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RESEARCH PAPER

Only-child matching penalty in the marriage market

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Abstract
This study explores the marriage matching of only-child individuals and the related outcomes. Specifically, we analyze two aspects: First, we investigate the marriage patterns of only children, examining whether people choose mates in a positive or negative assortative manner regarding only-child status. We find that, along with being more likely to remain single, only children are more likely to marry another only child. Second, we measure the matching premium or penalty as the difference in partners' socioeconomic status between only-child and non-only-child individuals, where socioeconomic status is approximated by years of schooling. Our estimates indicate that among women who marry an only-child husband, only children are penalized, as their partners' educational attainment is 0.63 years lower. Finally, we discuss the potential sources of this penalty in light of our empirical findings.

Keywords: marriage matching; only children; gender; machine learning

JEL Classification: J11; J12; J16

1. Introduction

Globally, there has been an increase in only child families in many developed countries. For example, in the Americas and Asia, the percentage of one-child families among those with children has nearly doubled in recent decades.[1] According to Eurostat (2022), the percentage of single-child families in European countries in 2021 was almost half (49%), whereas The Office for National Statistics (2020) found this to be 43.7% in the UK in 2019. Such social trends are affected by many modern issues, such as economic concerns, becoming a parent at an older age, infertility status, marital lives, and careers with high pressure, growing childcare expenses, and the simple desire to have only one

[1]For instance, the percentage of such families in the US increased from 11% in 1976 to 21% in 2016; in Canada it increased from 12% in 1981 to 26% in 2019; and in Japan it increased from 10% in 2002 to 18.6% in 2015. In Singapore, 19.0% of married women had one child in 2010, while 24% did so in 2020.

child. China's one-child policy has also contributed to only child families worldwide. There is, however, little understanding of only children's marriage outcomes.

Whether one can marry and to whom is hardly a matter of concern solely for only children; it also significantly impacts intergenerational relations. One of the major incentives for people to marry is the benefit derived from a larger family size, such as the provision of public goods, risk-sharing, and the advantages of economies of scale (Browning et al., 2014). Many assume that they will either be single or the two of a couple in most cases. However, if we take a larger view of the family, whether one's marriage partner is an only child significantly impacts the size of each natal family. When an only child is young, parents can devote many resources to their dependent child. However, when parents become old and dependent, they cannot benefit from their family size. Unlike individuals with siblings, only children face the task of caring for their parents alone, typically after their prime marrying age has passed.[2] While the labor market may work and resolve these intergenerational burden gaps among regions or nations, the marriage market may act on such gaps among families. How does the marriage market affect this disparity between only child and non-only child households?

We expand the literature on marriage matching by highlighting sibling structure—particularly only-child status—as a key dimension of partner evaluation. Existing economic studies emphasize the positive assortativity in education and socio-economic status (SES), and its implications for inequality within households (e.g., Mare, 1991; Pencavel, 1998; Fernández and Rogerson, 2001; Greenwood et al., 2014; Eika et al., 2019). Recent advances in multidimensional matching theory (Chiappori et al., 2012; Chiappori et al., 2018) provide a framework to evaluate the match quality based on observable characteristics. However, these studies have largely overlooked the role of innate family structure.

We build on Chiappori et al. (2018)'s framework to examine marriage matching and partner quality through the lens of only-child status. This is particularly relevant in aging societies, such as Japan, where caregiving responsibilities often fall disproportionately on individuals without siblings. In such contexts, sibling composition may function not only as a demographic trait but also as a signal of caregiving burdens and familial expectations. Social science research has begun to explore this dimension, showing that only children face greater difficulty finding partners due to presumed caregiving responsibilities (Yu and Hertog, 2018; Uchikoshi et al., 2023). While such studies highlight sibling structure at the individual level, the market-level implications for partner matching remain unexplored.[3]

The purpose of this paper is twofold. First, we assess assortativity in marriage matching with respect to only-child status by conducting an analysis comprising three components. We first compare the observed marriage patterns with those predicted under a counterfactual scenario of random matching. Next, to examine the robustness of

[2] Indeed, the literature has shown that strong family ties or customs may negatively impact the younger generation's economic activities, especially in industrialized and urbanized economies (Alesina and Giuliano, 2010). In families with only children, where externalities cannot occur, children are less likely to leave their parents (Konrad et al., 2002; Rainer and Siedler, 2009), resulting in fewer labor market opportunities (Rainer and Siedler, 2009).

[3] Only a few studies in economics directly examine how sibling composition relates to marriage outcomes. Angrist et al. (2010) found that individuals with many younger siblings are more likely to marry earlier and have more children, although only children were excluded. Vogl (2013) analyzed sibling-related marriage outcomes in Nepal, showing that younger sisters can accelerate marriage timing and reduce partner quality for older sisters. Appendix A provides a more detailed discussion of earlier studies in economics and the social sciences on sibling structure.

these patterns, we statistically evaluate the impact of only-child status on marital outcomes, particularly the likelihood of remaining single and that of marrying another only child. Finally, we analyze marital surplus based on the framework of Choo and Siow (2006), to provide one possible structural interpretation of the observed patterns. As a second component of the study, we estimate only child marriage matching outcomes following Chiappori et al. (2018), wherein the matching premium/penalty is measured by the difference in the partner's attractiveness. Here, educational attainment serves as a proxy for SES, and we examine how one's only-child status affects the marriage partner's SES.

In the first analysis, we find clear evidence of positive assortative matching with respect to only-child status. Although some mixed couples are observed, this reflects that the conditions for the symmetric case of Chiappori et al. (2018) are not fully satisfied. The analysis shows a greater tendency for only children to remain single and to form marriages with each other. Thus, the marriage market may contribute to reinforcing pre-existing disparities in family size. Moreover, our analysis of marital surplus indicates that surplus decreases along with increases in the number of only children within a couple. Taken together, these findings suggest that, although assortative matching by only-child status is present, it may not necessarily reflect the true preference among only children to marry one another.

Turning to the second analysis, we confirm the presence of a matching penalty associated with being an only child, and find that its magnitude appears to be gender asymmetric and contingent on the partner's only-child status. Specifically, while no significant penalty is observed in the pooled sample, only-child women face a pronounced matching penalty in the form of a reduction of approximately 0.63 years in their partner's years of education when they marry a man who is also an only child. This magnitude substantially exceeds the gender gap in education within our sample, which is 0.34.

To deepen our analysis, we discuss the potential sources of the observed matching penalty based on our empirical findings and insights from the literature. In addition, we conduct three supplemental analyses. First, we explore heterogeneities based on respondents' birth year, age, and educational attainment, finding that although higher education mitigates assortativity, these characteristics do not alter the main findings regarding partner SES. Second, we perform an analysis that does not control for respondents' own educational attainment, a key variable in the analysis of marriage market. The results show that this omission does not change our main findings. Third, we examine alternative sibling structures by measuring the matching penalty for heirs defined under patrilineal and primogeniture systems. While heirs under the patrilineal definition consistently experience smaller penalties than only children, this pattern does not hold under the primogeniture definition. Together, these analyses offer further insight into the robustness and contextual variations in the documented matching patterns.

This study makes several contributions to the literature by investigating only children's marriage matching in Japan. On the one hand, this study explores the role of the marriage market by clarifying the nature of assortativity on sibling composition. If the burden of caring for parents differs between only and non-only children, then the degree of assortativity conveys a significant message in the context of an aging society. For example, suppose that the marriage market is characterized by negative assortative mating (i.e., only and non-only children are more likely to marry each other). In this case, the burden of family caregiving is moving more toward equalization. Conversely, in the case of positive assortative mating, the marriage market is accelerating inequality in this respect. Therefore, our findings may be meaningful for ascertaining whether the

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marriage market is driving equalization in family size. Recent social science studies have shown that sibling composition, such as being an only child or lacking male siblings, affects marriage patterns (Yu and Hertog, 2018; Uchikoshi et al., 2023). This study contributes from an economic perspective by analyzing the market-level outcomes of one-child marriages, where the sibling structure may also reflect the underlying familial values and expectations.

Additionally, to our knowledge, this is the first study to measure marriage quality for only-child individuals. As noted earlier, few studies have examined marriage match quality with respect to only child status or sibling status composition, which are innate characteristics. Yu et al. (2012) and Angrist et al. (2010) examined the effects of sibling composition on marital status and age at first marriage as the marriage outcomes. Despite their insightful findings, these studies have failed to capture the perspective of the marriage market and matching with a partner. Thus, determining whether such an individual chooses their marital status or is forced to stay single remains challenging. Vogl (2013) examined women's arranged marriages in Nepal and the impact of certain sibling's presence on marriage outcomes and partner quality. Our study complements the literature by shedding light on only child marriages in developed countries with low fertility and aging populations from marriage market candidates' perspective. Furthermore, the only-child marriage patterns we uncovered reflect both sibling composition and education level, constituting a successful new application of a two-dimensional partner evaluation model (e.g., Chiappori et al., 2012; Chiappori et al., 2018)

Exploring the marriage matching of only children in Japan represents more than an exercise of academic curiosity. Many developed countries are experiencing population aging, with declining birth rates accompanied by an increasing number of only children. These phenomena have become a social problem owing to the burden of caring for older adults, with their longer life spans and extended caregiving periods, falls on their fewer children. Rainer and Siedler (2012) also suggested that the burden on the only child depends on the strength of social security and social expectations for informal family care. Japan is one of the countries with the most severely aging population and has an established social security system. At the same time, however, the duty of caring for older parents remains relatively strong in Japan and traditionally has been regarded as a family responsibility. Therefore, Japan is an interesting arena in which to explore how only children's relatively strong bonds with their parents may be linked to marriage matching outcomes and to shed light on the interdependence of parent-child relationships and marriage. Moreover, only children in the Japanese marriage market are also an appealing research population from the perspective of external validity as only children and children with siblings coexist in the same cohort, allowing cleaner observation of marriage market behavior.[4]

The remainder of this article is organized as follows. First, Section 2 explains the study background. Then, Section 3 describes the data. Section 4 elaborates on marriage patterns based on only child status, while Section 5 measures the marriage-matching premium/penalty. Section 6 discusses interpretations of the empirical results. In Section 7, we outline the supplementary analyses, while Section 8 presents the conclusions of the study.

[4]While China's one-child policy presents an intriguing natural experiment, its uniform application complicates the interpretation of assortative matching patterns within standard theoretical frameworks. Specifically, incentives under the policy in China, such as permitting a second child only when both spouses are only children, may distort marriage choices (Lu, 2023). See Wen (2023) as well.

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2. Background

This section provides background on the distinctive character of the Japanese family and the only child.

2.1 Families in Japan

Confucianism has strongly affected the family system in Asian countries, where repaying parents is considered a virtue; the philosophical rationale for strong family ties is traced to Catholicism in Europe (Koyano, 1996; Esping-Andersen, 1997; Tsutsui et al., 2014), resulting in a relatively large reliance on families rather than on society. In Japan, filial piety remains relatively strong, with caring for older parents traditionally being a family affair. According to Ministry of Health, Labour and Welfare (2020), in 2019, 28.2% of the primary caregivers for older adults requiring long-term care (LTC) were coresident couples of the younger generation (the older adults' children and their partners). This figure is more than double the 12.1% of the care was provided by paid caregivers. Thus, the burden of care on the younger generation is still not being shouldered by the market.

Until the end of the WWII, Japan's inheritance system was patrilineal, with the eldest son inheriting the family head's entire estate. In 1947, the law was amended to allow family members other than the heir (typically, the eldest son) to inherit equally. However, for families that have existed for a long time or in farm families, a culture of inheritance by the family head (i.e., eldest son) still exists, along with heavier obligations attached to this role.

Moreover, the burden of care tends to be on a specific child and their spouse, who may live with that child's parents. If the child living with the parents is the eldest son and heir, his wife tends to make her marriage decision with the understanding that she may eventually care for the parents-in-law (Ogawa and Ermisch, 1996).[5]

However, it should be mentioned that the masculine norm is slowly fading and that the tendency to care for one's own parents has increased. Thus, while patrilineal co-residence remains more common (and although the practice of co-residence with parents is still stronger in Japan than in many advanced countries, co-residence itself has been declining over time), the gap between living with the husband's parents and with the wife's parents has been narrowing (National Institute of Population and Social Security Research, 2020).[6]

2.2 Only children in Japan

A survey that has been conducted since 1940 shows that the percentage of only child families has gradually increased since the 1990s (Cabinet Office, 2021), indicating an increase from 10% in 2002 to 18.6% in 2015. Meanwhile, the percentage of families with

[5]Ogawa and Ermisch (1996) show that in Japan's traditional family structure, the eldest son is strongly expected to support and care for his parents, which is a major motive for multigenerational co-residence. In practice, most multigenerational households with couples of childbearing age live with the husband's parents, and a majority of respondents cite "obligation as the eldest son" as the reason for co-residence. The study further provides evidence that caregiving responsibilities fall primarily on the eldest son's wife, thereby reducing women's wages and the probability of full-time employment.

[6]According to National Institute of Population and Social Security Research (2020), the share of households in which the wife (under age 70) lived with her parents increased from 6.5% in 1998 to 9.5% in 2018, whereas the share living with the husband's parents fell from 22.2% to 23.7%.

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two children has remained stable at around 50% for almost 40 years. The rise in only child families can also be attributed to the decline in households with three or more children since the early 2000s.

