduces their childcare burden and encourages them to remain in the same jobs after giving birth. Furthermore, a break in the career path of a female with higher education has a greater adverse impact on human capital accumulation and income flow. Support from the older generation in such cases reduces the disruption to their careers, and thereby mitigates the negative impacts on employment and life-time income flow. The supportive effect on the career path is higher for females with higher education than for those with lower educational achievement.

Table 6 Results from regressions with interaction terms

	Employment of females			Log annual income of females		
	Probit			Tobit		
	(1)	(2)	(3)	(4)	(5)	(6)
Grandparental child-care	0.910*** (0.090)	0.549*** (0.070)	0.638*** (0.058)	4.263*** (0.457)	2.539*** (0.325)	1.936*** (0.533)
Grandparental child-care* Age of the youngest child	-0.061*** (0.019)			-0.271*** (0.078)		
Grandparental child-care* Urban residency (female)		0.298*** (0.110)			1.128** (0.487)	
Grandparental child-care* Female's education level			0.422** (0.202)			0.129** (0.056)
Number of children below age 2	-0.384*** (0.068)	-0.356*** (0.067)	-0.361*** (0.067)	-1.420*** (0.363)	-1.286*** (0.358)	-1.323** (0.359)
Age of the youngest child	0.063*** (0.013)	0.052*** (0.013)	0.053*** (0.013)	0.244*** (0.061)	0.179*** (0.058)	0.180*** (0.058)
Age of the female	0.033*** (0.005)	0.034*** (0.005)	0.034*** (0.005)	0.739*** (0.180)	0.708*** (0.179)	0.707*** (0.179)
Squared age of the female, divided by 100				-0.890*** (0.263)	-0.837*** (0.262)	-0.844*** (0.262)
Female's education level	0.548*** (0.084)	0.560*** (0.084)	0.443*** (0.096)			
Female's years of schooling				0.178*** (0.029)	0.182*** (0.029)	0.139*** (0.035)
Urban residency (female)	-0.246*** (0.048)	-0.330*** (0.056)	-0.249*** (0.048)	-0.240 (0.255)	-0.645** (0.313)	-0.256 (0.255)
Log household's total income (excluding the female's)	-0.066*** (0.015)	-0.065*** (0.016)	-0.067*** (0.015)			
Constant	-0.055 (0.221)	-0.029 (0.222)	-0.009 (0.222)	-13.922*** (3.020)	-13.047*** (2.997)	-12.790*** (3.002)
Significance test for the model	556.56 (P=0.0000)	505.04 (P=0.0000)	495.30 (P=0.0000)	47.74 (P=0.0000)	49.26 (P=0.0000)	49.22 (P=0.0000)
Log likelihood	-1924.98	-1926.84	-1928.28	-9682.81	-9685.85	-9685.89
Pseudo R ²	0.1392	0.1384	0.1377	0.0194	0.0191	0.0191
Number of obs.	3,795	3,795	3,795	4,192	4,192	4,192

Note: This table presents the estimates from the employment model and labor income model with interaction terms. ***, **, and * denote the result is significant at the 1%, 5%, and 10% level, respectively. Values in parentheses are standard errors, except those specified as *P* values. Wald endogeneity test is based on the χ^2 -statistic.

These results have serious implications for the phase-in of higher minimum retirement ages in China. Given that childcare purchased from the market is not a viable substitute at this time, much of the early childcare burden will continue to be shouldered by parents and grandparents. Raising

the retirement age will likely reduce the supply of available grandparental care, increase the opportunity cost of employment for young females, and discourage young mothers from trying to return to the labor force. Such a negative impact on the employment of young females and labor income is more severe for those with higher education, living in urban areas with younger children. Making things worse, the proposed adjustments to retirement policy hit urban grandparents with non-agricultural jobs the hardest.

5 Robustness check

The robustness of our empirical results may be affected by a variety of factors such as model specification, selection of instrumental variables, and within-sample heterogeneity. In this section, we conduct a series of robustness checks to ensure that our results are robust to different settings.

First, we check the robustness of results under different model specifications. Columns (1) to (3) in Table 7 report the results from the OLS estimator using various sets of control variables. The results are qualitatively the same as those in Table 4, and show that grandparental care significantly increases the likelihood of a young mother reentering working life. Columns (4) and (5) report the results using the IV-2SLS estimator. The first-step results are listed in column (4) and the second-step results are listed in column (5). It can be seen that the estimated coefficient for the instrumental variable “paternal grandmother still living” is significant and positive, as expected. The Cragg-Donald Wald F -statistic shows that the weak instrumental variable hypothesis is rejected. Columns (6) to (8) report the results from the OLS regressions with interaction terms; again, the impact of grandparental care on female employment is heterogeneous: The lower the age of the youngest child, the greater the impact. The impact is also higher for well-educated urban females than less-educated rural females. The results are fully consistent with those from the Probit model.

