THREE ESSAYS ON DEMOGRAPHIC ISSUES IN SOUTH KOREA

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ABSTRACT

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In chapter 1, I estimate the effect of a first birth on the labor market outcomes in South Korea over time using a method proposed by Kleven, Landais, and Søgaard (2019b). In many countries, the child penalty, which is the loss in earnings associated with childbirth, is large and persistent for mothers. My results show how the child penalty in Korea is different from the one in other countries. First, I find that Korean women experience a substantial penalty in earnings with a first childbirth compared to women in other countries. Second, while the child penalty in other countries comes from both the intensive and extensive margins, the penalty for Korean women arises almost exclusively on the extensive margin. Third, I find a substantial drop in earnings for mothers even before the child is born. Finally, to shed light on the source of the child penalty, I examine several of its correlates, including marriage, the lack of work benefits, and opportunity costs.

In chapter 2, I analyze the effect of skewed sex ratios at birth on the marriage market. Due to high son preference and reduced fertility rates, sex ratios at birth were skewed from the 1980s to the 2000s in South Korea. This can affect the timing of marriage when those generations start to enter the marriage market. I use large administrative data sets, including the Population Census and the Vital Statistics. The results show that a high SRB delays the marriage of men, while women marry early.

In chapter 3, I review the trend in fertility rates and policy changes and finds the source of low fertility rates in Korea. The Korean government spent over 200 billion dollars to increase fertility, but the total fertility rates continues to decline. I compare the trend in fertility rates in Korea with the one in Spain, Italy, and Japan. I show that the low fertility rates in Korea result mainly from delayed marriage.

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CHAPTER 1

IS THERE A CHILD PENALTY IN SOUTH KOREA?

1.1 Introduction

Although the size of the gender wage gap has narrowed over time (Blau and Kahn, 2006; Goldin, 2014), many papers across numerous countries show wage differentials between men and women with the birth of a child (Anderson, Binder, and Krause, 2002, 2003; Buckles, 2008; Glauber, 2018; Juhn and McCue, 2017; Kleven, Landais, Posch, Steinhauer, and Zweimüller, 2019a). This so-called child penalty can be an important source of the remaining gender gap in the labor market (Angelov, Johansson, and Lindahl, 2016; Kleven, Landais, and Søgaard, 2019b). Although the gender wage gap in Korea is the highest in OECD countries and the female labor force participation rates in Korea are low according to OECD (2017), there are few studies on the child penalty in Korea. I examine the child penalty for Korean women as a potential factor in the large wage gap.

I adopt an event study method to estimate the child penalty in Korea. This approach was first used by Kleven et al. (2019b) to examine the child penalty in Denmark around a woman's first childbirth. The event study allows me to examine the time path of the child penalty around the time of birth and across various aspects of the labor market: earnings, labor force participation, hours worked, and hourly wages. Kleven et al. (2019b) show that the child penalty in earnings is driven by all three margins (labor participation, hours worked, and hourly wages). With one of the lowest labor force participation rates for women in the OECD (Jones, 2005), the Korean child penalty may arise from different sources than other OECD countries.

I exploit the panel structure of the Korea Labor and Income Panel Study (hereafter KLIPS) to examine the impact of childbirth on labor market outcomes over time. Evidence from the KLIPS presents unique patterns in Korea. First, compared with other countries, the penalty in Korea is large. According to Kleven et al. (2019a), estimating the child penalty across six other countries such as Scandinavian (Denmark and Sweden), German Speaking (Austria and Germany), and

English Speaking (the United Kingdom and the United States) countries, the size of the long-run child penalty in earnings is between 21 and 61 percent, whereas the penalty in Korea is 68 percent. Second, while women in other countries experience the child penalty in participation rates, hours worked, and hourly wages, the penalty for Korean women comes almost exclusively from leaving the labor market. For women who stay in the labor force, I do not find differences in earnings. Third, I find that earnings decline for mothers even before the birth of the child, a pattern which is not observed in other countries. Fourth, the size of the child penalty differs by individual characteristics. Women with high opportunity costs of childbirth experience a lower child penalty than women with low opportunity costs around childbirth.

The remainder of this paper proceeds as follows. In Section 1.2, I introduce the previous literature on child penalties. Section 1.3 introduces the method. The data are described in Section 1.4. The results are presented in Section 1.5 and potential explanations for child penalties in Korea are discussed. Section 1.6 is the conclusion.

1.2 Literature Review

Kleven et al. (2019b) provide event study evidence of the effect of the first child on labor market outcomes in Denmark. They analyze the labor market outcomes for both the intensive and extensive margins. The key results from Kleven et al. (2019b) are presented in Figure 1.1. They find that women experience a decline in earnings with the birth of their first child, while men are not affected by childbirth. The long-run child penalty in earnings is 21 percent, which means women's earnings lag behind men's earnings by 21 percent 10 years after the first childbirth. Figure 1.1 shows that the child penalty in earnings is driven by both the intensive and extensive margins. Women in Denmark leave the labor market when they have a first child. At the same time, they experience a decline in hours worked and wage rates because women with children have a lower chance of achieving a high rank in a company and are more likely to move into the public sector and a family-friendly firm than men.

Kleven et al. (2019a) similarly examine the child penalty in six additional countries and find that

women experience the child penalty in every country. The size of the child penalties in earnings in those six countries ranges from 21 percent in Denmark to 61 percent in Germany.

Sieppi and Pehkonen (2019) use the method proposed by Kleven et al. (2019b) to estimate the child penalty in Finland. Consistent with Kleven et al. (2019b), the child penalty in Finland arises from both the intensive and extensive margins. The long-run child penalty is 25 percent.

Berniell, Berniell, de la Mata, Edo, and Marchionni (2021) examine the child penalty in Chile based on Kleven et al. (2019b). The child penalty in earnings is 28 percent, which comes from declines in participation rates and hours worked.

In Figure 1.2, I compare the child penalties in labor force participation rates in seven different countries. Among the results of seven countries from Sieppi and Pehkonen (2019) and Kleven et al. (2019a), women in the countries in Scandinavian such as Denmark, Sweden, and Finland experience a relatively smaller child penalty than women in other countries like Germany, the United Kingdom, and the United States. Additionally, in Scandinavian and German-speaking countries, there are sharp and immediate declines in earnings right after childbirth and then a slight recovery within two years after childbirth. Women in all seven countries experience the effect of childbirth on the labor market outcomes for 10 years after childbirth.

Many additional studies examine the effect of children on female earnings using a variety of other methods (Anderson et al., 2002, 2003; Buckles, 2008; Glauber, 2018; Juhn and McCue, 2017). Loughran and Zissimopoulos (2009) simultaneously investigate the effect of marriage and childbearing in the United States. The first childbirth reduces female wages by 2 to 3 percent, but has no impact on wage growth. According to Angelov et al. (2016), although the difference in labor force participation between men and women in Sweden is negligible, 15 years after the first childbirth, the child penalty in earnings for women is 32 percent due to a drop in hours worked.

Few papers study the effect of childbirth on female labor market outcomes in Korea. In contrast to the United States and European countries, Korea has low female labor force participation rates and many Korea women leave the labor force when they have children (OECD, 2017), few papers study the effect of childbirth on female labor market outcomes.

The existing literature on the child penalty in Korea is dated and has a selection issue. Berger, Groothuis, and Jeon (1997) estimate the wage equation by year using the 1980 and 1991 waves of the Korean Occupational Wage Survey. The authors show that there is a marriage penalty in female wages and that the size of the penalty has decreased over time. In 1980, married women earned 18 percent less than single women, but the estimated difference between married and single women was 3 percent in 1991. However, selection into the labor market can explain the small size of the penalties. Given that many Korean women leave the labor market around marriage and childbirth; therefore, estimating the effect of marriage or childbirth on wages can be biased. In this paper, I consider various labor market outcomes, including labor force participation rates.

Marriage and childbirth are highly correlated events in Korea, so the papers focus on marriage. Lee (2005) investigates the effect of marriage on Korean female labor supply. He shows that female labor supply declines by 41 percent after marriage. The size of the marriage impact is consistent with the results of Lee, Jang, and Sarkar (2008), which show that the labor supply of married women is 40 to 60 percent lower than that of single women. On the other hand, Nam (2010) analyzes the impact of an additional child using the number of daughters as an IV based on data from the Korean Population and Housing Census from 1980 to 2000. The results indicate that one additional child reduced the labor force participation of women with two or more children by 11 to 13 percent in 1985 and 1995. However, leaving the labor force before childbirth is not considered here, so the effect of childbirth on the labor market outcomes can be underestimated. Ma (2013) studies the relationship between employment status and first childbirth using the KLIPS from 1998 to 2007. She categorizes three employment status at first childbirth; never employed, employed, and previously employed. Women who worked before first childbirth are more likely to become mothers earlier than women who are currently employed at first childbirth. She explains this result by noting that Korean women leave their jobs when they anticipate becoming mothers.

The existing literature on Korea shows that marriage has greater effects on the female labor market outcomes than childbirth unlike other countries. Therefore, it is necessary to analyze the effects of those events over time to fully understand the effects on the labor market outcomes. I

examine the time path of the child penalty in Korea and show that Korean women receive the penalty mainly from childbirth.

1.3 Method

Following Kleven et al. (2019b), I analyze the effect of a first birth on labor market outcomes using an event-study method.

$$Y_{ist}^{g} = \sum_{j \neq -1} \alpha_{j}^{g} \cdot I[j = t] + \sum_{k} \beta_{k}^{g} \cdot I[k = age_{is}] + \sum_{y} \gamma_{y}^{g} \cdot I[y = s] + \nu_{ist}^{g} \tag{1.1}$$

Y_{ist}^{g} is the labor market outcome of individual i of gender g in year s and at event time t. I analyze four labor market outcomes: monthly wages, hours worked, the probability of having a job (participation rates), and hourly wages. The variable definitions are in Appendix A. The indicator variable for one year before the event, t=-1, is omitted; thus the event time coefficients measure the impact of childbirth relative to one year before the event. The event time, t, ranges from -5 to 10. The α_{j}^{g} in the baseline Equation 1.1 is the effect of the event of gender g at event time t. Childbirth can affect other aspects of economic status, such as occupation and workplace environment; thus Kleven et al. (2019b) suggest controlling only event time, age, and year in the event study. The regression controls for single year age, age_{is}, and year, y, indicators.

P_{t}^{g} is the effect of the first childbirth at year t as a percentage of the counterfactual outcome absent childbirth.

$$P_{t}^{g} \equiv \frac{\hat{\alpha}_{t}^{g}}{E[\tilde{Y}_{ist}^{g}|t]} \tag{1.2}$$

$\tilde{Y}_{ist}^{g}$ is the predicted outcome when omitting the effect of the event, so $\hat{\alpha}_{j}^{g}$ is subtracted from the fitted value, $\hat{Y}_{ist}^{g}$. $\tilde{Y}_{ist}^{g} = \sum_{k} \hat{\beta}_{k}^{g} \cdot I[k = age_{is}] + \sum_{y} \hat{\gamma}_{y}^{g} \cdot I[y = s]$.

$$P_{t} \equiv \frac{\hat{\alpha}_{t}^{m} - \hat{\alpha}_{t}^{w}}{E[\tilde{Y}_{ist}^{w}|t]} \tag{1.3}$$

P_{t} measures the percentage by which women lag behind men due to the first childbirth at event time t. The long-run penalty is the average value of the penalty (P_{t}) from event time 5 to 10 (from t=5 to t=10).

1.4 Data

I use the Korea Labor and Income Panel Study (KLIPS) from 1998 (1st wave) to 2018 (21st wave). The KLIPS selected 5,000 households in 1998 and added 1,415 households in 2009. The KLIPS follows all household members over 15 years old every year since 1998. The effect of a first child on an individual's labor market outcomes over time can be estimated by exploiting the panel structure.

The sample consists of all people aged 20-49 who had a first childbirth between 1999 and 2017. I use an unbalanced panel to maximize the sample size. The sample is all persons who are observed in the year of childbirth and at least one year before childbirth. The year of the first childbirth is recovered from the birth-date information of household members and their relation to the head of household. The KLIPS asks the year of the respondent's first birth only in the survey year when the respondent enters the sample. I infer the year of the first childbirth for others based on the birth-date information of household members and their relationship to the head of the household. For example, if the oldest child of the head of the household is in the data set and the child is two years old, the head and the spouse of the head are considered to have had their first child two years ago. The limitation of the data is that the year of the first childbirth cannot be identified if the parents and the child have never lived in the same household.

Like Kleven et al. (2019b), my main outcomes are earnings, labor force participation, hours worked, and hourly wages. Table 1.1 shows the summary statistics of those who gave birth to their first child between 1999 and 2017, measured one year prior to childbirth. $Earnings$ is a self-reported average monthly wage, and it is a real wage in 2019 Korean 10,000 won that is not conditional on employment. $Earnings$ is 0 if a person does not have a job. $Labor\ Force$ is an indicator variable for job status with a value of 1 if an individual earns a positive wage when the survey is conducted. Even before childbirth, men are paid twice as high as women. In addition to the gender pay gap, women's participation rate is just 0.59 one year before childbirth, while almost all men are in the labor force. These gender gaps in earnings and labor force participation rates observed in the summary statistics may indicate that the child penalty starts prior to childbirth. $Hours\ Worked$

and $Hourly\ Wages$ are conditional on employment, which means that these values are missing if a person does not work. $Hours\ Worked$ is the reported average working hours per week. Men tend to work more than women by 7 hours a week on average. I calculate $Hourly\ Wages$ as (monthly earnings/monthly total hours worked). Men's hourly wages are approximately 20 percent higher than women's wages. Women in the sample were approximately 2.5 years younger than men. The average level of education for both men and women are 14 years, with a college degree, and the level of education for men is slightly higher than that for women. The detailed definition for variables is in the Appendix.

1.5 Results

1.5.1 Baseline Results

Figure 1.3 shows how labor market outcomes change after a first birth. The dots in the graph represent estimates of the gender-specific impacts of childbirth for men, P_t^m, and women, P_t^w, across event time. P_t^m and P_t^w indicate the effect of the first child on labor market outcomes at t as a percentage of the counterfactual outcome. The long-run penalty is the average of the difference between men and women from 5 years to 10 years after the event. The shaded area is the 95 percent confidence band. The long-run child penalty in earnings is 67.5 percent. This penalty mostly arises from a decline in the female labor force participation rates.

A sharp divergence occurs one year before childbirth in Korea. In Figure 1.3, the estimated child penalty in earnings at two years before childbirth, P_{-2}^w, is 23.9 percent. Given that P_1^w is 32.1 percent, Korean women face a substantial penalty even before childbirth.

If this penalty prior to childbirth is considered, the long-run child penalty in earnings in Korea can be larger. According to the definition of the child penalty in Section 1.3, the long-run child penalty in earnings of women relative to men is 68 percent. However, this penalty is calculated by comparing earnings at t to earnings one year before childbirth to be consistent with previous research. The decline in earnings starts before childbirth. If I calculate the child penalty using two years before childbirth as a base year instead of one year before childbirth, the long-run child

penalty in earnings is 80 percent.

The size of the penalty is larger than in other countries. Even when the decrease before childbirth is not taken into account, the penalty in Korea is the largest among them in eight countries. As the child penalty in Korea mostly comes from extensive margins, Figure 1.2 compares the child penalty in labor force participation rates across countries. Even when the child penalty two years prior to childbirth (P_{-2}), which is observed only in Korea, is not included in the long-run child penalty, the size of the penalty in Korea is the third-largest after the United States and the United Kingdom.

The penalty in earnings is driven almost exclusively by the extensive margin (being out of the labor force). If a woman continues to hold her job after marriage, there is no penalty in working hours and hourly wages. One feature that distinguishes Korea from other countries is that there is a spike in the female hourly wage after childbirth, as shown in panel (d) in Figure 1.3. This can be evidence of selection into employment. A substantial number of women leave their jobs when their children are born. If a woman stays at her job after childbirth, the selection suggests that she is likely to have high incentives to remain in the labor force, possibly due to higher wages or the value she places on her career. As women tend to return to work overtime, the penalty of women in hourly wages starts to decrease.

The child penalty explains the substantial part of the gender gap. The gender earning gap at age 40 to 44, which is almost 10 years after first childbirth, in the KLIPS is 74.1 percent.[1] To compare the gender gap and the child penalty, I re-calculate the child penalty using counterfactual male earnings as a denominator. The re-calculated child penalty is 43.8 percent.[2] The long-run child penalty explains 59.1 percent of the gender gap in earnings in the early 40s.

1.5.2 Contributing Factors

While changing job characteristics, such as move into the public sector (Pertold-Gebicka, Pertold, and Gupta, 2016), help explain the child penalty in other countries, the child penalty for Korean

[1] $The\ unadjusted\ gender\ earning\ gap = \left(\frac{average\ male\ earning - average\ female\ earning}{average\ male\ earning}\right)$

[2] $P_t \equiv \frac{\hat{\alpha}_t^m - \hat{\alpha}_t^w}{E[\tilde{Y}_{ist}^m | t]}$

women comes exclusively from leaving the labor force, so changes within a job cannot explain the penalty in Korea. Therefore, I provide other contributing factors for the child penalty: the role of marriage, a lack of job benefits, and opportunity costs.

1.5.2.1 Role of Marriage

In this section, I investigate the role of marriage in explaining the earnings gap drop prior to childbirth among Koreans. An important difference between Korea and most other OECD countries is the fact that out-of-wedlock childbearing is much lower in Korea. While the average share of out-of-wedlock births among the OECD countries was 40.35 percent in 2016, the share in Korea was only 1.91 percent.[3] Thus, marriage almost always precedes childbirth in Korea.

