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in China**

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ABSTRACT

One-Child Policy and Marriage Market in China*

This study analyzes the effect of one-child policy on marriage market in China, and focuses on leftover situation, marriage age, and the age differential between husband and wife. Taking age of 30 as a cut-off point, the one-child policy has increased the leftover proportion about 1.2%, with 1.8% on men and 0.6% on women. Although the problem of urban leftover women has made eye-catching of the general public, the problem of the leftover men is much more serious than that of women: with the former arising from the true over-supply of men while the latter due to the matching process. The one-child policy on marriage age is positive and significant, no matter for urban, rural residents, or migrants, but the effect is smaller in the urban area, which is consistent with the fact that the sex ratio is more balanced in urban area. This policy also increases the age differential between husband and wife on the whole; however, it is positive and significant for the male-head families but negative for the female-headed families.

JEL Classification: J12, J13

Keywords: one-child policy, leftover situation, marriage age, age differential between husband and wife

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1. Introduction

China has witnessed upward trend of the proportion of unmarried adults in recent decades. The “leftover” situation, i.e., women or men have not married by the expected age, has been becoming more and more important, given the massive leftover individuals and increasing trend after the later 1990s. Zhenwu Zhai, president of the China Population Society, said in an interview with the People’s Daily: “Conservatively, there are about 30 million men who will not get married in the next 30 years.”

The “leftover” men and women in China can be the outcome of the economic growth, transition from a centrally-planned economy to a market-oriented economy, and social development. With the economic development and transition, there have been the declining trend of labor force participation, especially for females, and rising trend of working hours and strength. Thus for females, we can observe the concurrent phenomena of rising proportion of housing wives and rising success of women career. The latter phenomenon might lead to increasing of leftover women.

Another important contributing factor to the leftover men and women is the population policies. How population policy, such as one-child, leads to changes of marriage markets is an important topic. One main channel of one-child policy on marriage market is through the unbalanced sex ratio (more men than women) due to the interaction of one-child policy and son-preference culture. Theoretically, there may be a long-term effect of the one-child policy: when these children born under one-child policy grow up to the marriage age, they will have higher difficulty in the process of assortative mating due to the increased imbalanced sex ratio, which will lead to rising leftover men, even if the assortative mating patterns have remained unchanged. The leftover situation is expected to be unbalanced across regions and between males and females, as the sex ratio is more balanced in the urban area than in

the rural area; we expect a positive impact of one-child policy on the leftover individuals, in particular for men.

However, the proportion of leftover women has also been rising. According to a theory of “grading by grading in matching” in the sociology, male mate preference tends to find “low”, while that of female tends to find “high”. More specifically, based on the differences in social class, occupation and salary income, men and women are divided into four levels of A-, B-, C-, and D-level. Then, A-level male is assigned to B-level female, B-level male is assigned to C-level female, and C-level male is assigned to D-level female. The last remaining are the high quality A-level female and low-quality D-level male with poor conditions in all aspects.

This “grading by grading in matching” theory is in line with the fact that China's current urban leftover women and rural leftover men have both been increasing. Education is an important component of human capital. Correspondingly, the probability of women with high education level becoming “A-level women” is also greatly increased, which makes high educated women difficult to find suitable marriage targets. In addition, with women’s economic independence, marriage is no longer the only way to embody women’s values. They are more eager to pursue marital quality. Even if China’s sex ratio is imbalanced and there is a serious excess of marriageable men, these very good women cannot choose to be matched with men whose overall level is far below their own. As a result, there has been a parallel situation of male marriage squeeze and the problem of leftover women.

In this paper, we analyze the effect of one-child policy on marriage market in China, and focus on leftover situation, marriage age, and the age differential between husband and wife. In particular, we isolate the effect of one-child policy from other factors such as economic development and transition, improvement of female education, etc.

The first contribution of this paper is on the literature of the China's one-child policy. One-child policy is one of the most important social policies in current China, and it has produced profound impacts on many aspects of Chinese society. The effect of one-child policy on different outcomes has received considerable attention in the field of economics. For examples, Li, Yi and Zhang (2011) study the effect of one-child policy on the imbalance in the sex ratio, and find that this policy is the main driving force of the imbalance of sex ratio. Li and Zhang (2007) examine the impact of the birth rate due to one-child policy on economic growth. Because China's one-child policy applied only to the Han Chinese but not to minorities, this study employs the unique affirmative policy to identify the causal effect of the birth rate on economic growth, and finds that the birth rate has a negative impact on economic growth. Wei and Zhang (2011) analyze the effect of one-child policy on saving rate. Given the imbalance sex ratio, it has become more difficult for sons to find wives in the future, which heightens the saving rate of parents to prepare for the dowry and buying houses for marriages of their sons in the future. Edlund, Li, Yi and Zhang (2013) discuss the impact of one-child policy on the crime rate. The finding is that the imbalance in sex ratio deteriorates the problem of single men who cannot find wives and increases the crime rate, in particular the sex crime. Wei, Zhang and Liu (2016) analyze the effect of one-child policy on the housing price, and find that scarcer women help push up the dowry price including the housing price., Bulte, Heerink, and Zhang (2011) directly analyzes the effect of one-child policy on the missing women. They find that preference for boys is the main driver of the increased gender ratio, and that the one-child policy is responsible for about half of it.

These above studies investigate many important short- or long-term effects arising from the one-child policy. However, the systematic analysis of the relationship between one-child policy on marriage market using micro datasets is still lacking, and the role of one-child policy on the marriage market itself is of great interest to academia, policy circle, as well as public. Our study complements the previous literature in evaluating the long-term effects of one-child policy, analyzes the

phenomenon and reason for the leftover men and women, and investigates to what extent and why leftover men and women take place concurrently. We find that taking age of 30 as a cut-off point, the one-child policy has increased the leftover proportion about 1.2%, with 1.8% on men and 0.6% on women.¹

The second contribution of our paper is on the leftover men and women literature. In China, the leftover men and women (unmarried at an old age) and late marriage age upset the parents, relatives and even the whole society for almost two entire decades. The phenomenon is considered by To (2013), Gaetano (2014), Qian and Qian (2014), Yu and Xie (2015), Ji (2015), Wang, Chen, Zhao and Zhou (2015) and Fincher (2016). These studies on leftover people (in particular, women) and late marriage age generally find a delayed marriage age and a rise in the proportion of leftover men and women. Most of these studies are based on the methodology of sociology. None has directly touched upon the effect of one-child policy on the leftover situation, marriage age and age differentials between husband and wife.

