ESSAYS ON THE FERTILITY AND WOMEN IN THE LABOR MARKET

by

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ABSTRACT OF THE DISSERTATION

Essays on Fertility and Women in the Labor Market

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This thesis examines women's fertility choices and their experiences in the labor market. In particular, I provide insights into how fertility choices relate to women's labor market behavior and outcomes.

In Chapter 2, I investigate the response of women's fertility choices to financial incentives. I estimate the impact of a cash-transfer type of pro-natalist policy on the probability and timing of births by evaluating the case of the South Korean 'baby bonus' policy called 'birth encouragement grants'. I use the sample of married women taken from the Korea Labor and Income Panel Studies (KLIPS) and rely on the regional and over-time variation of the grant amounts for identification. There is a concern about endogeneity, because shared fertility patterns in the same county can affect the grant-setting decisions of county governments. I address this by controlling for county fixed

effects and the trend of pre-policy determinants of birth encouragement grants. Through this analysis, I find that the birth encouragement grants do not influence the

fertility choices of women in Korea. Furthermore, the results of the analysis imply that the work status and the earnings of women may be more significant factors in their fertility choices.

In Chapter 3, I estimate the magnitude of the cost of motherhood on the careers of working women in Korea. The conclusion of Chapter 2 implies that women's fertility choices may be more closely related to their outcome in the labor market than the direct financial costs of having children. Using the Korea Labor and Income Panel Studies (KLIPS) data, I estimate the family gap in pay, which is the pay difference between mothers and non-mothers, and the family gap in job change frequency, the job change frequency difference between mothers and non-mothers, of Korean women. Unlike previous studies that address only the sample selection problem from low labor force participation of mothers, I further acknowledge the selection into motherhood, the possibility that women making fertility decisions based on the prospect of pay and job change after childbirth and address this by using instrumental variables. I find that motherhood induces about one job change and a 37% discount in wages in South Korea. These findings are significantly different from the estimates derived from the type of specification frequently used in other studies, the fixed effect model with the Heckman selection correction. The Heckman model indicates only a 7% -9% wage discount. That is, the presence of children reduces a mother's pay from her earning potential by 7%-9%. I also find that the family gap in pay can be partially explained by information about job retention during childbirth and the child-rearing period.

In Chapter 4, I evaluate the presence of sex discrimination in job placement in the

labor market. Theoretically, uncertainty about career breaks for child bearing associated with female workers may drive firms to set higher bars for employment of women. Using the Youth Panel 2007 of South Korea and its rich information about college students' educational backgrounds and future plans, I restrict the sample to those college seniors who indicated they plan to seek jobs with large corporation jobs through their annual open recruitments, which are supposed to be fair and merit-based. Then, using a variation of the classical Oaxaca-Blinder method (Oaxaca, 1973; Blinder, 1973), I decompose the male-female difference in the probability of being placed in a large corporation job after college into the parts that can be explained by the average differences in the characteristics by sex and the part that cannot be explained by those characteristics. I focus on the labor market outcome of the first job of the college graduates to minimize the impact of unobservable factors of the gender gap in the labor market outcome other than discrimination, such as women seeking easier jobs after they have formed a family. The result supports the presence of sex discrimination in large corporation open recruitments in Korea and confirms that female college students must make more human capital investments or 'pass higher bars' to have the same chance of employment in a large corporation.

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Dedication

To my family.

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Chapter 1

Introduction

This thesis examines women's fertility choices and their experiences in the labor market. Many countries have experienced the trend of falling fertility in recent decades and it has gained interest from both policy makers, who want to reverse this trend, and economists, who strive to investigate the causes of such trends. This thesis starts from the hypothesis that the financial burden of having children and the male-female difference in the labor market experiences due to the inherent uncertainty of career break for children associated with female workers are the important determinants of the recent fertility pattern.

To investigate the response of women's fertility to financial incentives, in the second chapter, I estimate the impact of the South Korean 'baby bonus', a cash-transfer type of pro-natalist policy on women's probability and timing of births. I use the sample of married women taken from the Korea Labor and Income Panel Studies (KLIPS) and rely on the regional and over-time variation of the grant amounts for identification. The concern of endogeneity due to the shared fertility patterns in the same county is addressed by controlling for county fixed effects and the pre-policy determinants of the birth encouragement grants. The results suggests that the financial incentive of birth encouragement grant does not increase fertility and, rather, that the work status and the earnings of women might be more important determinant of fertility.

In Chapters 3 and 4, I study the experiences of women in the labor market in

direct and indirect relation to the experiences of motherhood. In Chapter 3, I study the effect of motherhood on women's labor market outcomes, in particular, pay and job change frequency. Sample selection may arise from two sources. The first source is the low labor force participation of women: the selection into work status. The second source is from the possibility that women's fertility decisions are affected by their labor market outcome: the selection into motherhood. Previous studies have addressed only the first type of selection bias, whereas I address both types using an instrumental variable method. I contribute to the literature by showing the importance of the second type of selection bias in the calculation of the motherhood penalty in the labor market. In fact, additional control of the selection into motherhood yields significantly larger estimates of the motherhood penalty than models that control only for selection into work status. My estimates of the career cost of motherhood in Korea show that there is approximately a 37% pay gap between mothers and childless women and one more job change for mothers than childless women.

Chapter 4 is motivated by the observation that Korea has the largest male-female pay gap, which appears to be attributed to men holding better jobs. I investigate whether there is sex discrimination in employment practices in Korea. Theoretically, if firms believe that female workers have a greater chance of separation for child care, which is costly, they may 'statistically' discriminate against female workers in recruitment. Using the Youth Panel of South Korea, which keeps records about one's education history, plans for career, and labor market outcomes, I consider a sample of college seniors who apply for large corporation open recruitments. I then decompose the male-female difference in

the probability of large corporation employment into the part that can be explained by the male-female difference in the levels of pre-labor market human capital investments and the part that cannot be explained by those factors. Because there are no male-female differences in the on-the-job human capital investments in the first jobs, I attribute the unexplained part of the male-female gap in the probability of large corporation employment as discrimination. I find that there is approximately a 6 percentage point's difference between men and women in the probability of employment by a large corporation through open recruitment, i.e., a 6 percentage point sex discrimination. This is generated from men being rewarded more for their human capital.

Chapter 2

Do "Baby Bonuses" lead to more babies?

A Case study of the South Korean Birth Encouragement Grant

2.1. Introduction

Falling fertility has been a common trend in almost all European and East Asian countries. Together with the trend of increasing life expectancy, it is seen as a significant threat to the economic sustainability. As expanding immigration is a politically sensitive solution, most countries with low fertility and aging population problems regard promoting childbirth as an important and necessary policy agenda. Consequently, many policies directly aimed at birth encouragement as well as those that indirectly promote child birth have been adopted by countries that share this problem. Forms of such pro-natalist policies differ slightly, but most contain conditional or unconditional cash transfers such as child subsidies of various amounts and one-time 'baby bonuses' to congratulate child birth.[1]

Baby bonus-type policies—small and one-time cash transfers—may not have the same impact as other types of cash transfers, such as child subsidies, yet they have not been studied extensively by economists, except for a few studies on Australian baby bonuses that found small positive effects (Drager et al., 2010; Risse, 2010; Sinclair et al., 2012). Most existing studies in the literature on fertility responses to financial incentives have

[1]See table 22 in the appendix for a summary of the pro-natalist policy packages of select countries.

evaluated child subsidy programs (Demeny, 1986; Gauthier & Hatzius, 1997; Laroque & Salanie, 2004; Brewer et al., 2012; Milligan, 2005; Todd & Wolpin, 2006; Keng & Shew, 2011; Cohen et al., 2013) or policies that indirectly generate financial incentives for having an additional child, such as tax credits (Wittington, 1992; Acs, 1996; Baughman & Dickert-Conlin, 2009). With a significant amount of the national budget in many countries allocated for baby bonuses and other cash-transfer-type child support programs, the question of whether an auxiliary one-time cash transfer has any birth encouragement effect on its own is worthwhile to study.

Baby bonus-type cash transfers are not widely studied because they are usually adopted as an auxiliary program to other child support programs and their separate effects are difficult to estimate. In most cases, the baby bonus is introduced at the national level, and hence the amount of baby bonus varies only by year. This means that the method of evaluation is limited to event studies. Also, when these baby bonuses are given with other pre-existing cash transfer-type pro-natalist policies, such as child subsidies, it is even more difficult to identify their independent impact on fertility.

In the absence of satisfactory empirical studies evaluating the baby bonuses, South Korea's baby bonus, called a 'birth encouragement grant' in direct translation, provides a unique opportunity to estimate how this type of cash transfer affects fertility. South Korea's birth encouragement grant has a significant regional and time variation due to the program's unusual initiation by county governments rather than the national government. In addition, during the period of 2002 to 2011, it was effectively the only pro-natalist policy in South Korea, since major nationwide programs such as the subsidies for daycare and

other county level pro-natalist policies were not implemented until after 2011.

This chapter, therefore, evaluates the impact of the birth encouragement grants on fertility using the individual panel data from the Korea Labor and Income Panel Study (KLIPS) in the period covering 2002 to 2011. In particular, it addresses two main questions: 1) whether birth encouragement grants increase the probability of birth and if the impact differs by income group and 2) whether they reduce the length of time between births.

In addition, a robustness check is performed using the county-level aggregate data to complement the shortfalls of the individual data analysis. In the aggregate data analysis, the effect of the birth encouragement grant may be more evident, since it uses all actual births, rather than a sample. Also, it allows for a simple comparison between short-run and long-run impact of the birth encouragement grant by allowing for differencing models.[2]

The validity of the estimation depends on the exogeneity of grant levels with respect to the outcome variables, the individual fertility indices. If there is a factor that is correlated with both the evolution of grant levels and fertility indices, then the estimated effects will be biased. This paper directly controls for this bias by using county fixed effects and additional trend controls.

The results of this analysis show that the birth encouragement grant has no effect on the probability of births but it may reduce the length of time between marriage and first birth. At the county level, the findings suggest that the birth encouragement grant could

[2] With individual data, observations vary by three dimensions– county, year, and individual. This makes the differencing models and their interpretation complicated.

have a very short term positive effect for the first and second child, but that it has no permanent impact.

In Section 2, the fertility trends and birth encouragement grant policy of South Korea are explained in more detail and in Section 3, data and samples are described. Section 4 discusses the estimation challenges and evaluates the first research question, namely whether birth encouragement grants increase the probability of birth and whether the effect differs by income groups. Section 5 evaluates the second research question, about whether the birth encouragement grant affects the timing of births. Section 6 contains a robustness check of the results using the aggregate data, and Section 7 concludes the paper.

2.2. Fertility Trends and Birth Encouragement Grants in South Korea

2.2.1. Recent Fertility Trends of South Korea

To situate this analysis, I briefly describe some noticeable patterns of fertility trends in South Korea. As shown in Figure 1, Korea's total fertility rate has been around 1.2 children per woman since 2000. It was previously around 2.5 children per woman during the 1980s, but due to nationwide family planning and birth control campaigns during the 1990s, it has dropped significantly. Fertility rates are lowest in Seoul City, followed by metropolitan cities and provinces, reflecting the higher living costs in these areas.

Decreasing fertility of recent years may be attributed to women choosing to have only one child. Table 1 reports the number of children had by married women ages 35-39,

by which point most have completed their lifetime fertility choices. Between 2000 and 2010, the fraction of married women ages 35-39 with no child stayed relatively constant (4%). On the other hand, the fraction of married women ages 35-39 with one child increased significantly from 16% to 26%, while the percentage of married women with two children decreased from 68% to 59%.

Along with decreasing fertility, women's average age at birth has been increasing steadily during the 2000s and 2010s. The increased age of mothers at first birth implies a shorter remaining time for an additional pregnancy, which can lead to a lower lifetime fertility of recent cohorts. As shown in Figure 2, in 2010, a woman's average age at first birth was greater than 30, and it has steadily increased since then, reaching 31 in 2014.

This pattern gained national attention in 2005, when the fertility rate reached the lowest point in the history of South Korea and in the world, 1.04 child per woman. Only after this point did the national government make birth encouragement part of its long-term national agenda. Many local governments also began to adopt pro-natalist policies, including the birth encouragement grants, the effect of which is the focus of this paper.

Figure 1. Recent Trends of the Total Fertility Rates of Select Cities and Provinces of South Korea

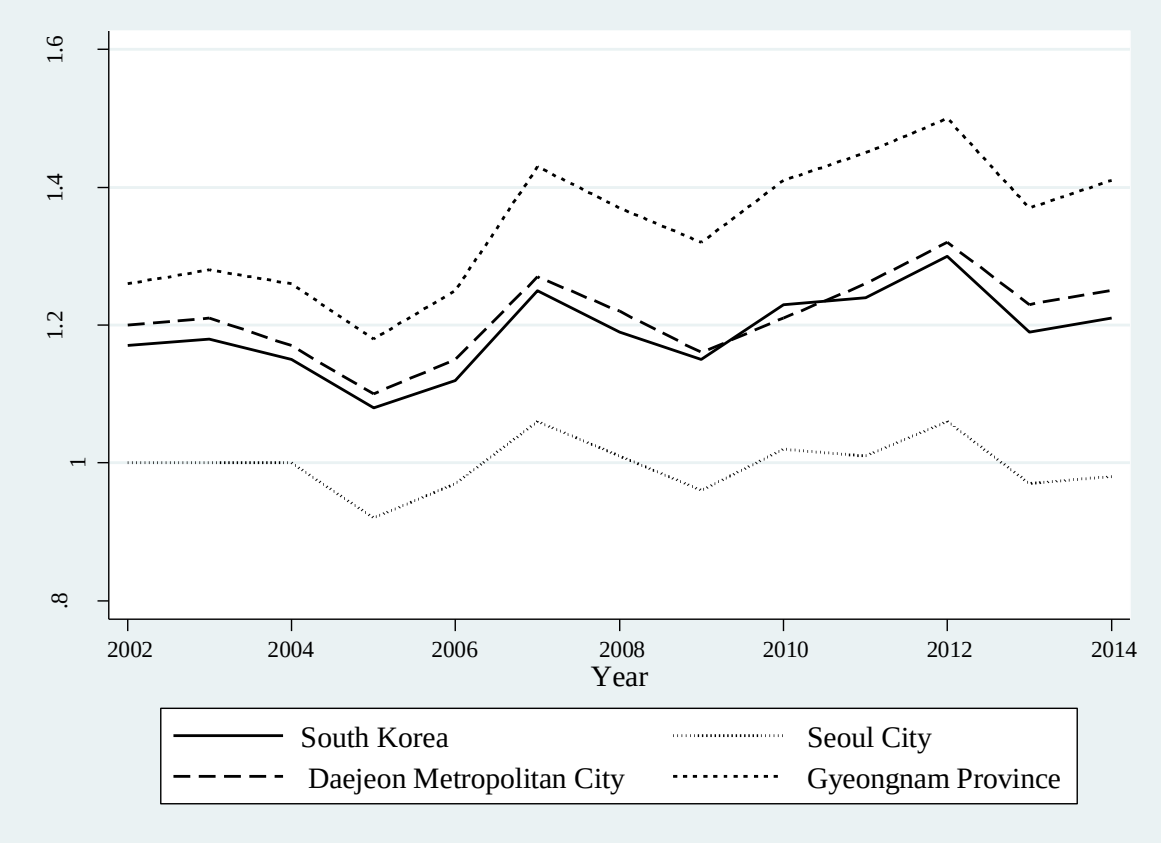

Figure 2 Recent Trends of Age at First Childbirth of South Korea

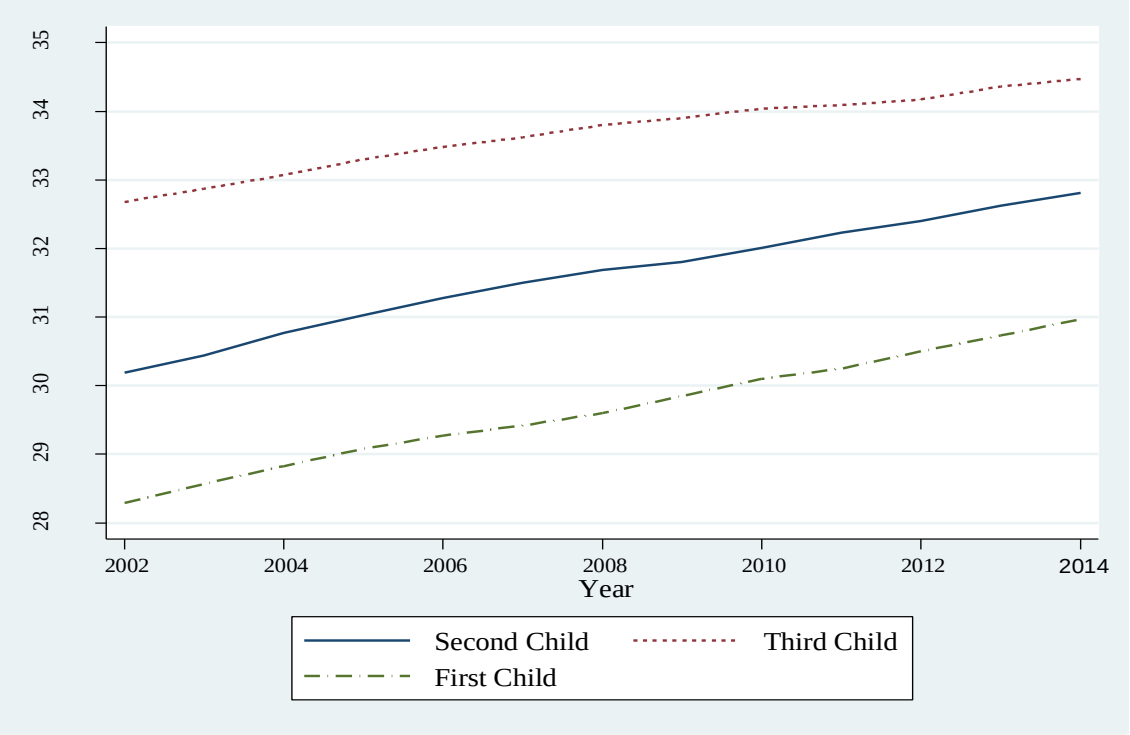

Table 1. Number and Percentage of Women in population by the Number of Children

Year	2000		2005		2010	
Age Group	All Ages	35-39	All Ages	35-39	All Ages	35-39
No child	783,392 (6%)	69,696 (4%)	920,785 (6%)	87,149 (5%)	607,138 (4%)	74,006 (4%)
1 child	2,134,188 (16%)	308,158 (16%)	2,255,163 (16%)	327,863 (17%)	2,719,021 (18%)	465,759 (26%)
2 children	5,709,309 (41%)	1,346,576 (68%)	6,311,778 (44%)	1,242,973 (66%)	6,972,218 (46%)	1,067,516 (59%)
3+ children	5,133,902 (37%)	257,367 (13%)	2,331,773 (16%)	220,831 (12%)	4,928,445 (32%)	196,055 (11%)
Number of Married women	13,760,791	1,981,797	14,413,990	1,896,777	15,226,822	1,803,336

* Source: 2000, 2005 and 2010 Census of South Korea by Korea Statistical Information Service (KOSIS)
* In the parenthesis are the percentages of married women with no child, one child, two children, and three or more children.