To separate the effect of marriage and childbirth on the labor market outcomes, I divide the sample into four groups based on the time gap between marriage and childbirth. The time gap is the calendar year difference between the first marriage and childbirth (the year of the first childbirth - the year of the first marriage). A one-year time gap means that a person has a first child one calendar year after marriage. These four groups are most common in the sample, and approximately 85 percent of women belong to one of these four groups. The share of each group is indicated in Figure 1.4. Figure 1.4 plots the child penalty in participation rates. The first panel in Figure 1.4 is the child penalty of people who marry and have a child in the same year. The rest of the panels show the child penalty of people who have a time gap between marriage and childbirth of 1 year, 2 years, and 3 years, respectively.

Women who marry and have a child in the same calendar year (panel (a)), which are the smallest share among the four groups, do not experience a decrease in the labor force participation rate before childbirth. The remaining three panels ((b), (c), and (d)) suggest that Korean women experience the penalty prior to childbirth. This penalty starting before childbirth can be from marriage or still from childbirth. Panel (d) illustrates that there is no marriage penalty, a decline in participation rates at the year of marriage, if a woman has her first child three years after marriage. The size of

[3] OECD Family Database, `http://www.oecd.org/els/family/database.htm`

the subsample for panel (d) is only 13 percent. Panels (b) and (c) in Figure 1.4 show the evidence of the marriage penalty. Women who have a first child after one or two years of marriage experience a drop in participation rates at the year of marriage. The penalty for participation rate for women in (c) decreases from 43.7 percent (P^w_{-3}) to 25.9 percent (P^w_{-2}) at the year of marriage, which confirms that marriage is a substantial part of the penalty prior to childbirth. The penalty using marriage as an event is presented in Appendix C. In the next section, I will discuss other potential explanations for the child penalty.

1.5.2.2 Lack of Work Benefits

Existing research shows that more generous family leave policies are associated with lower gender wage gaps (Gornick, Meyers, and Ross, 1998; Waldfogel, 1998). Korea introduced maternity leave in 1953. The length of leave was extended from 60 days to 90 days in 2001. An employer with more than one employee must provide maternity leave. An employer fully pays wages for the first 60 days of the leave period.[4] The employment insurance covers the wages for the last 30 days. This leave is given even for miscarriage or stillbirth. Even though any working woman who gives a birth to a child has been statutorily entitled to maternity leave for many years, studies show that many female workers do not have access to the leave. Kim (2018) points out that 25.7 percent of women eligible for employment insurance are not registered for the insurance as of 2016. Even with the insurance, 35.9 percent of pregnant female workers leave the labor force before their childbirth. Won and Pascall (2004) also show that approximately 36 percent of firms violate the legislation because the penalties of violation of maternity leave are insufficient. This implies that pregnancy is not protected well enough in Korea, which results in higher child penalties.

Evidence from the KLIPS also confirms that many Korean women do not have access to maternity leave. In Figure B.1, for women in the labor force at one year before childbirth, only 57 percent of them have access to maternity leave. Korean women leave the labor force before

[4]The employment insurance covers the maternity leave for preferentially supported enterprises for the first 60 days as well. Ministry of Employment and Labor (2013) provides the details of maternity protection programs.

childbirth, and therefore, access to leave at a specific event time reflects selection into the labor market. For example, women in the labor force at the year of childbirth can stay in the labor market because they have access to maternity leave at that time. Figure B.1 shows that more women report that they have access to leaves as event time increases.

Due to this selection issue, I define the access to maternity leave as whether or not the woman reports having ever worked at a firm that provides maternity leave before childbirth. Figure 1.6 shows the status of working through one year before to after childbirth by access to maternity leave. For those women with access to maternity leave, the probability of working through one year before childbirth (t=-1) to one year after childbirth (t=+1) is 48 percent. In contrast, women who worked at a firm not providing the leave or did not have a job before childbirth, only 14 percent of women continue to work around childbirth. Therefore, maternity leave can be one of the crucial factors for whether women continue to work. In Figure 1.6, there are three groups: men, the women who had worked in a workplace providing maternity leave before childbirth, and the rest of women. Women with access to maternity leave receive the smaller child penalty before and after childbirth than women without access to leave. Although the estimated size of the long-run child penalty for women with access to maternity leave is larger than that for women without access to leave, this is because of the pre-trend. There is no pre-trend between men and women with access to maternity leave. If the decrease prior to childbirth is taken into account, the penalty for women without leave would become larger. The women in workplaces offering maternity leave stay in their jobs before childbirth, but they still leave the labor force after childbirth. This result indicates that maternity leave plays an important role in reducing the size of the child penalty. It also confirms that it is difficult for married women to stay in their jobs after pregnancy. The child penalty by access to parental leave is presented in Appendix B.

1.5.2.3 Opportunity Costs

Finally, I consider whether opportunity cost is correlated with the child penalty. Existing research finds that the child penalty can vary by opportunity costs of childbirth. Anderson et al. (2003)

show the child penalty by the level of education. Women with a high school diploma experience the largest child penalty in wages among women with no degree or a college degree. They argue that the largest child penalty for medium-skilled women is due to a less flexible work schedule.

Table 1.2 compares characteristics based on the job status of women from one year before and one year after childbirth. If a woman *"Did Not Work"* works through one year before childbirth (t=-1) to one year after childbirth (t=+1), then her work status is defined as working (*"Work"*). Those who leave the labor force at least once from t=-1 to t=+1 are defined as nonworking (*"Did Not Work"*). Women who stay in the labor force tend to be older, highly educated, well-paid, and more experienced than those who leave the labor force around childbirth. Those women have higher opportunity costs for leaving the labor force, so they tend to stay more before and after childbirth. On the other hand, women with low earnings are more likely to leave the labor force because the opportunity cost of leaving the workforce to care for their child by themselves is lower. In summary, women with high opportunity costs in childbearing have a high level of education, high earnings, and longer tenure years.

The estimated child penalty by opportunity costs is plotted in Figure 1.7. First, panel (a) in Figure 1.7 is the child penalty in the participation rates by education. Females with low education are women with less than 14 years of education. Females with high education face a lower child penalty than females with low education around childbirth. In the short-run, while women with high education lag behind 34.5 percent in the participation rates relative to men, the penalty for women with low education is 41.1 percent.

In Figure 1.7 (b), women are categorized based on earnings at two years before childbirth (t=-2). The solid line in (b) represents the child penalty for women earning below the median. Those women earning below the median receive the higher child penalty at the time of childbirth than women earning above the median, but they are more likely to return to the labor force. As a result, the long-run child penalty is 45 percent point smaller for women earning below the median.

In panel (c), Women are grouped based on the most current job experience before childbirth. If a woman has less than 4 years of experience, this woman is regarded as a woman with short

job experience (solid black line in Figure 1.7.(c)). Women with short experience receive a higher penalty than women with long experience at childbirth. However, women with short job experience return to the labor force more, so the long-run penalty for them is smaller. The long-run child penalty for women with low opportunity costs is lower.

All panels in Figure 1.7 show that women with higher opportunity costs, who are highly educated, paid above the median, and worked longer before childbirth, receive a smaller child penalty in the short-run, but their penalty is more persistent than women with low opportunity costs.

Couples can jointly decide their labor market decisions, and therefore, the characteristics of a husband may affect the size of the child penalty of his wife. Panel B in Table 1.2 reports the characteristics of a husband in the year of childbirth (t=0). Husbands of the two groups are also different. Husbands of working women are more likely to be highly educated and have higher wages like their wives, which suggests assortative mating in Korean marriages. One interesting difference is hours worked. Even though the husbands of women who leave the labor force earn less, they work four hours longer a week. Their wives may be more responsible for childcare, which can lead to leaving the labor force. Figure 1.8 plots the child penalties by husband's characteristics. Women with a husband who is well paid, highly educated, and work less face a smaller child penalty around childbirth than women with a husband who is paid below the median, low educated, and work more.

Table 1.3 compares the short-run and the long-run penalty by individuals' opportunity costs. The long-run penalty defined in Section 1.3 is the average value of the penalty from t=5 to t=10. The short-run penalty is the average value of the penalty from t=0 to t=4. In the table, *Low* means the child penalty for women with low opportunity costs, and *High* is the child penalty for women with high opportunity costs.

Women with high opportunity costs in terms of their own characteristics receive a 4.1 percent point to 11.7 percent point smaller child penalty around childbirth (in the short-run) than women with low opportunity costs. This contradicts with the result of Anderson et al. (2002). They

argue that women experience skill depreciations when they leave the labor force with a birth of a child, so high skilled women receive a higher child penalty from the absence from the labor force. In Korea, many women leave the labor market around childbirth, and therefore, the pattern of women's staying in and returning to the market can be different by characteristics. Ma (2014) studies how women return to the labor force after childbirth in Korea using the KLIPS. She shows that women with good labor market standing are less likely to leave the labor force after childbirth, which is consistent with my result that women with high opportunity costs receive the smaller child penalty in the short-run. She argues that this results from job-protected maternity leave. Also, she shows that women return to the labor force three years after childbirth, and after their return, they experience downward occupational moves. Berniell et al. (2021) also show that labor informality increases for women in Chile with childbirth. My result shows that women's probability of working as a regular worker is lower relative to men in the long-run. Still, there is no statistically significant increase in the irregular job for women before and after childbirth (Figure B.4).

1.6 Conclusion

Many researchers consider the effect of children on the gender gap in numerous countries. However, there is not much literature on the child penalty in Korea despite the large gender gap. This paper uses the method proposed by Kleven et al. (2019b) to estimate the effect of first childbirth overtime. Using microdata from 1998 to 2018, I show that the child penalty in earnings is 68 percent and that this penalty in earnings is driven by the extensive margins. The child penalty in Korea has aspects that differ from those in other countries.

First, the 68 percent long-run penalty in earnings in Korea is the largest among those in countries investigated by studies using the same method. According to Kleven et al. (2019a), the long-run penalty is the smallest in Denmark, 21 percent, and German women suffer the largest penalty, 61 percent.

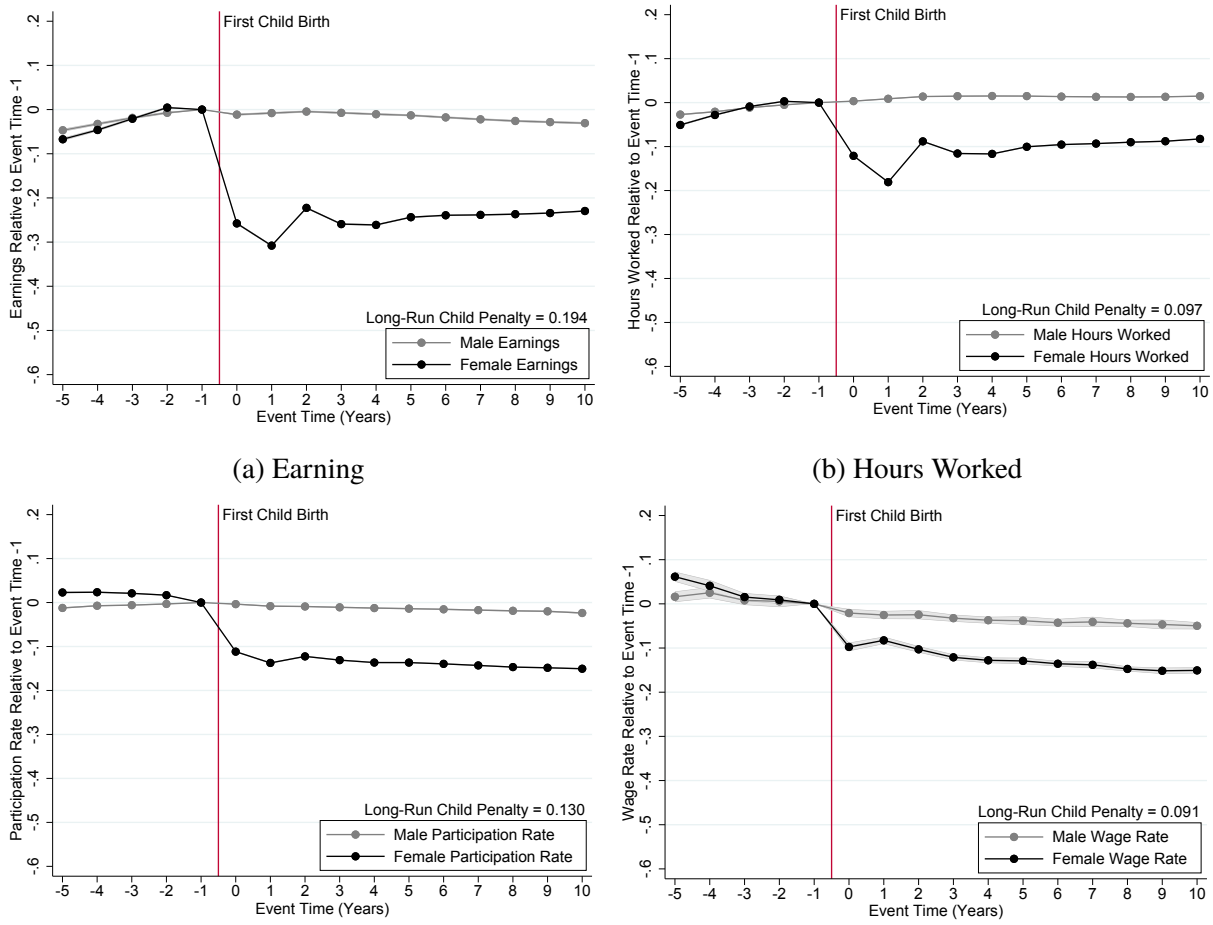
Second, the decrease in earnings of Korean women begins before the first childbirth. If this drop prior to childbirth is taken into account, the child penalty becomes larger, 82 percent in the

long-run. A part of the penalty prior to childbirth is explained by marriage. Women who have worked in a job with maternity leave experience no penalties prior to childbirth.

Third, the penalties come from losing or quitting their job. If women remain in the labor force after their first childbirth, then childbirth has no impact on women's working hours and hourly wage. This finding is not consistent with the results of Sieppi and Pehkonen (2019); Kleven et al. (2019a,b), which shows that women in those countries experience the child penalty mainly from the intensive margins.

Fourth, the pattern of the child penalty varies by opportunity costs. Women with low opportunity costs receive the higher child penalty in the short-run. However, they are more likely to return to the labor force, and thus, their long-run child penalty is smaller than the child penalty of women with high opportunity costs.

In this paper, I show the penalty patterns in Korea and examine factors for the penalty such as marriage, lack of work benefits, and opportunity costs. It does not explain why women leave their jobs after childbirth. Future research will investigate why women quit or lose their jobs and why Korean women suffer from such a large child penalty.



(a) Earning

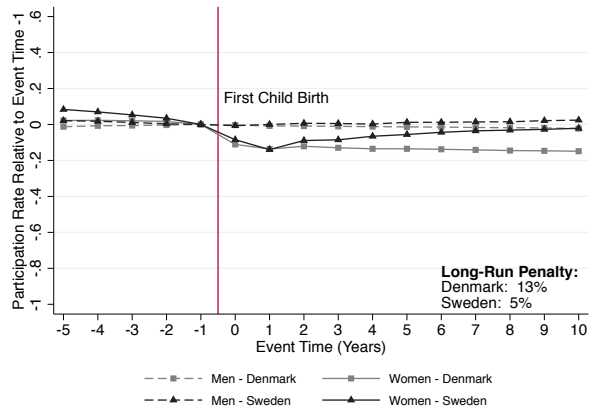
(b) Hours Worked

(c) Labor Force

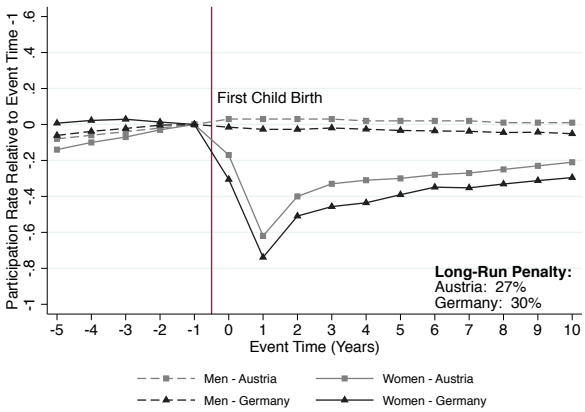
(d) Hourly Wage

Figure 1.1: The Child Penalty in Denmark

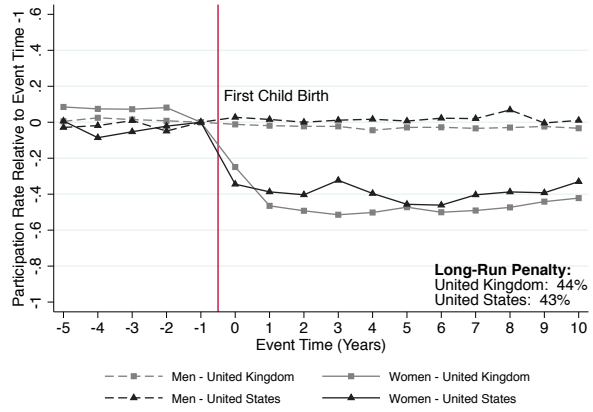
Notes: These figures are the baseline results of Kleven et al. (2019b). The long-run child penalty is measured at event time 10 (P_{10}).