In this study, we focus on the long-term impact of one-child policy on the leftover men and women, marriage age and age differentials between husband and wife, which have received little attention in the literature. Our study suggests that although the problem of urban leftover women has made eye-catching of the general public, the problem of the leftover men is much more serious than that of women: with the former arising from the true over-supply of men while the latter due to the matching process.

The third contribution of our paper is to provide direct evidence to support the theory of “grading by grading in matching”. Firstly, we find that employment and schooling variables have negative effect on leftover probability of men, while positive

¹ There is no consensus on the cutoff age of “leftover” individuals. Thus, we also use other cutoff ages, such as 26, 28, 32, 34, and 36, and we find that all of the results are robust to each cutoff age.

effect on that of women, which is consistent with the “grading by grading in matching” theory. Secondly, for the effect of the one-child policy on the age differential between husband and wife, we find it is positive and significant for the male-head families but negative for the female-headed families. This finding corroborates that economic situation determines the power in the marriage market. Higher-level men can find younger wives, and higher-level women can also find husbands with similar or even younger age. In addition, one-child policy intensifies this trend. The imbalance in sex ratio caused by one-child policy leads to higher competition in men in order to find wives, which drives up the age differentials between husband and wife in male-head households. However, it is not the case for higher-level women in female-head households.

Our fourth contribution is on the population policy discussion and debate in China. The effect of one-child policy on “leftover” individuals can be extended to related population policy analysis and discussion. How such population policies as one-child policy affects the marriage behaviors in the long run, is worthwhile to analyze as it directly leads to the long-run population structure and thus the economic structure (e.g., industry structure). For example, as China began to relax the one-child policy to two-child policy in 2016, our study can be used to predict future marriage behaviors and population structure. Therefore, the study makes a great contribution in analyzing the long-term effects of population policies.

Finally, our study can enrich and contribute to related literature and policy discussions around the world. First, different countries around the world still adopt vary different population policies to relax or tighten the population, and our findings can be beneficial for related debates and discussions. Secondly, each country has its unique culture and social norm, and our study provides evidence on how the effect from China's population policy interacted with Chinese culture and social norm can be different from other countries. Economist (2015) compares the single-person households in China with those in other countries or regions. From 2000 to 2010, the

number of single-person households in China had doubled, with over 58 million Chinese living by themselves, according to census data. Therefore, the number of single-person households in China is larger than that in America, Britain and France combined. The proportion makes up 14% of all households, which is still lower than that in Japan, US, Italy or Britain (25-30% in these four countries), or Germany or Norway (over 30% in these two countries). However, the proportion in China will definitely increase. The patterns of Chinese single-households are different from that in the Western countries, due to the traditions in marriage and living arrangement. In the west, many couple choose open marriage, so that not to be confined by traditional marriage. Although more and more youths in China follow this style, the proportion is still low. In addition, Chinese traditional culture attaches a high importance to households living together. However, the number is also affected by migrant workers migrating from the rural to the urban area. We will directly test the leftover men and women based on the marriage status. In addition, China differs from the Western countries in the imbalanced sex ratio caused by the one-child policy. Therefore, no matter high or low “leftover” proportion in the Western countries, there is no great differential between the proportion of leftover men and that of women. However, it is not the case in China due to the imbalance in sex ratio. To what extent it affects the leftover situations, is a brand-new and important topic in our study.

The remaining of this paper is as follows. In Section 2, we describe the data and methodology. Section 3 provides the background of marriage behavior in China. Section 4 analyzes the effect of one-child policy on leftover men and women. In Section 5, we present the effects of one-child policy on the marriage age and age differentials between husband and wife. Section 6 concludes the paper.

2. Data and Methodology

In this paper, we use the 2005 and 2015 the 1% National Population Sample

Survey of China (also known as the mini-census), the 2000 and 2010 the National Population Census of China. The census and the mini-census are the most reliable nationally representative data sources in China for the study of population issues. Both the census and the mini-census are conducted by the National Bureau of Statistics of China, and are comparable across years.

We define the leftover individuals as those unmarried after age 30 in this study. There is no consensus on the exact classification of “leftover” age, we also explore other cutoff ages such as 26, 28, 32, 34, and 36. In regressions, excluding those under 23 years old and over 40 years old, we mainly focus on the adults with normal marriage ages. In some descriptive tables such as the leftover rates for different age groups, we also include and report adults with other ages.

Following Li and Zhang (2007) and Li, Yi and Zhang (2001), we use a Difference-in-Differences methodology (DID) to identify the effect of one-child policy. We utilize the differential one-child policy between the Han and other minorities as a quasi-experiment to identify the causal effect on the leftover men and women, marriage age and age differentials between husband and wife. As the one-child policy has only been applied to the Han nationality, we have the Han Chinese as the treatment group and the ethnic minorities as the comparison group.

Let N and T be the nationality and birth cohort indicators, respectively. N equals 1 for a Han individual, and T equals 1 if the individual was born in the post-policy change period (after 1978). We use Y_i as a dependent variable to measure the outcome. We establish the following model:

$$Y_i = \beta_0 + \beta_1 \cdot N_i + \beta_2 \cdot T_i + \beta_3 \cdot N_i T_i + \beta_4 \cdot X_{it} + \mu_{it} \quad (1)$$

where i means the individual. Y_{it} is the dependent variable, indicating the leftover men or women, marriage age or age differentials between husband and wife. N_i is the nationality dummy (Han=1, others=0), in which “others” means Minority nationality. Han-nationality comprises 91.5% of the overall population in 2010. T_i

indicates whether or not the individual was born after 1978 when one-child policy was implemented. Thus, the interaction term N_iT_i measures whether one was affected by the one-child policy: it equals to 1 for those Han born after 1978 while 0 for other groups.² The coefficient β_3 of the interaction term N_iT_i measures the effect of one-child policy on the leftover men or women, marriage age or age differentials between husband and wife, and is the key parameter that we concern most. X_{it} includes other control variables such as education level, gender, year and region variables. In the main regressions, we only use the sample of Census 2010 and Mini-Census 2015, as the treatment group only appears in 2010 and 2015. The following table briefly describes the variables.