Second, our paper focuses on the downward labor transfer within families, i.e. the transfer from the parents to their own children establishing families. Obviously, labor can also be transferred intergenerationally when the younger generation cares for the older generation. The upward transfer crowds out the labor supply of young couples and generates negative impacts on their labor income, thus weakening the exogeneity of our instrumental variable. The literature suggests this problem is usually solved by using the health information on the older generation. For example, the robustness check Arpino et al. (2014) excludes families containing at least one grandparent suffering from chronic disease and possibly needing care from their children. The CFPS, however, does not consistently count grandparents as family members as many do not live at the same address as their children and grandchildren. Therefore, health information for such grandparents is missing. Here we use a dummy variable “substantial upward transfer” from the CFPS to control for upward labor

transfer, i.e., whether family members contribute a substantial amount of labor in looking after the older generation. The results are reported in Table 8 columns (1) and (2) for the employment model, and columns (5) and (6) for the income model. After accounting for the upward labor transfer, the results are still quite close to those shown in Tables 4 and 5. Furthermore, the estimated coefficients for the additional control variable are not significant, implying that downward labor transfer is the major pattern of intra-family labor transfer in our sample and has a positive impact on female employment.

Finally, the marital status of the childbearing female may distort the results. It has been found that single mothers (unmarried, divorced and widowed) behave differently in the labor market (Arpino et al., 2014). The likelihood that they receive grandparental support is much lower than for other females in the sample. To disentangle this within-sample heterogeneity, we exclude all single mothers and redo the regressions. The results are listed in columns (3) and (4), (7) and (8) in Table 8. Notably, they are still consistent with the results in Tables 4 and 5. This confirms that our results are robust to the within-sample heterogeneity caused by single mothers.

Table 7 Robustness check (1), linear model

	Employment of females							
	OLS			IV-2SLS		OLS with interaction terms		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Grandparental childcare	0.151*** (0.014)	0.189*** (0.014)	0.201*** (0.014)		0.213** (0.090)	0.323*** (0.027)	0.167*** (0.018)	0.193*** (0.015)
Grandparental childcare* Age of youngest child						-0.028*** (0.005)		
Grandparental childcare* Urban residency (female)							0.081*** (0.028)	
Grandparental childcare* Female's education level								0.067* (0.038)
Number of children below age of 2		-0.134*** (0.021)	-0.135*** (0.021)	-0.0015 (0.0218)	-0.135*** (0.021)	-0.147*** (0.021)	-0.135*** (0.021)	-0.136*** (0.021)
Age of youngest child		0.026*** (0.003)	0.014*** (0.003)	-0.0033 (0.0035)	0.014*** (0.003)	0.020*** (0.004)	0.014*** (0.003)	0.014*** (0.003)
Age of female			0.011*** (0.001)	-0.0089*** (0.0014)	0.011*** (0.002)	0.010*** (0.001)	0.011*** (0.001)	0.010*** (0.001)
Female's education level			0.160*** (0.021)	0.0763*** (0.0263)	0.159*** (0.021)	0.150*** (0.021)	0.159*** (0.021)	0.135*** (0.028)
Urban residency (female)			-0.073*** (0.014)	0.0152 (0.0153)	-0.073*** (0.014)	-0.069*** (0.014)	-0.098*** (0.018)	-0.073*** (0.014)
Log household's total income (excluding female's)			-0.017*** (0.003)	0.0007 (0.004)	0.017*** (0.003)	-0.017*** (0.003)	-0.016*** (0.003)	-0.017** (0.003)
Paternal grandmother still living				0.1543*** (0.0154)				
Constant	0.677*** (0.009)	0.583*** (0.023)	0.484*** (0.056)	0.500*** (0.0642)	0.476*** (0.083)	0.469*** (0.056)	0.492*** (0.056)	0.492*** (0.056)
Significance test for the model	110.73 (P=0.0000)	167.65 (P=0.0000)	100.80 (P=0.0000)	43.73 (P=0.0000)	533.37 (P=0.0000)	92.15 (P=0.0000)	89.05 (P=0.0000)	88.95 (P=0.0000)
R ²	0.0243	0.1243	0.1559		0.1557	0.1633	0.1576	0.1563
Weak IV test				99.10				
Number of obs.	3,795	3,795	3,795	3,795	3,795	3,795	3,795	3,795

Note: This table presents the estimates from linear regressions explaining female employment. ***, **, and * denote the result is significant at the 1%, 5%, and 10% level, respectively. Values in parentheses are standard errors, except those specified as *P* values. Regarding model significance tests, the *F*-statistic is reported for the OLS estimator and the Wald χ^2 -statistic is reported for the IV-2SLS estimator. The weak instrumental variable test in the IV-2SLS regression is based on the Cragg-Donald Wald *F*-statistic.