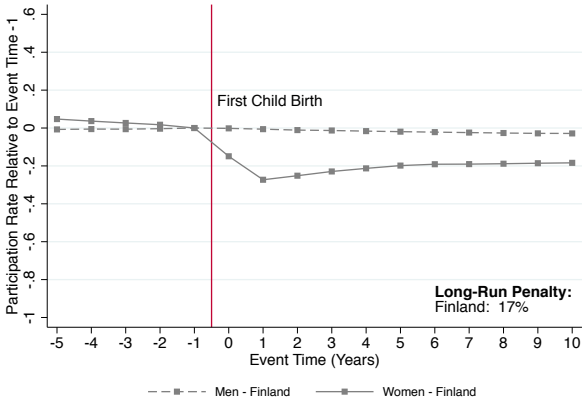
(a) Scandinavia



(b) German Speaking



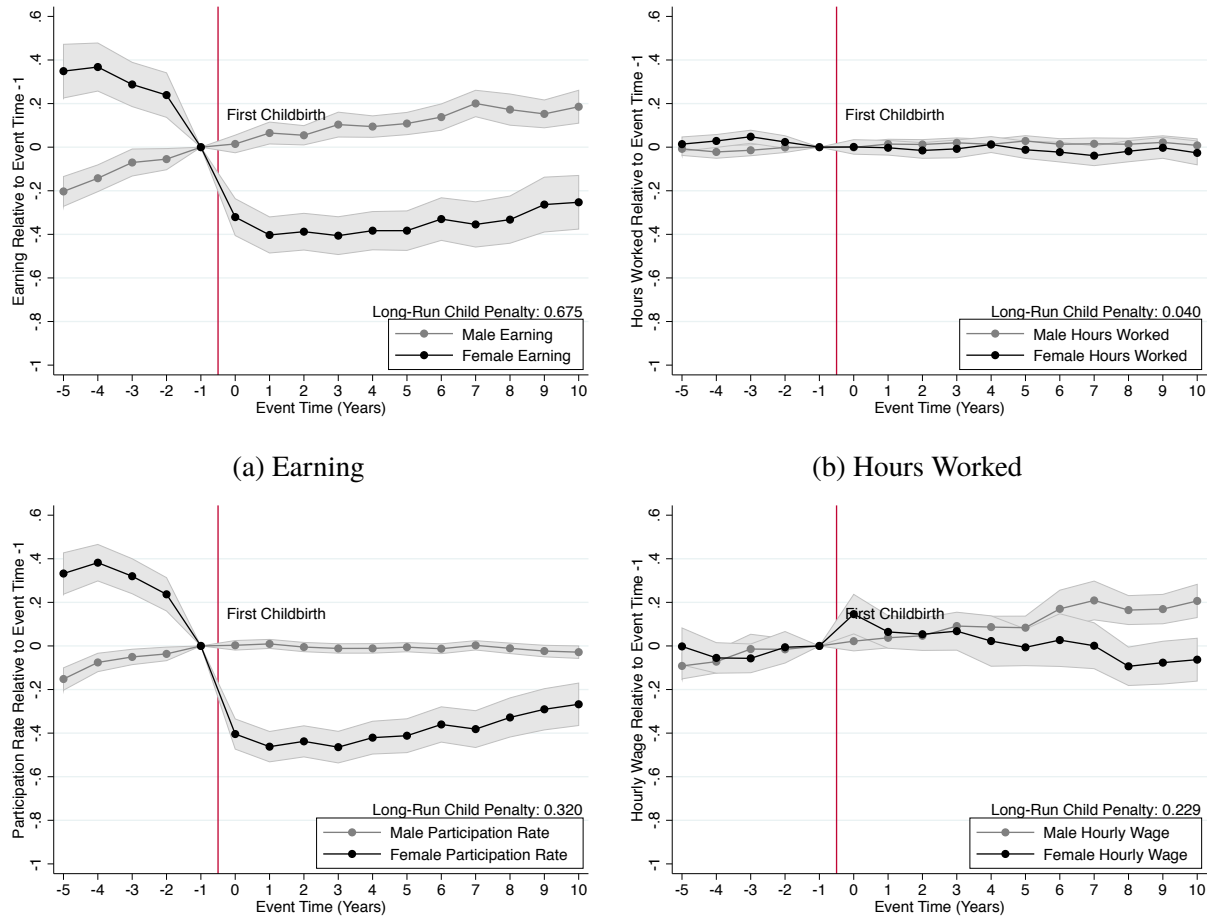
(c) English Speaking



(d) Finland

Figure 1.2: The Children Penalties in Other Countries

Notes: Panels (a), (b) and (c) are the results of Kleven et al. (2019a). The child penalty of Finland in panel (d) is from Sieppi and Pehkonen (2019). The long-run child penalty is the average value of the penalty from event time 5 to 10.



(a) Earning

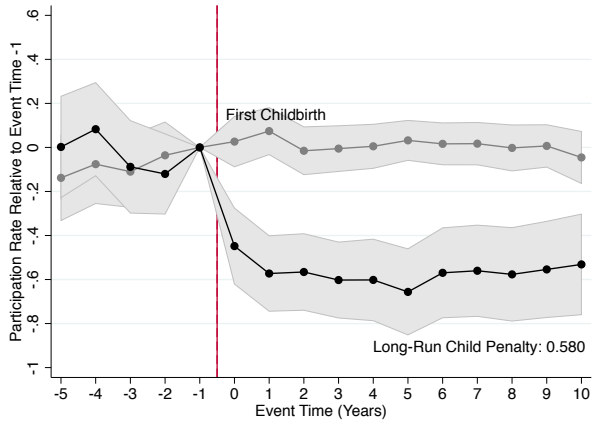
(b) Hours Worked

(c) Labor Force

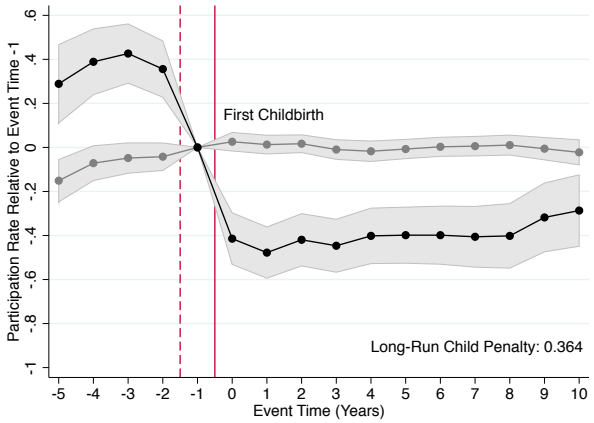
(d) Hourly Wage

Figure 1.3: The Child Penalty in Korea

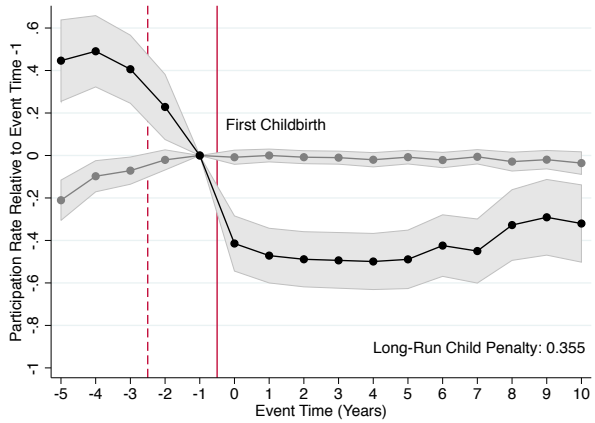
Notes: The long-run child penalty is the average value of the penalty from event time 5 to 10.



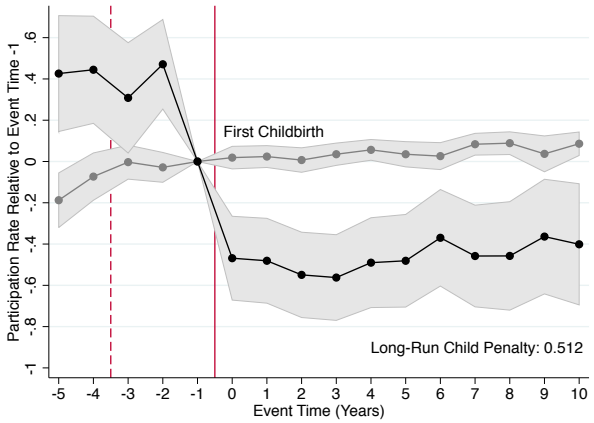
(a) Time Gap = 0 (10%)



(b) Time Gap = 1 (34 %)



(c) Time Gap = 2 (27%)



(d) Time Gap = 3 (13%)

Figure 1.4: The Child Penalty Depending on the Time Gap between Marriage and Childbirth

Notes: The proportion of subsample is in parentheses. The solid red line represents the year of first childbirth, and the dashed line plots the year of marriage. The time gap is the year difference between the first marriage and childbirth (the year of the first childbirth - the year of the first marriage).

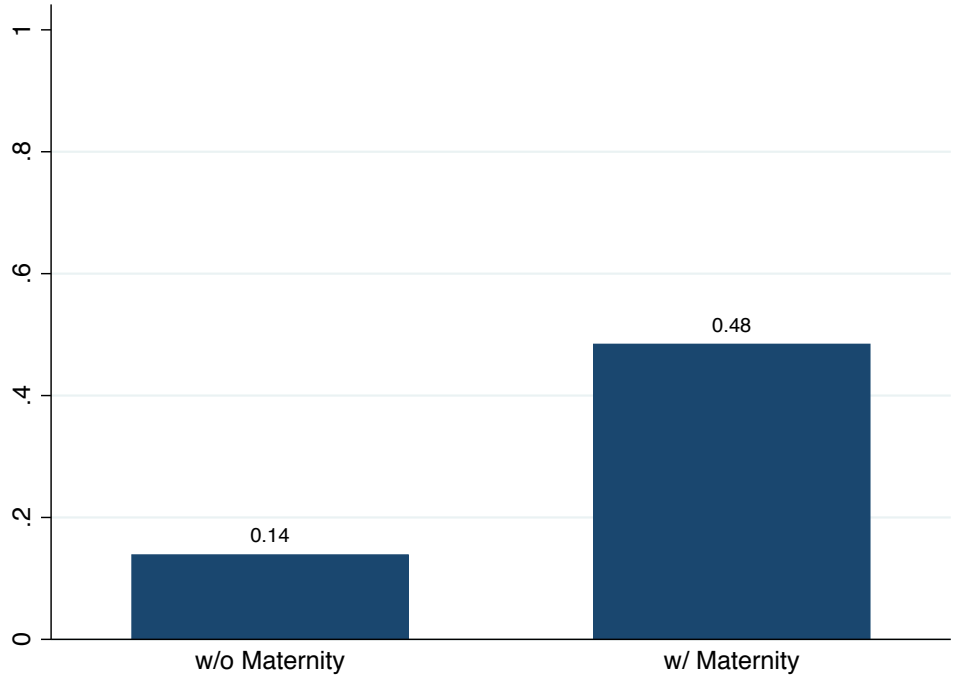


Figure 1.5: Probability of Working Through t=-1 to t=+1 by Access to Maternity Leave

Notes: Access to maternity leave is calculated based on whether they have worked in a firm providing maternity leave before childbirth or not.

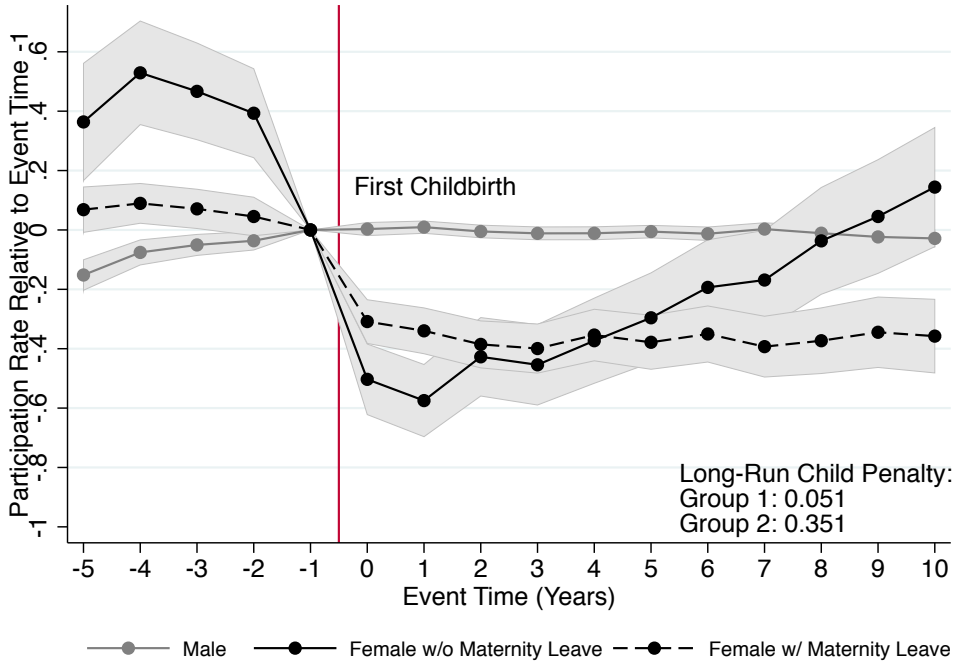
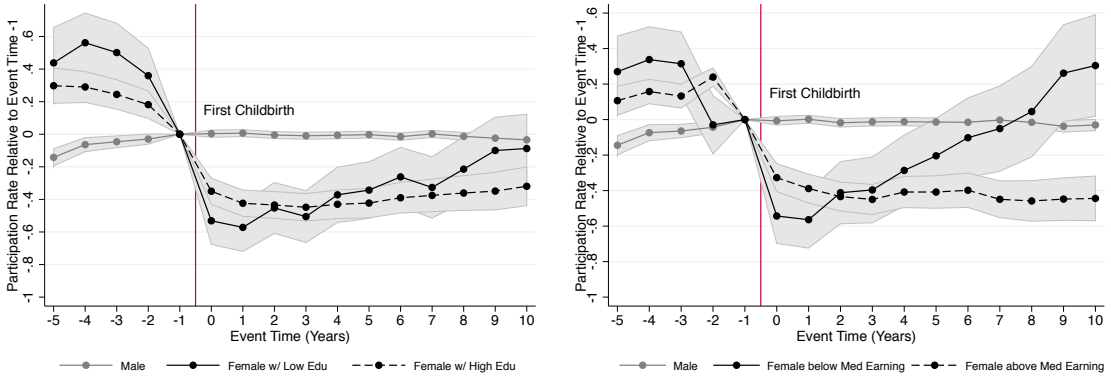


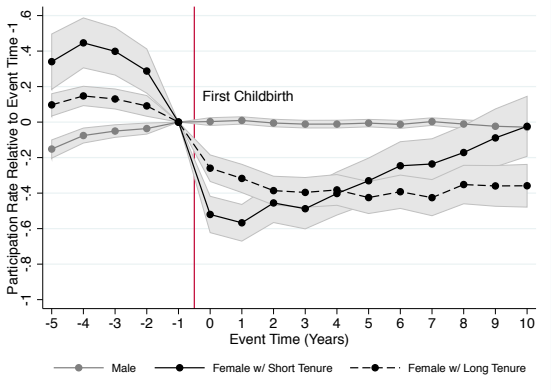
Figure 1.6: The Child Penalty by Access to Maternity Leave

Notes: The dashed black line represents the impact of childbirth of females who worked in a workplace that provides maternity leave before childbirth. The solid black line shows the effect of childbirth on the rest of the females.



(a) By Education

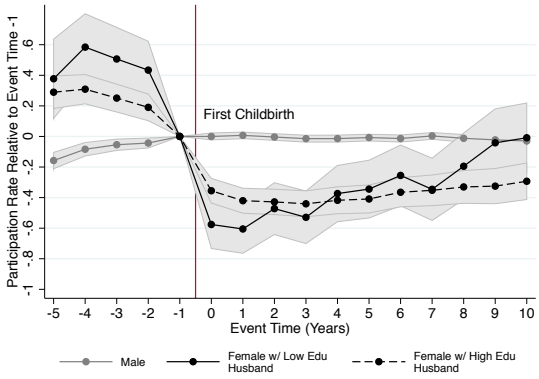
(b) By Earning



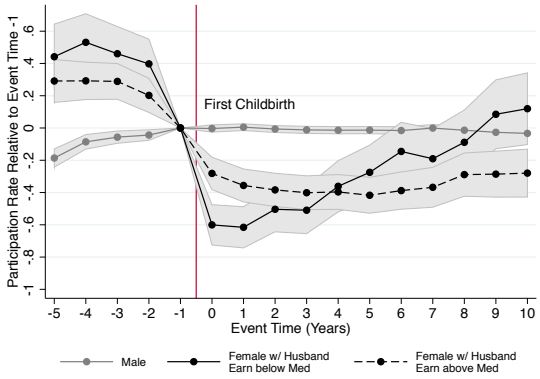
(c) By Tenure Year

Figure 1.7: Heterogeneities in the Child Penalty

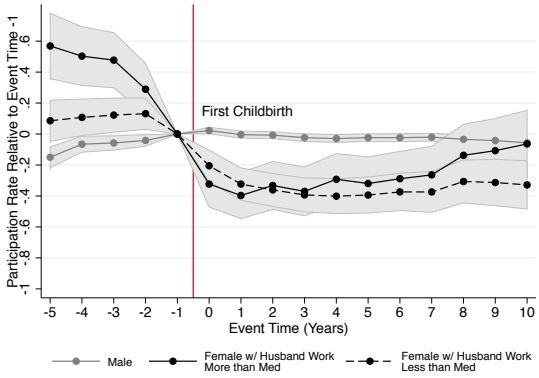
Notes: (a) Females with low education indicate women with less than 14 years of completed education. Women with high education means women with 14 or higher years of completed education (higher than a college degree). (b) Median earnings are calculated based on earnings at t=-2. (c) Tenure year counts tenure years at the most recent job before having a first child. Women with long tenure years mean women with more than 4 years at the job. If a woman works less than 4 years at the most recent job before childbirth, she is included in the group with short tenure years.



(a) By Education



(b) By Earning



(c) By Hours Worked

Figure 1.8: Heterogeneities in the Child Penalty by Husband's Characteristics

Notes: All husband's characteristics are based on t=0. (a) Men with low education indicate men with less than 14 years of completed education. Men with high education means men with 14 or higher years of completed education (higher than a college degree). Women with a husband with less than 14 years of completed education are women with low educated husband. (b) Median earnings are calculated based on earnings at t=0. (c) The solid black line is for women with a husband who works above the median hours worked.