<Table 1 here>

In particular, there exists one key variable: hukou (household registration) type. Hukou refers to the legal documents made by the administrative organization in charge of household administration to record and retain the basic information of the household population, which is also the identity of each citizen. The Census dataset provides information on the location of hukou registration, the hukou type (urban or rural), and the separation of hukou location and residence including the duration and reason of leaving hukou location. In our further analysis, based on hukou, we classify the sample into four subgroups: urban, rural residents, migrants, and urban residents including migrants. Urban sample consists of those who reside in the urban area with urban hukou, while rural sample includes those residing in the rural area with rural hukou. Migrants refer to those who migrate to the urban area with rural hukou (Han and Li 2017). Urban residents including migrants, consist of all individuals residing in the urban area, so that we can provide an overall perspective in all urban individuals.

3. Background of Marriage Behavior in China

There has been a social concern that the numbers of leftover men and women in

² Therefore, the difference between Han and others lies in the nationality. And, the difference between Han and Han *Born After 1978 lies in whether the Han-nationality individuals were born after the one-child policy.

China have been continuing to increase, not only in the urban area but also in the rural area. We define the leftover individuals as men and women who are still unmarried aged 30 and above. Combining the Census data of 2000, 2005, 2010, and 2015, we analyze the proportion of unmarried men and women in urban and rural areas, in sub-provincial prefectures, and across age groups.

<Table 2 here>

As seen from Table 2, from 2000 to 2010, the proportion of unmarried men and women over the age of 30 has been on an upward trend. From 2010 to 2015, there was a trend of slight decline due to the population aging and the decreasing proportion of young people. The proportion of unmarried men older than 30 is generally higher than that of women. The proportion of unmarried women aged over 30 in 2000 was only 0.49%, and by 2010 this proportion had risen to 1.60%, which had almost tripled in 10 years. Women's late marriage trend is more pronounced than that of men, and the rising rate of female leftover proportion is also larger than that of male. However, on the whole, the leftover problem of men is much more serious than that of women, no matter in which year or in which region.

In both urban and rural areas, the proportion of unmarried males and females above the age of 30 is on an upward trend, except that of rural males which remains quite stable over time. In addition, there is a clear difference between urban and rural areas in the leftover men and women. The proportion of leftover men and women in urban area has a similar increase trend, and the figure for men is about twice that of women. However, in rural areas, the proportion of unmarried men aged over 30 is several times that of women.

The problem of “leftover rural men” is much more serious than the “leftover women” problem; the problem of accumulated gender imbalance has become a serious social problem and has led to the phenomenon of “marriage squeeze” of men.

According to a 2010 report of the Institute of Population and Development of Xi'an Jiaotong University based on survey of a total of 369 administrative villages in 28 provinces across the country, the marriage squeezing is mainly concentrated on men with low education and low income in the western region.³

The leftover men and women also differ across regions. As shown in Appendix Table 1, the proportions of leftover men across provinces and prefectures are quite different, with only 15 provinces and prefectures showing a continuous upward trend. Furthermore, the change of proportion of leftover men is more gradual than that of women. The proportion of unmarried women over the age of 30 in almost all provinces and prefectures showed an upward trend, with the growth rate exceeding 100% (except Tibet, Qinghai and Sichuan). On the whole, the problem of leftover has been polarizing: it is more serious in the most developed prefectures such as Beijing and Shanghai, as well as in least developed prefectures such as Guangxi.

<Table 3 here>

The proportions of leftover men and women by age group are presented in Table 3. For both men and women, the proportion of unmarried ones over the age of 30 has been declining with increasing age, and has stabilized at the age over 45, and there is no longer a clear downward trend. For women, regardless of their age group, most of leftover men and women choose to remain single after age 45, if they have not been married before age 45. The proportion of unmarried individuals continues to increase from 2000 to 2010. For men, the proportions of 30-34, 35-39, and 40-44 old have been rising from 2000 to 2010, and the growth rate is relatively flat, while other age groups show a downward trend.

<Table 4 here>

³ Technical Report on Survey of Gender Disparities and Social Stability in 100 Villages.

For the married couples, the marriage age and age differential between husband and wife are shown in Table 4.⁴ The average marriage age has been increasing with time, and the male marriage age is larger than female. In addition, spouses marry at younger age in the rural area than in the urban area.

Also as shown in Table 4, the age differential between husband and wife, the husband age minus wife age in every household with married couple, also changes with time. We classify the households into two groups: male-head and female-head households.⁵ There is not much difference in the age differential between husband and wife between male-head and female-head households. In addition, the age differential between husband and wife has been quite stable over time. In the urban area, the average age differential between husband and wife has been larger than that in the rural area. Because of the increasing sex imbalance in the rural area, individuals tend to marry quickly at younger ages, in particular for men.

<Table 5 here>

As shown in Table 5, the leftover men or women, marriage age, and age differentials between husband and wife differ between minority group and Han group. The proportion of leftover individuals is higher in the minority group than Han group. In addition, the proportion of leftover individuals born after one-child policy is much higher than those born before the policy. Using different cutoff ages (30, 26, 28, 32, 34, and 36) to define “leftover”, the proportion is also quite different across groups. The proportion of leftover declines with the rising age, but the comparison relationship between the four groups remains stable. The preliminary comparison from descriptive statistics shows that the proportion of leftover in Han individuals is lower than that of minority individuals, and both have risen to a large extent for

⁴ We cannot observe the marriage age in the Mini-Census 2015 due to lack of information, but the age differentials between husband and wife can still be observed. Therefore in Table 4, we do not provide marriage age of year 2015.

⁵As far as the head of household is concerned, it is generally based on family habits, mainly in accordance with Household Register Book in China.

post-policy cohorts (born after 1978) than for pre-policy cohorts (born before 1978). The proportion increasing rate (post-policy / pre-policy) is higher for Han than minority individuals, if we classify the cutoff ages before 34. It is also the case for marriage age and age differentials between husband and wife: Han individuals have a higher rising rate (post-policy / pre-policy) than minority individuals. The schooling, working and other variables are also quite different across these groups. Therefore, we will employ the DID methodology in Equation (1) controlling for these variables, in order to get accurate results.