2.2.2. Birth Encouragement Grants

In 2002, when the falling fertility trend was only starting to gain the attention of policymakers, one county (Hampyeong-Gun of Gyeong Nam Province, in the southern part of South Korea) voluntarily began the 'Birth Congratulating Grant' program, which payed a cash grant to women whose registered addresses were in the county and who gave birth to a child (100,000 KRW for the first or second child and 300,000KRW[3] for the third or higher order births). Hampyeong-Gun County initiated this program to resolve the problem of its aging population by attracting young people and encouraging childbirth. Soon after, a few rural counties that shared the same concern copied this program. By 2005, 48 counties (17% of the counties in South Korea) had implemented this program. By then, the counties were concerned not only about the problem of their aging populations but also by the threat of losing their young population to nearby counties with birth encouragement grant programs. Accordingly, this competition expedited the spread of this program (Ahn, 2009; Lim, 2009).

In 2005, the Korean government legislated the 'Low Fertility, Aging Society Basic Law' (LFASBL), which set the legal basis for nationwide pro-natalist policies and clarified their sources of funding. The LFASBL especially incentivized county governments to initiate birth encouragement efforts by stating that the national government would subsidize any local government's program in line with birth encouragement goals, thus granting local governments a great latitude to choose the forms such policies would take.

[3] 1,000 KRW is approximately US$1.

As a result, many county governments chose the birth encouragement grant program as their only pro-natalist policy, with a simple eligibility requirement: residency in the county for certain months (usually 12 months). By 2010, about 83% of counties in South Korea had implemented some form of birth encouragement grant program.

With the unique origin of the birth encouragement grant, its competitive expansion, and the national government's commitment to financing counties' pro-natalist policies, county governments set their own grant amounts, relying on the national government's annually allocated budget along with their own annual budgets. This resulted in a large variation in grant amounts across counties (see Table 2 for the grant patterns). In particular, as seen in Table 2, "gun-counties", or rural counties,[4] tended to promise larger grants than other counties, reflecting their severe aging population problem.

In almost all counties, the amount of birth encouragement grants differed by a child's birth rank. Usually, birth encouragement grants for a first child were set at the lowest amount, with larger amounts offered for a second child and even larger amounts for a third child. Reflecting this, by 2010 almost all counties offered the birth encouragement grants for a third child (about 83%), while fewer counties offered grants for a first (about 47%) or second child (about 75%).

Birth encouragement grants have varied greatly over time too. As seen in Table 2,

[4] There are mainly three types of county level governments – 'District' of a metropolitan city, 'City' of a province, and a 'Gun' of a province, where Metropolitan cities and provinces are of the equal level in bureaucratic hierarchy. Gun-counties are typically rural counties in a province.

due to the expansion of the national budget allocated for pro-natalist policies[5] and increasing competition among counties, grant amounts increased every few years. Many counties expanded their grant programs from covering only the birth of a third child to rewarding first and second children as well. Furthermore, as county governments realized that the grant amounts were small relative to the cost of raising a child, many increased the amounts.

Table 2. Variation of the Birth Encouragement Grant Level over time and by county type

	All Counties			Excluding 'Gun' Counties			Only 'Gun' Counties		
Grants	2006	2008	2011	2006	2008	2011	2006	2008	2011
For first child	45.3 (45.6)	53.3 (68.5)	65.7 (86.9)	35.8 (28.8)	45.2 (52.2)	54.5 (94.2)	5.2 (52.3)	57.4 (75.7)	74.9 (8.1)
N	32	68	111	11	23	50	21	45	61
For second child	66.6 (124.5)	81.6 (121.9)	117.9 (146.5)	4.6 (25.0)	49.8 (47.3)	84.9 (94.4)	107.4 (192.5)	12.6 (167.0)	163.7 (188.8)
N	67	127	177	41	70	103	26	57	74
For third child	156.3 (231.2)	222.6 (329.5)	279.7 (332.7)	104.2 (156.7)	121.7 (153.6)	164.8 (167.7)	237.4 (298.8)	383.6 (451.5)	481.8 (439.7)
N	92	174	218	56	107	139	36	67	79

* In the beginning of the sample period, 2002, there was only one county with birth encouragement grant. Hampyeong-gun county had birth encouragement grant of 100,000KRW for first or second child and 300,000KRW for third or higher order birth child.
* Unit of grant is 10,000KRW (about USD10)

[5] According to the Ministry of Strategy and Finance, a national budget for pro-natalist policies was first allocated in 2006 (26,889,022,000 KRW). It steadily increased until 2009, when it reached its maximum, 42,165,965,000 KRW. In 2010 and 2011, it was slightly over 32,000,000,000 KRW. Overall, there was about 11% increase in the budget allocated based on the LFASBL.

The large variation of grant levels makes possible the estimation of their marginal impact. Identification of this impact relies on the premise that the grant levels vary exogenously with respect to the dependent variables – various fertility indices. However, since the birth encouragement grants have been adopted voluntarily by counties, one might suspect that the introduction of the policy and the grant levels are not fully exogenous to fertility rates. Therefore, I analyzed the determinants of grant introduction timing and the grant level using pre-policy (2001) county characteristics, controlling for the province-fixed effects. The timing of the county's grant introduction is given as the rank of "adoption timing", one being assigned to the first county to adopt the policy and the largest number assigned to the last county in the sample to adopt the policy. The grant levels are given by the average grant over the sample period, 2002~2011.

As shown in the result Table 3, the average age of the county's population, the size of net migration of the age 25-45 female population compared to the total population, and the distance from the closest metropolitan city are weakly significant determinants of adoption timing and grant level for the first and second child. However, the county's fertility index, or total fertility rate, is not significant. This is true even when different measures of a county's fertility index are included in various specifications, as shown in Tables 18~21 in the appendix. This implies that much of the variation of grant amounts is idiosyncratic with respect to counties' fertility patterns. In any case, to address the potential correlation between the trend of the determinants of grants and the trends of outcome variables, I directly control these factors in the estimation. Additionally, I control the pre-policy fertility rates, even though they do not have any explanatory power for the average

grant levels.

Table 3 Pre-policy (2001) Determinants of Grant Level and Adoption timing

N=215	Adoption Timing	Average Grant for the first child	Average Grant for the second child	Average Grant for the third child
Total Fertility Rate	-14.18 (5.51)	11.52 (9.38)	29.97 (29.08)	11.28 (52.93)
Average Age	-3.13** (1.51)	3.00** (1.51)	11.12** (4.69)	12.62 (8.51)
Female Population/total population	-207.43 (173.02)	267.75 (172.63)	824.95 (535.10)	292.75 (972.14)
Net Migration of 25-45 female/total population	-731.11* (372.33)	497.21 (371.50)	936.84 (1151.53)	861.73 (2092.03)
Marriage counts/total population	-426.27 (954.86)	-441.26 (952.70)	1151.46 (2953.12)	-2593.57 (5365.02)
Distance from a closest metropolitan city	-.12*** (.04)	.08** (.04)	.23** (.11)	.33 (.21)
Farming area per capita	34.16 (32.35)	45.54 (32.28)	36.17 (100.05)	46.24 (191.76)
Tax Revenue per capita	-.01 (.02)	-.005 (.02)	.01 (.06)	.05 (.11)
Capital city of a province	-11.15 (9.10)	5.32 (9.07)	14.99 (28.12)	27.5 (51.09)
Province FE	X	X	X	X
R-Squared (Adj R-squared)	.56	.36	.26	.49

* The unit of the observations is County.
* All of the models controls for province fixed effects and standard errors clustered by province.
* The unit of total tax revenue is 100,000,000KRW (or about USD100k).

Apart from the discussion about the variation of the birth encouragement grant levels, it is important to note that the grant amounts are small relative to the average monthly family income. While the average grants for the first child in 2006 and 2011 were 453,000 KRW and 657,000 KRW, as shown in Table 2.2, this was only 1.6% and 2% of the average annual income of families with no child in the respective years. Similarly, the

average grants for the second child in 2006 and 2011 were about 1.8% and 2.5% of the average annual household income of families with one child, and the average grants for the third child in 2006 and 2011 were about 3.7% and 5.3% of the average annual household income of families with two children.

What then, is the expected effect of the birth encouragement grant, a small one-time cash transfer? In naïve thinking, birth encouragement grants should clearly increase fertility due to income and price effects. If a child really is a 'normal good,' as Becker (1960) argued, then an increased income from the birth encouragement grant should increase the demand for children. Furthermore, since the grants reduce the relative price of children, both the income and the substitution effect will increase the demand for children relative to other goods. Therefore, Becker's theory predicts that the birth encouragement grant would have a positive effect on fertility, which can be shown in an empirical study through an increase in the probability of birth or a longer fertility period, allowing for additional children, by shifting the timing of first birth to a lower age.

However, since the decision to have a certain number of children is not a continuum of marginal choices (although the degree of preference is a continuous choice) but rather a discrete choice, grant levels must increase enough to induce any noticeable changes. Therefore, it is also possible that the birth encouragement grants have a zero or a very small effect in observable fertility patterns. In fact, birth encouragement grants are quite small (the average amount is 290,000KRW or 290USD) relative to the total cost of raising a child until completion of college, which the Korean Institute for Health and Social Affairs estimates to be about 200,000,000 KRW (or about $0.2 million) (Shin & Kim, 2010).

Nevertheless, since people are sometimes short-sighted, birth encouragement grants may still have a small but imperceptible positive effect.

2.3. Data and Sample

This paper uses the sample of married women[6] between the ages of 20 to 40 from the Korea Labor and Income Panel Study (KLIPS), panel data comparable to the Study of Income Dynamics (PSID) of the United States that contains rich information about the individuals' demographic, work history, and household information. The study period is 2002 to 2011, during which the birth encouragement grant was effectively the only pro-natalist policy for most counties.[7] The panel includes the complete records on 2,229 married women, and there are 9,706 total observations in this unbalanced panel.

One drawback of the KLIPS data is that it does not track the fertility history of women. The survey asks whether a woman has a child and the number of children they have upon the entry to the panel, but does not ask if any changes have occurred in subsequent surveys. Therefore, birth events and any changes to fertility variables are updated based on the household composition changes, following Brewer et al. (2012). More specifically, a child birth variable is generated to take the value of one when a new

[6] Further, in this policy evaluation, only married women are considered, as out-of-wedlock births comprise only a small fraction of total births (less than 2%) and tend to be 'accidental,' rather than a decision based on women's overall socio-economic conditions due to persisting traditional and conservative views of marriage and childbearing in Korea.

[7] Although during this period, a few counties had additional programs such as supplementary private infant health insurance, the value of which was about 30,000 KRW (≈ US$30) per month, such additional policies did not vary much. Therefore, it is directly controlled in the regression analysis.

family member of age zero is added between any two surveys. Since adoption is rare in South Korea and the age of women in the sample is restricted to 20 to 40, a new baby in a family is most likely a baby born between two surveys.

Another issue with the KLIPS data is that its design may under-represent the population living in the '*gun'* or rural counties. When the original households were sampled in the first survey in 1998, only the households that belonged to metropolises or urban counties of provinces were sampled. So, '*gun'*-county residents are present in the sample only if they have moved to a '*gun'*-county or separated from the original household. Nevertheless, in my sample, the proportion of women living in '*gun*'-counties is similar (actually slightly higher) to the proportion of the age 20-40 women living in '*gun*'-counties in 2010 census,[8] and they are similar in most aspects with the women living in non-*gun* counties, as shown in Table 4. The two groups only differ in household debt and assets, reflecting much higher real estate and rent prices in cities.

Using the sample of women from only the non-*gun* counties and limiting the interpretation to these regions may be sufficient for evaluating whether fertility decisions respond to financial incentives, which is the main research question of this paper. However, in the light of policy evaluation, dropping these observations will yield a much compromised interpretation. Therefore, I use the full sample of women from the KLIPS, including those who live in *gun*-counties. In fact, the estimation results are robust with the inclusion of *gun*-county residents. Nonetheless, one should note that the *gun*-county

[8] In my sample, fertile age women living in gun-county was about 8%, while it is 7% in the census of 2010.

residents in the KLIPS data, who originated in larger metropolitan areas and later moved for various reasons, could be different from women who have always lived in a *gun*-county. In this way, the results of this paper may not fully reflect the impact of birth encouragement grants on the *gun*-county residents.

Table 4. Summary Statistics: Full Sample, Non-gun-county residents, and Gun-county residents

	Full Sample N=9532	Without 'Gun'-county residents N=8689	Only 'Gun'-county residents N=843
Birth	.13 (.33)	.13 (.33)	.12 (.33)
Grant1	4.2 (23.9)	3.6 (22.8)	1.4 (32.9)
Grant2	16.6 (47.7)	15.7 (44.3)	26.7 (73.8)
Grant3	58.3 (148.6)	41.8 (82)	228.1 (386)
Age	34.3 (3.9)	34.3 (3.9)	34 (4)
Education (year)	13.1 (2.1)	13.1 (2.1)	12.9 (2.5)
Marriage duration (year)	9.8 (4.7)	9.8 (4.7)	10 (4.7)
Work	.5 (.5)	.5 (.5)	.5 (.5)
Own labor income	65.7 (105.9)	66 (106.1)	62.5 (104.2)
Household total income	300.9 (201.8)	301.6 (205.1)	293.8 (164)
Household debt	2760.1 (7881.9)	2892.4 (8184.9)	1396.6 (3151.9)
Total Asset	12154.6 (20687)	12671.5 (21368.4)	6927.1 (10080)

* Units of incomes and value of asset and debt are 10,000KRW.

Data on birth encouragement grants was manually collected from the Korean government's local law database, called Enhanced Local Laws and Regulation Information System (ELIS). This database tracks all local orders and amendments. By tracking new local orders initiating birth encouragement grants and amendments that expand these programs in terms of the amount of money awarded and the eligible number of children,

all changes in the birth encouragement grants for each county were recorded.

Moreover, to ensure that the grants listed in the local laws match with the actual amounts paid to women, they were cross checked with the received amounts reported in online communities for mothers, where active discussions about the grant amounts can be found. In some cases, the official grant amounts did not match what was actually paid because of delayed executions or excess demand. In those cases, the actual amounts paid were confirmed by contacting the local county governments.

In addition, some counties started awarding grants in the middle of a year rather than the beginning of the year, which means that the births that have occurred before the grant was set in that year may not have been affected by the stated grant amount. If there are many such non-affected births, then the estimated effect of the grants will understate their true impact. However, counties that started the program in the middle of the year almost always passed and publicized the new policy at the beginning of the year and paid the grant for all eligible babies born in the same year. Therefore, the information about the grant amounts should have been available at the time of the decision to conceive, regardless of when the grant was actually paid, and the bias from non-affected births should be marginal.

To analyze the effect of birth encouragement grants on the probability of birth, I use three subsamples for analysis: women at risk of first birth, defined as married women with no children; women at risk of second birth, defined as married women with one child; and women at risk of third birth, defined as married women with two children. Subsamples

are used instead of the full sample because only a small fraction of women aged 20-40 go through childbirth in any given period. Without restricting the sample to an at-risk group, the effect of the birth encouragement grant will be too dissipated to be captured by regression analysis. Even within these subsamples, many observations in the sample could be non-childbearing women. For example, women at risk of third birth may include many women who have terminated fertility decisions for reasons other than financial constraints, such as infertility or reaching the maximum number of children that they wanted to have. If the size of the non-childbearing observed population is not marginal, then this may drive the estimates of the regression analysis to zero. In general, the subsamples are similar in most aspects, except for some small differences in socio-economic status associated with the older average age of women at risk of having a second or third child. A more detailed description of the subsamples is given in table 16 in the Appendix.

To evaluate the effect of the birth encouragement grant on the timing of birth, I use the pooled cross-section of women who had first or second births. The difference between this subsample and the at-risk groups is that while the at-risk groups are formed based on the number of children women had at the time of entry to the panel as well as the number of birth events afterwards, this subsample contains only the women who got married and had a first birth or who had a first and second birth during the period covered by the panel. The subsample is defined in this way because the accurate length of time between births is observable only for this group of women. As in the case with the at-risk groups, women who had a first or a second birth during the panel year are similar in most attributes. Summary statistics and a detailed data description are available in the Appendix.