Table 1.1: Summary Statistics at One Year Before Childbirth

	Female	Male
Age	28.91	31.49
	(3.56)	(3.93)
Education	14.09	14.32
	(2.01)	(2.14)
Earnings	105.90	233.89
	(109.78)	(129.06)
Labor Force	0.59	0.92
	(0.49)	(0.27)
Hours Worked	43.91	50.76
	(10.81)	(12.35)
Hourly Wages	1.02	1.22
	(0.59)	(0.62)
Observations	1004	1054

Notes: Standard deviations are in parentheses. The sample consists of people who had a first child between 1999 and 2017. This table is based on the values at one year before childbirth. Earnings are monthly wages in 2019 Korean 10,000 won ($\simeq$ \$10). Average male earnings are 2.34 million Korean won (approximately \$2100). Education is the years of completed education.

Table 1.2: Comparison between Working and Non-working Women

	Work	*Did Not Work*	T-test
A. Own characteristics at t=-2			
Age	28.67	27.91	0.76***
	(3.49)	(3.69)	
Education	14.50	13.75	0.74***
	(1.92)	(1.90)	
Earnings	195.68	95.35	100.33***
	(133.81)	(89.00)	
Tenure Years	4.52	1.98	2.54***
	(3.68)	(2.70)	
B. Her husband's characteristics at t=0			
Age	31.66	30.96	0.70**
	(3.46)	(3.83)	
Education	15.17	13.99	2.06***
	(1.86)	(2.06)	
Earnings	257.63	143.48	114.15***
	(117.97)	(155.55)	
Hours Worked	46.74	50.46	-3.72***
	(11.91)	(13.05)	

Notes: Standard deviations in parentheses. The job status is defined based on the job between -1, 0, and +1. *"Work"*=women continue to work through t=-1 to t=+1, *"Did not work"*=women leave the labor force between -1 to +1.

Table 1.3: Short-run and Long-run Penalty in Participation Rates by Characteristics

	(1)	(2)	(3)	(4)
	Short-Run		Long-Run	
	Low	High	Low	High
A. By own characteristics				
Education	41.1	34.5	22.7	35.0
Earnings	36.6	32.5	-3.7	41.3
Tenure Years	40.4	28.7	19.2	37.1
B. By husband's characteristics				
Education	43.2	33.7	21.4	32.6
Earnings	43.9	29.6	9.0	31.3
Hours Worked	28.0	27.2	16.9	30.6

Notes: The short-run penalty is the average value of the penalty (P_t) from t=0 to t=4. The long-run penalty is from t=5 to from t=10. The penalties in (1) and (3) are for women with low opportunity costs who are low educated, paid below the median, and have short tenure years.

CHAPTER 2

MARRIAGE TRENDS IN SOUTH KOREA: THE ROLE OF SEX RATIOS

2.1 Introduction

Because of a rapid decline in the fertility rate and a strong preference for at least one son, sex ratios at birth (SRBs) in South Korea (hereafter Korea) from the 1980s to the 2000s were highly skewed. Figure 2.1 shows the changes in the total fertility rate (TFR) and the SRB (number of male births per 100 female births) from 1970 to 2018. The TRF in 1970 was approximately 4.5 and dropped sharply until the mid-1980s. With this rapid drop in fertility and the introduction of ultrasounds in the 1980s, the SRB grew sharply (Hwang, Lee, and Lee, 2019; Kim, 2004; Park and Cho, 1995a,b). The gray area in the figure indicates the natural SRB ranging from 105 to 107. The SRBs were above the range almost all years until the late 2000s and it peaked at 116.5 in 1990. There was a surplus of approximately 50,000 newborn boys over girls in 1990 alone. This imbalance in the SRB lasted for 20 years. As Korea has very low infant and child mortality (Han and Kim, 1990), this imbalance in the SRB directly affects the sex ratios at later ages.

In this paper, I examine whether this skewed sex ratio affects the marriage market twenty years later using the administrative Population and Housing Census. First, a lack of women can affect marriage rate. Figure 2.2 shows that the probability of marriage by cohorts of men and women. The probability of getting married is almost one for both men and women born between 1940 and 1960. The marriage patterns in all age groups for women born in the 1970s and 1980s have not yet been observed. However, the probabilities of marriage for women born in the 1970s and 1980s are high. For women born in the 1970s, the probability of marriage at the age of 45-49 is 93%. And for women born in the 1980s, the probability of marriage at the age of 35-39 is 80%. On the other hand, men born in the 1970s and 1980s are the generation that experienced the large imbalance in SRB. For those men, the probability of marriage is lower than that of women in all age groups. For men born in the 1980s, the probability of marriage at age 35-39 is 62%, which is 18 percent points

lower than that of women of the same generation.

Second, the skewed SRB could affect marriage timing. With a high sex ratio, men are more likely than women to have difficulty finding a spouse (Gould and Paserman, 2003; Loughran, 2002), and women can marry at an earlier age (Abramitzky, Delavande, and Vasconcelos, 2011). Figure 2.3 shows the average age at first marriage from 1990 to 2015. In 1990, the average age at marriage was 27.8 for men and 24.8 for women. By 2015, the age at marriage increased by 4.8 years for men and 5.2 years for women. In this paper, I investigate the effect of skewed SRB on the marriage timing.

Third, the skewed SRB could affect other outcomes related to the marriage market. For example, individuals might obtain more education to make themselves more attractive in the marriage market. Lafortune (2013) show that male's educational attainment increases as the sex ratios in the same ethnic and state group increased. The mating pattern can be affected by sex ratios. Abramitzky, Delavande, and Vasconcelos (2011) show that men were less likely to marry women from lower social classes when there were higher male mortality rates from a war. I examine the effect of SRB on other marital market outcomes as well.

The remainder of this paper proceeds as follows. Section 2.2 introduces previous literature investigating the effect of the sex ratio. The data are described in Section 2.3. Section 2.4 introduces the method. Section 2.5 shows the estimation results, and Section 2.6 concludes.

2.2 Literature Review

Many papers studying the delayed marriage in Korea focus on traditional norms. Specifically, highly educated women in East Asia are more likely to delay marriage (Brandt, Li, Turner, and Zou, 2018). Raymo, Park, Xie, and Yeung (2015) review marriage and family trends in East Asia. They suggest several potential explanations for late marriage. One is the opportunity cost of marriage for women. While economic indicators, such as GDP and the female labor force participation rate, have changed greatly, family expectations and obligations remain almost the same. Married women are strongly expected to have children and do more housework than men. Conservative attitudes

increase the costs of their marriage and childbearing, so women delay both.

Kim and Cheung (2015) model changes in traditional thought. They investigate the effect of changes in women's attitudes on their life decisions, such as those regarding marriage and childbirth. They use items from the Korean Longitudinal Survey of Women and Families (KLoWF). The KLoWF asks for respondents' opinions on marriage: "Marriage is a must," "It's good to marry early," "One must have a child," and "It's good to have children early when married." Family attitudes are measured by answers to these questions, and the measure of attitudes is then used as a dependent variable. The authors show how marriage and fertility change over time depending the attitudes. They show that married women in Korea have more traditional attitudes toward family formation than unmarried women, regardless of the level of education. Their data indicate that younger generations have less traditional attitudes than older generations, which may account for late marriage and low fertility.

Hwang (2016) also investigates the effect of gender norms on marriage and time use. She tests the traditional attitude that a wife has much more responsibility for housework than her husband. She compares the time usage in the household between a wife with a US-born Asian husband and a wife with a husband born in an East Asian country. In her model, US-born Asian husbands are less traditional than husbands born in an East Asian country because they are exposed to US gender norm from their childhood. She finds that the housework burden is larger for a wife married to a foreign-born man. Additionally, she shows that women from Korea and Japan in the US are more likely to marry out of their ethnic group. She argues that the reduced marriage rates among highly educated women come from the gaps between their rising economic status and the unchanged gender norms for women in traditional societies.

While the change in social norms is likely an important factor explaining the marriage trends in Korea, demographic factor could be important as well. The sex ratio can be affected by many factors, such as war, famine, and the sex preference of parents. This imbalance improves marriage conditions for women. Women can marry early and work less after marriage (Angrist, 2002; Guilmoto, 2012; Grosjean and Khattar, 2018). In contrast, men can marry up when there is male

scarcity (Abramitzky et al., 2011). The sex that has greater scarcity can derive more benefit from marriage. Angrist (2002) examines the relationship between the sex ratio and the probability of marriage. The sex ratio may be endogenous, so he exploits immigrant flows, considering that immigrant groups usually have high sex ratios and tend to marry within the same ethnic group. His results show that second-generation women are more likely to marry and less likely to work. Guilmoto (2012) simulates the effect of the skewed sex ratio on future marriage rates in China and India. One of his simulation scenarios is a rapid shift in the SRB. As he mentions in his paper, this is the case for Korea: Korea had a high SRB in the 1980s and 1990s, but the ratio returned to natural SRB (105-107, Hesketh and Xing (2006)) in approximately 2008. His indicator of the intensity of demographic disequilibria in the marriage market for China is highest in 2030 under this rapid change. This finding could be applied to the marriage market in Korea. Grosjean and Khattar (2018) investigate the long-run effect of male-biased sex ratios. They use the 18th- and 19th-century Australia Census data, as Australia had a very high sex ratio during that period. Under such conditions, women married early and worked less. The authors show that this conservative attitude still affects present-day marriage patterns in Australia.

The search cost also affects marriage rates. Bronson and Mazzocco (2018) suggest a negative effect of cohort size on marriage rates. A larger cohort size means that there are more people, which increases the search costs. Loughran (2002) proposes a one-sided search model for the marriage market. If women prefer men with high wages, this increases women's reservation utility when there is high male wage inequality. Gould and Paserman (2003) explore the same effect, but they also control for labor market conditions. They show that the marriage rate of women in the cities decreases as male wage inequality increases.

In addition to the research on the effect of sex ratio on marriage, many papers investigate additional effects of this factor. McKinnish (2007) finds a positive effect of sexually segregated workplaces on divorce. Svarer (2007), however, shows that the sex ratio at workplaces has no impact on partnership formation. China also has an extremely imbalanced sex ratio due to the one-child policy and son preference. Edlund, Li, Yi, and Zhang (2013) show that the high sex

ratio in the 16-25 age group accounts for a rise in crime. Trent and South (2011) argue that the sex ratio can affect partnering behavior. The authors conclude that women are more engaged in sexual relationships when there is a high sex ratio. Wei and Zhang (2011) explain the rising savings rate in China by referring to the high sex ratio. Parents save more to make their son attractive in the marriage market. Francis (2011) presents evidence that the higher intra-household bargaining power of women increases the number of girls in a family and improves the welfare of children. Hwang, Lee, and Lee (2019) show that parental gender norms proxied by the SRB affect the allocation of housework time between husbands and wives in Korea. Unlike the studies showing a higher bargaining power of women with a high sex ration, their result shows that the wife's housework time increase when the husband is from a province with a higher sex ratio at birth.

The effect of the imbalanced sex ratio in Korea has received relatively little attention to date. Edlund (1999) models how an imbalance in SRB in Asia affects various consequences, including marriage patterns. His model suggests a higher SRB results in a wider spousal age gap and higher probability of women marrying up. Raymo and Park (2020) argue that gender imbalance decreases marriage rates for highly educated women and less educated men. Rallu (2006) argues that there will be approximately 25 percent fewer females than males in 2025-2028 under a male-biased SRB. This will hinder the marriage rate of males.

In this paper, I will estimate the effect of the SRB on marriage timing and other marital outcomes, such as education, migration, and spousal gaps in age and education. Due to skewed SRB, there are more men than women when they enter the marriage market. I expect that men tend to marry later and move more, and have a higher level of education, and spousal gaps increase with a high SRB.

2.3 Data

The Population and Housing Census (hereafter census) and the Population Projection are used as data sources. Both the micro- and macro-level data of the census and the vital statistics are used. The macro-level data are made available at the Korean Statistics Information Service by Statistics

Korea (http://kosis.kr).

The census is designed to collect information on the population structures for all Korean and foreign residents. Statistics Korea conducted the survey once every five years until 2015, after which the census for the population started to be conducted once a year. The sample census selects 20% of households nationwide. There were 50 and 52 questions in the 2010 and 2015 censuses, respectively. I use the administrative micro-level census data from 2010 and 2015 to examine the effect of SRB on marriage timing.[1] My sample consists of people in the 2010 census born between 1975 and 1990 and people in the 2015 census who were born between 1975 and 1990 and did not marry until 2010 in the 2015 census.

Figure 2.5 shows the map of South Korea in 2015. There are 17 jurisdictions including one special city (Seoul), six metropolitan cities (Busan, Daegu, Incheon, Gwangju, Daejeon, and Ulsan), one special autonomous province (Jeju), eight provinces (Gyeonggi-do, Gangwon-do, Chungcheongbuk-do, Chungcheongnam-do, Jeollabuk-do, Jeollanam-do, Gyeongsangbuk-do, and Gyeongsangnam-do), and one special autonomous city (Sejong). Sejong was first created in 2012. Sejong is a combination of Chungcheongbuk-do and Chungcheongnam-do. If the reported birth region is Sejong in the 2015 census, the exact province where an individual was born is not identified. Therefore, my sample excludes those who report a birth region of Sejong in the 2015 census, amounting to 2,958 individuals, which is 0.121 percent of my sample. The number below the name of the province is the census regional code.

The Vital Statistics collects data from all Korean nationals residing in or outside Korea who reported a birth, death, marriage, or divorce status. Statistics Korea provides the data from 1981, and therefore, the SRB for people born before 1981 was not identified. The Population Projections are used to construct the SRB. Statistics Korea publishes the Population Projections every five years. They estimate the population based on the Population and Housing Census and Internal- and International-Migration Statistics. In the year in which the census was conducted, the population was determined based on the census. In the between-census periods, the population was calculated

[1] The Population and Housing Census 1% (2010, 2015), and the Vital Statistics - Birth (1981-1990) Statistics Korea Remote Access Service (RAS20031501)

based on the Internal- and International-Migration Statistics.

The summary statistics are reported in Table 2.1. Education is the completed education, and there are seven categories (1: No education, 2: Elementary, 3: Middle school, 4: High school, 5: Some college, 6: University, 7: Master's degree or above). The mean level of education for both men and women is college-level. While married women have a lower level of education than married men, the level of education for unmarried women is higher than that for unmarried men. In the estimation, a three-level education indicator is used (Low (1-3), Medium (4-5), High (6-7)) because the younger generations have not yet finished their schooling. For example, the youngest people in my sample is people born in 1990. They were 20 years old in 2010 and 25 years old in 2015. The completed level of education is not identified in the data. However, most people go to the college at the age of 19 or 20, so the three-level education indicator is used. Unmarried people are younger than married people. Men's age at first marriage is 2 years older than women's. Unmarried men and women tend to be born in areas with a high SRB.

2.4 Method

I investigate the impact of the SRB on marriage timing. The year of first marriage is used as the marriage timing. The effect of the SRB on marriage timing is estimated by a discrete-time hazard model. The Census is conducted every five years, so the sample is people who did not marry 5 years before the survey year. For the 2015 census, the sample is people who did not marry until 2010 and t measures the time until a person marries.

Cox (1972) proposed the discrete-time hazard model. I use a Logit specification for a discrete-time hazard model.

$$Pr(Y_{irs,t} = 1|X_{irs}, Y_{irs,t-1} = 0) = \frac{exp(\alpha^g SRB_{rs} + \beta^g X_{irs})}{1 + exp(\alpha^g SRB_{rs} + \beta^g X_{irs})} \tag{2.1}$$

This equation is estimated separately for men and women. $Pr(Y_{irs,t} = 1|X_{irs})$ is the probability that individual i of gender g married during interval t, given that no marriage occurred before t ($Y_{irs,t-1} = 0$). Y^g_{irs} is the marriage market outcome of individual i of gender g in birth region r in

birth year s. It takes a value of 1 if individual i marries and 0 otherwise. SRB_{rs} is the regional sex ratio at birth of age 0-4 in region r in birth year s. X_{irs} is a vector of covariates including birth-year fixed effects, birth-region fixed effects, counting years from age 18 fixed effects, and current year fixed effects.

To examine other marital outcomes, such as the level of education and mobility, I use a Probit model. If individual i of gender g born in birth region r in birth year s has a high level of education or lives in a different region from his or her birth region, then Y^g_{irs} in the equation takes a value of 1.

$$Pr(Y^g_{irs} = 1|\mathbf{X}) = \Phi(\delta^g SRB_{rs} + \rho^g X_{irs}) \tag{2.2}$$

Men face a higher competition in a region with a high sex ratio. Therefore, we expect that men in the region marry later, have a higher level of education and migrate more to make themselves attractive in the marriage market.

2.5 Results

2.5.1 Timing of Marriage

The estimation results are reported in Table 2.2. The SRB is the number of males aged 0-4 per 100 females aged 0-4 in the region. The first two columns are the results without covariates. A high SRB decreases the probability of first marriage for both men and women. Column (3) - (6) show the results with covariates. While men from the region with a high SRB marry late, women in the area with a high SRB tend to marry early. The results for both men and women are consistent with Abramitzky et al. (2011); Angrist (2002); Guilmoto (2012); Grosjean and Khattar (2018). Table 2.2 shows marginal effects as well. If a SRB is increased by 10, then the probability of marriage is increased by 0.16 percent point for women and decreased by 0.15 percent point for men. With the current year fixed effects, column (5) - (6) show if a SRB is increased by 10, then the probability of marriage is increased by 0.19 percent point for women and decreased by 0.14 percent point for men.