As we have discussed the single-person households in Section 1, we can briefly compare the leftover rates between China and other countries (or regions). Before-1978 cohorts have much lower leftover rates than those in the other countries (or regions). Even after-1978 cohorts still have lower leftover rates than those in the Western countries. These numbers might be comparable with those in Hong Kong or Taiwan, but still lower to some extent. As shown in Table 3, the proportion of 30-34 in 2000 (7.70%) declines to that of 35-39 in 2005 (5.10%), and further to 4.10% in 2010 and 3% in 2015. It indicates that a proportion of leftover individuals still end up in marriage, with delaying marriage age. However, we can still find a large tendency in the rising rate of leftover situation and great difference between men and women, as shown in Table 3. In summary, we have the following findings from descriptive statistics. Overall, the proportion of unmarried men and women over 30 years of age is on an upward trend. The figure of leftover women is much lower than that of men, while the increasing rate of leftover women is higher than that of men. The trend of late marriage among women is more continuous and extensive. On the whole, the problem of leftover has been polarizing: it is more serious in the most developed regions as well as in least developed regions. The proportions of leftover men and women tend to stabilize around the age of 45, which indicates that most of leftover men and women choose to remain single after age 45, given the status of remaining single before age 45. The proportion of leftover individuals is higher in the minority

group than Han group, and that of those born after one-child policy is much higher than those born before the policy. The proportion of leftover declines with the rising age, but the comparison relationship between the four groups remains stable.

The average marriage age has been increasing with years, and spouses marry at younger age in the rural area than in the urban area. The age differential between husband and wife has been quite stable over time. In the urban area, the average age differential between husband and wife has been larger than that in the rural area.

4. Effect of One-Child Policy on Leftover Situation

The one-child policy resulted in many problems, including the imbalance of sex ratio (Wei and Zhang 2011, Edlund et al. 2013), which caused higher difficulty in assortative mating. Therefore, the one-child policy may increase a higher proportion of leftover men and women, in particular the leftover men. To test this hypothesis, we use Equation (1) to analyze the effect of one-child policy on leftover situation, based on the linear probability model.⁶

<Table 6 here>

Table 6 provides the results, with columns (1) and (2) the overall sample and the rest two columns for men and women, respectively.⁷ As shown in Table 6, one-child policy has positive and significant effects on leftover probability. In particular, the coefficient of men is much higher than that of women, which indicates that one-child policy has led to a higher proportion of leftover men than women.

From the columns (1) and (2) of Table 6, overall the one-child policy has increased the leftover proportion about 1.2%. For other characteristics, in particular,

⁶ We also use the probit or logit models to test the robustness of results, and find results are similar.

⁷ Column (1) does not include prefecture and year effects, while Column (2) does.

employment and schooling variables have negative effect on leftover probability of men, while positive effect on that of women. It is consistent with the “grading by grading in matching” theory, and supports the mismatch in the marriage market of China. The main reason of leftover men lies in the lower education and economic status, while that of leftover women lies in the matching standard of higher-level women.

At last, the coefficients of male variable in columns (1) and (2) show that male probability of leftover is 3.5% higher than that of female on average, which is in accordance with the number of over 30 million leftover men than leftover women in the official statistics (National Bureau of Statistics, 2016). Given the significant effect of gender, in columns (3) and (4), we analyze the male and female samples separately. The effects on men and women are quite different, with 1.8% on men and 0.6% on women. The larger effect on men is consistent with the fact: as one-child policy engenders the sex imbalance towards men, it is more difficult for men to find spouse than women. Therefore, the leftover problem of men is more serious than that of women.

As mentioned in Section 2, we classify the sample into four subgroups: urban, rural residents, migrants, and urban residents including migrants. The results are shown in Table 7.

<Table 7 here>

We find different effects of one-child policy on leftover situation for urban, rural residents and migrants. As shown in Panel A of Table 7, the effect on urban residents is positive and insignificant, no matter for men or women. It means that one-child policy has not resulted in the leftover men or women in the urban area, although we have observed a high proportion of leftover men or women in urban areas (Table 2). It conforms to the intuition that one-child policy had not caused serious problem of gender selection when giving birth to child in the urban area. Therefore, it must have

been caused by other factors, such as rising schooling years and difficulty in assortative mating. As schooling years have different effects on leftover men and women (see Table 6), the more rapidly rising education of women in the urban area has increased the leftover proportion. In addition, along with the economic transition, the concept of marriage has also been shifting from parents-planned marriage towards free-love assortative mating (Li, 2008), which has increased the searching time in the marriage market, which causes the marriage delay and the rise in leftover proportion of urban residents.

It is not the case for rural residents and migrants, as shown in Panels B and C of Table 7, respectively. It arises from the fact that one-child policy had engendered serious problem of gender selection in the rural area. We find that the one-child policy has positive and significant effects on both rural residents and migrants. And, the coefficient of men is much higher than those of women, which supports our conjecture that the imbalance in the sex ratio deteriorates the problem of leftover men in the rural area. As the one-child policy has resulted in the imbalance in the sex ratio, especially in the rural area (Li, Yi and Zhang 2011), the level of difficulty for rural males to find suitable wives had been rising. If the problem of leftover women in the rural area mainly arises from the longer assortative mating process, the problem of leftover men in the rural area is much more serious. Most of the leftover men in the rural area might end up single throughout the whole life.

After including the migrants into urban residents, as shown in Panel D of Table 7, we find that one-child policy has significant and positive effect on urban leftover men, while without significant effect on urban women. As discussed in Panels A and C of Table 7, the positive effect can mainly be attributed to the migrants. There are two factors: more serious problem of leftover men than that of women, and a higher proportion of migrant men than that of migrant women. Given the fact that the marriage markets are quite segregated between migrants and urban natives, the two factors have exacerbated the problem of leftover men in the urban area. Although the

problem of urban leftover women has made eye-catching of the general public, the phenomenon of urban leftover men has been ignored, which in fact is a real problem. It follows that urban women become leftover due to the longer assortative mating process, while some urban leftover men cannot find spouses throughout the whole life. In addition, if more women choose not to marry throughout the life, more men would have to be leftover passively, due to the imbalanced sex ratio and “grading by grading in matching”.