2.4. Evaluation 1: Effect of Birth Encouragement Grants on the Probability of Birth

2.4.1. Estimation Model, Challenge and Method

To estimate the impact of the birth encouragement grants on the probability of birth, I use the county fixed effect model as the baseline model, which is given as the following:

$$(4.1)\quad Prob(\ \ Birth^{j}|i,t) = \beta_0 + \beta_1 Grant^{j}_{c,t-1} + X_{i,t}\beta_2' + year_t + c_c + \varepsilon_{i,c,t}$$

$$(4.2)\quad \varepsilon_{i,c,t} = \epsilon_{c,t} + v_i + \nu_{i,t}$$

Where $Birth^{j}_{i,t}$ is binary and equal to one if j[th] child birth occurred to person i in period t; $Grant^{j}_{c,t}$ is the grant amount for j[th] child birth of county c in year t-1; and $X_{i,t}$ includes the relevant demographic characteristics: age, age squared, education level, duration of marriage, and duration of marriage squared, as well as more detailed characteristics such as socio-economic status information (whether the woman works along with her income, lagged one period since the employment status in the same period could be affected by the childbirth event), household information (whether her spouse works and the spousal income,[9] as well as the total value of household assets), and other pro-natalist policies of the county if these policies exist(such as county-subsidized infant health insurance). In addition, a county's total tax revenue is included to absorb the potential simultaneity of the grant level and county women's birth patterns, since the national government may allocate

[9] KLIPS does not directly record the spousal income and work status. Therefore, the spousal income is defined as the remainder of the total household labor income after deducting the woman's own labor income. Also, spousal work status is based on whether the spousal income is zero or not.

more of the so-called 'shared tax'[10] to counties with low or high fertility to promote their birth encouragement efforts. Finally, $year_t$ includes year dummies, which are intended to absorb the effects of any concurrent nationwide pro-natalist policies.

The dependent variable is binary, and the grant variable is lagged one period to reflect the gestation period. Note that I do not separately estimate the impact of the existence of a grant policy by including an indicator for whether a county has a grant policy; nor do I introduce non-linearity by adding squared grants. This is because in the specifications of the preliminary study, whether a county has a grant or a squared grant did not make any difference in the results.

Since the model contains both individual-level and county-level variables, the error term is composed of the county-level unobserved factors, $\epsilon_{c,t}$, and the individual-level unobserved factors, v_i and $\nu_{i,t}$, as shown in the equation (4.2). An endogeneity problem may arise if the trend of the grant level is spuriously correlated with the dependent variable through $\epsilon_{c,t}$. For example, if a county-level factor, such as county's aggregate fertility pattern or factors related to the aggregate fertility, is correlated with an individual's fertility and the grant level, then the estimated effect of the grant will be biased.

I try to control this effect by two ways. I first control the county specific time trend in one model. Then, much of the variations of $\epsilon_{c,t}$ will be absorbed. This method, however,

[10] County government's tax revenue is mainly from two sources, own tax local tax revenue and 'shared tax (교부세).' The 'Shared tax' is the tax revenue of the national government allocated to the regional governments to balance out the tax-revenue disparities across the region. Often, the 'shared tax' is increased or decreased based on special needs of a county or to incentivize counties to use certain policies or improve efficiency of them.

might also absorb too many of the useful variations in the grant amounts. So, to complement this, I control the trend of the pre-policy determinants of the average grant levels as mentioned in section 2, generated by interacting the pre-policy determinants of the grants and fertility rate with the year, a technique that is often used in policy evaluations (for example, Hoynes and Schanzenbach, 2007). Then, with this control, much of the remaining variation of the grant will be the idiosyncratic part, and at least some part of the endogeneity will be removed. Also, this paper uses the linear probability model (LPM) instead of Probit, as the fixed effect estimators used in non-linear models generally suffer from the incidental parameter problem (Greene, 2002). While there has also been recent developments in fixed effect implementation of panel data using the logit model, identification in these models requires variation in not only the outcome variable but also in the predictor variables within the clusters (Rodridguez, 2007). Therefore, using the fixed effect logit model will cause my analysis to lose almost all information at the individual level.

Another possible issue with the estimation is that, due to the simple eligibility requirements of birth encouragement grant programs, potential recipients may 'shop' for a grant.[11] That is, some expectant mothers may migrate either physically or 'on paper'[12] to counties that offer larger grants. Furthermore, even if they migrate to another county for other reasons, the decision could still be affected by the grant amounts offered at the

[11] 'Shopping for a grant' is one of the main criticisms of birth encouragement grants although the extent is unknown. This can easily be done because in South Korea a baby's birth is not registered at the hospital but at the municipal office within 30 days of birth. A mother can change her registered address to a target county and register the baby's birth in that county.

[12] The practice of changing the registered address to another county.

destination. If this migration issue is not addressed, the estimation result will overstate the true impact of the policy. Since movers can be identified and the information on the difference in the amounts of grants between the destination and the source counties is available, a direct control in the regression can be considered.

However, because the intention to have a child causes mothers to move, not the other way around, the inclusion of a migration variable as a control will generate specification errors.[13] Ideally, instrumental variables could account for this possible migration, but when attempted, the instruments were generally too weak to be usable.[14] Therefore, I simply remove the observations that moved either in the same period as childbirth or one period before and limit the interpretation to 'those who did not move around the time of childbirth.'[15] Note that this only partially removes the potential migration effect since the sample still contains the women who might have moved but stayed to benefit from a high grant in their current county.[16]

2.4.2. Estimation Results

The estimation results are presented in Table 5. The first column reports the baseline county fixed effect results, while the second column contains the estimation results with the

[13] Note that the result is robust to adding direct control of movers in the regression.
[14] The IV that have been attempted to use was the population distance of a county from the threshold for additional representative in the national congress, following some news reports that suspect the intention of birth encouragement grants were to increase population for this purpose. The instrument was generally weak with first stage f-statistic value less than 10 in many specifications. However, the coefficient of birth encouragement grant variables were usually similar to fixed effect models.
[15] There are few such movers in the sample (0.06%).
[16] It is likely that the inclusion of those who might have moved doesn't change the result, given that there was no impact of 'move' found on the preliminary analysis that directly controlled for the movers.

additional county specific time trend. The third column controls the trends of pre-policy determinants instead of the county specific time trend. In all specifications, the effect of the grant is not significantly different from zero, with large standard errors and inconsistent signs. This implies that the grant for a first child has no effect on the probability of first birth.

The signs and magnitudes of other controls are relatively consistent and reasonable across specifications. Overall, a woman's age, employment, marriage duration, and spousal employment and income explain the probability of a first birth more effectively than the existence and amount of a birth encouragement grant. Increase in a woman's age is associated with the increased probability of a child birth, but at a decreasing rate. Similarly, an increase in the marriage duration increases the probability of the first birth, also at a decreasing rate. A working married woman, compared to a non-working married woman, has an approximately 23% lower chance of having a first child in the next period. Interestingly, however, while the spousal work status is positively correlated with the probability of a first birth, the spousal income is negatively correlated with the probability of a first birth. That is, in this sample, if a spouse is earning income, the probability of a first birth increases, but as the spousal income increases, the probability of a first birth falls. Despite the puzzling nature of this finding, it is consistent with the findings from another analysis by the Korea Institute for Health and Social Affairs (2017), which also finds that a better economic status of a husband predicts lower fertility. Also, tax revenue of a county is positive and significant in all specifications. Since it is unlikely that the county government's total tax revenue affects an individual's fertility choice directly, this

significant result probably absorbs the correlation between the ’shared tax’ and the aggregate fertility patterns.

When the subsample of women who are at risk of having a second child are considered, the grant is again not significant in any specifications using fixed effects, as shown in Table 6. In this model, fewer variables have explanatory power for the probability of a second birth. Only a woman’s age and level of education have a consistently significant impact on the probability of a second birth. Increase in age increases the probability of a second birth at a decreasing rate, and a one-year increase in education level reduces the probability of a second birth by 0.3~0.4%.

In the case of a third birth, grants have no significant effect on the probability of birth in all specifications, as shown in Table 7. As with the probability of first and second births, an increase in the marriage duration still increases the probability of birth at a decreasing rate. However, an increase in age reduces the probability of a third birth at an increasing rate. Furthermore, unlike in the cases of the first and second birth, where the value of household assets were not significant, the variable in this case is negative and significant. An increase in the value of household assets by 100,000,000 KRW (or US$100,000) decreases the probability of a third birth by 0.3~0.4%. One explanation might be that a higher value of household assets reflects women living in areas with higher housing prices, since the largest part of household assets value is usually the value of an owned home. Considering that areas with high real-estate prices tend to have higher costs of raising a child, as well as increased private education consumption and overall high living costs, an increased value of household assets may predict a lower chance of having

a third child.

In any case, I find that birth encouragement grants do not affect the probability of birth for all birth orders. The subsamples used in this analysis may contain a large proportion of 'no-response' population, in which case the estimation result will be biased to zero and the effects of the birth encouragement grants would be impossible to see. Of course, another possibility is that the birth encouragement grant has no impact on the probability of child birth. To investigate this, in Section 6, I evaluate the impact of the birth encouragement grant on the county's total number of births. Since the aggregate birth count data reflects all births that actually occurred in the county rather than a sample, the results may better delineate the impact of the birth encouragement grant on the population, if any such impact exists.

Table 5. Impact of Birth Encouragement Grant on the Probability of First Birth

Prob(First Birth) N=1,614	(1)	(2)	(3)
$Grant1_{t-1}$	.002 (.005)	-.01 (.03)	.02 (.005)
Age	.12* (.063)	.13* (.07)	.12* (.06)
Age^2	-.002* (.001)	-.002* (.0001)	-.002* (.001)
Education (years)	.01 (.01)	.01 (.01)	.01 (.01)
Marriage Duration (years)	.03 (.02)	.04* (.02)	.03* (.02)
Marriage Duration^2	-.003* (.001)	-.004** (.002)	-.003*** (.002)
Work	-.23*** (0.06)	-.23*** (.06)	-.23** (.054)
Own Income	.0005** (.0003)	.0005* (.0003)	.001** (.0002)

Spouse Work	.24*** (.09)	.23*** (.09)	.23*** (.09)
Spousal Income	-.0002** (.0001)	-.00002*** (.0001)	-.0002*** (.0001)
Household Asset	.01 (.01)	.013* (.006)	.01 (.01)
Infant Health insurance	-.03 (.06)	-.11 (.08)	-.04 (.08)
Tax Revenue	.02* (.01)	.04*** (.01)	.03** (.01)
Adj R-squared	.010	.005	.011
Pre-Policy Determinants			X
County FE	X	X	X
County FE X Year		X	
Year FE	X	X	X

* Units of grant and incomes are 1,000,000 KRW (about US$1,000), while the unit of household assets, debt, local tax revenue is 100,000,000KRW.
* Standard errors are clustered by county.

Table 6. Impact of Birth Encouragement Grant on the Probability of Second Birth

Prob(Second Birth) N=2,969	(1)	(2)	(3)
$Grant2_{t-1}$	0.001 (0.001)	0.002 (0.002)	0.001 (0.001)
Age	0.04** (0.02)	0.03* (0.02)	0.05*** (0.02)
Age^2	-0.0005** (0.0002)	-0.0005* (0.0003)	-0.001** (0.0003)
Education (years)	-0.003** (0.001)	-0.003 (0.003)	-0.004** (0.002)
Marriage Duration (years)	0.001 (0.005)	-0.0005 (0.005)	0.0001 (0.005)
Marriage Duration^2	-0.0003 (0.0002)	-0.0002 (.0003)	-0.0002 (0.0003)
Work	-0.02 (0.01)	-0.02* (0.01)	-0.02 (0.01)
Own Income	0.0001 (0.0001)	0.0001 (0.0001)	0.0001 (0.0001)
Spouse Work	0.02 (0.02)	0.02 (0.02)	0.02 (0.02)
Spousal Income	-0.00003 (0.00002)	-0.00003* (0.00001)	-0.00002 (0.00002)
Household Asset	0.003 (0.003)	0.003 (0.003)	0.001 (0.002)
Infant Health insurance	-0.05** (0.02)	0.06 (0.07)	-0.05 (0.02)
Tax Revenue	-0.003 (0.002)	-0.004 (0.003)	-0.004 (0.003)
Adj R-squared	0.038	0.069	0.039
Pre-Policy Determinants			X
County FE	X	X	X
County FE X Year		X	
Year FE	X	X	X

* Units of grant and incomes are 1,000,000 KRW (about US$1,000), while the unit of household assets, debt, local tax revenue is 100,000,000KRW.
* Standard errors are clustered by county.

Table 7. Impact of Birth Encouragement Grant on the Probability of Third Birth

Prob(Third Birth) N=5,999	(1)	(2)	(3)
$Grant3_{t-1}$	-.0003	.0003	-.0002
	(.0002)	(.0004)	(.0002)
Age	-.03*	-.03*	-.03*
	(.02)	(.02)	(.02)
Age^2	.0003	.0004*	.0003
	(.0002)	(.0002)	(.0002)
Education (years)	.001	.001	.001
	(.001)	(.001)	(.001)
Marriage Duration (years)	.004**	.004**	.004**
	(.002)	(.002)	(.002)
Marriage Duration^2	-.0002***	-.0002***	-.0002***
	(.0001)	(.0001)	(.0001)
Work	-.01***	-.02***	-.01***
	(.004)	(.005)	(.004)
Own Income	-.00001	-.00001	-.00001
	(.00002)	(.00002)	(.00002)
Spouse Work	.002	.003	.002
	(.01)	(.01)	(.01)
Spousal Income	.00001	.00001	.00001
	(.00002)	(.00002)	(.00001)
Household Asset	-.003***	-.004***	-.004***
	(.001)	(.001)	(.001)
Infant Health insurance	.001	-.0004	.003
	(.02)	(.02)	(.02)
Tax Revenue	-.001	-.001	-.0001
	(.002)	(.001)	(.0001)
Adj R-squared	.035	.032	.033
Pre-Policy Determinants			X
County FE	X	X	X
County FE X Year		X	
Year FE	X	X	X

* Units of grant and incomes are 1,000,000 KRW (about US$1,000), while the unit of household assets, debt, local tax revenue is 100,000,000KRW.
* Standard errors are clustered by county.

2.3.3. Evaluation by Income Quartiles

The effect of the birth encouragement grants may vary by an individual's financial state. Therefore, in this section, I repeat the same analysis by income percentile groups: bottom 20%, 20~40%, 40~60%, 60~80%, and 80~100% percentile groups. The income percentile group thresholds are defined based on the household income of the sample. The reason for using percentile thresholds from the sample of women used in this study, instead of the income percentile group cut-offs based on the whole sample of KLIPS, or based on other surveys, such as one done by Korea Statistical Information Service (KOSIS),[17] is because the income distribution of the age group 20~40 is different from the income distribution of the whole population, which contains a large, low-income elderly population, and there is no other survey that reports the income percentiles by age group. Also, since the income in the same year as child birth may be affected by the event of birth (e.g., a household member could take a temporary break from work), I generate the income groups based on the one-year lagged household income.

I use the dummy variable approach to capture the differential impacts of birth encouragement grants. I include the interaction of the grant variable with the income group indicators to the baseline model given in equation (4.1)[18], and add the income group indicators to capture the differential preference for fertility shared by women in the same

[17] Note that KLIPS is often thought to under-represent the income groups at the top of the distribution, it is not. A comparison with the 'survey of household economy' of KOSIS shows that the income distribution of KLIPS is similar to that of KOSIS, and may actually over-represent the top income groups according to Sung (2006). Also, in my own attempt to compare the income distribution, I find that there is no significant difference between the two surveys.

[18] I also estimated a model with the interaction of household income and grant level, and the results were not very different. There was no impact of grant that differs across the income group.

income group.

2.4.3. Estimation Results

In this estimation, the reference group, whose grant effect is captured by the grant variable, is the bottom 20 percentile income group. The result for the probability of a first birth in Table 8 shows that the grant has no impact on the probability of a first child's birth on the 20^{th}-percentile group. For other income groups, there seems to be no difference in the responsiveness to the grant, except for the 80^{th}-percentile group, which has a significant negative coefficient. Nevertheless, jointly, all of the grant variables are statistically insignificant, implying that there is no differential impact of birth encouragement grants across income groups.

The probability of first birth is not different across income groups in general. All income-group indicators are insignificant in all specifications. This implies that the preference for having a first child is not heterogeneous across the income groups. The explanatory variables included in this model have similar coefficients to the those in the previous section that pools all income groups.

In the case of the subsample of women at risk of having a second child, no heterogeneous impact of the birth encouragement grant by income group was found. The income group effect, however, was significant in some specifications. For example, a woman whose household income is between the 40th~60th percentile of income distribution, is less likely to have a second child based on the model that controls for the county fixed effects and the county specific time trends, as shown in Table 9, columns 1

and 2. Also, in all specifications, a woman whose household income is between the 60^{th}~80^{th} percentiles of income distribution is 3% less likely to have a second child. Finally, the grants for a third child have no differential effect on the probability of a third birth by income group, as shown in Table 10.

In sum, the birth encouragement grant does not seem to have an effect on the probability of birth, regardless of whether the analysis is done by pooling all income groups or separately by income group percentiles. However, if there is an effect, some income groups may be more responsive than other groups. For example, I find that the 80^{th}-percentile income group may be less responsive to the grant for a first child than the 20^{th}-percentile income group.

Table 8. Impact of Birth Encouragement Grants on the Probability of First Birth by Income

Prob(First Birth) N=1,614	(1)	(2)	(3)
$Grant1_{t-1}$	.02	-.07	.02
	(.01)	(.05)	(.01)
GrantXIncome40	-.02	.06	-.02
	(.01)	(.05)	(.01)
GrantXIncome60	-.01	.02	-.01
	(.04)	(.09)	(.04)
GrantXIncome80	-.19**	-.13	-.19**
	(.07)	(.09)	(.07)
GrantXIncome100	.04	.05	.04
	(.02)	(.05)	(.03)
Income40	-.01	-.04	-.02
	(.05)	(.05)	(.05)
Income60	.08	.06	.05
	(.06)	(.06)	(.05)
Income80	.03	.04	.03
	(.06)	(.06)	(.06)
Income100	-.01	-.04	-.03
	(.05)	(.06)	(.05)
Age	.13**	.11	.11*
	(.07)	(.08)	(.06)
Age^2	-.002**	-.001	-.001*
	(.001)	(.001)	(.001)
Education (years)	.01	.01*	.01
	(.01)	(.01)	(.01)
Marriage Duration (years)	.03	.05**	.03
	(.02)	(.03)	(.02)
Marriage Duration^2	-.002*	-.004***	-.002*
	(.001)	(.002)	(.001)
Work	-.23***	-.19***	-.19***
	(.06)	(.06)	(.05)
Own Income	.001**	.001*	.001*
	(.0003)	(.0003)	(.0002)
Spouse Work	.24***	.26***	.23***
	(.09)	(.09)	(.08)
Spouse Income	-.0002***	-.0002***	-.0002***
	(.0001)	(.0001)	(.0001)

Household Asset	.01	.01	-.01
	(.01)	(.01)	(.03)
Infant Health Insurance	-.04	-.25	-.05
	(.07)	(.17)	(.08)
Tax Revenue	.02	.02**	.02**
	(.01)	(.01)	(.01)
Adj R-squared	.021	.012	.017
Pre-Policy Determinants			X
County FE		X	X
County FE X Year		X	

* Unit of grant is 1,000,000 KRW (about USD 1,000).