People find their spouse in their age cohort. I used not the single-year SRB but the five-year SRB. Brainerd (2017) also uses sex ratios in five-year age groups. The Vital Statistics provides the sex ratios at age 0 by region, and the data are available from 1981. My sample consists of people in the 2010 and 2015 censuses. People born in 1981 are only 29 years old in 2010. However, the average age at marriage in 2010 is 31.84 for men and 28.91 for women (Figure 2.3). Many, especially for men, had not married yet. The aggregate Population Projection provides the sex ratios at age 0-4 by region. Hereafter, the SRB used in the estimation is the sex ratio at age 0-4 by region from the Population Projection.

Figure 2.6 shows the time trend for sex ratios at age 0-4 by region. The southeastern regions of Korea have had a higher SRB than other regions since 1975. The peak SRB occurred in 1990 for all provinces. In particular, in Gyeongsangnam-do and Daegu, the SRBs exceeded 120.

The administrative Vital Statistics - Birth data are provided from 1981. Table 2.3 reports the estimation results for people born between 1981 and 1990 with two different measures of SRB. (1) and (2) use the same sex ratios as the baseline result, sex ratios at age 0-4 (SRB 04). The exact SRB is available in the Vital Statistics for those who were born between 1981 and 1990. (3) and (4) estimate the model with the exact SRB.

The estimation results with the exact SRB show no effect of SRB on marriage timing for men, while women marry earlier as SRB increases. Compared to the estimates obtained with the exact SRB, the estimates obtained using the SRB 04 are lower for women and higher for men in terms of an absolute value. In case of men, the cohort with a high SRB generates unmarried men, so men will compete with the stock of men from a different age cohort. In contrast, according to the model of Edlund (1999), all women marry at their youngest age. Therefore, the 1-year SRB can be more important for women.

2.5.2 Other Marital Outcomes

Columns (1) - (4) in Table 2.4 are Probit estimates. As the SRB increases, the probability of high education and migration decreases for both men and women.

Choi and Hwang (2020) finds that boys receive more financial support for private academic education in Korea. In this section, I investigate how the level of education differs by region and by sex, and examine the relationship between marriage and education. I estimate the effect of SRB on the probability of high education (above university) using a Probit model. If individual i of gender g born in birth region r in birth year s has a high level of education, then $High\ Edu^{g}_{irs}$ takes a value of 1. The covariates include birth-year fixed effects and birth-region fixed effects. Column (1) - (2) show that if the SRB is increased by 10, then the probability of high education is decreased by 0.051 for women and 0.03 for men.

Due to the surplus of men, men face a high level of competition. They could decide to move to another region. Migration could delay marriages. In this section, I investigate the effect of SRB on migration. On average, 48.6 percent of women currently live in a different region than where they were born, and for men, 48 percent of men live in a different region in the data. People born in cities such as Seoul and other metropolitan cities tend to stay where they were born. The average migration gender gap is -0.021. $Migration^{g}_{irs}$ has value 1 if individual i lives in a different region from their birth region. Column (3) - (4) show that if the SRB is increased by 10, then the probability of migration is decreased by 0.045 for women and 0.021 for men. Men from an area with a high SRB are less likely to move from their birth region.

Columns (5) - (6) in Table 2.4 are linear regression results for a spousal gap in age and education. Column (5) suggests that spousal age difference increases with high sex ratios. If the SRB increases by 10, the age gap between a husband and a wife increases by 0.087 years old. This is consistent with (Angrist, 2002; Edlund, 1999; Guilmoto, 2012; Grosjean and Khattar, 2018), which shows that men married younger women when there were unbalanced sex ratios at birth due to a son preference. The result reported in column (6) shows that SRBs do not affect the education gap between wife and husband. This is inconsistent with the literature suggesting women's marrying up (Edlund, 1999).

2.6 Conclusions

The SRB in Korea was skewed from the 1980s to the 2000s due to a strong son preference. This imbalance in the sex ratio could affect the marriage market when children born during this period become of marriageable age. However, there are few papers studying the effect of SRB on the marriage market in Korea. In this paper, I investigate the effect of skewed SRB on various marriage market outcomes. First, I find that men's age at marriage is likely to be high as SRB increases while women tend to marry early. Women are more sensitive to SRB. If SRB increases by 10, then the probability of first marriage decreases by 0.15 percent point for men and increases by 0.16 percent point for women. As SRB increases, the age gap between husband and wife increases. My results show that SRB affects marriage market outcomes in the long-run. Second, I show that the probability of getting high education and migration for men decreases as SRB increases, which is inconsistent with the literature. This could be the structure of industry in a region with a high SRB. Manufacturing, where male employees are majority, is the largest industry in the region with a high SRB.

I show the long-run effect of SRB on the marriage market in Korea. Future research will investigate why the results of other marital outcomes, such as high education and migration, are different from the literature. The southeastern Korea has a high SRB (Figure 2.6). In those areas, manufacturing is one of the largest industries. For example, according to Census on Establishment, manufacturing was the largest industry in Daegu in 2010. In 2010, 155,490 employees worked in manufacturing, which is 19.7 percent of total employees. Only 29.4 percent of employees in manufacturing are women. Therefore, in those areas, men can have less incentives to migrate to other regions. This can affect the marriage market outcomes, the level of education, and migration. Future research will include other economic variables and investigate how the effect of SRB changes with these variables.

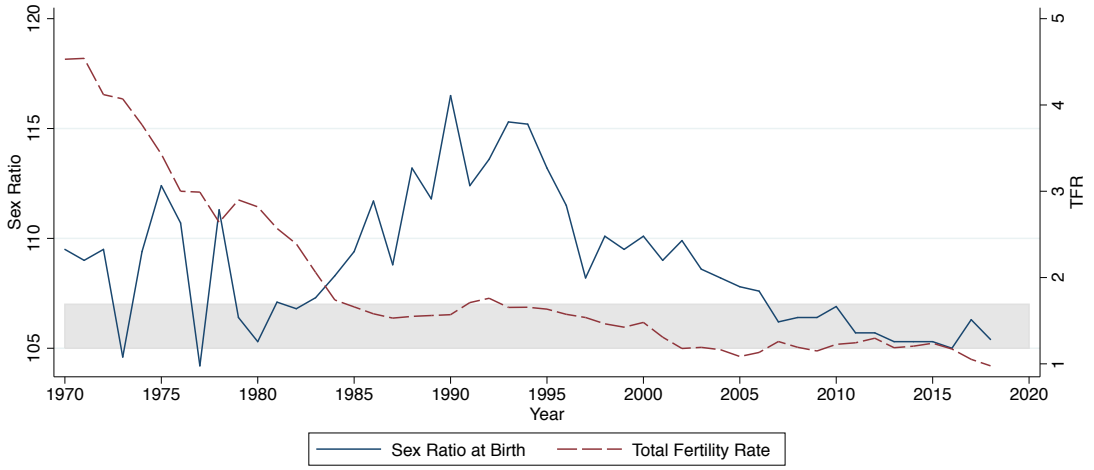
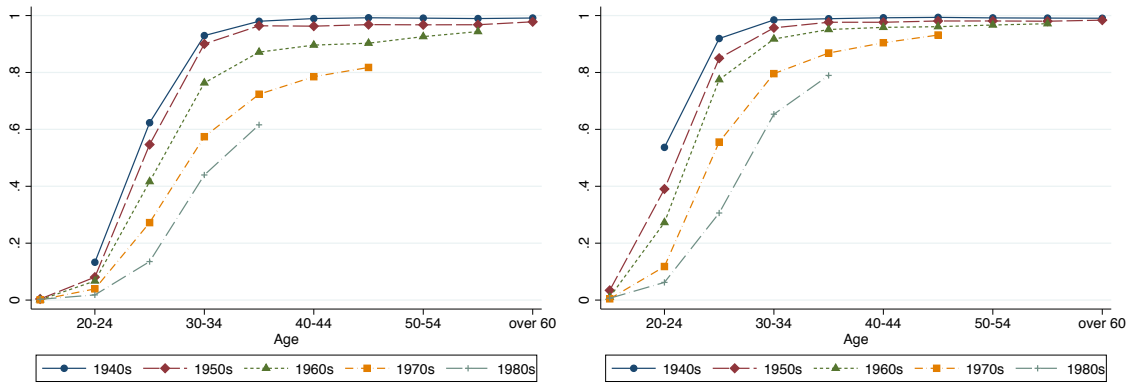


Figure 2.1: Sex Ratio at Birth and Total Fertility Rate

Notes: Data are from the Vital Statistics - Birth from 1970 to 2018. The sex ratio is the number of males per 100 females. The total fertility rate is the average number of children born per woman over a lifetime, given current age-specific fertility rates and assuming no female mortality during reproductive years. A gray area indicates the natural sex ratio at birth (105-107).



(a) Men (b) Women

Figure 2.2: Probability of Marriage

Notes: Data are from the Population and Housing Census from 1970 to 2015.

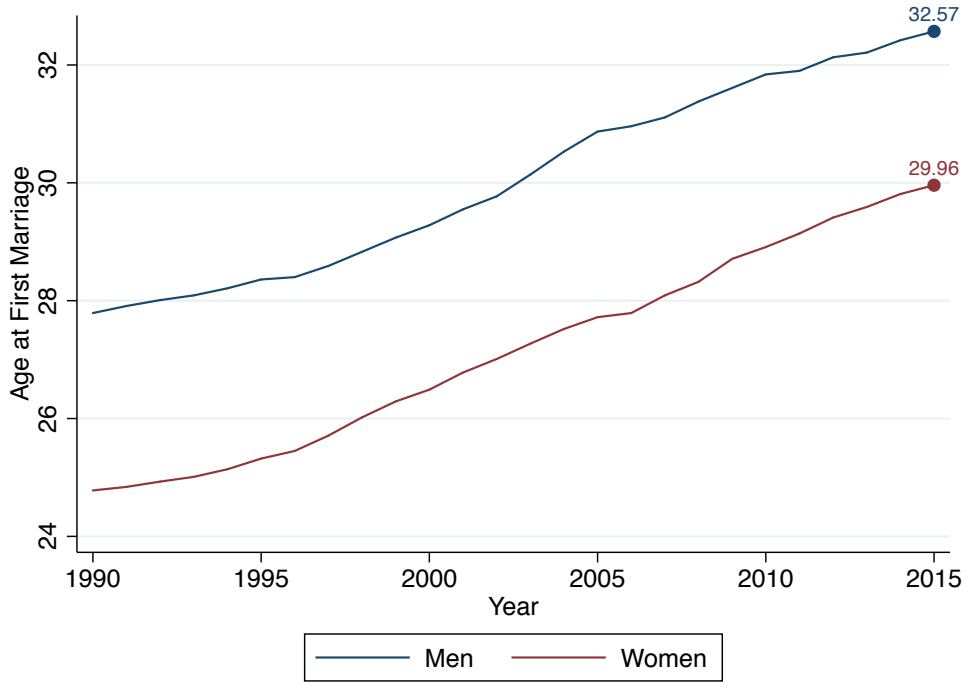


Figure 2.3: Age at First Marriage

Notes: Data are from the Vital Statistics - Marriage from 1990 to 2015.

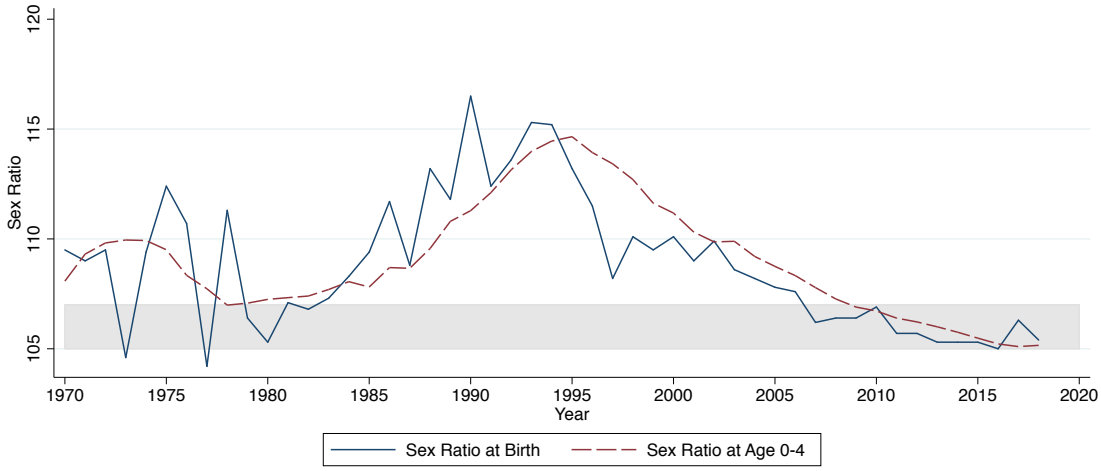


Figure 2.4: Sex Ratios

Notes: Sex ratios at birth are from the Vital Statistics from 1970 to 2018. Sex ratios at age 0-4 are calculated based on the number of males and females at age 0-4 is from the Population Projection. A gray area indicates the natural sex ratio at birth (105-107).

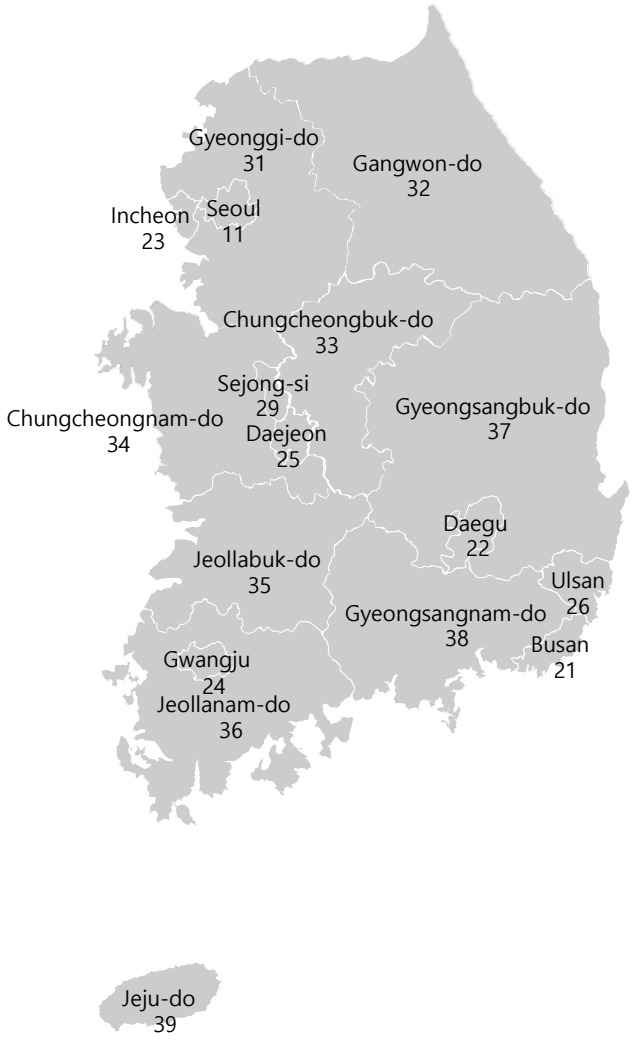
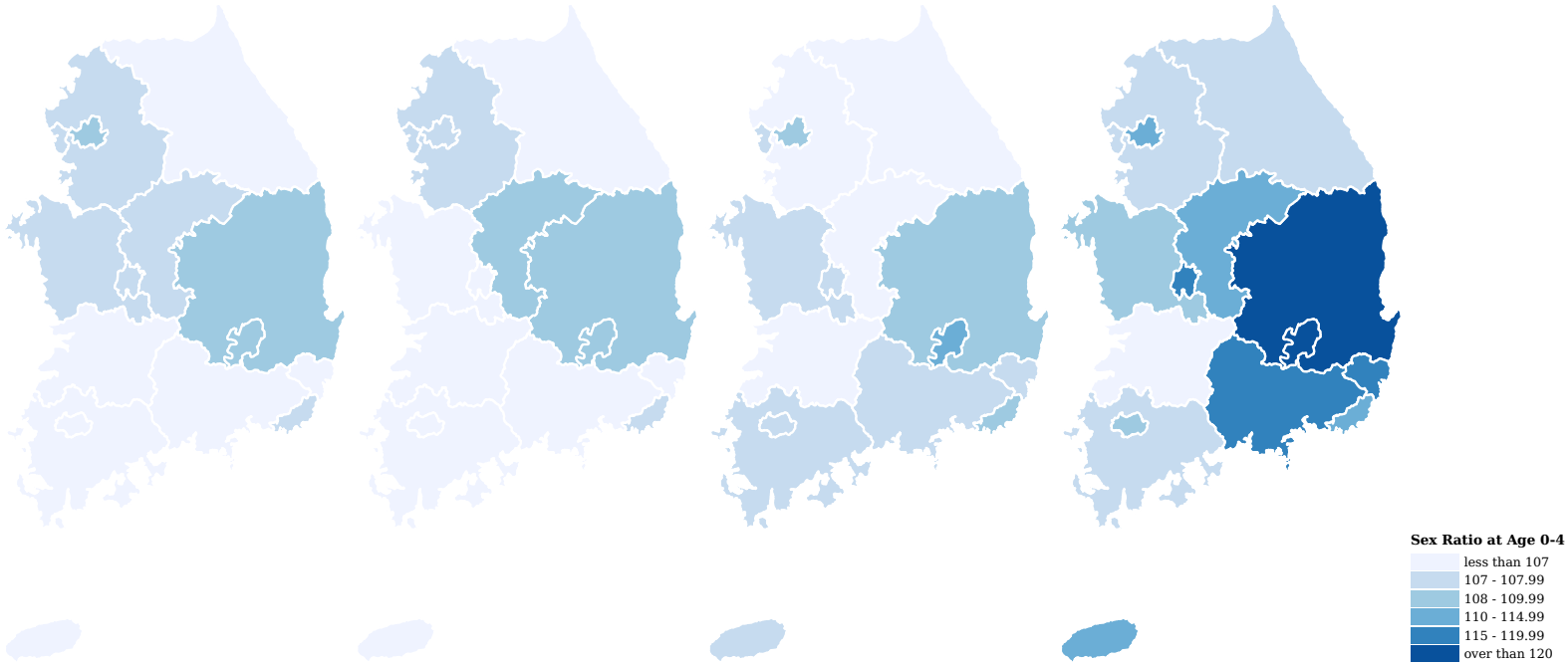


Figure 2.5: Map of South Korea in 2015

Notes: South Korea consists of one special city (Seoul), six metropolitan cities (Busan, Daegu, Incheon, Gwangju, Daejeon, and Ulsan), one special autonomous province (Jeju), eight provinces (Gyeonggi-do, Gangwon-do, Chungcheongbuk-do, Chungcheongnam-do, Jeollabuk-do, Jeollanam-do, Gyeongsangbuk-do, and Gyeongsangnam-do), and one special autonomous city (Sejong). The number below indicates a census regional code.