<Table 8 here>

There is a concern that the classification of “leftover” based on age 30 might suffer from arbitrariness, as there is no consensus on cutoff age to define leftover men and women. Thus, we conduct a robustness test using other cutoff ages such as 26, 28, 32, 34, and 36, with the results shown in Table 8. The independent variable is the interaction term: Han * Born after 1978, with different samples in every row and column. The dependent variable is leftover situation, with different cutoff ages: 26, 28, 32, 34, and 36 in Panels A, B, C, D, and E, respectively. If the cutoff age is based on age 26, individuals are too young to be attributed to “leftover”. However, we can still find that on the whole the male coefficient is much higher and significant. With the rising cutoff ages from 26, 28, 32, 34 to 36, almost all of the coefficients increase, with coefficients of urban samples becoming more significant. The differentials in coefficients between men and women also enlarge with the rising cutoff age, which further supports our judgment that the problem of aged leftover men is much more severe than that of women. In addition, based on Panels C, D, and E of Table 8, the problem of aged leftover men in the urban area is more severe than expected, although the social media usually focuses on urban leftover women. In sum, all of the results are robust to the choices of different cutoff ages.

5. Effect of One-Child Policy on Marriage Age, and the Age Differential Between Husband and Wife

We have found that one-child policy induces the leftover men and women, in particular in the rural area. However, whether it affects the marriage age for married couples remains a question. The comparison between the urban and rural areas shows that the sex ratio due to one-child policy is an important driving force on leftover individuals. The proportion of leftover individuals has been rising, and we can also expect a delayed marriage for those who have been married, and a changing age differential between husband and wife. We analyze these issues in this section.

<Table 9 here>

As shown in Table 9, the effect of one-child policy on marriage age is positive and significant. In addition, the effect is always positive for urban, rural residents, migrants, and urban residents including migrants, with only smaller coefficients in the urban area. However, one-child policy delays the marriage age of urban residents in the urban area, but has insignificant and positive effect on the leftover situation. The estimates of Table 9 also show that the policy that the imbalance in sex ratio caused by one-child policy further drives up the assortative mating process, and delays the marriage age for both genders, with larger effect on men than women.

These findings suggest that the effect is lower in the urban area with a more balanced sex ratio. In addition, the problem of the leftover men is much more serious than that of women: with the former arising from the true over-supply of men while the latter due to the matching process.

Next, we analyze the effect of one-child policy on the age differential between husband and wife. We divide the households into two groups: male-head and female-head households. The dependent variable age differential between husband and wife is calculated as the husband age minus wife age in every household with married couple. There is a concern that the influence of the growth of life expectancy, health level, education level and social openness on marriage age will affect the age

differentials between husband and wife. Thus, we control for prefecture fixed effect which consists of the growth of life expectancy, health level and social openness on marriage age at the prefecture level. In addition, we control for education level of husband and wife in all regressions. There are also other factors such as willingness to marry, which also affects the estimation results. Because of lack of information on willingness to marry in the Census and Mini-Census dataset, we cannot control for this variable. If there are more datasets in the future, we will analyze how this variable affects the estimation results.

<Table 10 here>

The results are in Table 10. We find that one-child policy increases the age differential between husband and wife on the whole, which is in accordance with previous findings that this policy induces sex ratio and delays marriage age especially for men. However, it is quite different for male-head and female-head families: the effect is positive and significant for the male-head families but negative for the female-headed families. This finding corroborates that economic situation determines the power in the marriage market. Higher-level men (with more wealth or human capital) can find younger wives, and higher-level women can also find husbands with similar or even younger age. In addition, one-child policy intensifies this trend. The imbalance in sex ratio caused by one-child policy leads to higher competition in men in order to find wives, which drives up the age differentials between husband and wife in male-head households. However, it is not the case for higher-level women in female-head households. The proportion of female-head households is lower than 20%, and thus the overall effect is dominated by male-head households.

As far as different groups are concerned, there exists some difference. One-child policy increases the age differential between husband and wife in almost all male-head households, except migrant households. However, the effect is different for female-head households: negative and significant in all households except

insignificant in urban households. The particular points of migrant men lie in the relative high-level in the marriage market and the earlier marriage age than urban men, which lead to the insignificant coefficient of this group. When we include migrants in the urban residents, the coefficients are consistent with the overall. In sum, the effect of one-child policy on age differential between husband and wife is positive and significant, with positive effect in male-head households and negative effect in female-head households. These findings corroborate that the imbalance in sex ratio caused by one-child policy leads to higher competition in men in order to find wives, which drives up the age differentials between husband and wife in male-head households.

6. Concluding Remarks

This is the first systematic study that analyzes the effect of China's one-child policy on marriage market, and focuses on leftover men and women, marriage age, and the age differential between husband and wife based on the China Population Census and Mini-Census. The main findings are:

1. The proportions of unmarried men and women over 30 years of age are on an upward trend. The figure of leftover women is much lower than that of men, while the increasing rate of leftover women is higher than that of men.
2. One-child policy has increased the leftover proportion about 1.2%. In addition, the effects on men and women are quite different, with 1.8% on men and 0.6% on women.
3. The effect of one-child policy on leftover urban residents with local hukou is positive and insignificant, in particular for women. However, the effects on leftover rural residents and migrants are positive and significant.
4. The effect of one-child policy on male probability of leftover is 3.5% higher than that of female on average. In particular, it is the case in the rural area, as

well as in the urban area. Although the problem of urban leftover women has made eye-catching of the general public, the phenomenon of urban leftover men has been ignored, which in fact is a real problem.