In Japan's male-dominated society, relatively strong family norms persist, and the burden tends to be concentrated on the offspring, especially a specific child. Here, being a male or female only child is a unique characteristic in postmarital life (Yu and Hertog, 2018; Uchikoshi et al., 2023). When an only child reaches adulthood, they automatically become the parents' heir. If the only child is a male, they automatically become the eldest son. If the only child is female, no eldest son exists to serve as the typical successor, while no other siblings exist to share the burden within the natal family. Consequently, the natal families of only child women have to give up not only intergenerational relations but also their surnames and family lines at the time of their marriage, all of which have been preserved over generations.[7] Encouragingly, the trend toward masculine domination is weakening (as discussed earlier). With this shift, only children, regardless of gender, are increasingly expected to bear the responsibility of caring for their own parents, particularly among younger generations.

Notably, an only child has the advantage that they can enjoy transfers from their parents throughout their lives. A prime example of postmarital income transfers are bequests from their parents.[8] Combined with the discussion on investment in education, which is examined later, only children seem not merely to be at a disadvantage but also to benefit from intergenerational relations.

Finally, despite the prevalent preference for sons in Asia, the male-to-female ratio among only children is nearly equal, as will be demonstrated with data in Section 3.[9] Thus, in Japan, the preference for sons may not be as pronounced as in other Asian countries where the sex ratio at birth is more distorted. Furthermore, families that exhibit a strong son preference often place significant value on upholding traditional family structures. These families are more inclined to pursue having multiple children to ensure the continuation of family leadership or adhering to the customary norm of having two children. Consequently, one-child families are more likely to reflect family planning based on the desired number of children rather than only on gender preference.

[7]In the past, when a woman had no brothers, it was common to adopt a son-in-law in order to maintain the family line. Wakabayashi and Horioka (2009) show that family patterns were generally consistent with the dynasty hypothesis, highlighting the strong linkage between parents and their successors. Specifically, self-employed parents were more likely to co-reside with their children, couples who adopted the wife's surname were less likely to live with the husband's parents, and even when the eldest child was female, families tended to co-reside with the eldest son. These findings underscore the enduring cultural centrality of the eldest son.

[8]According to The Yu-cho Foundation (2023), around 60% of respondents plan to divide their estates equally among their children, while about 10% would leave their entire estate to their only child. This suggests that only children may receive larger inheritances. The Dai-ichi Life Research Institute (2007), based on 715 samples, reported an average inheritance of 21.86 million yen, with 14.05 million yen for the eldest child and 13.03 million yen for younger siblings.

[9]Typically, the natural sex ratio at birth ranges from 103 to 107 boys for every 100 girls. However, this ratio tends to approach 50:50 as the children grow older. In Japan, for the generation under scrutiny, the sex ratio at birth has consistently hovered around 105, with the highest being 107.6 in 1966 (National Institute of Population and Social Security Research, 2021).

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3. Data and summary statistics

3.1 The national survey on migration

The National Survey on Migration is a nationally representative survey from Japan, encompassing data on sibling configuration, birthplace prefecture, year of birth, and marital status of each family member. The data are collected by the National Institute of Population and Social Security Research through a random sampling method.[10] The surveyors distribute and collect the questionnaires for each household. This study uses the latest available waves from 1991, 1996, 2001, 2006, and 2011.[11] The collection rates for each wave are 89.4%, 95.8%, 85.5%, 74.0%, and 74.7%, respectively. In this study, we use the following information for the analyses.

Only child dummy: The survey asks for the number of surviving older brothers, older sisters, younger brothers, and younger sisters. When none of these are present, the only child dummy equals one for these individuals. All others are assigned a value of 0.
Age at the time of the survey: To account for changing trends over five-year intervals, we control for the age of respondents at the time of the survey, along with information on the year of birth.
Years of schooling: The number of years of schooling for the individual is calculated from the highest school graduated category.
Birth year: The respondent's year of birth is used.
Regional block: The survey asks for the prefecture where the respondent was born. In the analyses, the 47 prefectures are classified into ten blocks and used to account for regional characteristics.[12]

[10]The National Institute of Population and Social Security Research periodically assesses the accuracy of its valid individual data at both the regional block and population levels across five-year age groups, with those aged 85 years and older comprising one group (The National Institute of Population and Social Security Research 1993, 1998, 2005, 2009, 2013). To validate these data, comparisons are made with the corresponding population estimates from the Ministry of Internal Affairs and Communications' Statistics Bureau. Such comparisons were conducted during the 3rd survey in 1991, 5th survey in 2001, 6th survey in 2006, and 7th survey in 2011. However, the 4th survey in 1996 was compared with census data from 1995. It is important to note that the 7th survey in 2011 excluded the three Tohoku prefectures significantly affected by the Great East Japan Earthquake. Therefore, comparisons were not made with these affected prefectures. Across these five surveys, the largest discrepancy at the regional level was observed in the Tokyo area, which showed a difference of −3.3 points out of the 10 blocks surveyed in the seventh survey conducted in 2011. Additionally, the largest difference in age distribution was −1.0 points, which was found for the 20-24 age group in the fourth survey conducted in 1996.

[11]The sample size for the 1991 wave is relatively small. This is mainly due to the missing values for the place of origin. In addition, the 1991 wave uses slightly different questionnaires although it does contain our necessary variables, whereas the other waves have been changed to be more uniform.

[12]Specifically, Hokkaido for the "Hokkaido" block; Aomori, Iwate, Miyagi, Akita, Yamagata, and Fukushima for the "Tohoku" block; Saitama, Chiba, Tokyo, and Kanagawa for the "Minamikanto" block; Ibaraki, Tochigi, Gunma, Yamanashi, and Nagano for the "Kitakanto and Koshin" block; Niigata, Toyama, Ishikawa, and Fukui for the "Hokuriku" block; Gifu, Shizuoka Aichi, and Mie for the "Tokai" block; Shiga, Kyoto, Osaka, Hyogo, Nara, and Wakayama for the "Kinki" block; Tottori, Shimane, Okayama, Hiroshima and Yamaguchi for the "Chugoku" block; Tokushima, Kagawa, Ehime, and Kochi for the "Shikoku" block; and Fukuoka, Saga, Nagasaki, Kumamoto, Oita, Miyazaki, Kagoshima, and Okinawa for the "Kyushu and Okinawa" block.

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3.2 Sample selection

Before examining the data, we highlight the key points regarding our samples. As explained later, this research explores marriage patterns of only children along with surplus analysis following the Choo and Siow (2006)'s framework. Then, we examine spousal SES matching based on the approach of Chiappori et al. (2018).

For the analyses of marriage patterns, we use information on the number of both single and married individuals. Ideally, the entire sample would be used for this analysis. However, due to data limitations discussed later, certain samples are excluded. Specifically, in the analyses of marriage patterns, while all single individuals from the survey are included, the sample of married individuals is restricted to household heads and their spouses. That is, married individuals who are not household heads or their spouses are excluded.

The issue with the dataset is that, while information on household members is available, detailed information about their spouses is not consistently provided. This information, such as the sibling composition, is only available for household heads and their spouses. Therefore, cases not involving household heads or their spouses must be excluded.[13]

Next, for the analysis of spousal matching characteristics, following Chiappori et al. (2018), we use data from household heads and their spouses for whom all relevant information was available. Consequently, singles and married individuals who are not household heads or their spouses are excluded from this analysis (the former exclusion is due to the definition of the analysis).

Formally, the sample is restricted to individuals aged between 23 and 65 in the survey year, for whom complete educational background information is available. The upper age limit is set due to the definition of the sibling structure variable. The number of siblings in the questionnaire is limited to those who are still alive. This restriction helps exclude older respondents who may have lost a sibling after entering the marriage market. Furthermore, the sample is limited to individuals for whom information on sibling composition, year of birth, and home prefecture is available.

Given these restrictions, unmarried individuals are limited to those who have never been married. The sample of married couples is restricted to those for whom information on both spouses is available; specifically, it includes couples where the respondent is either the household head or the spouse of the household head, and who are currently married. Individuals who are divorced, widowed, or separated are excluded. In addition, the sample is limited to couples in which both the respondent and their spouse reside in the same household. To ensure this, the sample is further restricted to households with at least two members. As a result of these sample restrictions, the number of observations decreased from 66,468 to 55,752.

3.3 Summary statistics

Table 1 presents the descriptive statistics for each respondent's gender and only-child status. For continuous variables, the figures indicate the median within each subsample, while percentages or the 25th and 75th percentiles within the subsample are provided in

[13]The number of excluded cases is 4,144, which accounts for less than 10% of the total, and therefore, is considered a relatively modest proportion. Moreover, since we observe no clear difference in the probability of not being a household head or their spouse between only and non-only children, the main analysis is conducted using information from household heads and their spouses.

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Table 1. Summary statistics

Characteristic	Men		Women	
	Non-only child $N = 26{,}945$[1]	Only child $N = 2032$[1]	Non-only child $N = 24{,}854$[1]	Only child $N = 1921$[1]
MarriageStatus				
Married	18,777 (70%)	1242 (61%)	18,700 (75%)	1319 (69%)
Single	8168 (30%)	790 (39%)	6154 (25%)	602 (31%)
Age	43 (33, 54)	41 (32, 52)	42 (32, 52)	41 (32, 51)
EducationYear				
0	15 (<0.1%)	2 (<0.1%)	18 (<0.1%)	0 (0%)
6	41 (0.2%)	2 (<0.1%)	23 (<0.1%)	1 (<0.1%)
9	3277 (12%)	214 (11%)	2386 (9.6%)	132 (6.9%)
12	10,539 (39%)	705 (35%)	10,578 (43%)	744 (39%)
14	3658 (14%)	332 (16%)	8264 (33%)	667 (35%)
16	9415 (35%)	777 (38%)	3585 (14%)	377 (20%)
BirthYear	1958 (1948, 1969)	1961 (1950, 1970)	1960 (1949, 1970)	1963 (1952, 1971)
RegionalBlock				
Chugoku	1682 (6.2%)	129 (6.3%)	1507 (6.1%)	130 (6.8%)
Hokkaido	1381 (5.1%)	119 (5.9%)	1239 (5.0%)	109 (5.7%)
Hokuriku	1444 (5.4%)	121 (6.0%)	1332 (5.4%)	83 (4.3%)
Kinki	3920 (15%)	346 (17%)	3,606 (15%)	318 (17%)
Kyusyu & Okinawa	3,985 (15%)	236 (12%)	3,708 (15%)	242 (13%)
Nouth Kanto & Koushin	2,456 (9.1%)	143 (7.0%)	2,219 (8.9%)	144 (7.5%)
Shikoku	1080 (4.0%)	65 (3.2%)	1000 (4.0%)	69 (3.6%)
South Kanto	5643 (21%)	551 (27%)	5347 (22%)	481 (25%)
Tohoku	2342 (8.7%)	120 (5.9%)	2151 (8.7%)	128 (6.7%)
Tokai	3012 (11%)	202 (9.9%)	2745 (11%)	217 (11%)
[1]n(%); Median (Q1, Q3)				

Notes: Continuous variables are reported as medians with 25th and 75th percentiles in parentheses. Categorical variables are reported as counts with within-group percentages. See Section 3 for details on data and sample construction.

parentheses. For categorical variables, the figures represent the number of samples and the percentage within each group. The following key points can be observed from these data.

First, the sample size of only children is necessarily small. Note that, as discussed in Section 2, no gender difference is observed for this variable, with the percentage of only children being about 7% each for men (= 2032/(26,945+2032)) and women (= 1921/(24,854+1921)). Second, only children's marital status is more likely to be single than

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that of non-only children at the descriptive level. Third, the average birth year of only children is later than that of non-only children. This may reflect the increasing prevalence of only-child families over time.

Finally, the key variable of interest, educational background, exhibits a noticeable difference based on only-child status. Specifically, only children tend to have slightly higher education levels. Regarding the years of education by gender, men generally have a higher level of education. Specifically, a large proportion of men in the 12-year high school graduate category as well as in the highest 16-year category. Conversely, women are concentrated in the high school diploma group and the second-highest educational level (14 years of schooling). This suggests that the polarization of educational attainment is more pronounced among men.

4. Marriage patterns for only-child status

This section explores marriage patterns based on three analyses. The first analysis descriptively examines whether the observed marriage patterns related to only-child status exhibit positive or negative assortative matching by comparing them with those generated through random matching. The second analysis formally tests these findings while also investigating the impact on the probability of remaining unmarried. Finally, we conduct supplementary analyses to gain a structural understanding of marriage patterns. Two key discussions emerge from these analyses.

The first key point is to understand the role of the marriage market by examining marriage patterns related to only-child status. Marriage patterns can exhibit positive or negative assortative mating (Becker, 1991), and different tendencies may be expected when viewed through the lens of only-child status.

The former occurs when individuals select partners who share characteristics. If caregiving responsibilities and economic incentives influence marriage decisions, non-only children, who generally face fewer caregiving burdens, may exit the marriage market first. Meanwhile, only children may be more likely to marry other only children.[14] Conversely, the latter arises when individuals avoid marrying those similar to them. A possible cause of this pattern could be the benefit of trade between providing domestic public goods. For example, an only child with high caregiving responsibilities may avoid marrying another only child. They may instead prefer a non-only child with lower caregiving burdens.

While financial resources and dynastic incentives may promote marriages between only and non-only children, preferences in marriage may also be influenced by family norms and the intergenerational transmission of values. Recent studies have raised theoretical questions regarding individuals from families with strong norms of filial piety: Do they tend to choose partners who share similar values or do they instead prioritize their own family by selecting partners with weaker norms (Cigno et al., 2017, 2021).[15] Such intergenerational normative factors may explain the observed assortativity

[14]If inheritance benefits outweigh caregiving burdens, only children may exit the market first, followed by non-only children. Shared family size preferences may also drive similar sibling structures in marriage.