Table 8 Robustness check (2)

	Employment of females				Log annual income of females			
	With upward transfer		Excluding single mothers		With upward transfer		Excluding single mothers	
	Probit	IV-Probit	Probit	IV-Probit	Tobit	IV-Tobit	Tobit	IV-Tobit
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Grandparental childcare	0.674*** (0.055)	0.816** (0.307)	0.668*** (0.056)	0.886*** (0.292)	3.033*** (0.247)	4.103** (1.621)	3.063*** (0.251)	4.199*** (1.565)
Number of children below age of 2	-0.355*** (0.067)	-0.353*** (0.067)	-0.352*** (0.067)	-0.348*** (0.068)	-1.279*** (0.358)	-1.291*** (0.359)	-1.266*** (0.362)	-1.278*** (0.363)
Age of youngest child	0.053*** (0.013)	0.053*** (0.013)	0.052*** (0.013)	0.053*** (0.013)	0.185*** (0.058)	0.190*** (0.058)	0.195*** (0.058)	0.201*** (0.059)
Age of female	0.034*** (0.005)	0.036*** (0.006)	0.035*** (0.005)	0.037*** (0.006)	0.695*** (0.179)	0.647*** (0.193)	0.638*** (0.181)	0.587*** (0.195)
Squared age of female, divided by 100					-0.819*** (0.262)	-0.730** (0.294)	-0.735*** (0.264)	-0.640** (0.295)
Female's education level	0.556*** (0.084)	0.546*** (0.087)	0.553*** (0.084)	0.537*** (0.088)				
Female's years of schooling					0.183*** (0.029)	0.176*** (0.031)	0.186*** (0.030)	0.178*** (0.032)
Urban residency (female)	-0.252*** (0.048)	-0.251*** (0.048)	-0.247*** (0.049)	-0.247*** (0.049)	-0.281 (0.255)	-0.270 (0.256)	-0.298 (0.257)	-0.287 (0.258)
Log household's total income (excluding female's)	-0.066*** (0.015)	-0.066*** (0.015)	-0.067*** (0.016)	-0.068*** (0.016)				
Upward transfer for old-age care	0.061 (0.079)	0.061 (0.079)			0.636* (0.381)	0.637* (0.381)		
Constant	-0.056 (0.221)	-0.149 (0.301)	-0.049 (0.227)	-0.192 (0.299)	-13.085*** (2.997)	-12.817*** (3.027)	-12.161*** (3.029)	-11.86*** (3.061)
Significance test for the model	505.25 (P=0.0000)	425.75 (P=0.0000)	488.74 (P=0.0000)	425.41 (P=0.0000)	48.80 (P=0.0000)	244.89 (P=0.0000)	54.57 (P=0.0000)	239.78 (P=0.0000)
Log likelihood	-1930.45	-4272.40	-1905.54	-4184.38	-9687.10	-12271.96	-9486.26	-12001.77
Wald endogeneity test		0.21 (P=0.6448)		0.55 (P=0.4603)		0.44 (P=0.5049)		0.54 (P=0.4631)
Pseudo R ²	0.1368		0.1350		0.0190		0.0190	
Number of obs.	3,795	3,795	3,719	3,719	4,192	4,192	4,109	4,109

Note: This table presents the estimates from regressions explaining female employment and regressions explaining female labor income, under various specifications. ***, **, and * denote the result is significant at the 1%, 5%, and 10% level, respectively. Values in parentheses are standard errors, except those specified as *P* values. Regarding model significance tests, the LR χ^2 -statistic is reported for Probit and Tobit estimators, and the Wald χ^2 -statistic is reported for the IV-Probit and IV-Tobit estimators. The Wald endogeneity test is based on the χ^2 -statistic.

6 Concluding remarks

China's labor market possesses two perplexing features. The female labor force participation rate is among world's highest and the childbearing-induced wage penalty is extremely low. Using data from the 2014 China Family Panel Survey (CFPS), we demonstrate that grandparental childcare goes a long way in explaining these features. Through the intra-family downward labor transfer, the older generation shares the burdens of childrearing with their childbearing daughters or daughters-in-law. This reduces the crowding-out effect of childcare on female employment, and shortens the fertility-induced breaks in women's careers. This support mitigates the disruption to the human capital accumulation of young women caused by childbirth and childcare, and thus implies smaller adverse shocks to their labor-income flows both in the short run and over their careers. The effects of grandparental childcare are especially pronounced for well-educated urban females with younger children. However, grandparental childcare has no significant effect on the labor-force participation rate of the male (spouse) or the male's wage rate.

Our paper also sheds some light on the current debate in China on raising the minimum retirement age. Besides the usual controversies on the speed of the phase-in, our results suggest an unpleasant hidden cost from raising the retirement age. Although retaining the old workers in the labor force reduces the burden of the pension system, it could well force young females to assume more of the childcare burden and crowd out their labor supply. Our results also indicate a need for better social protection policies along with the roll-out of higher retirement ages. A functional market offering qualified childcare services at affordable rates is needed to provide a viable alternative if the intra-family downward labor transfer is affected by later retirement. Policies against discrimination against childbearing females, as well as policies that provide insurance to birth-related career breaks and increase the involvement of males in childcare may also alleviate the negative shocks to the human capital accumulation and lifetime income flows of women in China.

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