5. With the rising cutoff ages from 26, 28, 32, 34 to 36, almost all of the coefficients increase, with coefficients of urban samples becoming more significant. In particular, the problem of aged leftover men in the urban area is more severe than expected, although the social media usually focuses on urban leftover women. In sum, all of the results are robust to the choice of cutoff ages, which supports our findings based on cutoff age 30 as the leftover age.
6. The average marriage age has been increasing with years, and spouses marry at younger age in the rural area than in the urban area. The effect of one-child policy on marriage age is positive and significant, no matter for urban, rural residents or migrants, with only smaller coefficients in the urban area. The imbalance in sex ratio caused by one-child policy further drives up the assortative mating process, and delays the marriage age for both genders, with larger effect on men than women.
7. One-child policy increases the age differential between husband and wife on the whole, with different effects on male-head and female-head families: positive and significant in the former while negative in the latter. The imbalance in sex ratio caused by one-child policy leads to higher competition in men in order to find wives, which drives up the age differentials between husband and wife in male-head households.

The findings of this study provide new evidence of impact of birth control policy on household behaviors many years later. And, the findings support that the effect is lower in the urban area with a more balanced sex ratio. In addition, the problem of the leftover men is much more serious than that of women in both rural and urban areas: with the former arising from the true over-supply of men while the latter due to the matching process.

Therefore, with the abolishment of one-child policy and implement of two-child policy, we can expect a more balanced sex ratio in the future, and a slowing down in the rise of leftover proportion, marriage age, and the age differential between husband and wife. Although two-child policy has been implemented, the birth rate has not increased to a large extent, due to the high costs of raising children. Therefore, we propose higher subsidies and lower taxes based on the number of children in the households. In addition, there is no need to restriction on two children, and it is time to lift the control over number of children for each household.

At last, the social media has attached too much importance on the leftover urban women, while ignoring the leftover men in particular in the rural area. This phenomenon of leftover men might lead to a series of social problems including crimes. Therefore, the policy implication lies in that no matter the social media or the government should attach great importance to the leftover men. Thus, a series of policies and measures should be implemented to make assortative mating more efficient and reduce the potential consequences of leftover.

There still exist valuable research projects to pursuit in the future. For example, two-child policy has been implemented, which has not been analyzed here. The long-term impacts of the two-child policy, including on the marriage market, has aroused the interests of researchers, the government, and the public. Thus, we look forward to more studies to tackle related problems in the near future.

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Table 1. Definition of Variables

Variable	Meaning	Explanation
Dependent variable		
Y	the leftover situation, marriage age or age differentials between husband and wife	Dummies or continuous variables
Independent variables		
$N_i T_i$	Interaction term	Effect of the one-child policy on the leftover situation, marriage age and age differentials between husband and wife
N_i	nationality	1, Han; 0, otherwise
T_i	Birth time	1, after 1978; 0, otherwise
Control variables		
male	male	1, male; 0 otherwise
region	Province and prefecture	Dummies of provinces and prefectures
schooling	Education level	Schooling years

Table 2. The Proportion of Leftover Men and Women in Urban and Rural Areas

	Nationwide		Urban		Rural	
	Male	Female	Male	Female	Male	Female
2000	4.5%	0.5%	2.7%	1.0%	5.4%	0.3%
2005	4.6%	0.8%	3.4%	1.4%	5.4%	0.5%
2010	5.2%	1.6%	4.9%	2.4%	5.5%	0.8%
2015	4.6%	1.3%	4.5%	2.1%	4.9%	0.7%

Data source: 2000、2010 Census, and 2005 and 2015 Mini-Census.

Table 3. The Leftover Men and Women Across Age Groups

Age	Male				Female			
	2000	2005	2010	2015	2000	2005	2010	2015
30-34	7.70%	10.70%	13.80%	14.20%	1.40%	2.60%	6.30%	6.60%
35-39	4.10%	5.10%	6.70%	6.50%	0.50%	0.90%	2.20%	2.10%
40-44	3.70%	3.40%	4.10%	4.20%	0.30%	0.50%	1.00%	0.90%
45-49	3.80%	3.20%	3.00%	3.00%	0.20%	0.40%	0.60%	0.50%
50-54	4.10%	3.40%	2.90%	2.20%	0.20%	0.30%	0.50%	0.30%
55-59	4.20%	3.40%	3.00%	2.40%	0.20%	0.20%	0.30%	0.20%
Over 60	3.10%	3.00%	2.90%	2.30%	0.20%	0.30%	0.40%	0.20%

Data source: 2000、2010 Census, and 2005 and 2015 Mini-Census.

Table 4. The Marriage Age and Age Differentials Between Husband and Wife in Urban and Rural Areas

	Marriage Age						Age Differentials Between Husband and Wife					
	Nationwide		Urban		Rural		Nationwide		Urban		Rural	
	Male	Female	Male	Female	Male	Female	Male Head	Female Head	Male Head	Female Head	Male Head	Female Head
2000	23.91	21.84	24.91	23.05	23.44	21.4	2.14	2.29	2.18	2.11	2.13	2.42
2005	24	21.82	25.26	23.15	23.39	21.25	2.19	2.3	2.34	2.25	1.92	2.11
2010	24.53	22.59	25.17	23.39	23.7	21.87	2.05	2.11	2.32	2.25	2.06	2.37
2015							1.92	1.99	2	2.03	1.86	1.85

Data source: 2000, 2010 Census, and 2005 and 2015 Mini-Census.

Table 5. Proportion of Leftover with Different Cutoff Ages (30, 26, 28, 32, 34, and 36), Marriage Age, and Age

Differential Between Husband and Wife in Different Groups

	Proportion of Leftover with Cutoff Age 30	Proportion of Leftover with Cutoff Age 26	Proportion of Leftover with Cutoff Age 28	Proportion of Leftover with Cutoff Age 32	Proportion of Leftover with Cutoff Age 34	Proportion of Leftover with Cutoff Age 36	Marriage Age	Age Differential Between Husband and Wife
Minority Nationality Born Before 1978	6.27%	7.74%	7.21%	5.62%	5.06%	4.73%	23.57	2.46
Han Nationality Born Before 1978	4.10%	5.33%	4.84%	3.68%	3.29%	2.95%	23.59	2.13
Minority Nationality Born After 1978	12.57%	20.89%	15.95%	10.27%	8.77%	7.91%	22.9	1.54
Han Nationality Born After 1978	9.21%	18.97%	13.02%	6.82%	5.08%	4.00%	23.26	1.26

Data source: 2000、2010 Census, and 2005 and 2015 Mini-Census.