(a) 1975 (b) 1980 (c) 1985 (d) 1990

Figure 2.6: Sex Ratio at Age 0-4

Notes: Data from the Population Projection. The ratio is calculated by the number of males aged from 0 to 4 per 100 females at the same age.

Table 2.1: Summary Statistics

	Married		Unmarried	
	Women	Men	Women	Men
Education	5.23	5.38	5.44	5.36
	(0.98)	(0.98)	(0.93)	(0.97)
Birth Year	1980.86	1980.26	1984.98	1983.95
	(3.89)	(3.59)	(4.12)	(4.23)
Year of First Marriage	2008.41	2009.80		
	(4.92)	(4.09)		
Age at First Marriage	27.55	29.54		
	(3.60)	(3.52)		
Sex Ratio at Age 0-4 (SRB)	108.01	107.93	109.08	108.76
	(1.83)	(1.64)	(3.40)	(3.05)
Observations	368,793	306,613	746,701	1,030,914

Notes: Standard deviations are in parentheses. Education is a categorical variable (1: No education, 2: Elementary, 3: Middle school, 4: High school, 5: Some college, 6: University, 7: Master's degree or above).

Table 2.2: Baseline Estimation Results

		(1)	(2)	(3)	(4)	(5)	(6)
		Women	Men	Women	Men	Women	Men
Survival Model	SRB	-0.90***	-0.10***	0.0032**	-0.0046**	0.0038**	-0.0041*
		(-102.16)	(-97.16)	(2.07)	(-2.33)	(2.14)	(-1.80)
Marginal Effects	SRB			0.00016**	-0.00015**	0.00019**	-0.00014*
				(2.07)	(-2.33)	(2.14)	(-1.80)
Covariates		NO	NO	YES	YES	YES	YES
Number of ID		1,115,494	1,337,527	1,115,494	1,337,527	1,115,494	1,337,527
Observations		7,138,906	9,208,860	6,546,785	8,596,335	6,546,785	8,596,335

Notes: t statistics in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.010$, Covariates = birth year fixed effects, birth region fixed effects, and counting years from age 18 fixed effects. Marginal effects are estimates of average marginal effect of SRB.

Table 2.3: Estimation Results: Different SRBs

	(1)	(2)	(3)	(4)
	1981-1990 w/ SRB 04		1981-1990 w/ exact SRB	
	Women	Men	Women	Men
SRB	0.00013	-0.0074***	0.0017*	-0.00059
	(0.07)	(-3.04)	(1.71)	(-0.50)
Covariates	YES	YES	YES	YES
Number of ID	811,225	932,299	811,225	932,299
Observation	4,082,336	5,092,859	4,082,336	5,092,859

Notes: t statistics in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.010$, Covariates = birth year fixed effects, birth region fixed effects, counting years from age 18 fixed effects. SRB 04 = sex ratio at age 0-4 in the birth region from the Population Projection. exact SRB = sex ratio at age 0 in the birth region from the Vital Statistics - Birth.

Table 2.4: Estimation Results: Other Marital Outcomes

	(1)	(2)	(3)	(4)	(5)	(6)
	High Education		Migration		Spousal Age Gap	Spousal Edu Gap
	Women	Men	Women	Men		
SRB	-0.00051	-0.0030***	-0.00045	-0.0021***	0.0087*	0.00026
	(-0.76)	(-4.56)	(-0.68)	(-3.30)	(1.84)	(0.11)
Covariates	YES	YES	YES	YES	YES	YES
Number of ID	1,115,494	1,337,527	1,115,494	1,337,527	237,573	237,573

Notes: t statistics in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.010$, Covariates in (1)-(4)= birth year fixed effects, and birth region fixed effects. Covariates in (5)-(6)= birth year fixed effects, birth region fixed effects, and marriage year fixed effects. In column (5) and (6), number of ID means the number of couples in the data. Spousal gap is a gap between husband and wife (spousal age gap = husband's age - wife's age).

CHAPTER 3

CHARACTERIZING SOUTH KOREA'S VERY LOW FERTILITY RATES

3.1 Introduction

South Korea has had the lowest fertility rates of any OECD country since 2013. The Total Fertility Rate (TFR) first dropped below one when it reached 0.98 in 2018, when the OECD average was 1.63. Korea is the only OECD country with a TFR below 1 (Figure 3.1). In 2006, the Korean government started "The Basic Plan for Low Fertility and Aged Society" to increase fertility rates. Since then, the government has spent 225 trillion Korean won (≈ $ 202 billion) over the course of 15 years.[1] Despite these government efforts, the TFR continues to decline, and the Korean government expects the TFR in 2020 to be 0.84.

Many scholars are studying the low fertility rates in Korea. Bak (2019) discusses three types of factors: demographic, cultural, and socioeconomic factors. He emphasizes increases in female's age at first marriage because births outside of marriage are not common in Korea. The marital fertility rate shows a decreasing trend in most age groups. Young people delay marriage and childbirth as unemployment rates and job insecurity rise.

The seminal theory of the quantity-quality trade-off in children was introduced by Becker (1960); Becker and Lewis (1973). Anderson and Kohler (2013) argue that the educational fever among parents partially explains the low fertility rate in Korea, as parents invest considerable money and time in their children's education, preventing them from having a large family.

Son (2018) examines the effect of childbirth grants on fertility rates. Korean municipalities provide childbirth grants, which consist of one-time grants and a child allowance. A 10 million Korean won increase in family benefits is associated with a 3.5% increase in the TFR.

In this paper, I review the trend of fertility and government policies associated with demography in Korea. I compare the TFR in Korea with one in other countries and explain how Korea is different

[1] Presidential Committee on Ageing Society and Population Policy

from other countries.

The remainder of this paper proceeds as follows. In Section 3.2, the trend in fertility is presented, and policy changes are discussed. Section 3.3 presents an international comparison of fertility patterns. Potential factors contributing to the low fertility rate in Korea are discussed in Section 3.4. Section 3.5 concludes.

3.2 The Trend in Fertility Rates

Figure 3.2 plots the TFR from 1970 to 2018. The red line in the figure indicates the replacement rate. According to the UN Population Division, the replacement rate is a total fertility level of approximately 2.1 children per woman. This value represents the average number of children a woman would need to have to reproduce herself by bearing a daughter who survives to childbearing age. Until 1985, Korea experienced a rapid decline in its TFR. This was due to a strong government population control project. The government implemented the Family Planning Project from 1962 to 1996. To achieve economic development, this program aimed to decrease birth rates. The government implemented various policies, including tax, loan, and medical benefits (Baik and Chung, 1996). For example, families with up to three children were eligible for a composite tax break. In 1977, eligibility was limited to families with up to two children. The government provided housing, farming, and fishery loan benefits to families who were sterilized after having a second child. In 1983, the government limited medical insurance coverage to a second delivery. Due to theses policies, the TFR dropped below the replacement rate in 1983.

The government launched “The New Population Policy" in 1996 to replace its anti-natal policy and improve the quality of life of the population (Korea Institute for Health and Social Affairs, 2015). This project involved improving family health and welfare, suppressing the rise in the birth sex ratio, increasing female employment, and preparing for an aging society. Despite this change in policy direction, the fertility rate continued to decline, reaching 1.09 in 2005.

The government started “The Basic Plan for Low Fertility and Aged Society" to increase fertility rates; the policy constitutes a series of five-year plans covering 2006-2010, 2011-2015, and 2016-

2020. The government provides subsidies such as cash rewards for childbirth and monthly childcare subsidies. According to the Korea Institute for Health and Social Affairs (2015), the government spent 60.5 trillion Korean won to address low fertility in the 2nd Basic Plan by greatly expanding the target of childcare subsidies, increasing the size to three times that in the 1st Basic Plan. The TFR rebounded until the 2nd Basic Plan ended. Under the 3rd Basic Plan, the government budget increased to 190 trillion Korean won from 109.9 trillion Korean won under the 2nd Basic Plan. The plan sought to increase the TFR above 1.5 by 2020. Even with this increased budget, the TFR in 2020 reached its lowest level, at 0.84.

3.3 International Comparison

Figure 3.3 shows the long-run trend in the TFR from 1960 to 2018 among four OECD countries; Korea, Japan, Italy, and Spain. I selected these four countries because Italy and Spain rank near the bottom of the OECD countries in terms of fertility rate (Figure 3.1). Second, Japan has a low fertility rate and a culture that is similar to that in Korea. All four countries have had a lower fertility rate than the OECD average since the mid-1980s. Among these four countries, Korea has experienced the most rapid decline in the TFR. Until the early 1980s, Korea had a higher fertility rate than the OECD average, but since then, it has decreased, and the country now has the lowest fertility rate among OECD countries.

To compare the recent trend in the TFR, Figure 3.4 plots the TFR from 1990. Until the early 2000s, Korea had the highest fertility rate among these four countries. However, in Spain and Italy, fertility rates began to rebound in the 2000s (Myrskylä, Kohler, and Billari, 2009). In contrast, the TFR in Korea declined sharply in 2000, resulting in Korea having the lowest fertility rate. The rebound in fertility rates in Japan and Korea began in the mid-2000s, later than in Italy and Spain. Despite this rebound, Korea still has the lowest TFR among these four countries and the OECD countries.

3.4 The Role of Marriage

Figure 3.5 shows the Age-Specific Fertility Rate (ASFR), the number of births to women in a specified age group per 1,000 women in that age group, from 1995 to 2018. The most notable change is the decline in fertility in the 25-29 age group. The fertility rate in the 25-29 age group in 2018 was less than a quarter of the fertility rate in the same group in 1995. Therefore, the decline in the fertility rate is driven by the decrease in the fertility rate among women under the age of 30. While the fertility rates of women under the age of 30 continue to decrease, the fertility rate of those over 30 has increased over time.

Table 3.1 compares the state of fertility among the four countries in 1995 and 2018. The ranks for the TFR and share of out-of-wedlock births are in ascending order, and the ranks for mean age at first marriage are in descending order. The TFR of Korea is ranked 24 out of the 33 OECD countries in 1995, and it ranked 1st in 2018. The fertility rate has changed dramatically over the past 20 years.

The third column in the table shows the mean age at first marriage. The mean age at marriage in Korea increased approximately five years both for men and women. This increase in age at first marriage is observed in all four countries. However, late-age marriages do not necessarily lead to declining birth rates. While the mean age at first marriage increased more in Italy and Spain than in Korea, the TFR in Korea decreased the most.

The traditional form of family can affect fertility rates. For example, in 2017, Denmark had the 27th lowest TFR among 36 countries. Browning, Chiappori, and Weiss (2014) suggest cohabitation as an explanation for this relatively high fertility rate compared to that of other countries using data from Statistics Denmark. They show that the number of cohabiting couples has increased in Scandinavia. Although cohabiting couples have fewer children than married couples, they have more children than singles. However, this is not the case in Korea, where premarital cohabitation is stigmatized. Kojima (2011) shows that the proportion of cohabitation in Korea was only 4.9% in 2009. Japan and Korea have similar cultures, but Japan has a higher cohabitation rate than Korea, 22.5%. The author also shows that this cohabitation has a positive effect on the first birth in Japan.

Out-of-wedlock births are not common in Korea, and the rate there was the lowest among the 36 OECD countries in 2016.[2] While the average share of the out-of-wedlock births among the OECD countries was 41.22% in 2018, the share in Korea is only 2.19%, which was again the lowest among the OECD countries. Figure 3.6 also shows that almost all Korean women marry and they have at least one child after marriage. Figure 3.7 plots the average number of children. The first panel in the figure shows the average number of children among women, and the second panel shows the average number of children among married women. The gap in the number of children between cohorts is smaller among married women than among women. For example, in age 35-39, the gap in the probability of having a child between the married people born in the 1970s and those born in the 1980s is 5.8 percentage points. At the same age, the gap between the unmarried 1970s and the unmarried 1980s is 12 percentage points. Therefore, delayed marriage could affect fertility rates. Figure 3.8 shows the trend of delayed marriage. From 1990 to 2020, the average age at first marriage increased 5.44 years for men and 6 years for women. Figure 3.9 shows the average number of children by age at first marriage. If people marry at later ages, then tend to have the smaller number of children. This suggests that delayed marriage has an impact on the decline in the fertility rate with reduced fertility among married couples.

3.5 Conclusions and Discussion

Korea has the lowest fertility around the world. In this paper, I review the trend in fertility and the policy changes in Korea. Korea already had the TFR below the replacement rate since the early 1980s. While the fertility rate of the younger generation has declined sharply, the fertility rate of those in their 30s and older has only slightly increased. Low fertility rates in Korea are highly correlated with delayed marriage.

[2] OECD Family Database, `http://www.oecd.org/els/family/database.htm`

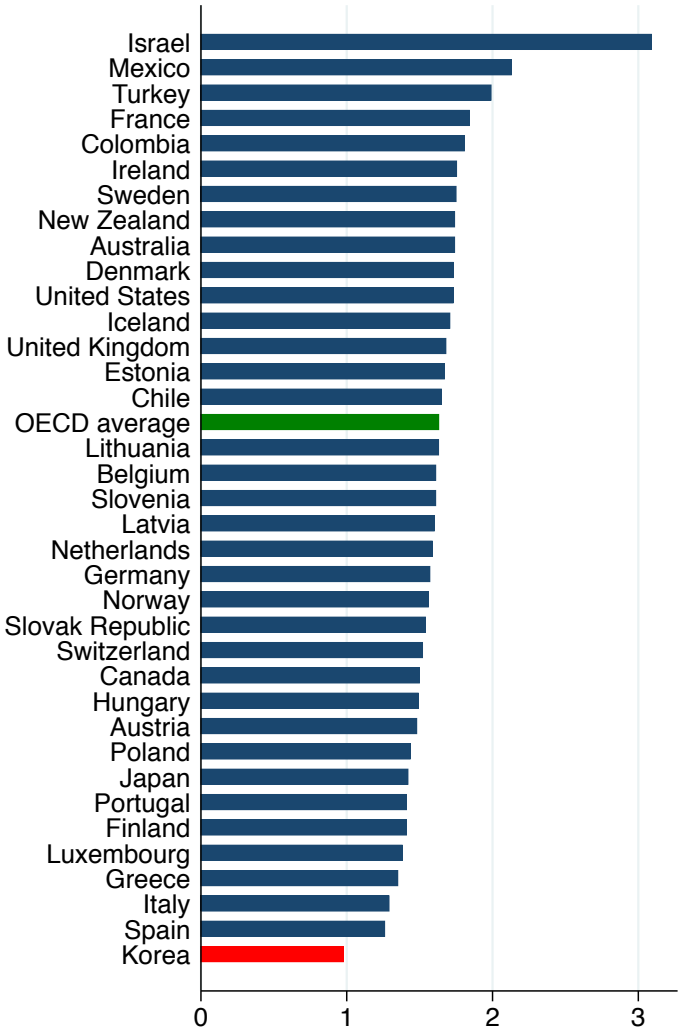


Figure 3.1: Total Fertility Rate in 2018

Notes: Data are from OECD Family Database. The total fertility rate is the average number of children born per woman over a lifetime, given current age-specific fertility rates and assuming no female mortality during reproductive years.

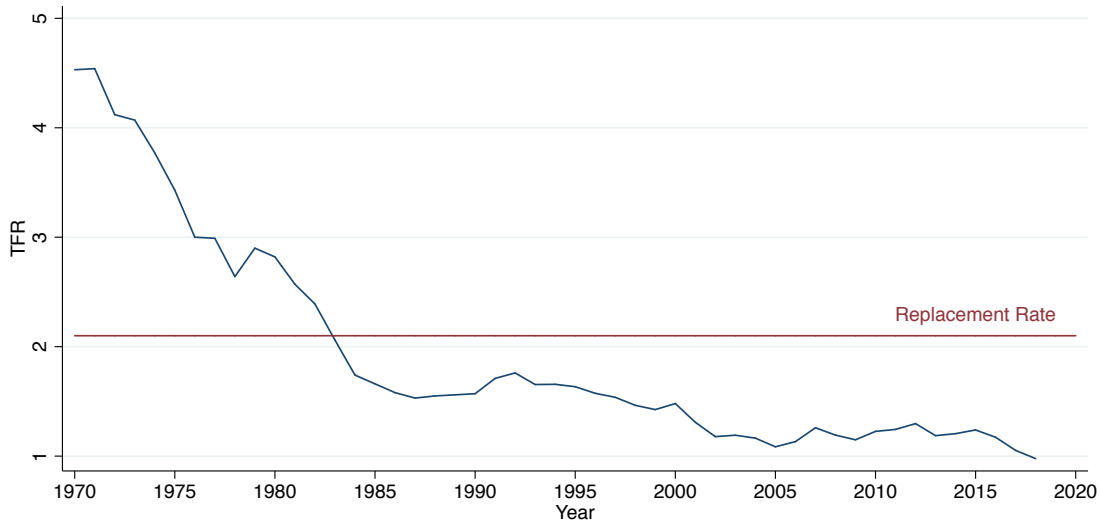


Figure 3.2: Total Fertility Rate

Notes: Data are from the Vital Statistics - Birth. The red line indicates replacement rate, the total fertility levels of about 2.1 children per woman.