[15]Recent studies have raised theoretical questions about the marriage partner of individuals from families with strong norms of filial obligation. Unlike other transmitted value factors such as ethnicity, religion, attitudes toward working women, or economic preferences (Bisin and Verdier (2000); Bisin et al. (2004); Fernández et al. (2004);Wu and Zhang (2021)), the transmission of strong family norms regarding filial piety can potentially create conflicts within families. According to Cigno et al. (2017) and Cigno et al. (2021),

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based on sibling structure, not because sibling composition is a familial value in itself, but because it can shape expectations about the family roles, particularly caregiving responsibilities.

If the analyses reveal that positive assortative mating holds, then, combined with the descriptive statistics showing that only children are more likely to remain unmarried, this suggests that the marriage market may function in a way that exacerbates disparities in the caregiving burden among the working-age population.

The second key point concerns examining marriage patterns in light of the framework of Chiappori et al. (2018). Their model predicts perfect positive assortative matching, meaning that men and women are exactly matched on multiple characteristics such as education and smoking habits. This prediction holds only under the symmetric case, which requires that the characteristics of men and women are similarly distributed and that these characteristics affect marital surplus in the same way for both genders. While our data indicate that the proportion of only children is the same for men and women, other conditions (e.g., the distribution of education) are not satisfied. The following analysis, therefore, evaluates how the observed marriage patterns deviate from this benchmark prediction.

4.1. Comparison with random matching

To capture the overall trend in marriage patterns among only children, we first compare the observed marriage patterns based on only-child status with those generated via random matching. For this purpose, we construct a counterfactual sample of randomly matched couples, following the permutation procedure employed by Chiappori et al. (2018). We assign pseudo-random IDs drawn from a uniform distribution to men and women, rank them accordingly, and match them based on these ranks.

Table 2 presents the observed and randomly generated patterns. Only children are more likely to marry other only children. Although the percentage difference in marriages between only children may seem small at first glance, it becomes striking when viewed from the only child's perspective. For example, in the random matching scenario, the share of marriages between only children is 7.3% among men (96/1319) and 7.7% among women (96/1242). Meanwhile, in the observed data, it rises to 14.5% for men (191/1319) and 15.4% for women (191/1242). Formally, the chi-squared test strongly rejects the null hypothesis that only-child status and matching patterns are independent ($\chi^2(1) = 166.2$, $p < 0.001$).

Despite the tendency of positive assortative matching, mixed marriages between only and non-only children also occur. As discussed above, according to Chiappori et al. (2018), perfect assortative matching would arise under a symmetric case wherein male and female characteristics play the same role in the surplus function, and the distributions of these characteristics are the same across genders (Proposition 1, p.169). This requires: (i) the distribution of only-child status is the same across genders; (ii) the distribution of SES is the same across genders; (iii) only-child status plays a symmetric

individuals from families with strong filial piety norms may choose to marry partners who also uphold these norms to preserve them. However, they may also prioritize their own family by marrying partners with weaker norms. If we consider only children as the group with the strongest parental care norms, assessing assortativity can help us provide some insights into this question. Although we do not directly uncover the underlying mechanism behind these results, our findings on partner choices can shed some light through the observable outcomes in the younger generations' adult pairings.

Table 2. Observed versus randomly matched marriage patterns

Characteristic	Husband: Non-only child $N = 18{,}777$[1]	Husband: Only child $N = 1242$[1]
Only child status with randomization		
Wife: Non-only child	17,554 (88%)	1146 (5.7%)
Wife: Only child	1223 (6.1%)	96 (0.5%)
Only child status in observed marriages		
Wife: Non-only child	17,649 (88%)	1051 (5.3%)
Wife: Only child	1128 (5.6%)	191 (1.0%)
[1]n(%)		

Notes: This table compares the observed marriage patterns with those generated under random matching. The columns indicate whether the husband is an only child, and the rows indicate the same for the wife. Each cell reports the number of couples for each combination, with the proportion relative to the total number of couples shown in parentheses. Random couples are generated by applying a random permutation to the observed married individuals, following the procedure of Chiappori et al. (2018). Men and women are each assigned IDs drawn from a uniform distribution, ranked accordingly, and then matched based on these ranks.

role in the marital surplus function; (iv) SES plays a symmetric role as well. At the observable level, Table 1 in Section 3.3 shows that the proportion of only children is nearly identical for men and women, suggesting symmetry in this dimension. Conversely, men tend to have higher educational attainment and greater variance in schooling. Thus, the distribution of education, which we use as an SES proxy, already violates one of the conditions for the symmetric case, which may hinder perfect assortative matching from fully holding.

4.2 Formal analysis of marriage patterns

This subsection statistically verifies the two trends previously observed in the marriage patterns of only children. Specifically, we examine the likelihood of each marriage pattern. Specifically, the estimand is the average values of the following:

$$E\left[Type^{partner}\middle|OnlyChild = 1, X\right] - E\left[Type^{partner}\middle|OnlyChild = 0, X\right] \tag{1}$$

This equation shows the expected difference in the likelihood of marriage outcomes between only and non-only children, where $Type^{partner} \in \{onlychild, non\text{-}onlychild, single\}$ is defined as follows: *onlychild* indicates that the partner is an only child, *non-onlychild* indicates that the partner has siblings, and *single* indicates that the individual remains unmarried. Here, *OnlyChild* on the right-hand side denotes a dummy variable that equals one if the individual is an only child.

Then, we present the estimates of how marital status differs between only and non-only children, controlling for gender, year of birth, age, and birthplace, as shown in Eq.(1).[16]

[16]Some may argue that using one's own education as a control variable can pose challenges to drawing causal inferences, as it is a post-treatment variable. However, our objective is not to measure causal effects but rather to shed light on how the presence or absence of siblings influences family formation among

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In the estimation, we employ the double-debiased machine learning for augmented inverse probability weighting estimator (Robins and Rotnitzky, 1995; Chernozhukov et al., 2018). While ordinary least squares (OLS) provides consistent estimators when the model is correctly specified, it can yield large biases under misspecification. Given the complexity of the confounding factors in the marriage market, strong reliance on linear specifications is risky, which motivates our use of double-debiased machine learning.

Double-debiased machine learning builds on augmented inverse probability weighting and incorporates cross-fitting, which mitigates the risk of overfitting and ensures asymptotic unbiasedness even when flexible machine learning methods are used. Nevertheless, double-debiased machine learning is not without limitations. It can suffer from large variance when the estimated propensity scores are close to zero or one, although this issue is not severe in our application (the minimum estimated propensity score is 0.038). Moreover, the protection against overfitting is only asymptotic; with small samples, this risk may not be fully alleviated. However, because our dataset is sufficiently large, these concerns are unlikely to affect our results. As shown in Table 1, our analysis is based on $N = 55,752$ individuals.[17]

Finally, the specific method can be summarized as follows: In the first stage, we estimate the nuisance functions that model the relationship between the partner's type and individual's own only-child status, conditional on the control variables. To flexibly capture conditional means without relying on parametric assumptions, we implement a stacking algorithm that combines OLS, random forests, and Bayesian additive regression trees. In the second stage, these estimates are incorporated into the augmented inverse probability weighting procedure to obtain the final estimator. Formally, the nuisance functions are expressed as $\Pr[Type^{partner}|OnlyChild, X]$ and $\Pr[OnlyChild|X]$. X denotes the control variables including years of one's own schooling, birth year, age, and region of birth. Note that we use robust standard error clustering at the household-level. We estimate this equation for each male and female sample. Technically, the estimator captures the percentage-point difference in the share of individuals in each marital status, defined by $Type^{partner}$, between only children and non-only children. Intuitively, it shows how being an only child relates to the likelihood of each marriage state.

Figure 1 shows the estimated associations for *OnlyChild* conditional on the type of marriage partner (as well as single status), which are sorted by own gender. The left panels show the results for singles, while the right panels show the results for marriage with only children. Note that we only present the results for the two statuses, as the values for the remaining group of those marrying non-only children are automatically calculated using these two results.

Comparing the estimated associations across the panels, we obtain four main insights: First, considering the panel as a whole, we observe similar trends in each panel regardless of gender. Second, the panel of singles reveals that only children are more likely to remain single than non-only children. The estimated differences are 0.07 for men and 0.05 for women. Although the point estimates are somewhat larger for men, the

adults. Therefore, this study incorporates one's own education as a control variable, following the empirical framework of Chiappori et al. (2018). Furthermore, even if education is not controlled for, it does not significantly alter the main findings based on our specification (see Section 7.2 and Appendix C).

[17]In the couple-level analysis, the unit of observation is the household, yielding $N = 20,019$ married couples. This is a sufficiently large sample for our estimation strategy.

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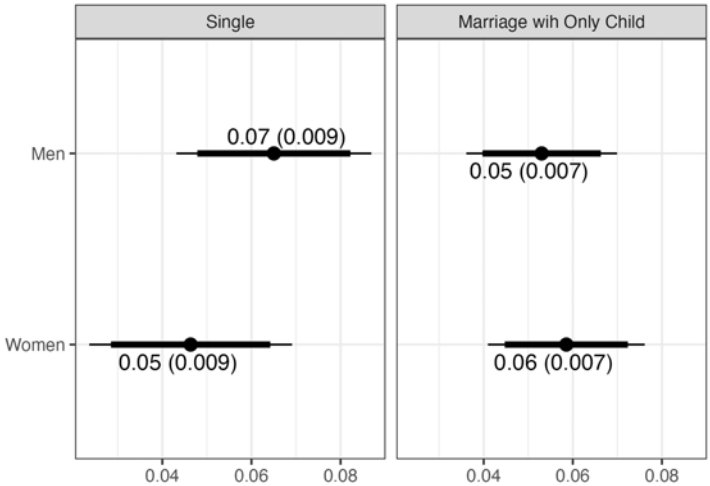

Figure 1. Estimated associations between only-child status and partner type.
Notes: This figure shows the different marital statuses according to only child status, namely, single (left graph) and married to an only child (right graph), estimated by Eq.(1), along with the 95% confidence intervals; thin lines show Bonferroni-corrected confidence intervals. All nuisance functions are estimated using the stacking method (Wolpert, 1992; Breiman, 1996), which consists of OLS (including squared terms of age, birth year, and years of schooling), random forests (Breiman, 2001), and Bayesian additive regression trees (Chipman et al., 2006; Chipman et al., 2010). Standard errors clustered at the household level are in parentheses. We compare groups of only children and non-only children, and the estimates represent the differences in the likelihood of being in each status. Specifically, they indicate the likelihood of being single for only children minus that for non-only children, and the likelihood of marrying another only child for only children minus that for non-only children, respectively.

gender difference is not statistically significant.[18] Third, only children are more likely to marry only-child partners. The related values are 0.05 for men and 0.06 for women. Finally, inextricably associated with the above results, the only-child status reduces the likelihood of marrying a non-only-child partner by 0.12 for men and 0.11 for women.

These results highlight two important points. First, people choose mates in a positive assortative manner regarding only-child status.[19] Second, only children are less likely to get married. These results indicate that family size tends to increase with marriage for non-only children. Consequently, family-size disparities are heightened by dynamics within the marriage market.

4.3 Systematic returns to marriage

Here, we estimate marriage returns, thus offering a structural perspective on the trends observed in the previous subsections. We first estimate the household-level marriage gain. According to Choo and Siow (2006), the total systematic gain to marriage for a type i male

[18]The difference between men and women is not statistically significant ($p = 0.140$ for single status and $p = 0.571$ for only-child status).

[19]Although we here limit ourselves to likelihood comparisons to intuitively understand the state of the marriage market, we conduct a formal analysis to measure assortativity on only-child status in Appendix B, following Chiappori et al. (2025). Using multiple other indices, we further confirm positive assortative mating on only-child status.

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Table 3. Systematic returns to marriage

Men	Women	Joint surplus	Male surplus	Female surplus
Only child	Only child	−2.57	−1.42	−1.15
Non-only child	Non-only child	1.82	0.77	1.05
Only child	Non-only child	−1.48	0.285	−1.77
Non-only child	Only child	−1.35	−1.98	0.628

Notes: This table reports the estimated household-level and individual-level returns to marriage by spouse-type combination, based on each partner's only-child status. Marriage types are labeled according to the only-child status of the male and female spouse, respectively. For example, a union between a non-only child male and an only child female is labeled as "Non-only child – Only child marriage." Each row corresponds to a specific marriage pattern. The three columns report: the total return to marriage in Eq.(2); the male individual return in Eq.(3); and the female individual return in Eq.(4).

and type j female can be identified by estimating the logarithm of the following variable:

$$\Pi_{i*j} = \frac{\mu_{ij}}{\sqrt{\mu_{i0} \times \mu_{0j}}} \tag{2}$$

where μ_i represents the number of marriages between type i males and type j females, whereas μ_{i0} and μ_{0j} denote the number of single males and females of each respective type. The larger this value, the greater the relative return on marriage for types i and j compared to remaining single. As noted in Choo and Siow (2006), the calculation normalizes by the number of singles, eliminating scale effects.

Additionally, individual-level systematic return can be computed. The return from marriage for a type i male to a type j female is given by:

$$n_{ij} = \ln\left(\frac{\mu_{ij}}{\mu_{i0}}\right) \tag{3}$$

Similarly, the systematic return from marriage for a type j female to a type i male is:

$$N_{ij} = \ln\left(\frac{\mu_{ij}}{\mu_{0j}}\right) \tag{4}$$

which can be identified through this estimation.