Table 9. Impact of Birth Encouragement Grants on the Probability of Second Birth, by Income

Prob(Second Birth) N=2,969	(1)	(2)	(3)
$Grant2_{t-1}$	-.004*	.0004	-.002
	(.002)	(.005)	(.002)
GrantXIncome40	.001	-.004	.001
	(.002)	(.004)	(.001)
GrantXIncome60	.01	.01	.01
	(.01)	(.01)	(.004)
GrantXIncome80	.005	.002	.005
	(.004)	(.01)	(.004)
GrantXIncome100	.01	.01	.01
	(.01)	(.01)	(.01)
Income40	-.004	-.005	-.004
	(.02)	(.02)	(.02)
Income60	-.03*	-.03*	-.03
	(.02)	(.02)	(.02)
Income80	-.03*	-.04*	-.03*
	(.02)	(.02)	(.02)
Income100	-.02	-.03*	-.02
	(.02)	(.02)	(.02)
Age	.05***	.04**	.05***
	(.02)	(.02)	(.02)
Age^2	-.001***	-.001**	-.001***
	(.0003)	(.0003)	(.0003)
Education (years)	-.005*	-.004	-.005*
	(.003)	(.003)	(.003)
Marriage Duration (years)	.003	.002	.003
	(.004)	(.004)	(.005)
Marriage Duration^2	-.0003	-.0003	-.0003
	(.0002)	(.0002)	(.0002)
Work	-.01	-.01	-.01
	(.01)	(.01)	(.01)
Own Income	.00004	.00004	.00004
	(.0001)	(.0001)	(.0001)
Spouse Work	.01	.02	.01
	(.02)	(.02)	(.02)
Spouse Income	-.00001	-.00001	-.00001
	(.00002)	(.00002)	(.00002)

Household Asset	.001	.002	.001
	(.002)	(.002)	(.002)
Infant Health Insurance	-.06*	.02	-.04*
	(.02)	(.05)	(.02)
Tax Revenue	-.02	-.01*	-.01*
	(.04)	(.003)	(.003)
Adj R-squared	.027	.061	.029
Pre-Policy Determinants			X
County FE	X	X	X
County FE X Year		X	

Table 10. Impact of Birth Encouragement Grants on the Probability of Third Birth, by Income

Prob(Third Birth) N=5,999	(1)	(2)	(3)
$Grant3_{t-1}$	-.001	-.001	-.0003
	(.001)	(.001)	(.001)
GrantXIncome40	.001	.001	.001
	(.001)	(.001)	(.001)
GrantXIncome60	.001	.0002	.0003
	(.001)	(.001)	(.001)
GrantXIncome80	-.0001	-.0002	.0001
	(.001)	(.001)	(.001)
GrantXIncome100	.001	.001	.001
	(.001)	(.001)	(.001)
Income40	.003	.004	.005
	(.01)	(.01)	(.01)
Income60	.01	.01	.01
	(.01)	(.01)	(.01)
Income80	.005	.005	.002
	(.01)	(.01)	(.01)
Income100	.001	.002	.001
	(.01)	(.01)	(.01)
Age	-.03*	-.03*	-.03*
	(.02)	(.02)	(.02)
Age^2	.0003	.0003	.0004*
	(.0002)	(.0002)	(.0002)
Education (years)	.001	.001	.001
	(.001)	(.001)	(.001)
Marriage Duration (years)	.004**	.004**	.004**
	(.002)	(.001)	(.002)
Marriage Duration^2	-.0002***	-.0002***	-.0002***
	(.0001)	(.0001)	(.0001)
Work	-.01***	-.01***	-.02***
	(.004)	(.004)	(.005)
Own Income	-.00003	-.00003	-.0001
	(.0001)	(.0001)	(.0001)
Spouse Work	.001	.001	.001
	(.01)	(.01)	(.01)
Spouse Income	.00002	.00003	.00001
	(.0001)	(.0001)	(.00002)

Household Asset	-.003***	-.003***	-.004***
	(.001)	(.001)	(.001)
Infant Health Insurance	.001	.002	.002
	(.02)	(.02)	(.03)
Tax Revenue	-.001	-.0001	-.0001
	(.002)	(.0001)	(.0001)
Adj R-squared	0.049	0.050	0.055
Pre-Policy Determinants			X
County FE		X	X
County FE X Year		X	
Year FE	X	X	X

Evaluation 2: Effect of Birth Encouragement Grant on Timing of Birth

2.4.4. Estimation Model, Challenge and Method

For this evaluation, as mentioned in Section 3, samples are generated by pooling a cross-section of women who started and completed their spell between marriage and first birth, or first birth and second birth, within the years covered by the KLIPS panel data. The dependent variable contains the months between the marriage to first birth or first birth to second birth, and the explanatory variables contain grant information and other factors influencing fertility decisions at the beginning of the period, either at the time of marriage and at the time of first birth. I chose this method of evaluation because I am interested in how the birth encouragement grants affect women's plans for fertility timing when they become 'at risk' for having first or second child. Because I restrict my sample in this way, my interpretation is limited to those who had a first or second birth during the period covered by the panel. To evaluate fertility timing decisions, 'time to first birth' or 'time to second birth' duration models are often used; however, due to the endogeneity concerns, which cannot be handled easily and reliably in the duration model framework, I use a

simple linear regression with county fixed effects as the baseline model.[19] The dependent variables in this model are the length of time between marriage and first birth and the length of time between first and second birth, measured in months.

The following is the baseline estimation equation:

$$(5.1) \qquad LengthofTime_{it} = \beta_0 + \beta_1 Grant^j{}_{cT} + X_{iT}\beta_2' + year \quad + c_c + \varepsilon_{iT}$$

In this equation, $LengthofTime_i$ is either the length of time between marriage and first birth or the length of time between first and second birth of a person i, measured at the time of relevant childbirth, t. The variable $Grant^j{}_{cT}$ is the amount of grant money offered for j[th] birth in the county c of person i's residence at the time of the start of the period, T. For example, if a woman gave birth to her first child in 2002 and her second child in 2004, then $Grant^j{}_{c2002}$ reports the level of the birth encouragement grant for a second child in year 2002, with the assumption that people make such fertility decisions at the start of the period in question. X_{iT} includes other explanatory variables such as a woman's age, age squared, education level, whether she works, her spousal earnings, the total value of household assets, the county's other pro-natalist policies , and the county's total tax revenue at the start of the period T. $year$ includes year dummies.

Endogeneity concerns are common for both dependent variables. As with the probability of birth models, a spurious correlation can exist between the grants and

[19] In the preliminary analysis using duration models, birth encouragement grants increased the length of time between marriage and first birth, likely due to the inability to control for the county fixed effects or trends, which should absorb the general increasing trend of the length of time between births.

individuals' fertility choices. Migration effect may also cause bias. In particular, if women who want to have a first child early are more likely to move to counties with large grants, then the estimated effect of the grant will be biased downwards, assuming a negative (lowering) impact of the birth encouragement grant on the length of time between marriage and first birth or between first and second birth.

To handle these concerns, I use the same approach as in the previous section. I control the county fixed effect and the county-specific time trend to absorb county-specific trending factors that may be correlated with the grant amounts. Also, I directly control the pre-policy determinants of grants in place of the county specific time trend. To address the migration issue, I once again remove the sample of women who moved in the period near a childbirth event and restrict the interpretation to women who did not move during the time of childbirth.

2.4.5. Estimation Results

In both the fixed effect model and the model that controls for the pre-policy determinants of the grants, the grant for a first child has a significant negative impact, as shown in the first and third columns of Table 11. A 1,000,000KRW (or about US$1,000) increase in the grant for the first child reduces the time between marriage and first birth by about 0.4~0.5 months. This finding is consistent with what was predicted in theory. Other than the grant amount, the three factors of age, years of education, and whether or not a woman works were the strongest predictors of the length of time between marriage and first birth. According to these results, older women tend to delay their first birth by 8~9

months. The higher the education level (one year), the sooner (1 month) the first birth occurs after marriage. Interestingly, if a woman worked at the time of marriage, she has her first baby about 5~6 months sooner than women who did not work. This may be because married families with women who are working at the start of their marriages can become financially stable sooner. Also, since a lot of women quit their job soon after their marriage, this finding does not suggest that women with careers tend to have children sooner.

When the dependent variable is the length of time between the first and second birth, the grant for the second child seems to have no effect on the timing of the birth, as shown in Table 12. Most other explanatory variables are insignificant, but a woman's age, the duration of marriage, whether she works, and her spousal income seem to explain some variations of the timing of a second birth. When the model includes fewer control variables –age, age-squared, education, work, marriage duration information, all of these variables turn significant, but the effect of the grant for the second child is still not significantly different from zero.

In summary, I find that the grant for a first child reduces the length of time between marriage and first birth slightly, while the grant for a second child has no impact on the length of time between first and second birth. The consistent and significant negative impact of the birth encouragement grant on the timing the first birth in this analysis may be attributed to the fact that this model used the data of women who actually gave birth, unlike the probability of birth analysis, which used data from women who might have a first birth. Therefore, the birth encouragement grant might have had some effect on the birth of the first child that has not been picked up in probability models due to the limitation

of the sample definition. Or it could be that the birth encouragement grant only affects those who already had plans for a child.

In the next section, I will analyze the impact of birth encouragement grants on the county's total births, which captures the conglomerated impacts of the timing effect and the birth probability effect. If birth encouragement grants did only have a small effect on the timing of women who chose to give birth, then even in the aggregate, with data from all actual births, they should not have a permanent or long term effect on the fertility.

Table 11. Impact of Birth Encouragement Grant on the Length of Time between Marriage and First Birth

Months between marriage and First birth N=705	(1)	(2)	(3)
$Grant1_{t-1}$	-.04*	-.09	-.05*
	(.02)	(.18)	(.02)
Age	8.14**	1.29**	9.05*
	(3.65)	(4.86)	(4.11)
Age2	-.09	-.13*	-.11
	(.06)	(.07)	(.07)
Education (years)	-1.02**	-.31	-1.01*
	(.50)	(.70)	(.58)
Work	-5.15**	-5.31*	-5.96**
	(2.12)	(2.89)	(2.44)
Spouse Income	.004	.01	.004
	(.007)	(.10)	(.01)
Total Asset	-.04	-.04	-.04
	(.03)	(.04)	(.04)
Infant Health Insurance	-19.88	-17.15	-9.20
	(13.12)	(4.53)	(17.54)
Tax Revenue	-.01	-.02*	-.03
	(.08)	(.01)	(.02)
Adjusted R-Squared	.138	.221	.220
Pre-Policy Determinants			X
County FE		X	X
County FE X Year		X	
Year FE	X	X	X

* Unit of Grant is 1,000,000 KRW.
* Standard errors are clustered by county.

Table 12. Impact of Birth Encouragement Grant on the Length of Time between First and Second Birth

Months between First and Second Birth N=334	(1)	(2)	(3)
$Grant2_{t-1}$	-.01 (.04)	.15 (.18)	-.02 (.04)
Age	1.17* (.61)	.83 (1.03)	1.26** (.62)
Age2	.13 (.13)	.11 (.15)	.12 (.11)
Education (years)	.13 (.98)	-.61 (1.77)	.20 (.98)
Marriage Duration (Years)	.58*** (.07)	.49*** (.11)	.57*** (.07)
Work	5.27* (2.86)	11.86 (7.02)	5.93* (3.40)
Spouse Income	-.01 (.01)	-.05* (.03)	-.01 (.01)
Total Asset	-.11* (.06)	-.01 (.10)	-.11 (.07)
Infant Health Insurance	23.77 (2.21)	23.29 (27.97)	18.95 (13.67)
Total Tax	-.02 (.02)	.01 (.01)	-.03 (.02)
Adjusted R-Squared	.146	.178	.194
Prepolicy determinants			X
County FE		X	X
County FE X Year		X	
Year FE	X	X	X

* Unit of Grant is 1,000,000 KRW.
* Standard errors are clustered by county.

2.5. Robustness Check Using Aggregate Data

In this section, I analyze aggregate fertility to complement the findings of my individual data analysis. Since the county's total birth data includes all actual births, rather than a sample, it is likely that a more pronounced effect of the birth encouragement grant can be observed in this analysis, even though the data reflects the combined effect of all micro-level changes in fertility related decisions. Also, with the aggregate fertility data, I use first difference and longer difference models to investigate whether the birth encouragement grant has only a short term effect or a longer term impact. To this end, I use the county-level total number of first, second, and third births and other relevant control variables of 215 counties[20] collected from the Korea Statistic Information Service (KOSIS). To address the potential endogeneity of the grants, I again control the county specific unobserved factors by differencing and include the trends of the pre-policy determinants of grants.

I used the first difference model instead of the county fixed effects model because it is usually difficult to tell whether a variable has a transitory or lasting impact in the fixed effect model. Since it is also useful to know whether the birth encouragement grant has lasting effects, I will also use the second difference models to make comparisons.[21]

Additionally, to alleviate the problem of reverse causality and account for the

[20] Total number of counties is 233 as of 2011, but this study excludes counties that underwent a merger or separation between 2002 and 2011. The aggregate data were collected from KOSIS. Also, 215 counties in the sample include gun-counties. The estimation results are robust to exclusion of 'gun'-counties from the sample.

[21] Longer differences have also been done in the preliminary analysis, and the results are similar after the second difference. Therefore I report only the second difference model results.

gestation period, I use a one-period lagged grant variable. Given that the county governments' policy decisions should be based on previous patterns of fertility and not the future, using a lagged explanatory variable will mitigate the reverse causality problem if it exists.

With county level data, it is necessary to directly control the issue of migration in the regression for two reasons. First, although the intention of child birth induces speculative migration at the micro level, the number of incoming fertile female movers at the county level should directly affect the total number of births that occur in the county. Thus, migration is an explanatory factor for the variations in the total number of births in a county. Secondly, in the aggregate data, movers cannot be identified. This means that simply removing movers and restricting the interpretation is not possible.

To respond to this problem, I add the net migration of women ages 20-40 to the model to capture the changes to the fertility indices attributed to an increase or decrease in the number female in-migrants to a county. This control cannot absorb all the migration effects on the total births in a county, however, especially the effect of speculative migration. If counties offering large grants get speculative migrants, then a larger proportion of their in-migrants will give birth to a child than in other counties with a similar number of in-migrants. Therefore, I add the interaction of the grant and net-migration of age 20-40 females to the model in order to absorb any disproportionate effect of speculative migration based on the grant amount.

The model also includes other variables that may affect the total number of births

in each county, such as the average age of the local population, the size of female population, and the variables related to the business cycle of the region (such as the number of hires of local businesses per thousand people). I also include the number of daycares per thousand people and whether the county provides infant health insurance, since these factors may be considered when people make fertility decisions.

A final question when approaching this analysis is whether to use weighted regression. In policy evaluations using aggregate data, weighted regressions are often used to account for either the population size-related heteroskedasticity or to calculate the population average partial effect. However, if the policy effect is heterogenous by county population size, then neither the OLS nor the WLS estimates represent the population average partial effects, according to Solon et al. (2015). According to these authors, if the OLS and WLS results are similar, which is the case in this paper, there is no heterogeneous policy effect by population size. And in such cases, using the WLS generates larger standard errors (meaning less precise estimates) than the OLS. Therefore, I do not use weights for the estimation.

The estimation results of the county data analysis are presented in Tables 13, 14, and 15. The first two columns report the first difference results and the third and fourth columns report the second difference results, with the second and fourth columns controlling for the trend of pre-policy determinants.

When the dependent variable is total first births, as shown in Table 6.1, the grant for the first child has a significant and positive coefficient in the simple first differenced

model. However, when the pre-policy determinants are added, the birth encouragement grant is no longer significant, implying that this effect is driven by spurious correlation. Furthermore, in the second difference model, no impact of the birth encouragement grant was found. The preliminary analysis using longer difference models yielded the same result. This implies that the birth encouragement grant does not have any impact on the first birth in the long-run, and the very short-run effect found in the first differenced model is likely to be from the birth timing shift effect found with the individual data.

In terms of other explanatory variables, the net migration of fertile age females out of total population and the fraction of women in the total population are positively correlated with the total number of first births. On the other hand, the number of marriages per county's population is statistically insignificant in the first difference model, but positive and significant in the second difference model. Perhaps this is because it takes time for married couples to conceive.

The estimation results for the total number of second births are similar to those for first births. In the first difference model without the pre-policy determinant control, as shown in the first column of Table 6.2, the grant for the second child has a positive and significant effect. However, as the pre-policy determinants get added and a longer difference is used, this effect disappears. Interestingly, in this case, the grant for the second child interacted with net migration of the ages 20~40 female population out of total population in the first difference model is positive and significant, but loses its significance in the second difference model. This implies the existence of speculative migration for the grant for the second child, which should only have a short-run effect.

Similar results have been found in the case of the total of third births. Birth encouragement grants for the third child have no impact on the total number of third child births in all counties analyzed either in the first difference or the second difference model. In terms of other explanatory variables, only the net migration of age 20-40 females has a positive effect on the total of third births.

In summary, although grants for the first and second child seem to have some impact on the total number of first and second births in the very short-run, as the time span of analysis stretches to two or more years, this impact disappears. Since the aggregate analysis reflects the conglomerated impact of the number of children and the timing of birth decisions, the answer to what drives the short-run positive impact is unclear.

Nevertheless, it is reasonable to suppose that this impact comes from the short term timing shift effect of women who already have plans for their first child. In the previous section, I showed that among women who actually had first child birth in the sample, their timing of first birth shifted forward slightly. Also, if birth encouragement grants had any significant impact on the individuals' decisions to have a certain number of children, then the grant's impact should become more prevalent as time stretches, which is not the case in South Korea.