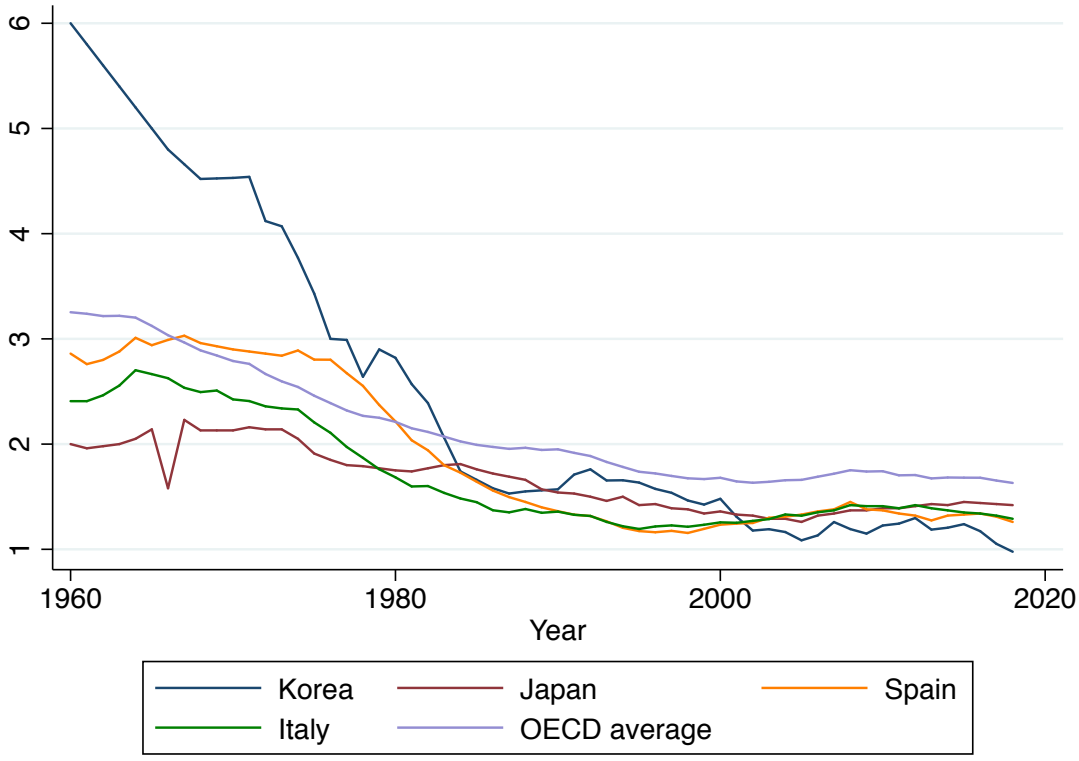


Figure 3.3: Total Fertility Rate from 1960

Notes: Data are from OECD Family Database.

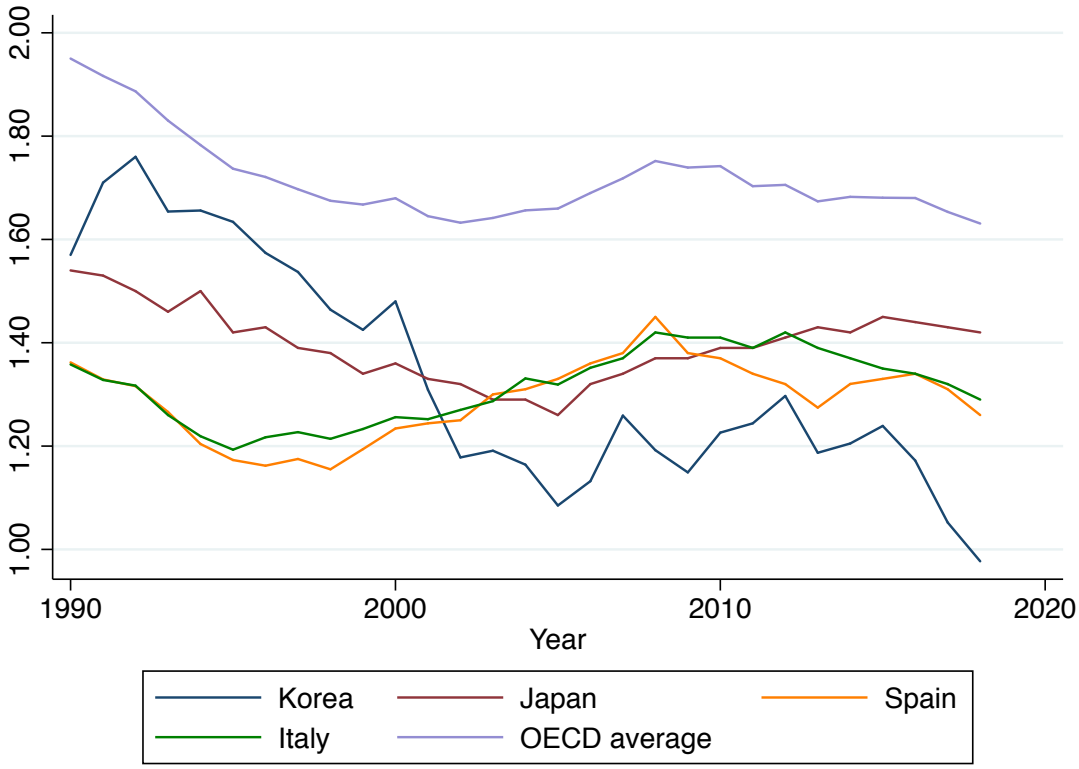


Figure 3.4: Total Fertility Rate from 1990

Notes: Data are from OECD Family Database.

Fertility Rebound: Myrskylä, Kohler, and Billari (2009)

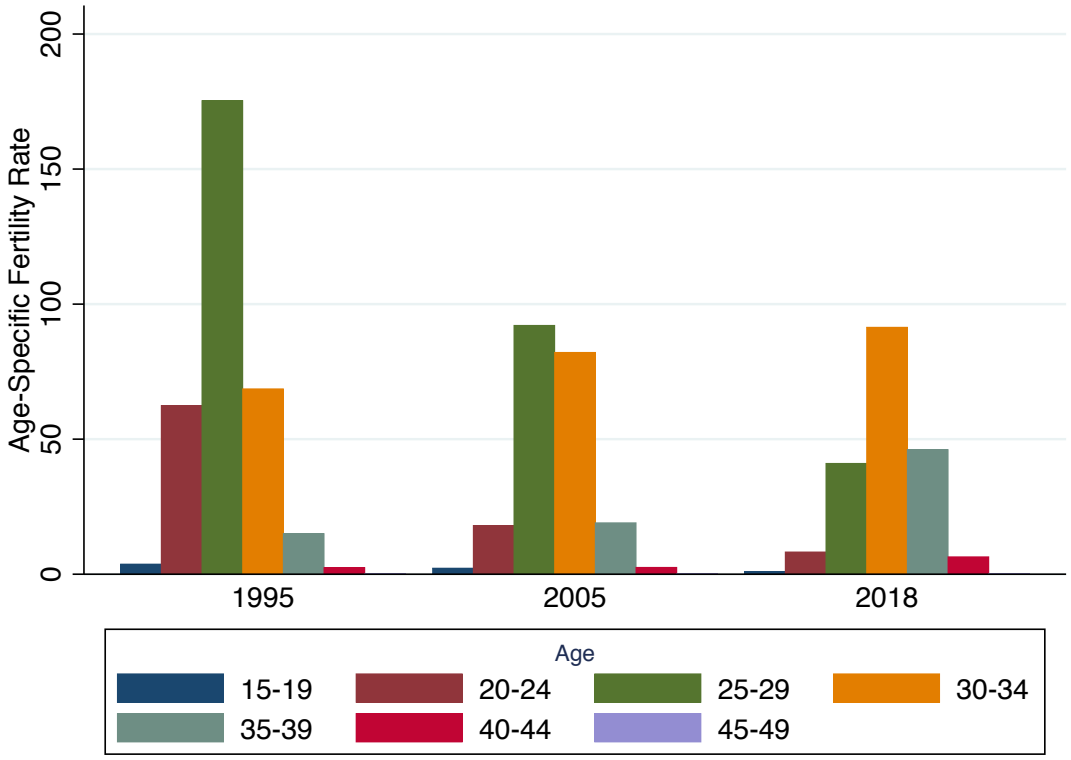
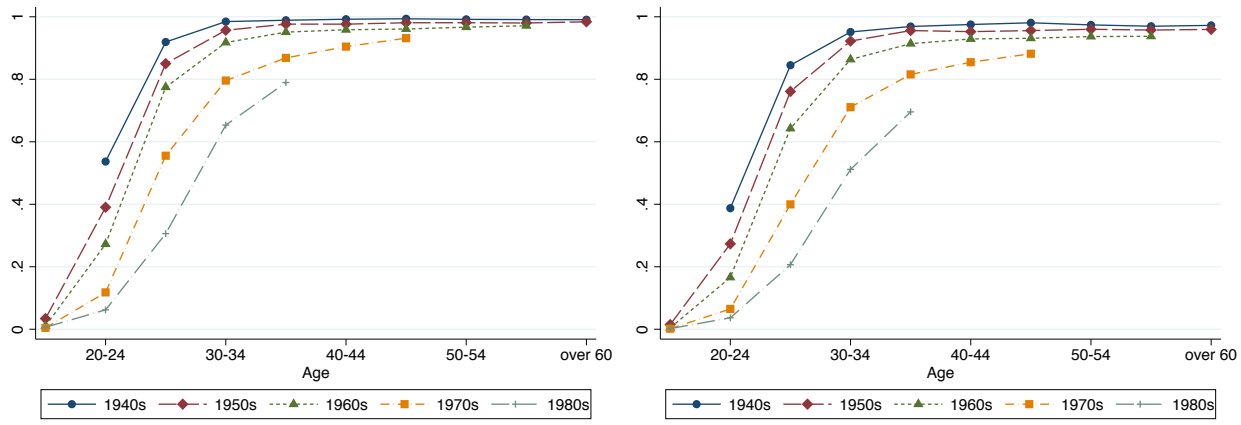


Figure 3.5: Age-Specific Fertility Rates

Notes: Data are from the Vital Statistics. The age-specific fertility rate measures the annual number of births to women of a specified age or age group per 1,000 women in that age group.

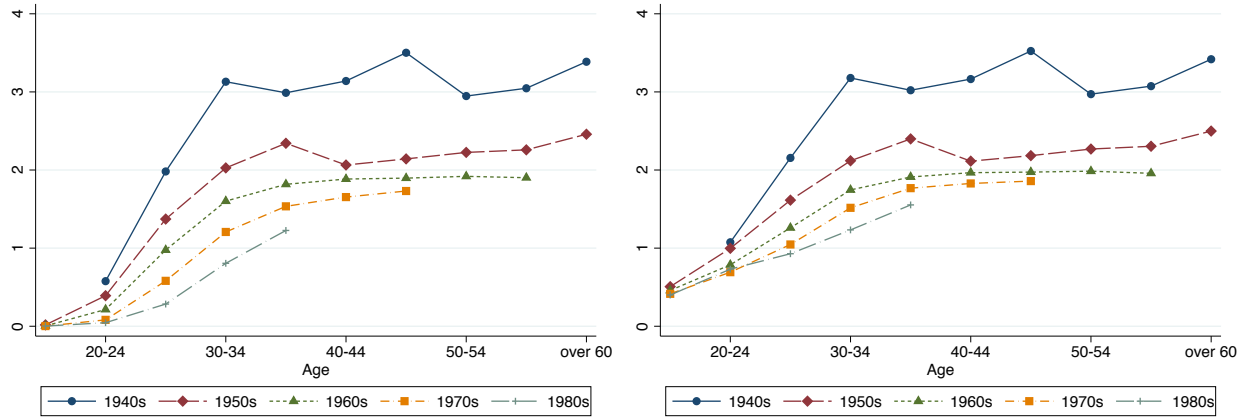


(a) Marriage

(b) Children

Figure 3.6: Women's Probability of Marriage and Having a Child by Age and Cohort

Notes: Data are from Population and Housing Census from 1970 to 2015.



(a) Among Women

(b) Among Married Women

Figure 3.7: Women's Average Number of Children by Age and Cohort

Notes: Data are from Population and Housing Census from 1970 to 2015.

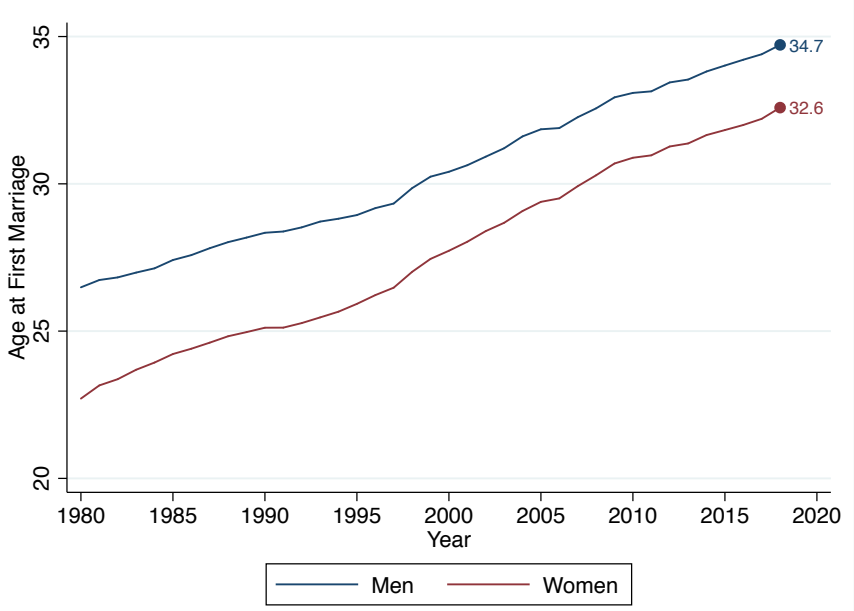


Figure 3.8: Age at First Marriage

Notes: Data are from Vital Statistics - Marriage from 1990 to 2020.

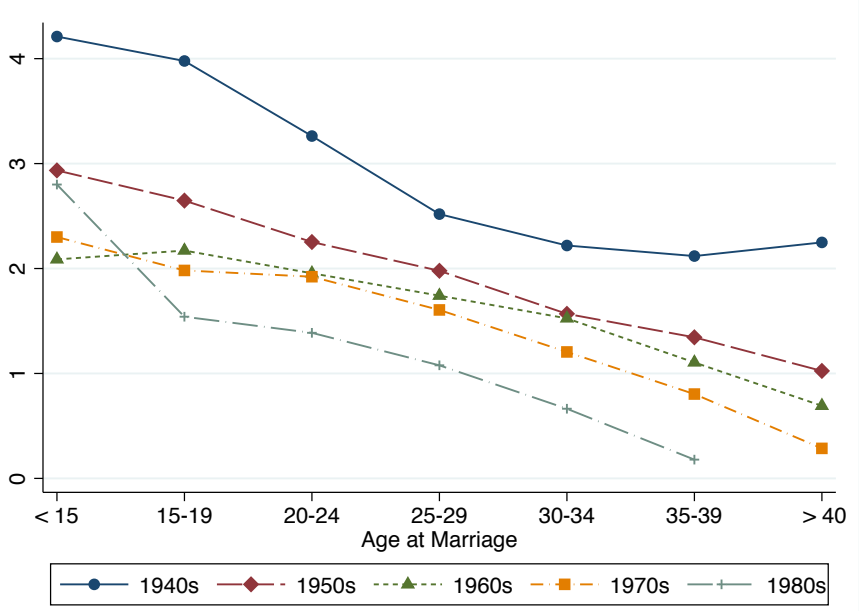


Figure 3.9: Average Number of Children by Age at Marriage

Notes: Data are from Population and Housing Census from 1970 to 2015.

Table 3.1: Total Fertility Rate, Share of Out-of-wedlock Birth, and Mean Age at First Marriage in 1995 and 2018

(a) 2018

Countries	TFR		Out-of-wedlock		Mean Age at Marriage			
	Mean	Rank	Share	Rank	Male	Rank	Female	Rank
Korea	0.98	1	2.19	1	32.9	13	30.2	16
Japan	1.42	10	2.30	2	31.1	21	29.4	17
Italy	1.29	4	34.0	12	35.0	3	32.2	5
Spain	1.26	3	47.30	22	35.4	2	33.2	2

(b) 1995

Countries	TFR		Out-of-wedlock		Mean Age at Marriage			
	Mean	Rank	Share	Rank	Male	Rank	Female	Rank
Korea	1.63	24	1.23	2	28.4	17	25.3	19
Japan	1.42	13	1.20	1	28.5	15	26.3	14
Italy	1.19	2	8.10	5	29.9	7	26.9	9
Spain	1.17	1	11.10	7	29.2	11	27.1	8

Notes: Data are from OECD Family Database. Ranks of TRF are out of 38 countries in 1995 and 2018. Ranks of out-of-wedlock births are out of 33 countries in 1995 and 2018. Ranks of mean age at marriage are out of 29 countries in 1995 and 28 countries in 2017. Mean age at first marriage is the average value in 2017.

APPENDICES

APPENDIX A

VARIABLE DEFINITION

- **Earnings**: Reported average monthly net income from the job is used (Q. What is the average monthly net income you make from this job?). The KLIPS provides the definition of the net income on the questionnaire. Net income = Total revenue - Total costs. Total costs (total expenses) include sales activity expenses, tax and duties, and other operational expenses for business maintenance(electricity, vehicle maintenance, etc.)