Table 3 shows the estimated household- and individual-level returns to marriage by type ij, specifically focusing on the combinations of the spouses' only-child statuses. Table 3 categorizes marriage patterns by only-child status, naming combinations in the order of male and female. Each row corresponds to a specific marriage pattern. For instance, a marriage between a non-only child male and an only child female is labeled as "Non-only child – Only child marriage." The three columns report the total return to marriage in Eq.(2), male's individual return in Eq.(3), and female's individual return in Eq.(4).

The highest total return is observed for marriages between non-only children, followed by mixed marriages where the female is an only child, then mixed marriages where the male is an only child. The lowest return is observed in marriages between two only children. This suggests that marriages involving only children tend to have lower returns. Furthermore, a comparison between mixed marriages where the husband is an only child and those where the wife is an only child reveals that the surplus size is generally similar. Thus, the presence of an only child has limited gender-based impact

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on the total household surplus. At the individual level, two main findings emerge: On the one hand, in homogeneous marriages concerning only-child status, females generally have higher returns. On the other hand, in mixed marriages, the only-child partner consistently attains higher individual returns than the non-only-child partner, regardless of gender. In addition, the gender difference in the surplus loss from marrying an only child appears small, with no clear pattern emerging.

5. Only-child matching premium/penalty in the marriage market

In this section, we examine whether an individual's only-child status is related to the quality of the marriage match. Ideally, we would like to measure the only child matching premium/penalty defined on a utility basis. However, this is not possible because it is unobservable. Thus, we alternatively use the partner's SES as its approximation. Human capital, as a key component of SES, is likely a monotonic form of attractiveness and linking it with the arguments on household inequality is practical (Mare, 1991; Pencavel, 1998; Fernández and Rogerson, 2001; Breen and Salazar, 2011; Greenwood et al., 2014; Greenwood et al., 2016; Eika et al., 2019). Following this view and Chiappori et al. (2018) who treat educational background as a proxy for SES in the marriage market, we estimate the matching premium/penalty regarding partner SES, as formally described in the empirical analysis subsection.

5.1 Estimand

This subsection presents the estimands that are estimated in the following sections. Let $SES^{partner}$ denote the partner's SES. The estimand here is the average values of the following expression:

$$E\left[SES^{\,partner} \;\middle|\; OnlyChild = 1, X\right] - E\left[SES^{\,partner} \;\middle|\; OnlyChild = 0, X\right]. \tag{5}$$

Eq.(5) shows that only children's partners are likely to be more or less educated than non-only children's partners. Note that if we assume $E[SES^{partner}|OnlyChild, X] = \beta_0 + \beta_1 OnlyChild + \beta\mathbf{X}$, we can use the same approach as in Chiappori et al. (2018). However, the following section proposes a more flexible estimation strategy rather than relying on such a linear specification.

In the following analyses, we use SES as a proxy for a partner's attractiveness other than only-child status. As in Chiappori et al. (2018), we assume that, holding other conditions constant, individuals want a marriage partner with a higher SES. Thus, when Eq.(5) takes negative values, the married partner's SES is lower for the only child, suggesting the existence of an only child penalty and vice versa.

5.2 Estimation method

We estimate how the partner's SES differs between only and non-only children, controlling for X, as described in Eq.(5) and its estimand. The dependent variable is $SES^{partner}$, which captures attractiveness other than only-child status. Operationally, following Chiappori et al. (2018), we proxy $SES^{partner}$ by the partner's years of schooling. As in the previous analysis, *OnlyChild*, our variable of interest, is a dummy variable that equals one for an only child. X includes own years of schooling, birth year, age, and birth region. Again, we control for the individual's years of schooling to focus on the disparity in adulthood and to consider positive assortativity on education for couples. Note that

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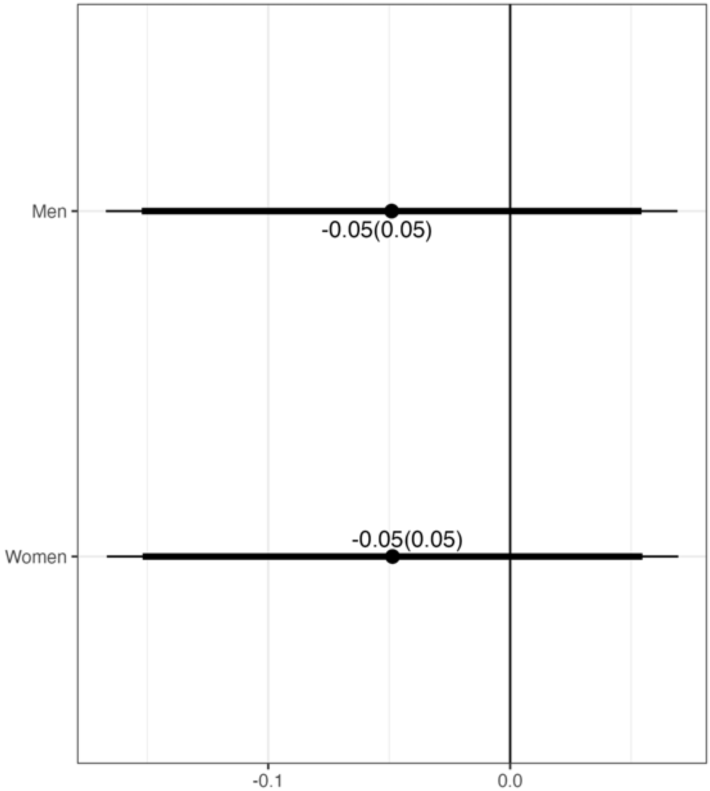

Figure 2. Estimated differences in partners' years of schooling by only-child status (Pooled sample).
Notes: This figure shows the difference in partners' years of schooling according to only child status, estimated by Eq.(5), along with the 95% confidence intervals; thin lines show Bonferroni-corrected confidence intervals. All nuisance functions are estimated using the stacking method (Wolpert, 1992; Breiman, 1996), which consists of OLS (including squared terms of age, birth year, and years of schooling), random forests (Breiman, 2001), and Bayesian additive regression trees (Chipman et al., 2006; Chipman et al., 2010). Standard errors clustered at the household level are in parentheses. We compare groups of only children and non-only children, and the estimates represent the differences in their partners' years of schooling after controlling for other variables. Specifically, they indicate the years of schooling of only children's partners minus those of non-only children's partners.

the same machine-learning procedure is followed as in the previous analysis in Section 4.2.

5.3 Results: partner's years of schooling (Pooled sample analysis)

Figure 2 shows the estimated associations of *OnlyChild* using the total sample by gender. The panel presents the estimated relationship between only-child status and the spouse's years of schooling. Figure 2 does not show a significant only-child-matching premium or penalty in the pooled sample for either men or women.

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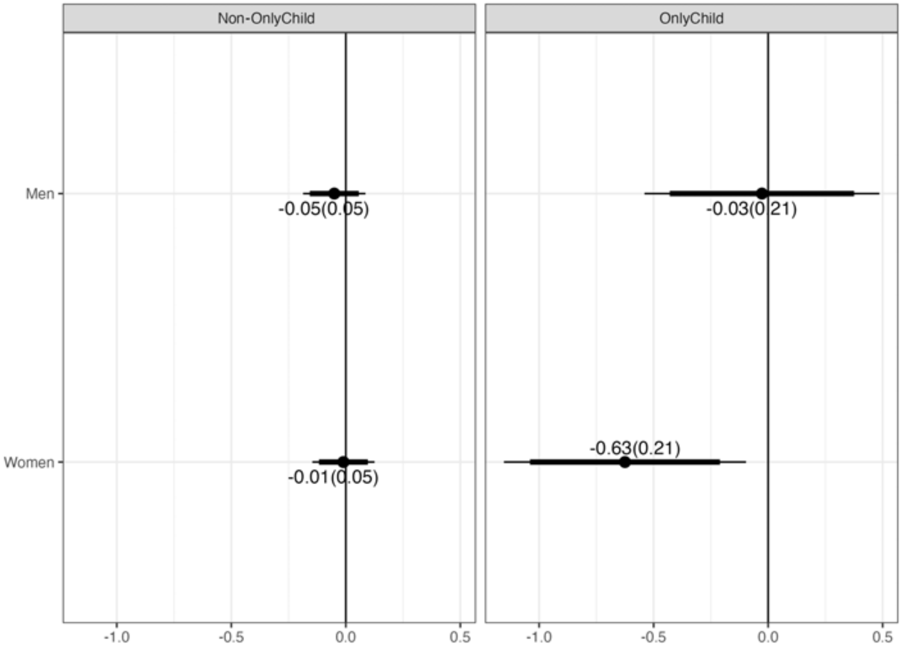

Figure 3. Estimated differences in partners' years of schooling by only-child status (Subsample analysis). *Notes:* This figure shows the difference in partners' years of schooling for subsamples defined by partner type, namely, married to a non-only child (left graph) and married to an only child (right graph), estimated by Eq.(5), along with the 95% confidence intervals; thin lines show Bonferroni-corrected confidence intervals. All nuisance functions are estimated using the stacking method (Wolpert, 1992; Breiman, 1996), which consists of OLS (including squared terms of age, birth year, and years of schooling), random forests (Breiman, 2001), and Bayesian additive regression trees (Chipman et al., 2006; Chipman et al., 2010). Standard errors clustered at the household level are in parentheses. We compare groups of only children and non-only children, and the estimates represent the differences in their partners' years of schooling after controlling for other variables. Specifically, they are calculated as the years of schooling of only children's partners minus those of non-only children's partners.

5.4 Results: partner's years of schooling (Subsample analysis by partner's status)

As we have seen, the difference is small and unclear in the results for the pooled sample. However, considering that the benefits of larger family size may differ, the partner's only child status may matter in determining the premium/penalty. Therefore, we analyze the SES penalty using subsamples characterized by the partner's only child status.

Figure 3 presents the results for this subsample analysis, restricted to the respondent's gender and the marriage partner's only-child status. Similar to the pooled-sample figure (Figure 2), the upper and lower parts of this figure correspond to the male and female samples, respectively. Furthermore, we show the results for the left-hand panels with individuals whose marriage partner is a non-only child, and the right panels for individuals whose partner is an only child.

Figure 3 shows that the results vary considerably by the respondent's gender and the partner's only-child status. In the subsample in which the spouse is a non-only child, the estimated associations for both men and women are close to zero, indicating that an individual's only-child status is not significantly related to their partner's years of schooling in such marriages. However, in the subsample where the partner is an only child, gender-specific patterns emerge: the association for men remains near zero

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(−0.03, not significant at the 5 % level), whereas the association for women is notably negative at −0.63 and statistically significant. The penalty for female only-children married to male only-children (−0.63) is nearly twice the average gender gap observed in the full sample (0.34). Given that a gap of 0.34 years is already substantial, this comparison illustrates the considerable magnitude of the estimated association. A more detailed interpretation of these findings is presented in Section 6.

6. Discussion

In the previous section, we showed that when only-child women marry only-child men, their husbands' educational attainment is 0.63 years lower than that of the husbands of non-only-child women. We now explore possible interpretations of why the outcomes differ depending on the partner's characteristics and whether gender-specific differences exist.

First, we consider why the only-child penalty is observed particularly when the marriage partner is also an only child. One possibility is that only children prefer partners who are also only children, such as due to shared values or experiences, even if this means compromising on SES. However, in Japan, only-child households are less common than in many Western countries. Further, the ideal family structure is often perceived as having two siblings (Raymo, 2022). Thus, "marriages between only children" may not necessarily be considered aspirational.

Another explanation may be that only children, who may face disadvantages in the marriage market, end up marrying each other as a form of mutual compromise. This view is supported by prior research. For instance, Yu and Hertog (2018) found that in online matchmaking in Japan, only children tend to be avoided by others; moreover, even among only children, mutual avoidance may occur.

Turning to our own evidence, although the surplus analysis presented in Section 4.3 cannot be directly compared with the penalty estimations based on the framework of Chiappori et al. (2018), the findings do partly align with this interpretation. Specifically, being an only child reduces the couple's surplus, with couples composed of two only children showing the smallest total surplus, as illustrated in Table 3.

Next, we explain why the penalty appears only for women. Table 3 suggests that the relationship between only-child status and marital surplus does not differ substantially by gender. Meanwhile, Figure 3 shows that the penalty in terms of spouses' educational attainment is observed only for women. Initially, these findings may appear inconsistent: Table 3 suggests limited gender difference in the impact of only-child status on surplus, while Figure 3 highlights a gender-specific penalty. However, several explanations may underlie this apparent inconsistency.

First, gender differences in the distribution of education amplify this asymmetry. Male educational attainment is more dispersed, making penalties for women more salient when measured through their partners' education. Second, education, as a component of SES, has different implications for marital surplus by gender. Research has consistently shown that men's SES is more highly valued in the marriage market than women's (Fisman et al., 2006; Hitsch et al., 2010; Low, 2014; Bertrand et al., 2015). Because education, as a component of SES, carries different weights for men and women in the marriage market, the penalty becomes more salient for female-only children, who are more likely to experience it through the lower educational attainment of their spouses. In the Japanese context, Uchikoshi et al. (2024) further demonstrates that women are more sensitive to a partner's income than men. This reinforces the view that

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men's SES, including education, carries greater weight. Conversely, the distribution of only-child status does not significantly differ between men and women. Thus, distributional differences in only-child status cannot account for the asymmetry.