Table 6. The Effect of One-Child Policy on Leftover Situation

	All	All	Male	Female
Han	-0.029*** (0.001)	-0.012*** (0.001)	-0.018*** (0.002)	-0.004*** (0.001)
Born after 1978	0.005*** (0.002)	0.004*** (0.002)	0.004 (0.003)	0.005*** (0.002)
Han * Born after 1978	0.012*** (0.001)	0.012*** (0.002)	0.018*** (0.002)	0.006*** (0.002)
Employment	-0.013*** (0.000)	-0.013*** (0.000)	-0.044*** (0.001)	0.003*** (0.000)
Schooling	0.000 (0.000)	-0.000* (0.000)	-0.003*** (0.000)	0.002*** (0.000)
Age	0.062*** (0.000)	0.062*** (0.000)	0.085*** (0.001)	0.040*** (0.001)
Age square	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)
Male	0.035*** (0.000)	0.035*** (0.000)		
Prefecture and Year Fixed Effect	No	Yes	Yes	Yes
R^2	0.03	0.04	0.05	0.03
N	1,239,229	1,239,229	625,716	613,513

Note: Standard errors in parentheses: * significant at 10%; ** significant at 5%; *** significant at 1%. The dependent variable is leftover situation, with cutoff age 30.

**Table 7. Effect of One-Child Policy on Leftover Situation for Urban,
Rural Residents and Migrants**

	All	Men	Women
Panel A: Urban			
Han	0.002 (0.003)	0.001 (0.004)	0.002 (0.003)
Born after 1978	0.016*** (0.003)	0.024*** (0.005)	0.009** (0.004)
Han * Born after 1978	-0.001 (0.003)	0.001 (0.005)	-0.002 (0.003)
Panel B: Rural			
Han	-0.014*** (0.002)	-0.020*** (0.003)	-0.008*** (0.002)
Born after 1978	-0.001 (0.002)	-0.003 (0.004)	0.000 (0.002)
Han * Born after 1978	0.015*** (0.002)	0.020*** (0.004)	0.009*** (0.002)
Panel C: Migrant			
Han	-0.025*** (0.003)	-0.034*** (0.004)	-0.010*** (0.004)
Born after 1978	0.003 (0.004)	-0.003 (0.005)	0.011** (0.004)
Han * Born after 1978	0.018*** (0.003)	0.025*** (0.005)	0.007* (0.004)
Panel D: Urban including Migrants			
Han	-0.009*** (0.002)	-0.016*** (0.003)	-0.001 (0.002)
Born after 1978	0.010*** (0.002)	0.012*** (0.004)	0.010*** (0.003)
Han * Born after 1978	0.007*** (0.002)	0.013*** (0.003)	0.001 (0.003)

Note: Standard errors in parentheses: * significant at 10%; ** significant at 5%; *** significant at 1%. The dependent variable is leftover situation, with cutoff age 30. The control variables include employment, schooling years, age and its square, gender, prefecture and year fixed effects.

***Table 8. Effect of One-Child Policy on Leftover Situation for Urban,
Rural Residents and Migrants***

Independent Variable: Han * Born after 1978			
Sample	All	Men	Women
Panel A: Age 26 as the cutoff age of leftover			
All	0.010*** (0.002)	0.012*** (0.004)	0.007*** (0.003)
Urban including Migrants	-0.000 (0.003)	0.001 (0.005)	-0.003 (0.005)
Rural	0.010*** (0.003)	0.010* (0.005)	0.010*** (0.003)
Panel B: Age 28 as the cutoff age of leftover			
All	0.011*** (0.002)	0.013*** (0.003)	0.007*** (0.002)
Urban including Migrants	0.004 (0.003)	0.006 (0.004)	0.000 (0.004)
Rural	0.012*** (0.002)	0.013*** (0.004)	0.010*** (0.002)
Panel C: Age 32 as the cutoff age of leftover			
All	0.016*** (0.001)	0.025*** (0.002)	0.007*** (0.001)
Urban including Migrants	0.013*** (0.002)	0.022*** (0.003)	0.004* (0.002)
Rural	0.019*** (0.002)	0.026*** (0.003)	0.011*** (0.001)
Panel D: Age 34 as the cutoff age of leftover			
All	0.017*** (0.001)	0.026*** (0.002)	0.006*** (0.001)
Urban including Migrants	0.014*** (0.001)	0.023*** (0.002)	0.003** (0.002)
Rural	0.020*** (0.001)	0.028*** (0.003)	0.010*** (0.001)
Panel E: Age 36 as the cutoff age of leftover			
All	0.017*** (0.001)	0.028*** (0.001)	0.006*** (0.001)
Urban including Migrants	0.013*** (0.001)	0.022*** (0.002)	0.003*** (0.001)

Rural	0.022*** (0.001)	0.032*** (0.002)	0.010*** (0.001)
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Note: Standard errors in parentheses: * significant at 10%; ** significant at 5%; *** significant at 1%. The independent variable is the interaction term: Han * Born after 1978, with different samples in every row and column. The dependent variable is leftover situation, with different cutoff ages: 26, 28, 32, 34, and 36 in Panels A, B, C, D, and E, respectively. The control variables include employment, schooling years, age and its square, gender, prefecture and year fixed effects.

Table 9. Effect of One-Child Policy on Marriage Age

	All	Men	Women
Panel A: Overall			
Han	-0.126*** (0.027)	-0.137*** (0.040)	-0.115*** (0.036)
Born after 1978	-0.014 (0.039)	-0.067 (0.060)	0.080 (0.050)
Han * Born after 1978	0.344*** (0.037)	0.357*** (0.057)	0.322*** (0.048)
Panel B: Urban			
Han	0.022 (0.049)	0.036 (0.074)	0.004 (0.065)
Born after 1978	0.093 (0.075)	0.003 (0.117)	0.216** (0.097)
Han * Born after 1978	0.284*** (0.073)	0.332*** (0.114)	0.243*** (0.094)
Panel C: Rural			
Han	-0.184*** (0.040)	-0.199*** (0.062)	-0.160*** (0.051)
Born after 1978	-0.072 (0.054)	-0.136 (0.089)	0.034 (0.068)
Han * Born after 1978	0.433*** (0.051)	0.488*** (0.085)	0.361*** (0.064)
Panel D: Migrant			
Han	-0.340*** (0.056)	-0.382*** (0.075)	-0.296*** (0.084)
Born after 1978	-0.023 (0.078)	-0.113 (0.106)	0.151 (0.115)
Han * Born after 1978	0.463*** (0.075)	0.486*** (0.101)	0.444*** (0.110)
Panel E: Urban including Migrants			
Han	-0.102*** (0.037)	-0.135** (0.053)	-0.063 (0.052)
Born after 1978	0.061 (0.054)	-0.017 (0.079)	0.176** (0.074)
Han * Born after 1978	0.311*** (0.052)	0.328*** (0.076)	0.287*** (0.072)