Table 13. Impact of Birth Encouragement Grant on the Total Number of First Birth

Log(Total First Births) N= 2,016	FD	FD	SD	SD
$Grant1_{t-1}$	.002**	.001	.001	-.004
	(.001)	(.002)	(.03)	(.03)
Net Migration of 20-40 female/population	9.17***	8.29***	8.74***	8.43***
	(1.78)	(1.67)	(1.77)	(1.76)
Grant1Xmigration/population	-.09	-.08	.02	.02
	(.06)	(.06)	(.03)	(.03)
Female2040/population	1.71***	1.69***	1.54*	1.75***
	(.52)	(.51)	(.90)	(.91)
Average age	.01	-.01	-.05	-.04
	(.01)	(.01)	(.03)	(.03)
Total marriage/ population	-.21	-.17	.12***	.10***
	(.38)	(.38)	(.03)	(.03)
Tax Revenue/population	-.00005	-.00003	-.00005	-.0004
	(.00005)	(.00004)	(.00005)	(.0005)
Farming area/population	1.47	-.09	4.10	4.55
	(1.67)	(1.79)	(2.65)	(2.81)
Daycare/1000 children	-.01	.01	.002	.001
	(.01)	(.01)	(.01)	(.01)
Total Business/1000 people	-.003	-.002	.0003	-.0002
	(.004)	(.004)	(.004)	(.004)
Infant Health Insurance	.02	.02	.02	.15
	(.05)	(.05)	(.18)	(.15)
Adj R-squared	.105	.129	.139	.168
Pre-policy Determinant		X		X

* FD stands for First Difference models; SD stands for Second Difference models.
* Unit of Grant is 1,000,000 KRW.
* Standard errors are clustered by county.

Table 14. Impact of Birth Encouragement Grant on the Total Number of Second Birth

Log(Total Second Births) N= 2,016	FD	FD	SD	SD
$Grant2_{t-1}$	.02**	.02	.003	.002
	(.01)	(.02)	(.01)	(.01)
Net Migration of 20-40 female/population	2.75**	2.79**	3.09**	3.09**
	(1.10)	(1.11)	(1.24)	(1.26)
Grant2Xmigration/population	.02*	.02*	.01	.01
	(.01)	(.01)	(.01)	(.01)
Female2040/population	-.003	-.005	.13	.12
	(.32)	(.34)	(.35)	(.35)
Average age	-.01	-.01	.001	.002
	(.01)	(.01)	(.01)	(.01)
Total marriage	.24	.29	-.09	-.09
	(.71)	(.72)	(.10)	(.10)
Tax Revenue/population	.000002	.000001	.000001	.000001
	(.00001)	(.00001)	(.00001)	(.00001)
Farming area/population	.27	.54	1.96	1.96
	(1.13)	(1.11)	(1.60)	(1.64)
Daycare/1000 children	-.0001	-.001	.004	.004
	(.003)	(.003)	(.005)	(.005)
Total Business/1000 people	-.002	-.002	.002	.002
	(.001)	(.001)	(.002)	(.002)
Infant Health Insurance	.01	.01	.02	.03
	(.02)	(.02)	(.04)	(.04)
Adj R-squared	.226	.230	.200	.202
Pre-policy Determinant		X		X

* Unit of Grant is 1,000,000 KRW.
* Standard errors are clustered by county.

Table 15. Impact of Birth Encouragement Grant on the Total Number of Third Births

Log(Total Third Births) N= 2,016	FD	FD	SD	SD
$Grant3_{t-1}$	.0003	.0004	.001	.001
	(.0004)	(.0005)	(.005)	(.005)
Net Migration of 20-40 female/population	2.23*	2.19*	3.03*	2.86*
	(1.30)	(1.28)	(1.73)	(1.76)
Grant3Xmigration/population	.001	.001	.004	.004
	(.007)	(.01)	(.006)	(.006)
Female2040/population	.007	.007	.01	.01
	(.05)	(.05)	(.01)	(.01)
Average age	-.03**	-.03*	-.02	-.02
	(.01)	(.01)	(.02)	(.02)
Total marriage	.07	.07	.08	.07
	(.11)	(.12)	(.16)	(.16)
Tax Revenue/population	.000005	.000005	.000005	.000006
	(.00002)	(.00002)	(.00002)	(.00002)
Farming area/population	-.84	-.36	.37	.30
	(1.03)	(1.05)	(2.09)	(2.12)
Daycare/1000 children	.006	.004	.004	.004
	(.005)	(.005)	(.01)	(.01)
Total Business/1000 people	.003	.004	.02*	.02*
	(.004)	(.004)	(.01)	(.01)
Infant Health Insurance	.01	.02	.02	.02
	(.04)	(.04)	(.06)	(.06)
Adj R-squared	.175	.178	.163	.162
Pre-policy Determinant		X		X

* Unit of Grant is 1,000,000 KRW.
* Standard errors are clustered by county.

2.7. Conclusion

This paper evaluated the impact of baby-bonuses on fertility with the case of the county-level South Korean birth encouragement grants. Using the regional and time variation of the amounts of the birth encouragement grants, and addressing the endogeneity of the grant levels by controlling the county fixed effects and trends, this paper finds that the birth encouragement grants do not have any significant impact of increasing child birth.

When the probability of child birth was estimated for the women who are at risk

of birth, birth encouragement grants had no significant impact. However, when only the women who actually gave birth were considered, birth encouragement grants seemed to reduce slightly the length of time between the marriage and first birth, which is consistent with the theoretic prediction. This finding suggests that the birth encouragement grant is effective mostly in changing birth timing of women who already had plans for a child, while it does not increase fertility in the general female population.

Consistent with this finding, at the county level, birth encouragement grants for the first and second child have some positive effects on the total first and second births in certain first difference specifications. Once a longer difference is implemented, however, such as a second difference, all the positive impacts of the birth encouragement grants disappeared, suggesting that their effect is only short-lived, if it exists.

Revisiting the initial question, do baby bonuses increase babies? Probably not, at least in the case of South Korea. Even though this paper's findings suggest that the fertility responds to the financial incentives by shifting the timing of births and hence may affect the short-run aggregate fertility, this effect is weak and very short-lived. So, it seems that the South Korean baby bonus has not increased babies.

2.8. Appendix

Summary Statistics

The average age of the sample of women at risk of first birth is 30.6, while those who are at risk of second and third birth are on average 33.7 and 34.8 years old. Within the sample, women who at risk of first birth have more years of education and are more likely to be working in a secure job, in the sense that the job has a low chance of layoff and better benefits. Also, their monthly earnings are larger than the other two groups, while spousal income is largest for women at risk of a third child. Note that while all other variables are quite similar across the three groups, marriage duration differs widely by subsamples. While the average marriage duration of the subsample of women who are at risk of first birth is 54.23 months (about 4.5 years), it is significantly longer, at 107.28 months (8.9 years) and 126.76 months (10.6 years), for the subsamples of women who are at risk of second and third births. Table 17 compares subsamples of women who actually had first and second birth. The marriage duration of women who actually had first a birth was 53.01 months, and that of women who had a second birth was 78.18 months, which is a much smaller gap than the overall at-risk groups. This wide gap of marriage duration of at-risk groups implicitly shows that the at-risk group for second and third children includes a large fraction of women who may have completed their fertility plan.

Women who had a first birth are younger than those who had a second birth. The other characteristics of both groups are quite similar, except that more women having a first birth (50% as opposed to 43%) live in large cities. In general, more people live in large cities but fertility rates there are lower due to high living costs; hence it looks as if more women having the first birth are city residents.

Table 16. Summary Statistics: Full Sample of women and those at risk of each order of birth

Mean (SD)	Full Sample	At-risk of 1st birth	At-risk of 2nd birth	At-risk of 3rd birth
Age	34.3	30.6	33.7	34.8
	(4.0)	(3.5)	(3.9)	(3.9)
Education	13.1	13.9	13.2	12.9
(Year)	(2.1)	(2.0)	(1.9)	(2.2)
Marriage Duration	117.8	54.2	107.3	126.8
(Months)	(57.0)	(32.6)	(49.3)	(58.7)
Work	.4	.5	.4	.5
	(.5)	(.5)	(.5)	(.5)
Secure Job	.3	.4	.2	.3
	(.4)	(.5)	(.4)	(.4)
Monthly Earnings	54.0	73.4	49.5	54.7
	(90.7)	(98.2)	(89.7)	(91.8)
Spouse Income	83.8	72.0	75.5	87.2
	(150.0)	(151.8)	(149.1)	(148.7)
Household Debt	2790.8	2267.8	2700.6	2938.4
	(8203.7)	(6242.1)	(6455.2)	(9428.6)
Household Asset	12175.6	12513.8	11573.2	12934.1
	(20730.7)	(24657.4)	(20035.2)	(22153.4)
Metropolitan City	.5	.5	.5	.5
	(.5)	(.5)	(.5)	(.5)
N	9,706	1,614	2,969	5,999
(i=individuals)	(i=2,229)	(i=790)	(i=936)	(i= 1,405)

* Unit of monthly earning, spouse income, household debt and asset is 10,000KRW (about US$10)

Table 17. Summary Statistics: Subsample of women who had first birth and second birth

Mean (SD)	Full Sample (Cross-Section, 2009)	Had First Birth	Had Second Birth
Age	34.4	30.5	32.2
	(3.7)	(3.3)	(3.2)

Education (year)	13.4 (2.0)	14.0 (1.8)	13.6 (1.9)
Duration of marriage (months)	114.8 (54.6)	53 (31.4)	78.2 (35.1)
Work	.4 (.5)	.4 (.5)	.4 (.5)
Monthly Earnings	60.1 (98.1)	62.8 (92.9)	62.2 (100)
Spouse Income	71.9 (136.4)	63.7 (148)	57.2 (136.8)
Household Debt	3538.6 (12211.7)	2330.4 (6417.6)	3341.8 (13091.7)
Household Asset	14275 (22560.3)	13517.2 (27227.9)	15898.2 (33731.6)
Metropolitan/Seoul City	.5 (.5)	.5 (.5)	.4 (.5)
N	821	706	336

* Unit of monthly earning, spouse income, household debt and asset is 10,000KRW (about US$10)

Table 18. Effect of Pre-policy Total Births and Fertility Rate on Birth Encouragement Grant adoption and Grant levels

N=215	Adoption Timing	Average Grant for the first child	Average Grant for the second child	Average Grant for the third child
Total Births	.006 (.004)	.0003 (.001)	-.003 (.004)	-.013 (.009)

Total Fertility Rate	8.65 (12.49)	5.89 (9.56)	-3.11 (16.71)	23.52 (39.63)
Population	.0001 (.0001)	-.0001 (.0001)	-.0002** (.0001)	-.0002 (.0002)
Female Population	-.001 (.001)	.0003 (.0002)	.001** (.0004)	-.0002 (.0002)
Net Migration of 20-40 female	-.003 (.002)	.001 (.001)	.001 (.001)	-.0004 (.004)
Average Age	-.193 (1.17)	1.65 (1.43)	4.23** (.831)	.248 (5.36)
Marriage counts	-.001 (.004)	-.001 (.001)	.0001 (.001)	-.011 (.01)
Distance from a metropolitan city	-.002 (.089)	.049 (.059)	.005 (.074)	-.136 (.197)
Farming area	-.001 (.0004)	-.0001 (.0002)	.0003 (.0002)	.001 (.001)
Tax Revenue	.00002 (.00002)	-.0002 (.0002)	-.0001 (.0001)	.0001 (.0001)
Capital city of a province	-15.05 (9.26)	2.11 (3.81)	4.24 (6.29)	-6.36 (10.97)
Adj R-squared	.641	.343	.601	.280

Table 19. Effect of Pre-policy Fertility rate on Birth Encouragement Grant adoption and levels without Province Fixed Effects

N=215	Adoption Timing	Average Grant for the first child	Average Grant for the second child	Average Grant for the third child
Total Fertility Rate	-26.25** (1.58)	13.77 (9.21)	3.87 (27.50)	48.66 (56.59)

Average Age	-3.31** (1.59)	4.17*** (1.38)	12.89*** (4.14)	16.67* (8.50)
Female Population/total population	-16.95 (179.63)	39.56** (155.61)	817.93* (466.95)	-174.72 (959.05)
Net Migration of 25-45 female/total population	-838.07** (40.74)	447.86 (347.14)	732.63 (1041.73)	168.23 (2139.56)
Marriage counts/total population	509.53 (1068.48)	-1156.73 (925.56)	-75.93 (2777.53)	-4561.45 (5704.62)
Distance from a metropolitan city	-.08*** (.03)	.03 (.03)	.09 (.08)	.18 (.16)
Farming area per capita	23.64 (35.92)	52.94** (31.11)	-44.45 (93.38)	-277.71 (191.79)
Tax Revenue per capita	-.04** (.02)	-.01 (.02)	-.003 (.05)	.04 (.11)
Capital city of a province	11.37** (5.37)	-.44 (4.65)	-4.02 (13.97)	-3.88 (28.70)
Province FE				
Adj R-squared	.322	.242	.181	.231

Table 20. Effect of Pre-policy Total Births in County on Birth Encouragement Grant Adoption and levels without Province Fixed Effects

N=215	Adoption Timing	Average Grant for the first child	Average Grant for the second child	Average Grant for the third child
Total births	-.005 (.004)	.002 (.004)	.004 (.01)	.03 (.02)
Average Age	-.002 (.002)	2.15*** (.45)	5.84*** (1.32)	16.00*** (2.69)

Total Female Population age 20-45	-1.10** (.50)	-.00001 (.0002)	-.0001 (.001)	-.001 (.001)
Net Migration of 25-45 female	.0003 (.0002)	-.0001 (.001)	-.001 (.004)	-.001 (.01)
Total Marriage counts	-.001 (.004)	-.002 (.004)	-.004 (.01)	-.02 (.02)
Distance from a closest metropolitan city	-.09*** (.03)	.02 (.03)	.06 (.08)	.20 (.16)
Total Farming area	-.0005** (.0002)	.00002 (.0002)	-.001 (.001)	-.002 (.001)
Total Tax Revenue	-.0000001 (.0000001)	-.00000002 (.0000001)	.00000005 (.000002)	.0000002 (.0000003)
Capital city of a province	13.75** (5.51)	-.42 (4.89)	-4.52 (14.45)	-12.96 (29.39)
Province FE				
Adj R-squared	.291	.211	.142	.253

Table 21. Effect of Pre-policy Total Births in County on Birth Encouragement Grant adoption and levels

N=215	Adoption Timing	Average Grant for the first child	Average Grant for the second child	Average Grant for the third child
Total births	.007 (.005)	-.0004 (.004)	.002 (.01)	.004 (.02)
Average Age	.471 (.50)	1.50*** (.51)	4.62*** (1.58)	11.70*** (2.84)

Total Female Population age 20-45	-.0002 (.0002)	.0001 (.0002)	-.0001 (.001)	.00005 (.001)
Net Migration of 25-45 female	-.004*** (.001)	.001 (.001)	.0004 (.004)	.002 (.005)
Total Marriage counts	-.002 (.004)	.0001 (.004)	.001 (.005)	-.001 (.021)
Distance from a closest metropolitan city	-.131*** (.040)	.071* (.041)	.201* (.112)	.321 (.201)
Total Farming area	-.0001 (.0002)	-.0002 (.0002)	-.0004 (.001)	-.001 (.001)
Total Tax Revenue	4.3e-09 (6.5e-08)	-3.9e-08 (6.5e-08)	-2.3e-08 (2.0e-07)	1.1e-07 (3.7e-07)
Capital city of a province	-22.04** (9.49)	4.84 (9.67)	16.56 (29.85)	16.57 (53.84)
Province FE	X	X	X	X
Adj R-squared	.522	.272	.161	.433

Table 22. Some Examples of Cash-Transfer type Pro-natalist policies of Select Countries

Country	Policies as of 2015
France	- A cash incentive of average £675 monthly (nearly the minimum wage) for a mother to stay off work for one year following the birth of her third child - Cash grant up to £1064 to couples having their third child - Housing mortgage preferential treatment to couples with three children - Subsidized public transportation fare; tax benefit; subsidized childcare

UK	-	£20.70 per week for the first child and £13.70 per week for each additional child
Finland	-	100~182 €/month as childcare subsidy until the child reaches age of 17
	-	Additional single parents supplement of 47.79 €/month per child per month
Australia	-	Baby Bonus of up to $2,060 (paid even if the baby is stillborn
Russia	-	Baby bonus of RUB 453 026 (USD 9 000) for second and every following child.
Chez republic	-	Baby bonus of 13000 CZK (approx. 670 USD) for each first child born to mothers with low income.
Italy	-	Baby Bonus of 80 euros per month until age 3
Canada	-	Between 1988~1997, Quebec introduced the Allowance upto CAN$8,000 (tax-free cash transfer) for Newborn The program gave tax free money to parents who bore children.
	-	Canada Child Tax Benefit (CCTB)
US	-	Tax incentives (e.g. Earned Income Tax Credit), means-tested programs for single & low-income moms (Note: Not directly targeting to increase fertility rate, rather as a social safety net)
Japan	-	13,000 Yen per month to parents with children up to the age of fifteen
	-	Means-tested additional cash benefits
Taiwan	-	Baby bonus of 20,000 Taiwanese dollars
	-	Means-tested cash benefit introduced in 2012 for families with children under age 2
	-	A means-tested tax deduction for parents with preschool-age children. Low-income taxpayers with children under age 5 can qualify for a deduction amounting to about 10 per cent of the annual minimum wage.
Singapore	-	Baby Bonus (cash gift + CDA co-saving): S$24,000
	-	Tax rebate of S$15,000
	-	Childcare subsidies: S$53,000
	-	Paid Childcare leave (6days per year, per parent)
	-	Total of around $166,000 until children reaches age 13

*Note: these are only cash-transfer type pro-natlist policies; all countries also have other pro-natalist policy packages that may include policies such as paid materinity and parental leave, subsidized energy cost…etc.
*Sources: Wong and Yeoh (2003), ELIZAROV and Levin (2015), Hoem (2008), United Nations Expert Group Meeting on Policy Responses to Low Fertility, Policy Brief (2015), Public Policy Research Centre Hong Kong Institute of Asia-Pacific Studies (2008), Mitchell (2010), Ministry of Health, Labour and Welfare of Japan

Chapter 3

The Career Cost of Motherhood in South Korea:

An estimation of the family gap

3.1. Introduction

In 2005, South Korea recorded the world's lowest measured fertility rate. Each woman in South Korea, on average, had 1.08 children during her life (OECD). The decline in fertility is not unique to South Korea. Most East Asian countries, including Taiwan, Japan, and Singapore have experienced sharp declines in fertility over the past two decades. The South Korean government viewed the trend as threatening to its economic growth and instituted various policies to increase fertility. These policies focused mainly on the reduction of childbirth and childcare costs and, as a result, since 2009, a substantial proportion of daycare and preschool costs have been covered by government subsidies. Nevertheless, fertility rates have remained persistently low, implying that the direct financial costs of having children may not be the most significant factor affecting low fertility. Therefore, there must be another aspect of the low fertility problem besides the direct financial costs of having children.