In summary, the apparent inconsistency between Table 3 and Figure 3 can be reconciled by considering both the distributional properties of education and its role in shaping marital surplus. Therefore, the gender asymmetry observed in Figure 3 is less likely to arise from only-child status per se; rather, it reflects how education functions in the marriage market as a core element of SES.

Finally, Vogl (2013) offers an important comparison. The author studied arranged marriage markets in developing countries in an analysis focusing on specific sibling compositions. The finding revealed that women with sisters tend to marry earlier and their spouses tend to have lower educational attainment, which is a sign of lower search quality or compromise in partner selection.[20] In contrast, while our findings similarly show that their spouses tend to have lower educational attainment, we also find that only children are slightly more likely to remain single. This suggests that the mechanism behind our findings differs from those driven primarily by rushed or early marriage, yielding lower-quality matches.

7. Supplementary analyses

We have thus far observed that only-child individuals incur penalties in terms of lower partner SES. In addition to their heavier burden of caregiving, a widely discussed factor, only children also face a matching penalty, particularly when they marry another only child, potentially exacerbating the inequality. In this section, we deepen our understanding of the marital outcomes of only children from three perspectives: first, by conducting a heterogeneity analysis; second, by estimating a model that does not control for respondents' own educational attainment, a key variable in the marriage market; and third, by examining alternative sibling configurations.

7.1 Heterogeneity in only-child marriage matching outcomes

Here, we examine how only-child marriage matching outcomes vary with heterogeneity. In particular, we focus on two types of heterogeneity. The first is the demographic characteristics such as birth year and age. The meaning of being an only child may change over time, and individuals may change their marriage behaviors depending on their own age. The second is educational background. A higher level of education may increase one's attractiveness and mitigate the penalty associated with being an only child. In addition, if caregiving duties are critical for their attractiveness, one may purchase these services from the market if they can sufficiently afford to do so.

To explore these issues, we analyze the patterns of heterogeneity separately for men and women. Specifically, we estimate a linear approximation model of the conditional mean differences using the double-debiased machine learning framework. Semenova and Chernozhukov (2021) extended the work of Chernozhukov et al. (2018) and proposed a method to estimate such linear approximation models for mean differences. This method reduces misspecification errors while preserving asymptotic unbiasedness

[20]Vogl (2013)'s findings indicated that when a woman has a younger sibling of the same gender (i.e., a sister), the quality of the mate tends to be lower. According to the study, this outcome was attributed to the older sister being hurried into marriage to expedite the younger sister's marriage.

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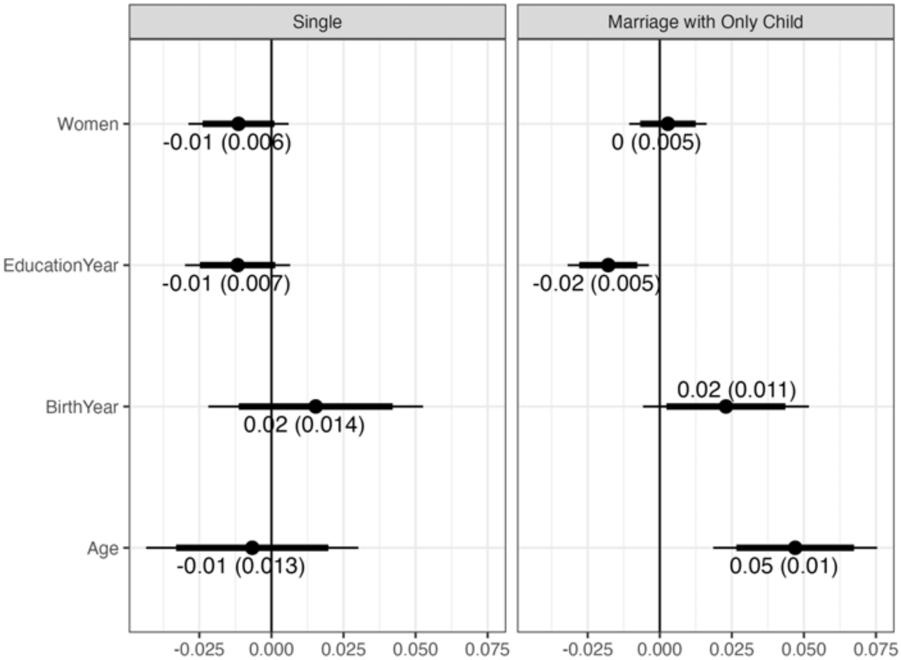

Figure 4. Estimated associations between only-child status and partner type (Heterogeneity analysis).
Notes: This figure shows the best linear projection of the conditional difference in marital outcomes by only-child status, single (left graph) and married to an only child partner (right graph), along with the 95% confidence intervals; thin lines show Bonferroni-corrected confidence intervals. All nuisance functions are estimated using the stacking method (Wolpert, 1992; Breiman, 1996), which consists of OLS (including squared terms of age, birth year, and years of schooling), random forests (Breiman, 2001), and Bayesian additive regression trees (Chipman et al., 2006; Chipman et al., 2010). Standard errors clustered at the household level are in parentheses. We compare groups of only children and non-only children. Each variable is interpreted as follows. The coefficient for women is relative to men (the omitted category). Years of schooling, birth year, and age estimates represent the association between the dependent variable and a one – standard-deviation change from the mean of these variables, respectively.

and normality, similar to the augmented inverse probability weighting estimator, and allows for approximate computation of confidence intervals. For these reasons, we employ this method in our heterogeneity analysis.

Figure 4 shows the results of the heterogeneity analysis of marriage patterns. We first examine the association with birth year. The results show that the more recent the respondent's birth cohort, the stronger the main patterns: only children are somewhat more likely to remain single (though this estimated association is not statistically significant), tend to marry other only children, and are correspondingly less likely to marry non-only children. Regarding age, being older at the time of the survey is not significantly related to the likelihood of remaining single, but it shows a stronger tendency for only children to marry other only children. For education, the magnitudes of the main patterns become weaker. We next interpret these results from the perspective of economic incentives to form larger families and parental monetary transfers.

Figure 4 shows results for birth year that can be understood if we account for the circumstances in which Japan has experienced the gradual socialization of older adults'

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care through public policies (and slowly fading social norms regarding filial obligations).[21] However, this trend of socialization of care may also reflect the trend of women's advancement in society and the decrease in their labor in households. Women who were typically used to care for their parents and the parents-in-law are now more difficult to rely on as caregivers. Consequently, the difficulty of caregiving arrangements within households may lead to the enhanced trend that people choose mates in a positive assortative manner based on only child status (i.e., only children are less likely to be chosen as a marital partners at the market level, even though those who do marry are more likely to marry another only child). In terms of other factors, such as monetary transfer, only children's attractiveness may be weakened by the declining relative importance of parental monetary transfers compared with their own economic capabilities.

Regarding the heterogeneity in age, the main trend becomes more prominent as respondents get older at the time of the survey. Given that younger individuals remain single, this result reflects that the trend regarding the choice of marriage partner becomes even stronger when comparing those who are already married and young compared to those who are older. This suggests that individuals who marry at a later age may be selecting partners with a more realistic understanding of caregiving responsibilities. The results for education level may reflect that only children can overcome their disadvantages if one's educational background is higher, as discussed above.

Finally, Figure 5 shows the estimates of the matching premium/penalty measured by the partner's SES. The main results are not significantly related to either own birth year, age, or education. In summary, heterogeneity appears to influence the choice of marital partner based only on sibling structure and not the partner's SES.

7.2 Excluding education from controls

This subsection examines whether our main result holds when education is not controlled for. As discussed in the main text, only children tend to be more educated, which may offset the penalty. Thus, we also explore how our main results change once positive educational assortativity is taken into account. In Appendix C, we follow the same procedure as in the main text but exclude the respondent's own education from the control variables.

According to Appendix C, only children are more likely to remain single and more likely to marry another only child, consistent with the main results obtained without controlling for education. However, the results for years of schooling show a modest deviation from the main findings. A clear difference emerges depending on the type of marriage partner: Being married to a non-only child is associated with a significantly higher partner education level for only children, although the estimated difference is relatively small. Conversely, the partner's education tends to decrease for both male and female only children who marry another only child. As the main results show, this is particularly evident for women, with estimated associations that are significant and of similar magnitude.

[21]Historically, children's burden of filial duty has been declining. First, in 1961, Japan enacted a national pension system. Additionally, with the enactment of the Long-Term Care Insurance Law in 2000, a system was put in place for society to support the care of older adults.

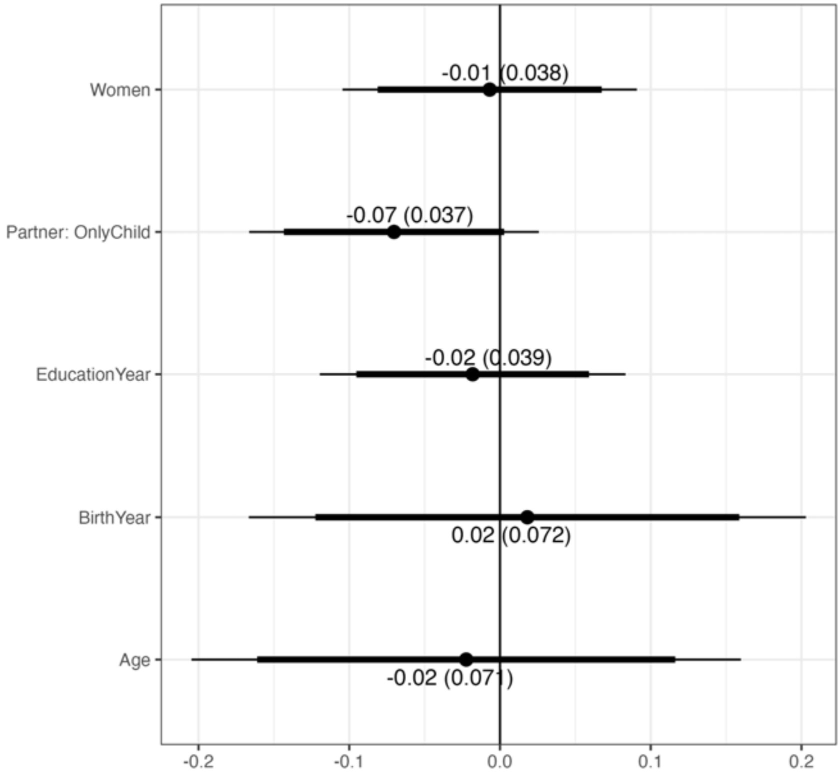

Figure 5. Estimated differences in partners' years of schooling by only-child status (Heterogeneity analysis).

Notes: This figure shows the best linear projection of the conditional difference in partners' years of schooling, along with the 95% confidence intervals; thin lines show Bonferroni-corrected confidence intervals. All nuisance functions are estimated using the stacking method (Wolpert, 1992; Breiman, 1996), which consists of OLS (including the squared terms of age, birth year, and years of schooling), random forests (Breiman, 2001), and Bayesian additive regression trees (Chipman et al., 2006; Chipman et al., 2010). Standard errors clustered at the household level are in parentheses. We compare groups of only children and non-only children. Each variable is interpreted as follows. The coefficient for women is relative to men (the omitted category). For the partner variable, the coefficient for only children is relative to marriages with partners who are non-only children (the omitted category). Years of schooling, birth year, and age estimates represent the association between the dependent variable and a one-standard-deviation change from the mean of these variables, respectively.

In summary, although the impact is small, a notable difference from the main result is the presence of a premium for those married to non-only children. This pattern is likely due to the omission of education controls and reflects the well-documented positive correlation in educational attainment between spouses. However, this does not contradict our main finding of a penalty associated with marrying an only child.

7.3 Alternative sibling positions

Thus far, we have examined the relationships between being an only child and marriage patterns. However, the underlying factors driving these patterns remain to be understood. To gain further insights, we conduct an additional analysis that considers

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alternative sibling positions and interprets them in terms of intergenerational relationships. If such relationships account for the disadvantages experienced by only children in the marriage market, policy interventions, such as promoting the socialization of informal care, could help mitigate these penalties.

In this context, we explore two alternative sibling positions: the status of being the eldest son and that of being the eldest child. In Japan, the eldest son (and their wife) traditionally bears certain obligations, including caring for their parents. Similarly, the eldest daughter with no male siblings is expected to assume this role. While the influence of the eldest son is widely known, the concept of primogeniture, wherein inheritance goes to the eldest child, suggests that birth order may be more significant than simply being the eldest son. Recent trends indicate a growing preference for individuals to take care of their own parents and expect their own children to care for them. Additionally, considering the persistent gender gap in the provision of informal care, women are expected to care for their parents even if they have younger brothers. If two siblings have a significant age difference, the first-born effect may be even more pronounced than that of the eldest son. Considering these two cases, we test whether and how these sibling positions matter in shaping marriage patterns. To focus on sibling position, we analyze samples from families with only two siblings. This approach allows us to extend our main findings on only-child marriage matching outcomes and make meaningful comparisons (for the detailed analysis, see Appendix D).

Two key findings emerge. First, patrilineal heiresses who marry only children exhibit patterns that, while not statistically significant, are partially consistent with the main results regarding the marital matching patterns based on their partners' types and educational background of only-child women. Specifically, the observed association for patrilineal heiresses married to an only child aligns with our main findings, indicating a sizable difference; however, it is not statistically significant. The absence of a partner education penalty for heiresses married to individuals who are non-only children also coincides with our results for only children.