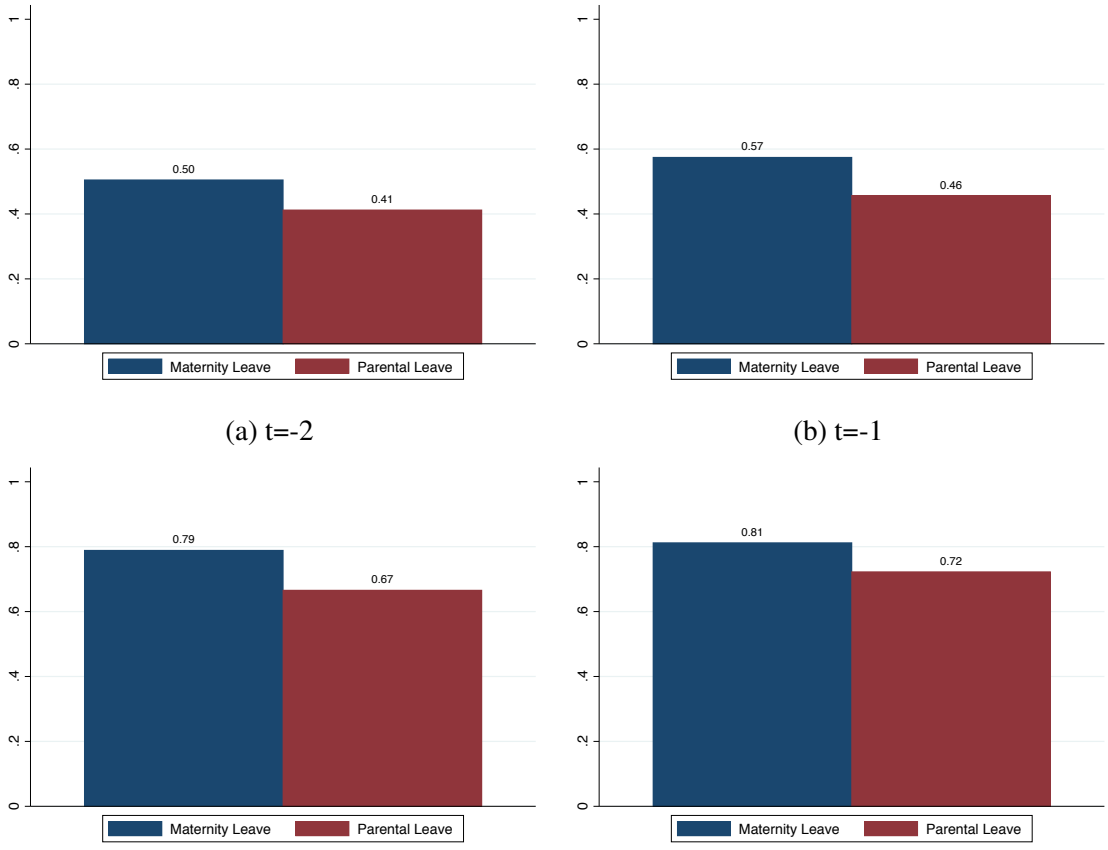
- **Hours Worked**: Reported average weekly work hours are used (Q. How many hours a week do you usually work at this job, excluding lunchtime? And how many days a week do you usually work?).

- **Labor Force**: Reported employment status is used (Q. Please tell us which best describes your current employment status.). Even if an individual answers that s/he is working, s/he is coded as nonworking if his (or her) earning is zero.

- **Hourly Wages**: Earnings/(Hours Worked*4.345)

APPENDIX B

SUPPLEMENT



(a) t=-2 (b) t=-1

(c) t=0 (d) t=+1

Figure B.1: Access to Leaves by Eventtime

Notes: Using only women with a job.

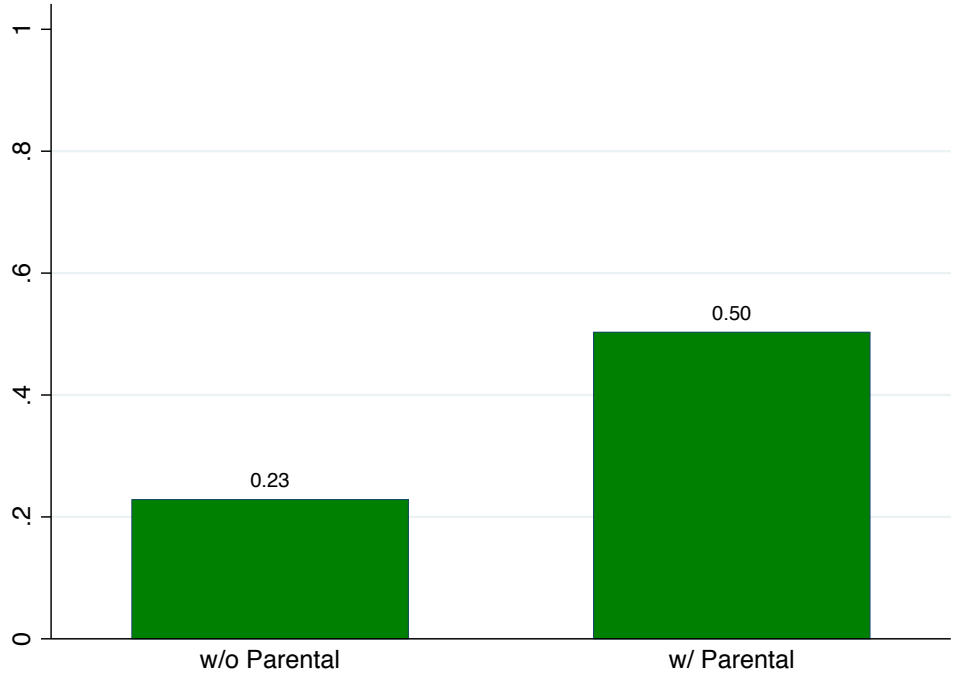


Figure B.2: Probability of Working Through t=-1 to t=+1 by Access to Parental Leave

Notes: Access to parental leave is calculated based on whether they have worked in a firm providing parental leave before childbirth or not. Parental leave in Korea: The length of the leave is one year. The employment insurance covers 80 percent of ordinary earnings for the first three months (with a minimum of KRW 700,000 ($\approx$ \$650) and a maximum of KRW 1,500,000($\approx$ \$1, 350)) and 50 percent of ordinary earnings for the rest of the leave (with a minimum of KRW 700,000 ($\approx$ \$650) and a maximum of KRW 1,200,000($\approx$ \$1, 100))

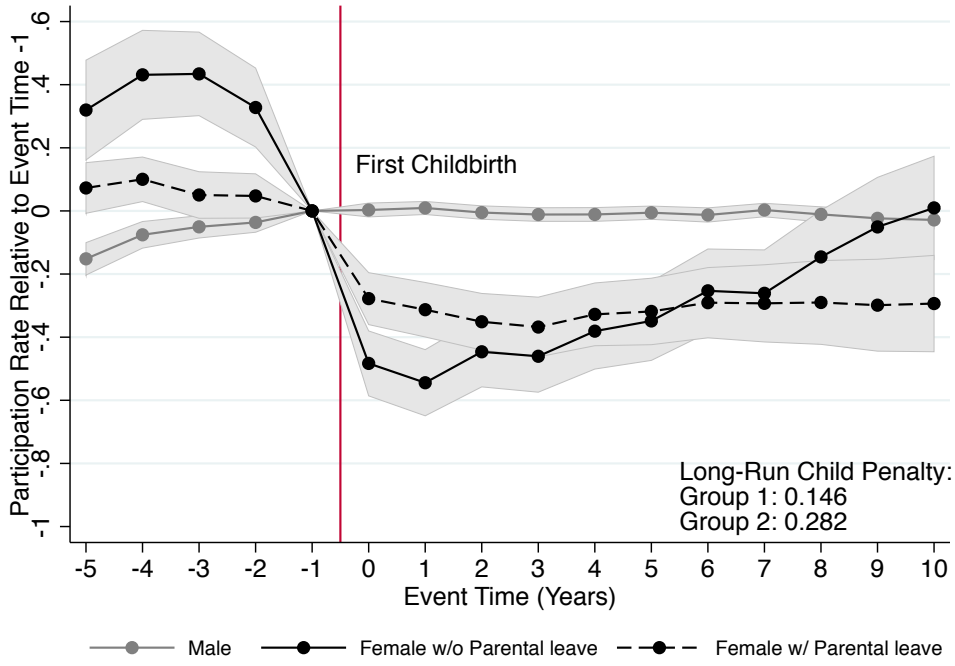


Figure B.3: The Child Penalty by Access to Parental Leave

Notes: The black dash line represents the impact of childbirth of female who had worked in a workplace that provides parental leave before childbirth. The solid black line shows the effect of childbirth of the rest of female.

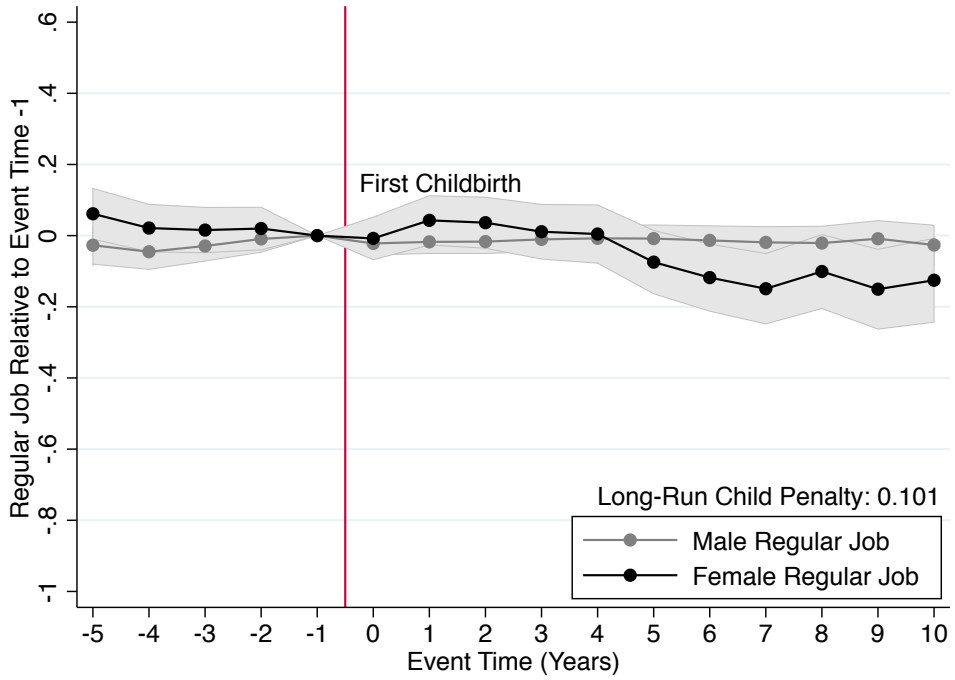


Figure B.4: The Child Penalty in Working as a Regular Worker

APPENDIX C

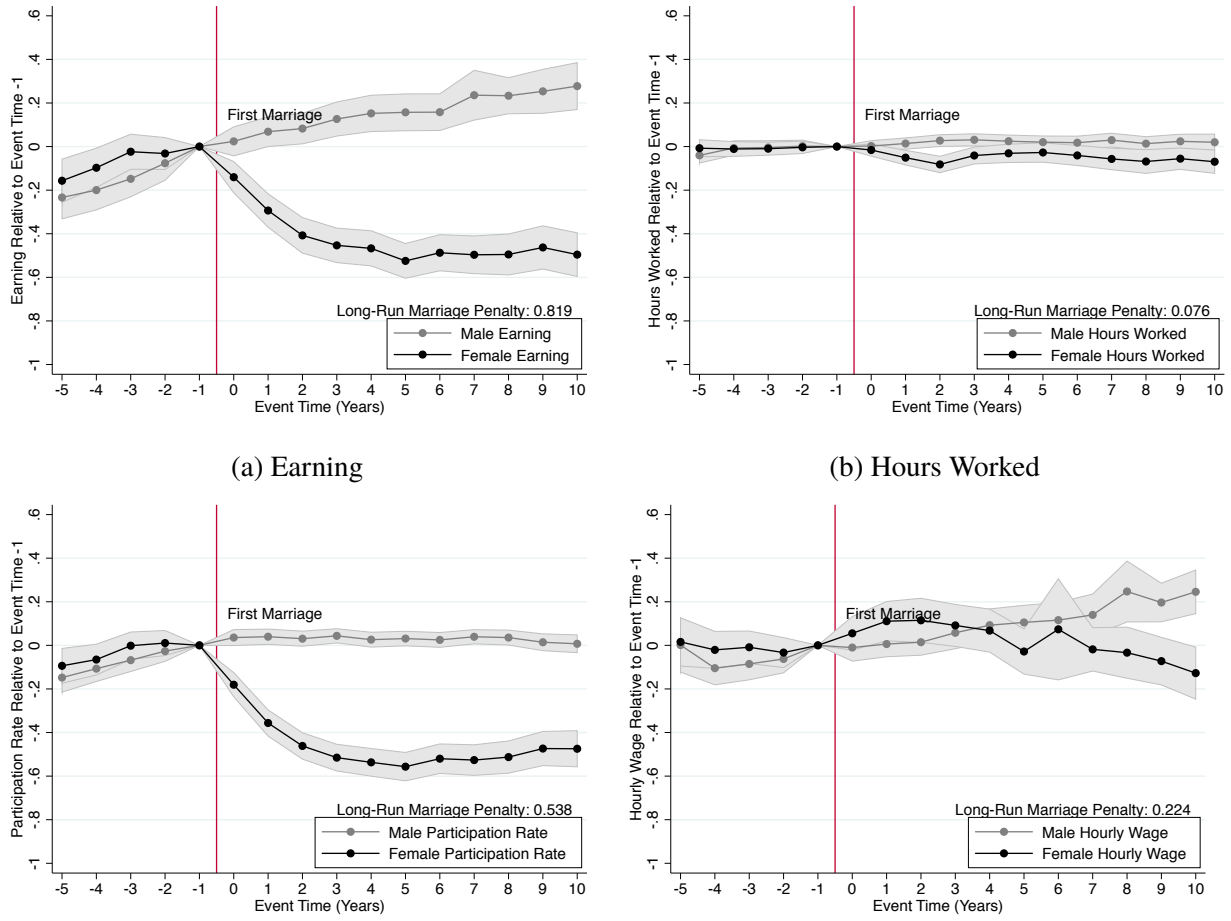
MARRIAGE PENALTY

Many papers estimate the effect of marriage on the labor market Loughran and Zissimopoulos (2009). Lee (2005) also shows the great effect of marriage in Korea, where marriage reduces the female labor supply by 41 percent. Figure 1.3 confirms that the penalty starts before the first childbirth, which may coincide with the timing of marriage. Therefore, in this section, I estimate the marriage penalty instead of the child penalty. The event is the first marriage, not the first childbirth. The KLIPS asks for the year of marriage for people included for the first time and their marital status every year, and these data are used as the year of the first marriage. Table C.1 shows the summary statistics for the marriage penalty one year before marriage. The average age at marriage was 27.39 for women and 30.50 for men; thus, men are approximately three years older than women on average when they marry. The two samples used to estimate the child and marriage penalties may be different. While the sample for the estimation for the child penalty is people who had a first child between 1999 and 2017, the sample here is people who married between 1999 and 2017. Some married couples might not have a child, and there could be some out-of-wedlock births. People who did not have the information before the event in the survey were excluded. Therefore, people who are added to a household due to marriage are excluded from the estimation of the marriage penalty. Some couples married before the KLIPS started and had a first child after that; those couples were not included in the sample for marriage penalty but are included in the sample for the child penalty. Therefore, there are more individuals in the estimation of the child penalty.

Figure C.1 illustrates the effect of the first marriage. The sample here is people who married between 1999 and 2017. The base year, therefore, is the one year before the first marriage. Earnings are unconditional on employment, so an individual has zero earnings if he or she is not working. Panels (b) and (c) in the figure show the estimates for working hours and hourly wages among employed people. The long-run marriage penalty in earnings is 82 percent for women;

thus, Korean women experience a significantly large penalty from marriage. This divergence in earnings is not observed in Sieppi and Pehkonen (2019); Kleven et al. (2019a,b). As a result of changing the definition of the event, both men and women have the same increasing trend in earnings before marriage, but while men's earnings continue to increase after marriage, women's earnings have decreased since their marriage. Panels (b) and (d) show that there are few gaps between men and women before and after their marriage when childbirth is used as the event. In panel (c), the probability of working is significantly reduced for women, which explains the driver for the reduction in women's earnings. Women who continue to work after marriage have working conditions similar to shoes of men in terms of hourly wages and working hours. However, it is difficult for women to remain in the labor market after marriage. Therefore, being out of the labor force is the main cause of the marriage penalty for women.

C.1 Baseline Results of Marriage Penalty



(a) Earning

(b) Hours Worked

(c) Labor Force

(d) Hourly Wage

Figure C.1: Marriage Penalty

C.2 Summary Statistics

Table C.1: Summary Statistics at One Year Before Marriage

	Female	Male
Age	27.40	30.53
	(3.66)	(4.43)
Education	13.97	13.95
	(2.04)	(2.20)
Earnings	135.26	205.51
	(99.99)	(182.75)
Labor Force	0.78	0.84
	(0.41)	(0.36)
Hours Worked	46.08	50.87
	(10.61)	(12.74)
Hourly Wages	0.93	1.17
	(0.58)	(0.76)
Observations	708	788

Notes: Standard deviations are in parentheses. The sample consists of people who married between 1999 and 2017. This table is based on the values at one year before marriage. Wages are monthly in 2019 Korean 10,000 won ($\simeq$ \$10). Education is the years of completed education.

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