One of the significant 'other factors' might be the cost of children to the mother's career. During the 1990s and 2000s, Korean women significantly increased their human capital investments and eventually surpassed that of men in 2009 (KOSIS).[22] As a result, many Korean women aimed to participate actively in the labor market and have a career rather than to become a homemaker and a secondary earner in the household. If having

[22] In 2009, men's and women's college enrollment rates were 81.6% and 82.4%, respectively. Since then, women's college enrollment rates stayed above that of men. Since 2011, it leveled off at around 75% for women and 68% for men.

children brings a sizable ‘career cost’ to mothers, this may in part explain the low fertility rate of Korean women.

There are various ways that children can be ‘costly’ to a mother’s career. For example, a woman may have to take a break from work or reduce her workload, which could result in the depreciation of her skills and lower pay. In other cases, a woman may have no choice but to change jobs after childbirth if her current job doesn’t support maternity or parental leave, resulting in the loss of a good job match and tenure. Therefore, choosing to become a mother may mean a sizeable compromise in a woman’s future career path, which in turn might affect their fertility decisions.

This paper tries to quantify the career cost of having children in South Korea by estimating the size of family gap in pay and the job changes difference between mothers and non-mothers after controlling for their characteristics. In addition, this paper will examine whether lower job retention can explain the family gap in pay and whether the size of the family gap differs by number of children.

This paper differs from other studies in the literature of family gap in pay in that it is one of few case studies that acknowledges that the ‘motherhood penalty’ in the labor market goes beyond the pay gap and affects patterns of job change. It is also one of the few studies to look at the family gap in an East Asian country. Most important, however, this study differs from previous studies in the method of estimation. Unlike other studies in the literature that address only the issue of selection into employment, this paper further addresses the issue of selection into motherhood by the instrumental variable method. I

mainly use the ‘optimal IV,’ an instrumental variable for a binary variable constructed based on the error structure, following Klein and Vella (2010) as an instrument for the presence of any children to a woman. In addition, following other studies, I estimate the family gap using the fixed effects.

By doing so, I achieve two things. First, I show that using fixed effects may significantly underestimate the family gap. Although the family gap in pay is estimated to be around 7% if only the selection into work status and individual fixed effects are controlled, once the selection into motherhood is controlled by IV, the pay gap grows to 37%. Also, although the family gap in job change is actually negative in the fixed effect models, it is positive and sized around one in the IV models, suggesting that having children induces mothers to have one more job change.

Second, I provide the range of family gap that is actually felt by women in South Korea. The lower boundary is given by fixed effect estimates. This is because the fixed effect estimates are based on the within-mothers’ changes in pay. So, if mothers are inclined to sort into certain types of jobs, for instance, jobs with low pay and low intensity, and these choices were mostly voluntary, then the fixed effect estimates will represent the career cost of children felt by women in the labor market. On the other hand, the IV estimates will represent the upper bound of the family gap. It measures the career cost by comparing women who have children with similar women who are childless and do not have to compromise their career ambitions for children. So, if the aforementioned endogenous choices of career are mostly involuntary and women have no other choice but to choose low paying jobs due to lack of family policies or flexible work arrangements,

then IV estimates will be larger than the FE estimates and represent the actual career costs felt by the women. The range of the family gap in pay felt by Korean women, therefore, will be somewhere between 7%-37%.

In the next section, I briefly review the literature and show how the estimates of this paper can compare with previous papers. Section III introduces the data used for this study and presents a raw data analysis on the family gap. In section IV, the estimation strategy and challenge is discussed in detail, and the results are presented in section V. Section VI concludes this paper.

3.2. Literature

The pay gap between women with children and single women, or the 'family gap', have been actively researched in the last two decades. The discussion originally started as an explanation for the unexplained part of the gender wage gap. The idea was that women's relatively greater role as care givers contributes to the pay gap between men and women. In fact, cross-country studies show that there is a high correlation between the gender wage gap and the family gap (Harkness and Waldfogel, 2003).

Previous research has shown that the Anglo-Saxon countries – U.S., UK, and Australia, and Germany- have larger family gaps than the Scandinavian countries that have well-established family policies including parental leave. The estimated size of family gap is around 4~12% for the U.S (Waldfogel, 1997; Lunberg and Rose, 2000), 12~32% for the U.K.(Davis et al, 2005; Harkness and Waldfogel, 2003), 11~26% for Germany (Beblo et al

2008; Gangl and Ziefle, 2009; Felfe, 2012; Kunze et al, 2004), while it is near zero in countries like Denmark, Norway, and Sweden (Davis et al, 2005; Simonsen and Skipper, 2009; Gupta and Smith, 2002; Petersen, 2010; Harkness and Waldfogel, 2003).

The factors contributing to the family gap include the relatively lower human capital investment by women with children than by single women (Taniguchi, 1999; Gupta and Smith, 2002), and the availability of job-protected maternity leave and job retention after childbirth (Waldfogel, 1998; Phipps et al, 2001; Anderson et al, 2002; Meurs et al, 2010). The tendency of women changing jobs to accommodate their dual role as a mother and an employee after childbirth explains some part of the observed family gap (Gangl and Ziefle 2009; Amuedo-Dorantes and Kimmel, 2008). In particular, in the fore-mentioned case studies of Denmark and Norway, when the information about retention after childbirth are controlled in the estimation models, the family gap almost disappeared. Nevertheless, in countries like Germany, U.S., U.K., even after all of the fore-mentioned factors are controlled for, the pay gap between mothers and non-mothers remained. The remaining family gap may be attributed to the employer discrimination against women or the statistical discrimination reflecting the perceived lower productivity or intensity of work by women with children.

In terms of estimation strategy, most of the previous studies acknowledge the existence of sample selection bias since not all women work and working women can be different from non-working women. Studies most commonly use the Heckman selection correction to address this issue. Previous studies, however, rarely recognize that women also may choose their fertility decision based on their career prospects. That is, the fertility

decision can be endogenous. Although many studies tried to control the effect of individual-specific unobserved characteristics such as ability and ambition on women's pay by using panel data (Waldfogel, 1997; Anderson et al, 2002; Gangl and Ziefle, 2009; Gupta and Smith, 2002) or the twins (Simonsen et al, 2012), these studies still don't explicitly discuss how women's choice of fertility can be correlated with their labor market outcome, such as pay and potential job change after childbirth. Therefore, the estimates from these studies are likely to be biased downward.

One study by Beblo et al (2008), however, controls the selection into motherhood by using detailed data on German workers, which includes the employer information. The authors use the propensity score matching model to compare women hired by the same employer and have the same job title but differ in the number of children. This study finds a family gap of 19% when matching is done within an establishment and job, and 24% when the sample is matched by individual's demographic and labor market characteristics but not on the establishment and job. What this means is that if two women who have similar characteristics and chose the same job and establishment are compared, there is about 19% of family gap, but when women with similar characteristics but possibly chosen different jobs and establishment are compared, then there is 24% of family gap. Since the within establishment and job estimates already reflects the 'sorting effect,' for example, women with similar preference for children choosing similar employer and job, this estimate will be similar to the individual fixed effect estimates. On the other hand, the estimates from matching on all characteristics except for the job title and establishment will be the somewhat like the IV estimate that accounts for the endogenous sorting effects,

i.e., some women having to choose ‘easier job’ because of the conflicts between career ambition and desired fertility choice. As in the study by Beblo et al (2008), I also expect the estimated size of family gap to be larger in the IV estimations than in the fixed effects with Korean data.

3.1. Data

This paper uses the sample of married women between ages 25-45 with salaried jobs from the Korea Labor and Income Panel Studies (KLIPS) in years 2002~2012. The age is restricted from 25 to 45 years to focus on the years women are most likely to be making fertility and career decisions. Also, the sample is restricted to women with ‘salaried jobs’ to focus on pay gaps in the offered wages and to avoid the problem of measurement error, which is prevalent for non-salaried workers including the self-employed. The reason for considering only the married women is that firstly, out-of-wedlock childbirth is rare in South Korea (less than 5%) and the fertility of non-married mothers likely suffers from measurement error, since the childbirth information used is indirectly obtained from the survey. Secondly, if there is some discrimination against ‘married women,’ then the group of married women without children can serve as a logical comparison group to married mothers.

The main explanatory variable in this study is the indicator for whether a woman has any children. Since the KLIPS records women’s fertility history only at their time of entry to the panel and does not update it in the following surveys, the fertility related

variable is constructed based on the answers in the first survey and the household composition changes in the following surveys, following Brewer et al. (2012). For example, if a married woman didn't have any children at the time of entry to panel and a child of age one[23] is present in the same household in the next survey, then this woman is classified as having a child in the second survey. The information about pay and jobs are based on the rich job history information in the KLIPS, which includes self-reported average monthly salary and job history measures. Restricting the sample of women to those without any missing information, this paper uses 8,069 observations from 1,998 women who appear, on average, 4 times in the panel.

3.1.1. Descriptive Statistics

I first present the summary statistics for the sample of married women ages 25-45 and then show the summary statistics for the working women who are used in this paper. As shown in Table 23, the full sample of women ages 25-45 had an average of 1.08 children. The number of children increased over time from 0.95 child per woman in 2002 to 1.29 children per woman in 2012. This increase was associated with the decreased fraction of women with no children. About 43~50% of women worked during the sample period and among the working women, about 83% of them held salaried jobs. These women constitute the sample used for the family gap analysis.

The average monthly salary increased significantly over time, as did the average

[23] When baby is just born, she is one year old based on the traditional age counting system in Korea.

years of education (from about 11.9 years to 13.5 years). The fraction hired in a 'secure job' – a job with a low chance of layoff and better benefits- increased slightly and the average tenure in months also increased over time. This, together with the increase in the average years of education, implies that Korean women increased their human capital investment and become more devoted to their careers. The job number, which indicates the cumulative job changes (the number of jobs the person has held so far including their current job), fluctuated and increased slightly between 2002 and 2012. This probably reflects the push for deregulation in the labor market which occurred during the sample period and resulted in relatively easier turnover for employers.[24]

[24]Since the 1998 financial crisis, Korean Government envisioned that increasing the flexibility in the labor market would increase efficiency. Therefore, the Roh Mu-Hyun administration (2002~2008) and the administrations after that and followed this vision of the previous administration and pushed for the increase of labor market flexibility. Even though over the course of time, the safety net for temporary workers improved, the practices of employment with terminating contract increased steeply.

Table 23. Summary Statistics of Sample of Married Women of age 25-45 in 2002-2012

Means (Standard Deviation)	All years	2002	2007	2012
Children	1.08 (.95)	.95 (.99)	1.03 (.92)	1.29 (.952)
No Child	.35 (.48)	.45 (.50)	.36 (.48)	.25 (.431)
One Child	.28 (.45)	.19 (.40)	.30 (.46)	.31 (.46)
Two or More children	.37 (.48)	.35 (.48)	.34 (.47)	.45 (.50)
Work	.48 (.50)	.44 (.50)	.47 (.50)	.50 (.500
Work - Salaried job	.40 (.49)	.37 (.48)	.39 (.49)	.43 (.49)
Monthly Salary (10,000 KRW[25])	139.73 (92.28)	97.30 (62.51)	141.26 (103.56)	176.22 (102.79)
Age	36.57 (5.22)	36.48 (5.50)	36.39 (5.25)	37.03 (4.82)
Education (Year)	12.85 (2.36)	11.89 (2.62)	12.90 (2.27)	13.54 (2.05)
Tenure (Months)	50.82 (55.81)	41.60 (52.45)	49.80 (54.70)	60.71 (61.72)
Secure Job	.25 (.44)	.26 (.437)	.25 (.43)	.260 (.44)
Part Time Job	.06 (.24)	.07 (.26)	.05 (.21)	.06 (.24)
Job Number	3.38 (1.98)	3.05 (1.65)	3.58 (2.05)	3.38 (2.14)
N	20,077	1,729	1,780	1,926

Comparison of Working women by Motherhood

On average, women with children have higher salaries than women without children, but this gap has narrowed over time, as shown in Table 24. In the sample of mothers, mothers with one child earn more than mothers with two or more children. Mothers with two or more children still earn more than non-mothers. Working women with children, on average,

[25] 10,000 KRW is approximately USD 10.

change jobs more frequently, but mothers with one child actually change jobs less frequently than non-mothers, even though their average ages are similar. Working women with two or more children changed their jobs most often until 2007, but in the 2012 statistics, their average number of job changes was about the same as the mothers with one child. Mothers with two or more children might have more job changes because they are about two to five years older than non-mothers and mothers with one child.

There was not a significant difference in the level of education between working mothers and non-mothers, but in general, mothers with one child had most years of education, about one extra year of education than working mothers with two or more children in 2007. Then, in 2012, all groups, including non-mothers, had a similar level of education. On average, mothers with two or more children had the longest job tenure, probably reflecting their overall older ages. This also indicates the possibility that mothers with two or more children staying in the labor market are not intermittent workers. The fraction of women holding a 'secure jobs', a job that does not have a terminating date and where employment is more stable, is larger for mothers until 2007; this level becomes slightly lower than non-mothers in 2012. Among mothers, significantly more mothers with one child hold a 'secure job' than the mothers with two or more children. In fact, in 2007 and 2012, the fraction of mothers with two or more children holding a 'secure job' was lower than that of non-mothers. Also, the fraction of working women in part time jobs was highest for mothers with two or more children.

In summary, it seems that mothers may be positively selected from the population of working women. Among mothers, however, mothers with one child have significantly

better labor market outcomes than non-mothers, while mothers with two or more children have a similar labor market outcome as non-mothers. This suggests the possibility that mothers with one child may have choose to have children because of their better labor market outcomes and mothers with two or more children may have compromised their careers as a result of having many children, or been less career-oriented to begin with. If these scenarios are true, the regression analysis will suffer from the problem of reverse causality. This problem must be addressed to accurately measure the career cost of having children in Korea.

Comparison of Mothers by Work Status

As shown in Table 25, mothers and non-working mothers have similar characteristics, except for the value of household non-labor income. When mothers with same number of children are compared, the differences are small and can be explained by the fact that working mothers' households have two wage earners. The level of non-labor income, however, differs significantly even when mothers with same number of children are compared, implying its potential relevance for the work decisions of mothers.

The two groups have similar numbers of children. In fact, until 2007, working moms had, on average, slightly more children (!). Years of education, a measure of human capital investment, are similar between working mothers and non-working mothers even when women with same number of children are compared, which means that the number of children a woman chooses to have may be somewhat independent of the market offered wage. This implies that the sample selection correction for 'selection into work status'

probably will not correct for much of the selection bias. Rather, reverse causality or the selection into motherhood would be a more significant sources of estimation bias.

Table 24. Mean of Characteristics of Working (salaried) Women by Motherhood

	2002				2007				2012			
		Mothers		Non-Mothers		Mothers		Non-Mothers		Mothers		Non-Mothers
Number of Children	All	One	Two or more	None	All	One	Two or more	None	All moms	One	Two or more	None
Monthly Salary	103.57	105.42	102.95	86.47	152.53	155.96	15.00	122.07	176.28	184.30	17.79	176.10
Job Number	3.18	2.93	3.25	3.12	3.68	3.31	3.96	3.48	3.36	3.37	3.35	3.30
Children	1.86	1.00	2.15	0	1.65	1	2.13	0	1.70	1	2.17	0
Age	38.12	34.56	39.30	34.42	36.86	34.74	38.42	35.99	37.51	36.81	37.98	35.93
Education	11.56	12.77	11.15	12.39	12.93	13.56	12.47	12.96	13.65	13.85	13.51	13.73
Tenure	46.89	44.83	57.57	21.28	56.06	56.04	56.08	36.24	63.80	6.59	63.27	51.29
Secure Job	.71	.75	.70	.67	.65	.68	.61	.62	.60	.64	.56	.63
Part Time Job	.18	.14	.20	.22	.12	.10	.13	.11	.15	.12	.16	.11
N	405	106	299	231	438	186	252	257	581	236	345	241

* Unit of monthly salary is 10,000 KRW (approximately, US$10). Education is measured as the years of formal education; tenure is given in months.

Table 25. Means of Characteristics of Mothers by Work Status

	2002		2007		2012	
	Working Moms	Non-working Moms	Working Moms	Non-working Moms	Working Moms	Non-working Moms
All Mothers						
Children	1.86	1.65	1.66	1.60	1.68	1.73
Age	38.11	36.00	37.05	35.50	37.61	37.03
Education	11.56	11.70	12.84	13.02	13.55	13.46
Household Annual Labor Income	3066.87	2614.24	4270.08	4064.63	4564.13	4131.76
Household Annual Non-Labor Income	86.71	149.19	95.23	136.99	64.84	108.35
Household Debt	2027.64	2621.50	2854.38	3757.79	2835.05	2966.82
Household Asset	6899.58	6881.22	14410.77	14296.57	13547.65	13004.29
Home Owner	.60	.58	.59	.58	.50	.47
N	405	501	438	617	581	763
Mothers with One Child						
Age	34.56	31.84	34.74	33.99	36.81	36.34
Education	12.77	12.69	13.56	13.26	13.85	13.71
Household Annual Labor Income	3121.327	2234.15	3928.561	3810.81	4378.79	3916.98
Household Annual Non-Labor Income	24.95	171.94	101.90	121.31	60.38	180.22
Household Debt	1643.03	1329.78	3238.64	3679.32	2166.95	2744.83
Household Asset	6075.87	5131.65	15308.42	14578.96	12968.88	15078.07
Home Owner	.42	.49	.62	.56	.53	.52
N	106	235	148	316	236	356
Mothers with Two or more Children						
Age	39.07	38.85	38.53	36.68	38.30	37.45
Education	11.25	11.13	12.47	12.88	13.52	13.37
Household Annual Labor Income	3031.69	2719.74	4578.918	4102.65	4817.27	4075.14
Household Annual Non-Labor Income	109.77	126.109	109.77	142.42	61.55	65.46
Household Debt	2078.36	3734.80	2818.07	4029.35	3403.86	2970.56
Household Asset	6872.47	8201.14	15437.19	14485.75	14454	11822.01
Home Owner	.65	.65	.61	.61	.49	.45
N	299	266	290	301	345	407

* Units of Household annual labor income, non-labor income, debt and asset are 10,000 KRW (approximately, US$10). Education is given as the years spent in the formal education.