Second, among men expected to bear family responsibilities, especially patrilineal heirs, we observe clear tendencies in partner selection. Specifically, they tend to have a higher probability of remaining single and are more likely to avoid marrying only children. They may themselves be avoided due to their family responsibilities, which mirrors the patterns observed for only children. Moreover, the tendency of eldest sons with siblings to avoid only children does not contradict the main result of positive assortativity by only-child status. Instead, it may suggest that these eldest sons, who are likely to bear heavier familial duties, are more cautious in choosing a spouse who, as an only child, may prioritize caring for their own parents.

These findings do not dismiss the possibility that the strength of intergenerational relationships plays a role in the penalties faced by only children. Furthermore, the penalty associated with being an only child exceeds that of being an heir with one sibling, as suggested by the analyses based on the two definitions. This highlights the potential challenges faced by only children who lack the support of siblings; conversely, heirs under either of the two definitions can share their responsibilities among siblings.

8. Conclusion

We investigate marriage matching among only children, focusing on the strength of their intergenerational ties. Our analysis shows that assortative mating based on only-child status is significantly more pronounced in actual marriages than in random matches. Statistical tests confirm the presence of positive assortative mating, and we also find that only children are more likely to remain single.

Second, we measure the matching premium/penalty by applying the framework of Chiappori et al. (2018), finding an only-child matching penalty in terms of lower partner SES. Furthermore, this penalty is more pronounced for female only children who marry male only children, which we attempt to explain in the discussion section by combining our data analysis with existing literature.

Moreover, we conduct additional analyses to obtain a more profound understanding of the underlying mechanisms of the penalty. Heterogeneity analyses reveal that one's own educational level alleviates the disparity in partner choice. Additionally, assortativity based on only child status becomes more pronounced among respondents born more recently and those who are older. Next, we estimate a model that does not control for respondents' own educational attainment; the results show that omitting this control does not change the main findings. Finally, other analyses exploring alternative sibling positions do not refute the possibility that heavier filial obligations influence only children's marriage patterns.

Several conclusions can be drawn from these findings. First, sibling composition, which is an inherent factor beyond an individual's control, tends to disadvantage certain individuals in terms of finding a suitable match in the marriage market. Specifically, being an only child often involves compromising on the attractiveness of their marriage partners' SES. Second, the marriage market exacerbates disparities in family sizes. Given that only children tend to bear greater caregiving responsibility, our finding that they are more likely to remain unmarried or to marry other only children implies an increase in the inequality of caregiving burdens through the marriage market. Regarding the penalties faced by only children, socializing the burden of care may help address two negative aspects: the disadvantageous marriages of only children and the widening gap in caregiving burdens among the younger generations.

Before concluding, we will discuss the limitations of this study and future research directions. The only information we have regarding sibling composition is on *surviving* siblings. Since we may include those who have already lost siblings in our sample, we may underestimate the penalty for older generations. This issue also prevents us from considering the possibility that only child status may be driven by biological factors (e.g., infertility or the low probability of survival of all siblings), as Lu and Vogl (2022) noted. Since families with weak constitutions may be disadvantaged in the marriage market, such data may allow for alternative interpretations. Considering data limitations, parental information that could impact monetary transfers, such as bequests, should also be considered when examining sibling composition and marital outcomes. However, the dataset utilized here lacks information on parental SES. Including such additional parental information can offer further insights.

Relatedly, this study uses data from Japan, which is an East Asian country with strong traditions of filial piety, to focus on intergenerational relationships. Although the results appear reasonable, other sources of explanation for the only child penalty are possible. Future research can explore the effects of variations in policy changes on marriage patterns, if any, in other economies, à la Bau (2021), who demonstrated that pension reforms implemented in male-dominated and female-dominated societies affect cultural changes in marital practices. Scholars can also analyze the impact of alternative sibling structures on marital outcomes. While the current analysis primarily focused on only-child status, which is less influenced by specific periods and cultures, a potential avenue for future research is to comprehensively investigate the effects of sibling structure in conjunction with those of masculine culture.

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Furthermore, this study is restricted to analyzing marital status and spouse characteristics as dependent variables. However, it does not determine whether individuals are actually experiencing penalties or facing life challenges. Ideally, investigating whether sibling composition results in differences in utility levels could provide valuable insights. If subjective well-being indicators were available, this could open up another avenue for future research, broadening the understanding of our findings and deepening insights into how sibling configurations influence life outcomes.

Finally, our findings can provide valuable insights into the pace of population decline. Vogl (2020), focusing on the evolutionary process of intergenerational associations in fertility, raised the possibility of marriage assortativity as a mechanism that may contribute to the acceleration of population decline. Our discovery of assortativity represents a significant advancement in our understanding of demographics. Thus, it would be meaningful to examine the demographic impact of positive assortativity on sibship size in the marriage market, as it may contribute to a further decline in fertility rates.

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References

Alesina, A., & Giuliano, P. (2010). The power of the family. *Journal of Economic Growth*, 15(2), 93–125.

Angrist, J., Lavy, V., & Schlosser, A. (2010). Multiple experiments for the causal link between the quantity and quality of children. *Journal of Labor Economics*, 28(4), 773–824.

Bau, N. (2021). Can policy change culture? Government pension plans and traditional kinship practices. *American Economic Review*, 111(6), 1880–1917.

Becker, G. S. (1991). *A treatise on the family: Enlarged edition*. Harvard University Press.

Becker, G. S., & Lewis, H. G. (1973). On the interaction between the quantity and quality of children. *Journal of Political Economy*, 81(2, Part 2), S279–S288.

Becker, G. S., & Tomes, N. (1976). Child endowments and the quantity and quality of children. *Journal of Political Economy*, 84(4, Part 2), S143–S162.

Bertrand, M., Kamenica, E., & Pan, J. (2015). Gender identity and relative income within households. *The Quarterly Journal of Economics*, 130(2), 571–614.

Bisin, A., Topa, G., & Verdier, T. (2004). Religious intermarriage and socialization in the united states. *Journal of Political Economy*, 112(3), 615–664.

Bisin, A., & Verdier, T. (2000). "beyond the melting pot": cultural transmission, marriage, and the evolution of ethnic and religious traits. *The Quarterly Journal of Economics*, 115(3), 955–988.

Black, S. E., Devereux, P. J., & Salvanes, K. G. (2005). The more the merrier? the effect of family size and birth order on children's education. *The Quarterly Journal of Economics*, 120(2), 669–700.

Blake, J. (1989). *Family size and achievement*, volume 3. Univ of California Press.

Breen, R., & Salazar, L. (2011). Educational assortative mating and earnings inequality in the united states. *American Journal of Sociology*, 117(3), 808–843.

Breiman, L. (1996). Bagging predictors. *Machine Learning*, 24, 123–140.

Breiman, L. (2001). Random forests. *Machine Learning*, 45, 5–32.

Browning, M., Chiappori, P.-A., & Weiss, Y. (2014). *Economics of the Family*. Cambridge University Press.

Cabinet Office (2021). Basic data on marriage and family (kekkon to kazoku wo meguru kiso data). https://www.gender.go.jp/kaigi/kento/Marriage-Family/2nd/pdf/1.pdf (accessed January 6, 2023).

Chernozhukov, V., Chetverikov, D., Demirer, M., Duflo, E., Hansen, C., Newey, W., & Robins, J. (2018). Double/debiased machine learning for treatment and structural parameters. *The Econometrics Journal*, 21(1), C1–C68.

Chiappori, P.-A., Costa Dias, M., Meghir, C., & Zhang, H. (2025). Changes in marital sorting: Theory and evidence from the United States. *Journal of Political Economy* (Forthcoming).

Chiappori, P.-A., Oreffice, S., & Quintana-Domeque, C. (2012). Fatter attraction: Anthropometric and socioeconomic matching on the marriage market. *Journal of Political Economy*, 120(4), 659–695.

Chiappori, P.-A., Oreffice, S., & Quintana-Domeque, C. (2018). Bidimensional matching with heterogeneous preferences: education and smoking in the marriage market. *Journal of the European Economic Association*, 16(1), 161–198.

Chipman, H., George, E., & McCulloch, R. (2006). Bayesian ensemble learning. *Advances in Neural Information Processing Systems*, 19.

Chipman, H. A., George, E. I., & McCulloch, R. E. (2010). Bart: Bayesian additive regression trees. *The Annals of Applied Statistics*, 4(1), 266–298.

Choo, E., & Siow, A. (2006). Who marries whom and why. *Journal of Political Economy*, 114(1), 175–201.

Cigno, A., Gioffré, A., & Luporini, A. (2021). Evolution of individual preferences and persistence of family rules. *Review of Economics of the Household*, 19(4), 935–958.

Cigno, A., Komura, M., & Luporini, A. (2017). Self-enforcing family rules, marriage and the (non) neutrality of public intervention. *Journal of Population Economics*, 30(3), 805–834.

Coward, R. T., & Dwyer, J. W. (1990). The association of gender, sibling network composition, and patterns of parent care by adult children. *Research on Aging*, 12(2), 158–181.

Dwyer, J. W., & Coward, R. T. (1991). A multivariate comparison of the involvement of adult sons versus daughters in the care of impaired parents. *Journal of Gerontology*, 46(5), S259–S269.

Eika, L., Mogstad, M., & Zafar, B. (2019). Educational assortative mating and household income inequality. *Journal of Political Economy*, 127(6), 2795–2835.

Esping-Andersen, G. (1997). Hybrid or unique?: The japanese welfare state between europe and america. *Journal of European Social Policy*, 7(3), 179–189.

Eurostat (2022). Household composition statistics. https://ec.europa.eu/eurostat/statistics-explained (accessed January 6, 2023).

Feinberg, M. E., Solmeyer, A. R., & McHale, S. M. (2012). The third rail of family systems: sibling relationships, mental and behavioral health, and preventive intervention in childhood and adolescence. *Clinical Child and Family Psychology Review*, 15(1), 43–57.

Fenton, N. (1928). The only child. *The Pedagogical Seminary and Journal of Genetic Psychology*, 35(4), 546–556.

Fernández, R., Fogli, A., & Olivetti, C. (2004). Mothers and sons: preference formation and female labor force dynamics. *The Quarterly Journal of Economics*, 119(4), 1249–1299.

Fernández, R., & Rogerson, R. (2001). Sorting and long-run inequality. *The Quarterly Journal of Economics*, 116(4), 1305–1341.

Fisman, R., Iyengar, S. S., Kamenica, E., & Simonson, I. (2006). Gender differences in mate selection: evidence from a speed dating experiment. *The Quarterly Journal of Economics*, 121(2), 673–697.

Galor, O., & Weil, D. N. (2000). Population, technology, and growth: from malthusian stagnation to the demographic transition and beyond. *American Economic Review*, 90(4), 806–828.

Greenwood, J., Guner, N., Kocharkov, G., & Santos, C. (2014). Marry your like: assortative mating and income inequality. *American Economic Review*, 104(5), 348–353.

Greenwood, J., Guner, N., Kocharkov, G., & Santos, C. (2016). Technology and the changing family: a unified model of marriage, divorce, educational attainment, and married female labor-force participation. *American Economic Journal: Macroeconomics*, 8(1), 1–41.

Griffiths, N. L., Thomas, K., Dyer, B., Rea, J., & Bardi, A. (2021). The values of only-children: Power and benevolence in the spotlight. *Journal of Research in Personality*, 92, 104096.
Hazan, M. & Berdugo, B. (2002). Child labour, fertility, and economic growth. *The Economic Journal*, 112(482), 810–828.
Hitsch, G. J., Hortaçsu, A., & Ariely, D. (2010). Matching and sorting in online dating. *American Economic Review*, 100(1), 130–163.
Kessler, D. (1991). Birth order, family size, and achievement: family structure and wage determination. *Journal of Labor Economics*, 9(4), 413–426.
Kojima, H. (1993). Sibling configuration and coresidence of married couples with an older mother in japan. *International Journal of Japanese Sociology*, 2(1), 1–16.
Konrad, K. A., Künemund, H., Lommerud, K. E., & Robledo, J. R. (2002). Geography of the family. *American Economic Review*, 92(4), 981–998.
Koyano, W. (1996). Filial piety and intergenerational solidarity in japan. *Australian Journal on Ageing*, 15(2), 51–56.
Lee, J. (2008). Sibling size and investment in children's education: an asian instrument. *Journal of Population Economics*, 21(4), 855–875.
Li, B., & Zhang, H. (2017). Does population control lead to better child quality? evidence from china's one-child policy enforcement. *Journal of Comparative Economics*, 45(2), 246–260.
Liu, H. (2014). The quality–quantity trade-off: evidence from the relaxation of china's one-child policy. *Journal of Population Economics*, 27(2), 565–602.
Low, C. (2014). *Essays in gender economics*. PhD thesis, Columbia University.
Lu, D. (2023). The more the merrier? the effect of relaxing birth quotas on marriage outcomes. SSRN working paper.
Lu, F. R. & Vogl, T. (2022). Intergenerational persistence in child mortality. Technical report, National Bureau of Economic Research.
Mancillas, A. (2006). Challenging the stereotypes about only children: a review of the literature and implications for practice. *Journal of Counseling & Development*, 84(3), 268–275.
Mare, R. D. (1991). Five decades of educational assortative mating. *American Sociological Review*, 15–32.
Mellor, S. (1990). How do only children differ from other children? *The Journal of Genetic Psychology*, 151(2), 221–230.
Ministry of Health, Labour and Welfare (2020). Summary report of comprehensive survey of living conditions 2019. https://www.mhlw.go.jp/english/database/db-hss/dl/report_gaikyo_2019.pdf (accessed January 6, 2023).
Moav, O. (2005). Cheap children and the persistence of poverty. *The Economic Journal*, 115(500), 88–110.
National Institute of Population and Social Security Research (2020). The 6th national survey on family in japan, 2018. https://www.ipss.go.jp/ps-katei/j/NSFJ6/Mhoukoku/Mhoukoku.pdf (accessed 6 January 2023).
National Institute of Population and Social Security Research (2021). Population statistics data book 2021, table 4-1: Number of births by sex and sex ratio of births, 1873–2019. https://www.ipss.go.jp/syoushika/tohkei/Popular/P_Detail2021.asp?fname=T04-01.htm (accessed October 7, 2025).
Ogawa, N., & Ermisch, J. F. (1996). Family structure, home time demands, and the employment patterns of japanese married women. *Journal of Labor Economics*, 14(4), 677–702.
Pencavel, J. (1998). Assortative mating by schooling and the work behavior of wives and husbands. *The American Economic Review*, 88(2), 326–329.
Polit, D. F., & Falbo, T. (1987). Only children and personality development: a quantitative review. *Journal of Marriage and the Family*, 309–325.
Polit, D. F., & Falbo, T. (1988). The intellectual achievement of only children. *Journal of Biosocial Science*, 20(3), 275–286.
Polit, D. F., Nuttall, R. L., & Nuttall, E. V. (1980). The only child grows up: a look at some characteristics of adult only children. *Family Relations*, 99–106.
Poston Jr, D. L., & Falbo, T. (1990). Academic performance and personality traits of chinese children:" onlies" versus others. *American Journal of Sociology*, 96(2), 433–451.
Qian, N. (2009). Quantity-quality and the one child policy: The only-child disadvantage in school enrollment in rural china. Technical report, National Bureau of Economic Research.
Qin, X., Zhuang, C. C., & Yang, R. (2017). Does the one-child policy improve children's human capital in urban china? a regression discontinuity design. *Journal of Comparative Economics*, 45(2), 287–303.