Note: Standard errors in parentheses: * significant at 10%; ** significant at 5%; *** significant at 1%. The dependent variable is the marriage age. The control variables include employment, schooling years, age and its square, gender, prefecture and year

fixed effects.

Table 10. Effect of One-Child Policy on Age Differentials Between

Husband and Wife

	Overall	Male Head	Female Head
Panel A: Overall			
Han	-0.133*** (0.020)	-0.155*** (0.020)	0.223*** (0.078)
Born after 1978	0.013 (0.040)	-0.096** (0.042)	1.214*** (0.142)
Han * Born after 1978	0.202*** (0.040)	0.243*** (0.041)	-0.695*** (0.139)
Panel B: Urban			
Han	-0.177*** (0.035)	-0.239*** (0.038)	0.196** (0.096)
Born after 1978	-0.664*** (0.074)	-0.862*** (0.081)	0.529*** (0.186)
Han * Born after 1978	0.390*** (0.073)	0.449*** (0.080)	-0.222 (0.183)
Panel C: Rural			
Han	-0.148*** (0.025)	-0.153*** (0.025)	0.140 (0.143)
Born after 1978	0.263*** (0.052)	0.135** (0.053)	2.229*** (0.247)
Han * Born after 1978	0.286*** (0.051)	0.345*** (0.053)	-0.998*** (0.239)
Panel D: Migrant			
Han	-0.043 (0.089)	-0.063 (0.090)	0.586 (0.606)
Born after 1978	0.710*** (0.131)	0.649*** (0.133)	2.173*** (0.809)
Han * Born after 1978	-0.195 (0.125)	-0.102 (0.127)	-1.853** (0.748)
Panel E: Urban including Migrants			
Han	-0.155*** (0.033)	-0.207*** (0.035)	0.219** (0.094)
Born after 1978	-0.395***	-0.521***	0.675***

	(0.064)	(0.068)	(0.177)
Han * Born after 1978	0.217***	0.261***	-0.373**
	(0.063)	(0.067)	(0.174)

Note: Standard errors in parentheses: * significant at 10%; ** significant at 5%; *** significant at 1%. The dependent variable is the age differential between husband and wife. The control variables include employment, schooling years, age and its square, gender, prefecture and year fixed effects.

Appendix Table 1. Proportion of Leftover People Across Regions

	Male				Female			
	2000 (%)	2005 (%)	2010 (%)	2015 (%)	2000 (%)	2005 (%)	2010 (%)	2015 (%)
Beijing	3.65	4.3	6.11	4.10	0.95	1.57	4.4	2.79
Tianjin	2.86	3.02	4.31	2.88	0.62	1.22	2.44	2.20
Hebei	5.02	4.33	3.79	3.46	0.26	0.3	0.86	0.80
Shanxi	4.61%	4.21	4.77	4.18	0.14	0.3	0.86	0.81
Inner Mongolia	4.83	4.41	4.54	4.36	0.28	0.45	0.98	0.95
Liaoning	3.62	3.23	5.55	5.04	0.69	0.85	2.21	2.19
Jilin	3.43	3.67	5.06	4.22	0.73	0.74	2.17	1.73
Heilongjiang	2.45	3.09	5.43	4.35	0.59	0.69	2.17	1.77
Shanghai	4.95	4.54	6.69	4.60	0.94	1.48	3.42	2.71
Jiangsu	3.68	3.53	3.07	2.78	0.29	0.35	0.95	0.74
Zhejiang	4.09	4.4	4.13	4.29	0.36	0.4	0.99	0.94
Anhui	5.01	4.95	4.67	4.09	0.17	0.24	0.71	0.65
Fujian	3.6	4.46	4.1	3.91	0.69	0.63	1.53	1.22
Jiangxi	2.94	3.25	4.53	3.66	0.33	0.37	1.15	0.87
Shandong	4.43	4.07	3.82	3.28	0.18	0.28	1	0.72
Henan	5.03	4.65	4.37	3.89	0.28	0.21	1.04	1.05
Hubei	3.69	3.78	5.56	4.75	0.27	0.36	1.33	1.15
Hunan	4.84	5.1	5.77	5.10	0.33	0.53	1.2	1.10
Guangdong	5.87	5.72	7.13	5.88	1.71	1.57	3.63	2.74
Guangxi	7.75	7.29	10.84	10.04	0.61	0.97	3.26	2.23
Hainan	5.82	7.54	8.35	9.55	1.29	1.47	3.65	2.70
Chongqing	5.83	5.51	5.98	4.20	0.26	0.41	1.25	1.02
Sichuan	5.23	5.59	5.63	4.97	0.53	0.63	1.06	1.04
Guizhou	4.28	4.26	5.77	6.51	0.43	0.44	1.23	1.24

Yunnan	3.81	4.91	5.59	6.95	0.44	0.64	1.32	1.18
Tibet	13.26	14.59	18.42	14.36	10.5	10.95	16.45	12.42
Shaanxi	4.11	4.46	3.7	4.60	0.31	0.33	1.25	1.10
Gansu	4.37	4.43	5.02	4.33	0.43	0.52	1.28	0.80
Qinghai	3.58	4.94	5.2	6.72	1.7	1.17	1.17	2.80
Ningxia	1.88	1.9	2.6	3.29	0.26	0.43	1.72	0.78
Xinjiang	2.88	3.47	5.25	3.84	0.75	0.95	2.23	1.44

Data source: 2000、2010 Census, and 2005 and 2015 Mini-Census.