3.1.2. Family Gap in Pay

Data on the raw family gap in pay is shown in Table 26. Interestingly, the ratio of mothers' to non-mothers' in pay is greater than one in 2002 and 2007. In Table 4, the family gap in pay was 1.20 in 2002 and 1.01 in 2007, implying a motherhood 'premium.' Usually, in studies of other countries, even in the raw data, this ratio is less than one, implying a motherhood penalty, and the gap decreases as more controls are added in the regression analysis. There are few countries – Canada, Australia, Germany, and Sweden (Waldfogel and Harkness, 2003) – which have a raw motherhood premium, but even in these countries, the raw motherhood premium is very small. In contrast, the ratio was at most 1.41 (between mothers with two or more children and non-mothers in 2002) in the raw data of South Korea, although it decreased gradually and reached numbers around 1 by 2012 across all types of mothers defined by education level and the number of children. This pattern in the raw data suggests that there was actually a motherhood premium in the earlier years, and even in 2012, there was no observable motherhood penalty in pay.

The observed raw motherhood premium could be due to the higher average age of mothers. However, considering that motherhood usually accompanies at least a short break from work for childbirth or a lower intensity of work, the shown premium in the earlier years and no family gap even in 2012 implies the presence of the effect of 'selection into motherhood.' Since the availability of work benefits such as maternity leave are closely correlated with salary levels, working women with high salaries could be more likely to have children than those with lower salaries.

By education level, the observed motherhood 'premium' was usually largest for the mothers with lowest education level, no matter their number of children, followed by the mothers with at least four years of college education. Mothers with a high school diploma had the lowest motherhood 'premium' in years 2002 and 2007, and they had a motherhood penalty of 9~2% in 2012. In terms of the changes in the family gap, the decrease in the motherhood premium was steepest for mothers who did not complete high school, followed by high school graduate mothers and college graduate mothers. This is because their salary did not increase as much as that of the other groups. While the average growth in pay for between 2002 and 2012 for mothers who did not finish high school was 270,600 KRW, average pay growth was 509,200 KRW for high school graduate mothers and 602,800 KRW for college graduate mothers. The increase in average pay for both high school graduate mothers and college graduate mothers was more than double the increase for the mothers who did not finish high school. Also, pay for mothers who did not finish high school increased by 472,400KRW during this same period, almost double the size of increase in average pay for high school drop-out mothers.

The large increase in the family gap for mothers who did not finish high school seems to be related to the pattern of job changes during this period. As shown in the Table 5, during this period, mothers who did not finish high school changed jobs on average about 1.36 times more often, while the increase was not as steep (0.5~0.6 more job changes) for other groups. During this same period, the Korean government pushed for the deregulation in the labor market and increased the fraction of 'temporary employment' positions employers can have. This change affected low-skill jobs most, thus mothers who did not

finish high school were more often left in jobs that did not protect their employment status after childbirth and during early child-rearing, leading to more frequent job changes. Reflecting this policy change, the fraction of these mothers holding a 'secure job' decreased significantly during this period, from 32% to 6%, while for non-mothers who did not finish high school, it increased from 13% to 15%.

In the case of mothers who graduated high school and/or college, the ratio between mothers' and non-mothers' pay didn't worsen as much in comparison with mothers who did not finish high school. This could be because they were not hit as harshly by the shifts in the labor market and because their increased fertility during this period weakened the link between their earnings and selection into motherhood.

Table 26. Family Gap by Motherhood and Education Level

Unit: 10,000KRW ($10)	2002	2007	2012	Δ (2012-2002)
Mean of Pay				
Moms	103.57	123.34	146.53	42.96
High School Drop out	77.75	85.92	104.81	27.06
High School or some college	99.29	137.25	150.21	50.92
4 year college or above	176.28	216.29	236.56	60.28
Moms with One Child	105.42	155.96	184.30	78.88
High School Drop out	70.93	78.91	93.33	22.4
High School or some college	89.98	134.97	152.42	62.44
4 year college or above	165.42	207.21	238.05	72.63
Moms with Two or more Children	101.96	144.34	172.04	70.08
High School Drop out	78.80	86,44	111.36	32.56
High School or some college	100.66	132.30	147.37	46.71
4 year college or above	177.6	229.75	237.45	59.85
Non-moms	86.47	122.07	176.1	89.63
High School Drop outs	55.76	70.85	103	47.24
High School or some college	80.46	110.44	153.86	73.4
4 year college or above	140.13	175.46	221.51	81.38
Family Gap				
Moms/Non-Moms	1.20	1.01	0.83	-0.37
High School Drop outs	1.39	1.21	1.02	-0.38
High School or some college	1.23	1.24	0.98	-0.26
4 year college or above	1.26	1.23	1.07	-0.19
Moms with one Child/Non-Moms	1.22	1.28	1.05	-0.17
High School Drop out	1.27	1.11	0.91	-0.37
High School or some college	1.12	1.22	0.99	-0.13
4 year college or above	1.18	1.18	1.07	-0.11
Moms with two or more children /Non-moms	1.18	1.18	0.98	-0.20
High School Drop out	1.41	1.22	1.08	-0.33
High School or some college	1.25	1.20	0.96	-0.29
4 year college or above	1.27	1.31	1.07	-0.20

3.1.3. Family Gap in Job Change Frequency

I define the raw family gap in job change analogous to the raw family gap in pay. That is, it is the ratio of the average number of mothers' job changes to the average number of non-mothers' job changes. In the case of Korea, since family policies such as maternity or parental leave are not strictly enforced, I expect the family gap in job change frequency to

be greater than one. In fact, the raw data presented in Table 5 backs up this hypothesis, as it shows the family gap mostly greater than one.

Reflecting the labor market changes during the sample period, as mentioned in the previous section, job change frequency increased for all groups defined by motherhood and education, as shown in Table 27. The rate of change differed by mothers' levels of education, with a larger increase for mothers who did not finish high school than for college graduate mothers whose family gap was below one in 2002 and slightly above one in 2012. This implicitly shows that college graduate mothers in 2002 had relatively 'secure' jobs and that the selection into motherhood by the quality of jobs also existed in the earlier period. In the case of high school graduates, the family gap in job change frequency did not change much over time. This could be because this group has the lowest labor force participation rate, around 40% regardless of their number of children, and seems to be working selectively. That is, they are usually the second earners in the family and stay in the labor market only if the job is relatively stable and can support their dual role as mother and worker.

By the number of children, as shown in the descriptive statistics for the family gap in pay, mothers with one child changed jobs less frequently than the mothers with two or more children. Mothers who graduated college also changed jobs less frequently than non-mothers in the same group until 2007. This suggests that the choice of motherhood might be endogenous to the prospect of job changes for working women.

Table 27. Family Gap in Job Change Frequency by Motherhood and Education level

	2002	2007	2012	Δ (2012-2002)
Mean Job Change Frequencies				
Moms	3.08	3.77	3.48	0.4
High School Drop outs	3.19	4.89	4.55	1.36
High School or some college	3.21	3.91	3.74	0.53
4 year college or above	2.21	2.68	2.77	0.56
Moms with One Child	3.02	3.44	3.52	0.5
High School Drop out	3.75	5.33	4.80	1.05
High School or some college	3.14	3.71	3.92	0.78
4 year college or above	2.03	2.52	2.80	0.77
Moms with Two or more Children	3.08	3.88	3.50	0.42
High School Drop out	3.07	4.93	5.28	2.21
High School or some college	3.22	3,85	3.69	0.47
4 year college or above	2.38	2.97	2.76	0.38
Non-moms	2.83	3.16	3.25	0.42
High School Drop outs	3.07	4.06	3.43	0.36
High School or some college	3.01	3.41	3.62	0.61
4 year college or above	2.31	2.59	2.72	0.41
Family Gap				
Moms/Non-moms	1.09	1.19	1.07	-0.02
High School Drop outs	1.04	1.21	1.33	0.29
High School or some college	1.07	1.15	1.03	-0.03
4 year college or above	0.96	1.03	1.02	0.06
Moms with One Child/Non-moms	1.07	1.09	1.08	0.02
High School Drop out	1.22	1.31	1.40	0.18
High School or some college	1.04	1.09	1.08	0.04
4 year college or above	0.88	0.97	1.03	0.15
Moms with Two or more Children /Non-moms	1.09	1.23	1.08	-0.01
High School Drop out	1.00	1.21	1.54	0.54
High School or some college	1.07	1.13	1.02	-0.05
4 year college or above	1.03	1.15	1.01	-0.02

Overall, the family gaps in pay and job change frequency in the raw data are informative primarily because they demonstrate the selection into motherhood. In particular, the family gap in pay is greater than one in most years all groups, but for college graduate mothers, in some years, the family gap in job change status is smaller than one, implying that mothers are earning a 'motherhood premium' and have more stable jobs. In

the simple regression analysis controlling for differences in age and education levels between mothers and non-mothers, the results were the same (see Table 33 in the appendix). Overall, mothers are doing better in the labor market even after controlling for their education level. Since this could be the result of selection biases, in the following section, I conduct an econometric analysis of the family gap that controls for selection effects, and I get a different result from what the raw data shows.

3.2. Method

This paper aims to calculate the effective family gap in pay and job change frequency, or the 'career costs' of motherhood, as opposed to the observed raw family gaps. I define the effective family gap in pay or job change frequency as the difference in pay or job change frequency between mothers and non-mothers after controlling for their demographic and roughly defined labor market characteristics – whether a woman holds a 'secure job' - the jobs that are non-temporary, 'part time job,' tenure level, and job change history.

By doing so, I am comparing a mother and a married childless woman who have roughly similar jobs; for example, mothers who hold secure jobs and have a certain level of tenure with single women with secure jobs and same level of tenure. One might be concerned that controlling for these variables misses out the career cost of children associated with women having to change job choices as a result of motherhood. However, this categorization of 'job' is very rough and in the case of the South Korean labor market, there still is a large pay difference across secure jobs by employer type and rank within the

firm. If mothers are less likely to be promoted or if it takes them much longer tenure to be promoted, then this impact will be calculated in the career cost. Similarly, if mothers change jobs for a different purpose, than single women, – for example, moving to an easier job rather than moving for career ambition –then the cost of compromising a career will be reflected in the career cost calculation. So, the effective family gap in pay estimated in this paper will reflect these challenges women face in their career paths.

This calculation, however, does not include the career costs generated by mothers being interrupted in their career and hence achieving lower tenure, or having to change jobs more frequently. For this reason, I use a separate model that allows the tenure level and job change frequency to vary freely. The comparison of this estimation to the results from the model that controls for tenure and job change frequency can suggest how career interruption affects a mother's pay. Also, choosing a part time job can be the result of motherhood and can be viewed as a kind of career interruption, so I also estimate the model without this variable.

The reason for controlling the rough characteristics of jobs held by women is because there is not enough information about women's human capital investments to predict their pay level in the labor market, other than their education levels shown in the data. So, assuming that 1) all workers, mothers and non-mothers alike, prefer secure jobs, 2) once in this type of job, they are unlikely to change to temporary jobs, unless they exit the labor market, and 3) the transition to a secure job with an intention to have children is difficult, unless the woman was already competent enough to hold a secure job or a similar kind of employment. I include this third variable in the calculation of the effective family

gap in pay as a proxy for competence at the time of motherhood. If I do not control this, I would be comparing the career cost of motherhood for women with very different productivity levels.

The regression model used for the analysis of family gap is based on the classical wage regression equation following Mincer (1974). I use the log of monthly salary as the dependent variable when estimating the family gap, and use the job number or the number of the current job[26], a measure of cumulative job changes, as the dependent variable when estimating the family gap in job changes. Note that when the job number is the dependent variable, the same Mincer wage equation based regression model is used. Thus, the model for job changes incorporates the idea that the cumulative number of job changes represented by the job number will increase over time but will not increase as fast as one gets older, because older people tend to be reluctant to change jobs as frequently as younger people.

The main explanatory variable of interest is the indicator for whether a woman has any children. Its coefficient will measure the impact of the presence of children on mothers' labor market outcomes as compared to women without children. Ideally, the impact of the presence of varied numbers of children should be shown with the use of an indicator for each number of children a woman has. However, to just-identify this kind of model using the IV method requires at least as many excluded variables as the number of indicators to

[26] If, for example, the job number is 4, this means the current job is the fourth job this person held in her life.

be instrumented. Hence, by specifying the model to any child or number of children, this paper only estimates the impact of the presence of children in general, rather than the differential impact of presence of children by number of children. To complement this limitation, I estimate the fixed effect models with indicators for numbers of children, but, as will be discussed later, the result of this method can only provide a rough picture of whether mothers with one child have larger or smaller career costs than mothers with two or more children.

The variables controlled in the model are individual's age, their age-squared, their education level, whether they live in a large city, and characteristics related to the labor market – tenure and whether their job is 'secure' or part-time. Additionally, in the wage regression, job number and job number squared are controlled to reflect the effect of losing a good job match on pay when job changes are more frequent. Year dummies are also included to control the business cycle effect.

In the estimation, as proposed in the beginning of this section, I estimate the family gap in pay and job change frequency using various estimation methods, first with full controls and then without information related with women's retention in the labor market during the childrearing period, job tenure, job change history, and part-time status information, to gain insights about selection effects and the explanatory power of job retention on the observed family gaps.

Sample Selection Problem

To estimate the effect of the presence of children on the labor market outcome of

women or the size of the family gaps, the aforementioned issues of sample selection should not be ignored. There are two selection effects. The first one is the issue of working women not fully representing the population wage offer distribution or the job number distribution, since not all women work in the labor market. If wages from these unobserved women's markets are not represented, the estimated effect of children can be biased, especially if the unobserved women's wages have a different distribution of the effect of children on the offered wage from that of the observed women. For example, if women with low market wages are less likely to be working and if they have larger family gaps than women with higher market wages, then without the correction of the selection to work, the family gap will be underestimated. Similarly, if the unobserved women include a disproportionate number of women who would have changed their job as a result of having children but chose not to participate in the labor market, and this group is not taken into consideration, the effect of children on a mother's job change frequency will be underestimated.

In fact, in the previous section, the motherhood penalty on pay and job change frequency decreased with the mother's level of education. Also, labor force participation was lower for high school graduates than college graduates. Therefore, in the Korean data, when the effect of selection to work is controlled, the estimated (absolute) size of the family gaps will increase.

This paper controls the sample selection bias from the unobserved salaries or job number of women who do not work by including the inverse Mills ratio calculated from the work decision probit model, using household non-labor income as the excluded variable, following other studies in the literature (Heckman, 1979). Since household non-labor

income is unlikely to be observed by the employer and not expected to affect wages offered in the market, using it as the excluded variable will improve the efficiency of the selection model.

The selection problem, however, is not limited to the selection to work status. Many studies in the literature ignore the more serious problem of selection into motherhood. If working women decide or plan to have children based on the evolution of their career path, then the variable 'any children' will be endogenous. If some women decide to have children because they have high salaries and better benefits that allow job retention, such as paid maternity leave, then this selection issue leads to the problem of reverse causality or simultaneity. In that case, even if individual specific unobserved heterogeneity is controlled using fixed effects as in most of other studies, selection bias of this kind remains. Fixed effects only control for the time invariant difference between women who will have children and those who will not, but many women may decide on family size based on their changing status in the labor market.

This scenario is quite likely in the case of South Korea. In my previous paper using the KLIPS data, I showed that while working women have a lower probability of childbirth in general, among the working women there was a positive correlation between salary and probability of childbirth. Also, the motherhood premium, as shown in the raw data, is likely the result of better off women deciding to have more children. Therefore, only if this channel of endogeneity is controlled, can I estimate the causal effect of having children on the labor market outcome of mothers.

To handle the endogeneity of the presence of children, I instrument the indicator for the presence of children by an IV constructed utilizing the error structure, following Klein and Vella (2010).[27] Additionally, this paper tests the findings by using a parametric instrument, the husband's age,[28] for the continuous explanatory variable 'number of children,' the results of which are provided in the Appendix. For this case, I use the number of children instead of the indicator for presence of any children as the explanatory variable because the instrument tends to be weak with a binary explanatory variable.

The instrumental variable approach should yield an estimation result that controls for both the time variant and invariant unobserved factors generating the endogeneity of the number of children, under the assumption that the instruments are valid. Intuitively, the estimate will represent how a woman's pay or job change frequency would differ if she had chosen not to have children, and had not planned her career around her children. . In other words, this estimate will net out the sorting effect, i.e., if women who have plans for children choose certain types of jobs. In this way, it will capture the gap between what a woman could have achieved if she remained childless and what she actually earns as a

[27] The authors showed that when an endogenous binary variable is heteroskedastic, its predicted probability at the heteroskedasticity-controlled indices can be used as an instrument for the variable. It is naturally strongly correlated with the binary variable and its structure ensures the exclusion restriction.

[28] There is a positive correlation between the husband's age and the number of children (with first stage f-statistic around 16~17) and it is expected to satisfy the exclusion restriction since the spouse age is unobserved by the employers and shouldn't affect the female worker's wage. Also, ability or career ambition, which are controlled in the fixed effect models, should be arguably independent of the husband's age as well. Overidentification tests using the combination of the age of spouse and other more debatable instruments such as duration of marriage was passed in all cases, implying that at least, the least arguable instrument, the age of husband, is excluded. See Table 34 in the appendix. The result of the specifications using husband's age as the IV is not presented as the main result, as the used explanatory variable, the number of children, ignores the potential non-linearity of the relationship between the number of children and women's labor market outcome.

mother.