https://doi.org/10.1017/dem.2025.10011 Published online by Cambridge University Press

Rainer, H., & Siedler, T. (2009). O brother, where art thou? the effects of having a sibling on geographic mobility and labour market outcomes. *Economica*, 76(303), 528–556.

Rainer, H. & Siedler, T. (2012). Family location and caregiving patterns from an international perspective. *Population and Development Review*, 38(2), 337–351.

Raymo, J. M. (2022). The second demographic transition in japan: a review of the evidence. *China Population and Development Studies*, 6(3), 267–287.

Robins, J. M., & Rotnitzky, A. (1995). Semiparametric efficiency in multivariate regression models with missing data. *Journal of the American Statistical Association*, 90(429), 122–129.

Rosenzweig, M. R., & Zhang, J. (2009). Do population control policies induce more human capital investment? twins, birth weight and china's "one-child" policy. *The Review of Economic Studies*, 76(3), 1149–1174.

Semenova, V., & Chernozhukov, V. (2021). Debiased machine learning of conditional average treatment effects and other causal functions. *The Econometrics Journal*, 24(2), 264–289.

Spitze, G., & Logan, J. R. (1991). Sibling structure and intergenerational relations. *Journal of Marriage and the Family*, 871–884.

The Dai-ichi Life Research Institute (2007). The summary report on the results of survey on inheritance among middle-aged and older adults in japan, 2005 (japanese). https://www.dlri.co.jp/pdf/ld/01-14/news0701.pdf (accessed January 6, 2024).

The Office for National Statistics (2020). Number of families by number of dependent children, uk, 1996 to 2019. https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/families (accessed January 6, 2023).

The Yu-cho Foundation (2023). The summary report on the results of the 5th survey on household finances and savings in japan, 2022 (japanese). https://www.yu-cho-f.jp/wp-content/uploads/survey_report-9.pdf (accessed January 6, 2024).

Tsutsui, T., Muramatsu, N., & Higashino, S. (2014). Changes in perceived filial obligation norms among coresident family caregivers in japan. *The Gerontologist*, 54(5), 797–807.

Uchikoshi, F., Ono, Y., Miwa, H., & Raymo, J. M. (2024). Revisiting marriage market mismatch: A conjoint survey experiment approach.

Uchikoshi, F., Raymo, J. M., & Yoda, S. (2023). Family norms and declining first-marriage rates: the role of sibship position in the japanese marriage market. *Demography*, 60(3), 939–963.

Vogl, T. S. (2013). Marriage institutions and sibling competition: evidence from south asia. *The Quarterly Journal of Economics*, 128(3), 1017–1072.

Vogl, T. S. (2020). Intergenerational associations and the fertility transition. *Journal of the European Economic Association*, 18(6), 2972–3005.

Wakabayashi, M., & Horioka, C. Y. (2009). Is the eldest son different? The residential choice of siblings in japan. *Japan and the World Economy*, 21(4), 337–348.

Wen, F. (2023). Assortative mating on only-child status and accumulation of economic advantages in contemporary china. SSRN working paper.

Wolpert, D. H. (1992). Stacked generalization. *Neural Networks*, 5(2), 241–259.

Wu, J. and Zhang, H. (2021). Preference evolution in different matching markets. *European Economic Review*, 137, 103804.

Yu, W.-h., & Hertog, E. (2018). Family characteristics and mate selection: Evidence from computer-assisted dating in japan. *Journal of Marriage and Family*, 80(3), 589–606.

Yu, W.-h., Su, K.-h., & Chiu, C.-T. (2012). Sibship characteristics and transition to first marriage in taiwan: explaining gender asymmetries. *Population Research and Policy Review*, 31(4), 609–636.

Appendix A. Prior literature on only children and marriage

This appendix concisely reviews previous research on only children and marriage outcomes. Specifically, we focus on three dimensions: (1) the association between sibling composition and marriage outcomes, (2) educational attainment, and (3) relevant psychosocial mechanisms and other lifetime outcomes.

A.1 Studies on sibling composition and marital outcomes

While not always centered on only children, many social science studies have explored how family background—including sibship size and birth order—shapes marital behavior. For example, Yu et al. (2012) found that birth order and sibship gender composition affect age at first marriage in gender-asymmetric ways. In Japan, Kojima (1993) discussed marriage arrangements based on sibling structure.

More directly, Yu and Hertog (2018) analyzed online dating behavior in Japan, and found that only children receive fewer requests and are more likely to send requests, suggesting a disadvantage in the early stages of mate search. Using representative data from Japan, Uchikoshi et al. (2023) also analyzed the effect of the change in population structure of sibling composition (including only children) on demographic change using different indicators. The authors showed that children who are expected to care for their parents are less likely to marry. Specifically, they calculated the percentage of the male/female population with a particular sibling composition that is actually married to someone with that background.

In economics, Vogl (2013) examined arranged marriages in Nepal and showed that sibling composition, specifically the presence of younger sisters, can pressurize women into earlier and lower-quality marriages. Thus, sibling structure may influence not only whether and when individuals marry but also the quality of their matches.

A.2 Studies on sibling composition and educational outcomes

We use the education of one's partner as a key indicator of marriage quality. Studies have examined whether being an only child affects educational attainment, a potential confounder in assortative mating. Theoretical frameworks such as the quality – quantity trade-off model suggest that children in smaller families may benefit from more parental investment (Becker and Lewis, 1973; Becker and Tomes, 1976; Galor and Weil, 2000; Hazan and Berdugo, 2002; Moav, 2005).

Empirical findings, however, are mixed. Some studies report educational disadvantages for only children. For instance, Black et al. (2005) and Qian (2009) showed that only children tend to have lower educational outcomes than those with siblings.

Conversely, other studies highlight the advantages of being an only child or growing up in a smaller family. For example, Lee (2008) found that only children receive higher per-child expenditures. Meanwhile, Rosenzweig and Zhang (2009) showed that the presence of twin siblings, compared to being an only child, lowers educational outcomes. Further evidence using the one-child policy as a natural experiment suggests that additional siblings reduce educational attainment: Liu (2014) and Li and Zhang (2017) found negative effects of sibling size using one-child policy variation, while Qin et al. (2017) reach a similar conclusion using a regression discontinuity design.

Taken together, these findings suggest that while some studies emphasize the disadvantages of being an only child, others underscore the benefits of smaller family size. The impact of sibling composition on educational attainment is therefore complex and context-dependent.

A.3 Studies on sibling composition and other outcomes

Psychological studies have long debated whether only children differ from those with siblings in terms of personality and social development. Early stereotypes portrayed only children as spoiled or socially

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disadvantaged, a view famously summarized by G. Stanley Hall's remark that being an only child is "a disease in itself" (as cited in Fenton, 1928). While such views have been challenged, they continue to persist in public discourse (Mancillas, 2006; Griffiths et al., 2021).

From a developmental perspective, sibling relationships are seen as early training grounds for emotional regulation and social interaction. As noted by Feinberg et al. (2012), individuals with siblings may gain interpersonal skills relevant for later romantic relationships. However, recent research challenges the negative stereotype of only children, and highlights positive traits such as creativity, resilience, and adult success (Blake, 1989; Mellor, 1990; Polit et al., 1980; Polit and Falbo, 1987; Polit and Falbo, 1988; Poston Jr and Falbo, 1990).

Several studies have examined how sibling composition influences labor market outcomes, often treating them as indicators of child quality. Kessler (1991) found that only children had lower employment rates in adolescence but higher rates in their late twenties compared to middle children. Black et al. (2005) showed that having more siblings reduced full-time employment and earnings, especially for women; meanwhile, men's incomes declined, but their employment status remained unaffected. By contrast, Angrist et al. (2010) found no consistent effect of sibling number. Despite these mixed findings, socioeconomic success clearly affects marriage decisions, making it a relevant confounder in analyses of only child status.

In addition, many studies have addressed caregiving responsibilities for aging parents. Research across countries shows that only children bear a heavier caregiving burden than those with siblings (Coward and Dwyer, 1990; Dwyer and Coward, 1991; Spitze and Logan, 1991; Rainer and Siedler, 2012). Economic theory suggests that siblings may free-ride by avoiding proximity to parents (Konrad et al., 2002; Rainer and Siedler, 2009). Using German microdata, Rainer and Siedler (2009) found that only children are less able to move away from parents, and hence, face reduced labor market opportunities.

Appendix B. Assortativeness

This appendix formally checks the assortativity of only child status. In the main text, we focus on differences in marriage and partner-type probabilities between the two parties (i.e., only and non-only children). However, we use existing indices for robustness checks on the results of positive assortativity obtained from the difference in their marriage probabilities.

Here, we use four standard indices introduced in Chiappori et al. (2025): odds ratio, likelihood ratio, minimum distance, and correlation. The odds ratio and likelihood ratio indices are interpreted as indicating positive assortativity when their values exceed one. In our context, the odds ratio index indicates the ratio of marriages between only children relative to mixed marriages with respect to sibling composition. Meanwhile, the likelihood ratio index represents the ratio of the probability of positive assortative matching in terms of sibling structure relative to what would occur randomly.

The remaining two indices, minimum distance and correlation, indicate positive assortativity when their values are positive. The minimum distance index represents the weight of the perfectly assortative component, while the correlation index measures the correlation between the wife's and husband's only child status.

All indices show positive assortativity in the pooled data. The values are 1.05 for the odds ratio, 1.01 for the likelihood ratio, 0.09 for the minimum distance, and 0.09 for the correlation. These results suggest a consistent, albeit weak pattern of positive assortative matching in only-child status.

Appendix C. Excluding education from controls

This appendix tests whether our main result holds without controlling for education. As discussed in the main text, only children tend to be more educated, and thus the penalty may no longer appear. Another interesting aspect is how only-child status is related to the partner's education overall, particularly after accounting for the positive assortativity of education. Therefore, we follow the same procedure described in the main text and remove one's own education from the control variables. The sibling composition of the

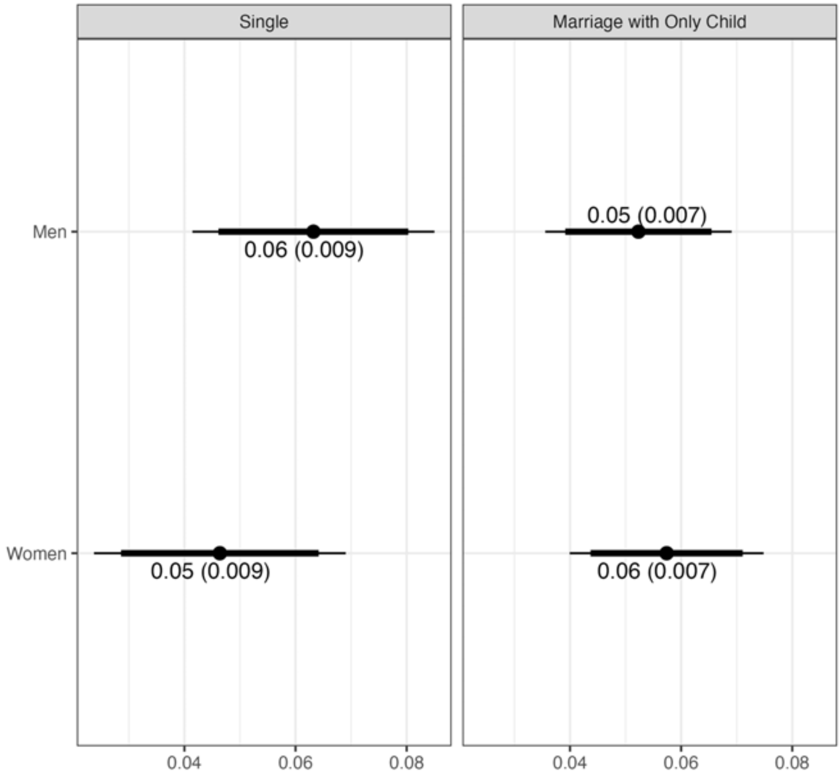

Figure A1. Estimated associations between only-child status and partner type (without controlling for education).

Notes: This figure shows the different marital statuses according to only child status, namely, single (left graph) and married to an only child (right graph), estimated by Eq.(1), along with the 95% confidence intervals; thin lines show Bonferroni-corrected confidence intervals. All nuisance functions are estimated using the stacking method (Wolpert, 1992; Breiman, 1996), which consists of OLS (including the squared terms of age and birth year but NOT years of schooling), random forests (Breiman, 2001), and Bayesian additive regression trees (Chipman et al., 2006, 2010). Standard errors clustered at the household level are in parentheses. We compare groups of only children and non-only children, and the estimates represent the differences in the likelihood of being in each status. Specifically, they indicate the only children's likelihood of being single minus the non-only children's likelihood of being single, and the only children's likelihood of being married to another only child minus that of non-only children, respectively.

marriage partner is indicated by Figure A1, while the educational background of the marriage partner is indicated by Figure A2.

According to Figure A1, the tendency for only children to remain single and marry another only child persists, even without accounting for education. This provides further support for our main findings, demonstrating the robustness of the observed patterns. Conversely, the estimates related to years of schooling show some variation from the main result. As shown in Figure A2, the spouse type plays a key role here: Only children who marry non-only children tend to have partners with higher educational levels, although the magnitude of this association is modest. Conversely, when both spouses are only children, their partner's education tends to be lower. This pattern is statistically significant for women, with an estimate of −0.61, which is very close to the main result of −0.63.

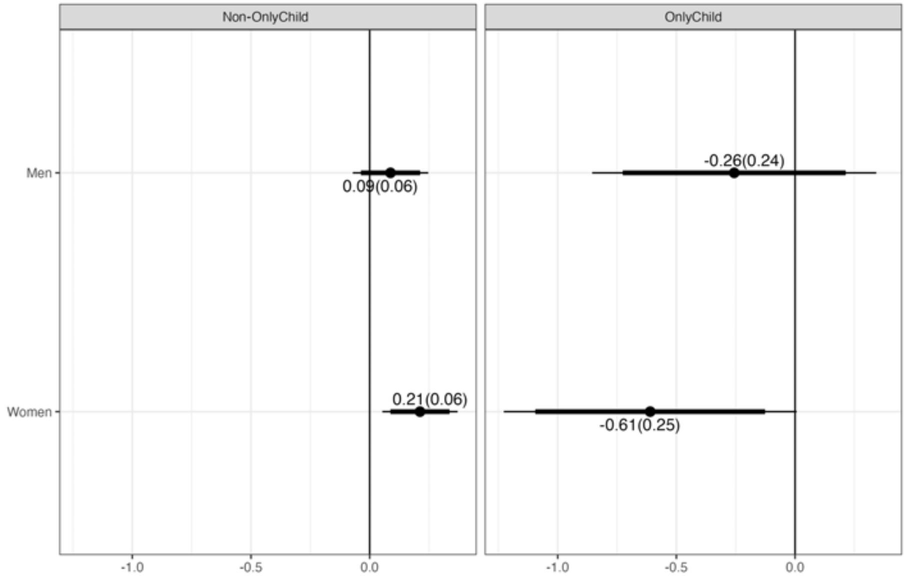

Figure A2. Estimated differences in partners' years of schooling by only-child status (Subsample analysis, without controlling for education).

Notes: This figure shows the difference in partners' years of schooling according to only child status, for subsamples defined by partner type, namely, married to non-only children (left graph) and married to only children (right graph), estimated by Eq.(5), along with the 95% confidence intervals; thin lines show Bonferroni-corrected confidence intervals. All nuisance functions are estimated using the stacking method (Wolpert, 1992; Breiman, 1996), which consists of OLS (including the squared terms of age and birth year, but not years of schooling), random forests (Breiman, 2001), and Bayesian additive regression trees (Chipman et al., 2006, 2010). Standard errors clustered at the household level are in parentheses. We compare groups of only children and non-only children. The estimates represent the differences in their partners' years of schooling after controlling for other variables. Specifically, they indicate the years of schooling of only children's partners minus those of non-only children's partners.

Appendix D. Alternative sibling positions

This subsection examines the relationships between alternative sibling positions and marriage matching outcomes. In our analysis with two-sibling respondents, one's position can be determined by the position of the other sibling. For instance, if one is a male and the first-born child, he is considered the heir if the other sibling is a younger brother, an elder sister, or a younger sister. If one is a female, the first-born daughter without a male sibling is considered the heiress. Thus, we define a dummy variable called "Patrilineal" that equals one for males when the other sibling is a younger brother, an older sister, or a younger sister, and zero if he has an older brother. For females, the dummy variable takes a value of one if the other sibling is a younger sister and zero if the other sibling is an elder brother, a younger brother, or an elder sister. However, if we focus on birth order, then both males and females become heirs if they are first-born children. Hence, we define a dummy variable called "Primogeniture" that takes a value of one when the other sibling is a younger brother or sister, and zero if they have an older brother or sister. Finally, we categorize individuals' marital status into three groups: married to an only child, married to a non-only child, and single. This allows us to compare the results with our main findings.

Figure A3 shows the results for the relationships between heir positions and marital statuses according to the two definitions. The results indicate that under either definition, male heirs are more likely to remain single and less likely to marry only children. In contrast, the results differ for women depending on the definition used. Under the definition of a patrilineal heiress, the probability of remaining single increases. Moreover, while not statistically significant, the likelihood of marrying an only child also slightly increases.

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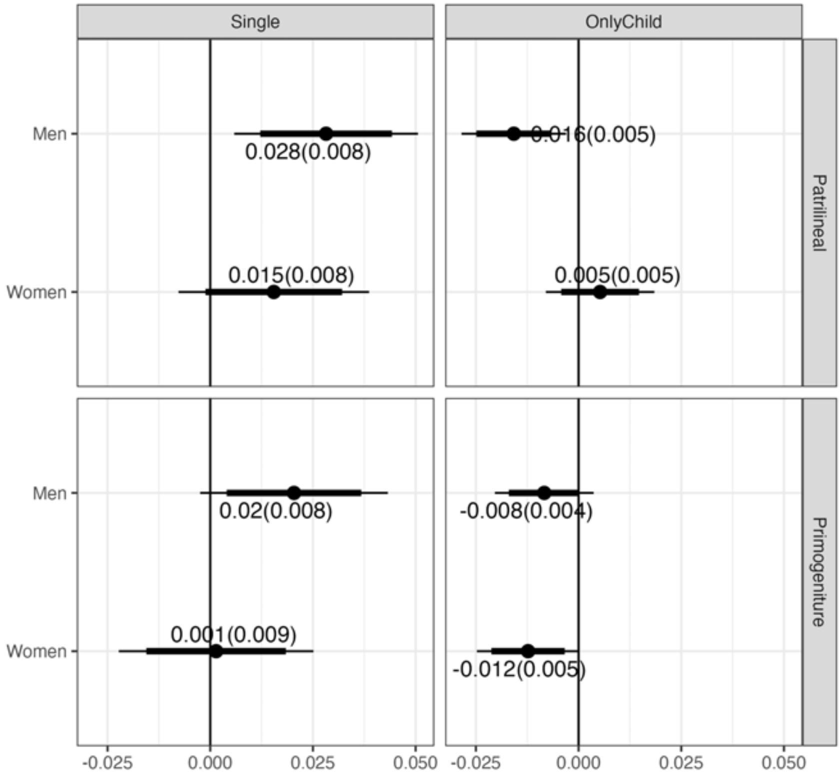

Figure A3. Estimated associations between heir status and partner type.

Notes: This figure shows the different marital statuses according to sibling positions, namely, single (left graph) and married to an only child (right graph), along with the 95% confidence intervals; thin lines show Bonferroni-corrected confidence intervals. The sibling positions are defined by dummy variables called "Patrilineal" (top graph) and "Primogeniture" (bottom graph) among respondents with one sibling. The patrilineal variable equals one for males when the other sibling is a younger brother, an older sister, or a younger sister, and zero if he has an older brother. For females, the dummy equals one if the other sibling is a younger sister and zero if the other sibling is an older brother, a younger brother, or an older sister. Primogeniture equals one when the other sibling is a younger brother or sister, and zero if they have an older brother or sister for both males and females. All nuisance functions are estimated using the stacking method (Wolpert, 1992; Breiman, 1996), which consists of OLS (including the squared terms for age, birth year, and years of schooling), random forests (Breiman, 2001), and Bayesian additive regression trees (Chipman et al., 2006, 2010). Standard errors clustered at the household level are in parentheses. We compare groups of heirs and non-heirs for each definition. These estimates represent the differences in the likelihood of being in each status. Specifically, they indicate the likelihood of being single for heirs minus that for non-heirs, and the likelihood of marrying an only child for heirs minus that for non-heirs, respectively.

However, under the definition of primogeniture, no significant difference is observed on the likelihood of remaining single and the probability of marrying an only child is actually lower.

The difference between these two definitions lies in whether the younger sibling includes a brother. Patrilineal heiresses are also disadvantaged in marriage, similar to those faced by only children. This is likely because they are expected to assume family responsibilities. Conversely, primogeniture heiresses may have a younger brother, allowing for the possibility of sharing or delegating caregiving responsibilities. In this sense, much like only children, patrilineal heiresses may be expected to assume broader family responsibilities, including caring for older parents within the household or as part of their marital role.

Meanwhile, no significant differences are observed for the education level of the marriage partner under either definition, as shown in Figure A4. However, in the case of heirs and heiresses of both definitions, the

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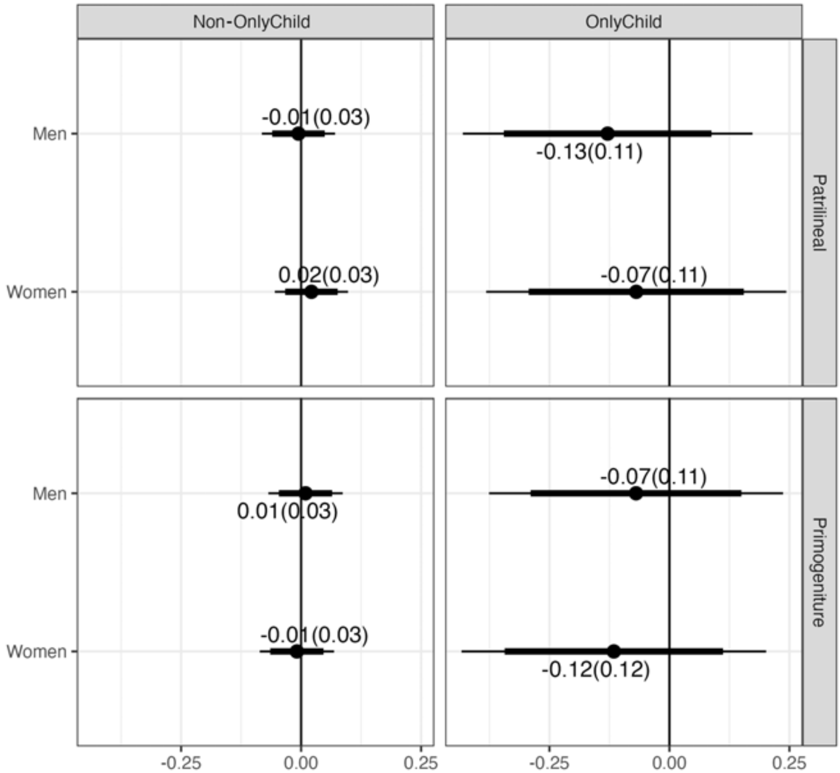

Figure A4. Estimated differences in partners' years of schooling by heir status (Subsample analysis).
Notes: This figure shows the difference in the partners' years of schooling according to alternative sibling position for subsamples defined by partner type. Specifically, it shows the results among marriages with a non-only child partner (left graph) and marriages with an only child partner (right graph), along with the 95% confidence intervals; thin lines show Bonferroni-corrected confidence intervals. The sibling positions are defined by dummy variables called "Patrilineal" (top graph) and "Primogeniture" (bottom graph) among respondents with one sibling. The patrilineal variable equals one for males when the other sibling is a younger brother, an older sister, or a younger sister, and zero if he has an older brother. For females, the dummy variable equals one if the other sibling is a younger sister and zero if the other sibling is an older brother, a younger brother, or an older sister. Primogeniture equals one when the other sibling is a younger brother or sister, and zero if they have an older brother or sister for both males and females. All nuisance functions are estimated using the stacking method (Wolpert, 1992; Breiman, 1996), which consists of OLS (including squared terms of age, birth year, and years of schooling), random forests (Breiman, 2001), and Bayesian additive regression trees (Chipman et al., 2006; Chipman et al., 2010). Standard errors clustered at the household level are in parentheses. We compare groups of heirs and non-heirs in each definition, and the estimates represent the differences in their partners' years of schooling after controlling for other variables. Specifically, they indicate the years of schooling of heirs' partners minus those of non-heirs' partners.

negative association is greater when the marriage partner is an only child, which aligns with our main findings. Overall, penalties associated with each dummy variable are not as pronounced as the pattern observed for individuals who are only children.

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