This paper interprets the estimated effect from the IV model with the inverse Mills ratio, which controls for both sources of selection as the main result and uses the other estimation results to discuss the pattern of selection effects in the estimation of the family gaps. Note that the standard errors are bootstrapped since the variance-covariance matrix of the IV-Heckman model is not accurately calculated in software packages, following Wooldridge (2010).[29]

In addition to the IV method, as mentioned earlier, this paper estimates the family gap using the fixed effect model with selection correction, following Wooldridge (1995), to complement the findings of the IV method. There are several benefits to estimating this model. First, although this approach cannot fully control the effect of the selection into motherhood among working women, the estimates it produces for the Korean case can be compared with those of other countries, since most previous studies have also used this method. Second, by comparing the result of the fixed effect method with the IV method, some insights about the ability to control the selection bias using the fixed effect method can be obtained. Third, even though the fixed effect model has some limitations, it can still control the endogeneity problem to some degree, and if the instrumental variable is not valid, then fixed effect estimates are more efficient and less biased. Also, by including indicators for the number of children, this model can provide a rough image of how the career costs compare between mothers with one child and mothers with two or more

[29] In the other specifications, it is clustered by individual

children. Due to the reverse causality issue, however, since the type of selection of mothers with one child compared to mothers with two or more children is unknown (i.e., whether they are positively or negatively selected), the size of coefficient estimated through this method can only tell which types of mothers pay more 'absolute' level of penalty, rather than giving an estimate of the marginal cost of children on the mother's pay.

Most importantly, the estimates from the fixed effect model are valuable for interpretation. While the IV estimates, which yield the gap between what a woman could have achieved childless and as a mother in cross-section, the FE estimates compare the labor market outcome within women, most of whom may have changed their career paths to accommodate their role as mothers. Therefore, the fixed effect estimates will not fully account for the compromises in a woman's career caused by the limited job choices available to mothers and potential mothers.

The IV estimates will be closer to the motherhood penalty that Korean women actually 'feel' in the labor market outcome, if women who choose easier jobs or lower pay to support their role as mothers are mostly unwilling to change their path but had no choice. Alternatively, the estimated size of the 'career cost' from the fixed effect model will better represent what they sense in the labor market if most mothers change their path voluntarily. Therefore, the career cost of children that is really felt by Korean women will be somewhere between the IV estimates and the FE estimates.

3.3. Results

3.3.1. Family Gap in Pay

The estimation result for the family gap in pay is presented in Table 28. One can immediately notice a large difference in the size of the coefficient on the indicator for the presence of a child across the model specifications. In the simple OLS regression, which does not control for the selection into work status, the coefficient on children is positive and significant. From this alone, there seems to be about a 2.7% motherhood premium in pay in the sample of working women. As the selection into work status is addressed using the Heckman selection method, the coefficient on the 'Any Child' variable slightly decreases. The included inverse Mills ratio is positive and significant, which implies the presence of sample selection bias and shows that the mothers who are working are on average offered a higher wage than the full sample, including those who are not working.

When the fixed effect model is used and the individual unobserved heterogeneity (e.g. ability and career ambition) is controlled for, the coefficient on the variable 'any child' turns negative and significant. Note that in the fixed effect estimation, the coefficient on the variable 'any child' will only measure the impact of the presence of children for women with only one child, because this variable can only change when a woman has her first child during the panel years. Based on the fixed effect estimates, with everything else being equal, when a woman has her first child, her salary falls by 7~9%. A family gap of this size is not very different from the estimates of the other countries, which finds a decrease of about 0~17%. Note that the estimated coefficient is not very different between the fixed effect model and the model that additionally controls the selection into work status, and the inverse Mills ratio is also not significant. This implies that the selection to work status is

largely associated with the individuals' time-invariant characteristics and the fixed effect model may effectively control the bias from this source, at least in the case of South Korean data.

When the IV method is used, the negative effect of children on the mother's pay increases in magnitudes. Once the selection into motherhood is controlled by using the IV, as shown in column 5 of Table 6, the family gap is about 27%. That is, when a woman has children, her pay is reduced by 27% compared to similar women who stayed childless. The significantly larger family gap found in the IV model confirms the presence of the effect of the selection into motherhood by women whose career prospects do not change much after childbirth. When the selection into work status is further controlled, the magnitude of the estimated coefficient of the 'any child' variable increases further, implying a family gap of about 37%. This implies that a larger fraction of women who are unobserved in the labor market are those who would have, on average, had a larger family gap than the women who are working. Based on the estimate from the IV-Heckman model, in Korea, if a woman in the sample has a child exogenously from her current career status, then her offered salary will fall by 37%, controlling for her age, education level, tenure, and other labor market related characteristics.

Similar results are found in the IV estimation using the husband's age as the instrument for the number of children, as shown in Table 35 in the appendix. Here, the result of the specification that controls both types of selection methods, which appears in the last column of the table, shows that the marginal impact of children on their mother's pay is about 30%. Since this specification ignores the likelihood of the non-linear

relationship between the number of children and their mother's pay, I cannot directly compare the size of the estimates. However, in the specifications using the number of children as the explanatory variable, the impact of the number of children on a mother's pay radically changes as different types of selection are controlled. In particular, the IV estimates are much larger than the FE estimates or the OLS. This confirms the presence of both selection into motherhood and selection into work.

The large difference in the career cost of children shown in the fixed effect and IV methods may be specific to the case of South Korea, where the effect of children on women's labor market outcomes can differ widely by employer due to variations in the degree to which family policies are enforced.[30] However, even in the case of other countries, there is still a significant possibility that childbirth decisions are influenced by labor market outcomes, demanding a further investigation of the family gap, controlling for this effect.

The other variables included in the model all have coefficients with expected signs. Age and tenure are positively but concavely related with market wage, and wage increases by 4~8% for each additional year of formal education. If a woman holds a 'secure job' her salary is about 19~24% higher than women who do not hold a 'secure job, based on OLS and IV estimates, while their salary is only about 8~10% higher in the FE model. In the FE model, the effect of holding a 'secure job' is estimated from women who moved from

[30] For example, government jobs guarantee very generous family policies including unpaid job protected parental leave up to three years and paid parental and maternity leave, while in the private sector, there is one year of partially paid parental leave mandated by law but not enforced well.

holding a ‘non-secure job’ to a ‘secure job,’ and if these women were earning similar level of income before they changed the job, then the estimated effect of ‘secure job’ in the FE model can be smaller than the other model specifications. If a woman has a part time job, then her salary is about 36~50% lower than those who work full-time. In the case of the ‘job number,’ since job changes are still less frequent in one’s work history in the South Korean labor market and often result from layoffs or pressure to leave, rather than a voluntary change, the increase in job changes is associated with a lower salary. Whether or not one lives in a metropolitan city does not make any significant difference in earnings in FE and IV models.

Family gap in Pay and Job Retention

When the variables related with career retention, such as tenure and job number information, are not controlled, the estimated negative effects of children in all specifications are larger in magnitude, as shown in Table 29. In particular, in the IV estimation, there were pay gaps of about 30% (IV) and 40% (IV-Heckman) associated with children, which is 3 percentage points larger than the result from the fully controlled models. Inclusion or omission of the indicator for part time status does not change the estimation result much. This result indirectly shows that one source of the observed motherhood penalty or the family gap has to do with involuntary job changes after childbirth or the loss of tenure as a result of career break or a job change. In any case, the family gap was still about 27~37% even after controlling for the job retention during childbirth and the childrearing period.

Table 28. Effect of Presence of Children on Mother's Pay

Logsalary1 N=8,069	OLS	OLS-Heckman	FE	FE-Heckman	IV	IV-Heckman
Any Child	.027*** (.010)	.022** (.010)	-.073*** (.023)	-.088*** (.028)	-.270*** (.105)	-.370*** (.140)
Age	.030*** (.011)	.108*** (.029)	.005 (.024)	-.018 (.027)	.075*** (.024)	.267*** (.089)
Age^2	-.0004** (.0002)	-.001*** (.0004)	-.00005 (.0003)	.0001 (.0003)	-.001*** (.0003)	-.004*** (.001)
Education (Years)	.075*** (.002)	.038*** (.013)			.059*** (.004)	-.028 (.034)
Tenure (Months)	.005*** (.0002)	.005*** (.0002)	.003*** (.0004)	.002*** (.0004)	.004*** (.0004)	.004*** (.0004)
Tenure Squared	-.00001*** (.000001)	.00001*** (.000001)	-.000003** (.000001)	-.000003** (.000001)	-.000001 (.000001)	-.000001 (.000001)
Job Number	-.039*** (.008)	-.040*** (.009)	.090*** (.028)	.083*** (.031)	-.084*** (.012)	-.085*** (.013)
Job Number^2	.004*** (.001)	.004*** (.001)	-.001 (.002)	-.001 (.002)	.008*** (.001)	.008*** (.001)
Secure job	.190*** (.012)	.191*** (.012)	.100*** (.019)	.092** (.020)	.237*** (.017)	.242*** (.018)
Part time job	-.503*** (.020)	-.503*** (.020)	-.384*** (.031)	-.366*** (.033)	-.457*** (.030)	-.457*** (.030)
Metropolitan city	.012 (.010)	.012 (.010)	-001 (.016)	-.001 (.018)	.004 (.016)	-.004 (.019)
IMR		.703*** (.243)		.087 (.087)		1.626*** (.619)
Optimal IV [First stage F-stat]					[74.225]	[48.64]
Year dummies	X	X	X	X	X	X
R-Squared	.513	.514	(Within) .327	(Within) .308	(Centered) .491	(Centered) .452

***** The unit of monthly salary is 10,000 KRW (approximately, USD 10).

Table 29. Effect of Presence of Children on Mother's Pay without tenure and job number control

Logsalary1 N=8,069	OLS	OLS-Heckman	FE	FE-Heckman	IV	IV-Heckman	IV-Heckman
Any Child	.039***	.031	-.081***	-.091***	-.295**	-.398**	-.396**
	(.010)	(.011)	(.017)	(.024)	(.145)	(.194)	(.193)
Age	.018	-.046	.025	.011	.070**	.275**	.291***
	(.019)	(.023)	(.026)	(.032)	(.034)	(.124)	(.096)
Age^2	-.0002	.0005	-.0001	-.0003	-.001**	-.004**	-.004**
	(.0002)	(.0003)	(.0002)	(.0003)	(.0004)	(.002)	(.001)
Education (Years)	.080***	.068			.061***	-.031	-.035
	(.005)	(.005)			(.007)	(.047)	(.037)
Metropolitan city	.029	.032	.001	.004	.007	.0003	-.012
	(.019)	(.020)	(.015)	(.025)	(.027)	(.029)	(.019)
Secure job	.352***	.341	.110***	.080***	.237***	.242**	.399***
	(.019)	(.021)	(.019)	(.021)	(.025)	(.027)	(.019)
Part time job	-.527***	-.535	-.392***	-.387***	-.458***	-.459***	
	(.028)	(.029)	(.031)	(.038)	(.041)	(.042)	
IMR		.811***		.070		1.72**	-1.83***
		(.207)		(.115)		(.038)	(.665)
Optimal IV [First stage f-stat]							
Year dummies	X	X	X	X	X	X	X
R-Squared	.463	.462	.313 (within)	.317 (within)	.274 (Centered)	.231 (Centered)	.230 (Centered)

Family Gap in Pay by Number of Children

Previous studies in the literature estimated the effect of children by each number of child, acknowledging the potential difference in the effects on mother's pay by the number of children. I also estimate the effect of presence of children on a mother's pay, by the number of children using the fixed effect model to compare the effect of the first child and the second child on a mother's pay in Korea. Since the fixed effect specification using the indicator for the presence of any child essentially captures the impact of the first child on a mother's pay, I use indicators for the number of children instead of the indicator for the presence of children to estimate the differential impact of the presence of one child versus

two or more children.[31] Although the estimated effect is not fully independent from the effect of the selection into motherhood, it can at least show if the motherhood penalty differs for each order of child birth. This estimation does not control for the selection into work status, however, since the selection into work status is largely associated with an individual's time-invariant unobserved characteristics.

The results are provided in Table 30. When the indicator for presence of any children is used as the explanatory variable, the presence of any child (the first child) causes a mother's pay to drop about 7% from her natural trend. When the indicators for one child and two or more children are used, the first child is associated with a 7% drop in a mother's pay, while the second child is associated with about 12% drop in a mother's pay from her natural trend. So, based on the fixed effect estimation, although the largest pay gap is for women with two or more children, in terms of marginal effects, going from no children to having one child seems to generate a larger penalty than going from one child to two or more children, which is consistent with findings from case studies of other countries. However, since the FE models do not control for selection into motherhood, this result may not hold if one controls for the effect of selection into motherhood. For example, if mothers with one child are significantly different from mothers with two or more children, especially if mothers with two or more children are positively selected among all mothers, then controlling for this effect will generate a significantly larger marginal impact of going from a first to a second child. These estimates also suggest that the number of children and

[31] Note that I do not do this in the instrumental variable estimation due to the limited availability of instruments

their mother's pay may not be linearly related because the motherhood penalty for women with two or more children is noticeably lower than two times the size of the penalty for women with one child.

Table 30. Effect of Presence of Children on Mother's Pay by Number of children

Log(salary) N=8,069	FE	FE
Any Child	-.073*** (.023)	
One Child		-.072*** (.023)
Two Children or more		-.117*** (.035)
Age	.005 (.024)	.015 (.025)
Age^2	-.00005 (.0003)	-.0002 (.0002)
Secure job	.100*** (.019)	.100*** (.019)
Part time	-.384*** (.031)	-.384*** (.031)
Tenure (Months)	.003*** (.0004)	.003*** (.0004)
Tenure^2	-.000003** (.000001)	-.000003** (.000001)
Job number	.090*** (.028)	.089*** (.027)
Job number^2	-.001 (.002)	-.001 (.002)
Metropolitan city	-.001 (.016)	-.0004 (.016)
Year dummies	X	X
R-Squared (Within)	.327	.328

3.3.2. Family Gap in Job change frequency

The results for the estimation of the effect of the presence of children on a woman's job number is presented in Table 31. The first two columns show the simple ordinary least

square results, the third column reports the fixed effect results, and the last two columns report the IV results. Note that the fixed effect model did not control the selection into work-status because the inverse Mills ratio is insignificant in the fixed effect models.

The estimation result shows that in the simple OLS models, the coefficient on 'any child' is positive and around 0.34, implying that an additional child is associated with 0.34 more job changes, when the mother's demographic and labor market characteristics are fixed. The estimates do not differ much whether the selection to work-status is controlled for, even though the inverse Mills ratio in the OLS model is significant. This means that non-working women have a slightly different distribution of potential job numbers, but the distribution of the effect of children on their job changes does not differ much. This pattern is similar in the IV estimation, where the inclusion of inverse Mills ratio does not greatly change the size of the coefficient of 'any child.'

Interestingly, in the fixed effect estimation, the sign of the effect of the presence of any child is negative and significant, unlike what is seen in all other specifications. In fact, this negative effect of the presence of children on a mother's job number is robust to specification.[32] Considering that the job number can only increase over one's life cycle,[33] this sign is possible only if women do not change jobs as often after they have children. In particular, if they plan to have children in the near future and move to a less-intensive or a job that promises retention after childbirth before childbirth and then do not change jobs

[32] See table 36 in the appendix for the estimation result using other specifications of Fixed effect.

[33] There are very few (12 out of all observations) that returned to one of the previous employers.

after having children, their pre-childbirth job change trend will show relatively more frequent job changes than their post-childbirth job change trend. So, after having children, their job change trend will fall below their 'normal' job change frequency potentials based on their own trend before having children.

The specifications using the indicators for number of children shown in Table 32 reveals that mothers with two or more children were least likely to change jobs. They changed 0.42 jobs less frequently than their potential without a child. This finding is similar to some previous studies, which estimated the job change behaviors of mothers using fixed effects and found that mothers do not change jobs as often as single women (Gangl and Ziefle, 2009).

In the IV models, the coefficient on 'any child' is positive and significant. It increased from about 0.34 in the OLS models to 0.95 in the IV model. Although the estimates cannot be directly compared, this pattern is observed in the models estimating the marginal impact of children on mother's job change frequencies, as shown in Table 37 in the appendix. In this case, the size of coefficient also grows significantly when the variable 'number of children' is instrumented by the husband's age. This implies that the fertility choice is endogenous, causing the underestimation of the effect of children on a mother's job change frequency.[34] In other words, women who do not have to change jobs

[34] A consistent result was found when the dependent variable is the binary job change indicator. As shown in table A6 in the appendix, having children reduces the probability of job change 'within' a woman, but in cross-section, with the instrumental variable, the marginal effect of an additional child on mother's job change probability was around 56% increase.

or quit after having children were having more children and this effect was significant. Based on the IV estimates, having one additional child increases a mother's job change frequency by 0.97, almost one more job change.

Considering that job changes are stressful and usually associated with the loss of firm-specific human capital, having to change jobs once for each additional child would be high 'career cost' for mothers. Also, in relation to the family gap in pay analysis, the job number had a consistently negative and significant sign. This means that a mother's low pay is attributed to her job change patterns. Based on the cross-sectional analysis, it seems that some mothers whose jobs do not provide for maternity breaks, but who cannot afford to become stay home moms, change jobs after childbirth and lose a good match, thus experiencing the reduction in pay.

In terms of other controls added in the model, most of the variables have expected signs. The job number increases with age but at a slower rate, more educated women tend to change jobs less frequently, and those who hold a secure job have also changed jobs less frequently. Increased tenure means a lower job change number, while in metropolitan cities, women changed jobs more often. Curiously, the sign of the indicator for whether a woman works part time is negative and significant. This variable, however, consistently has positive and significant signs until the tenure information is added to the model. So, given the same tenure level, a part timer will have changed jobs less, but in general, without controlling for tenure, part timers changed jobs more often.

Table 31. Effect of Presence of Children on Job Change Frequency

Job Number N=8,069	OLS	OLS-Heckman	FE	IV	IV-Heckman
Any Child	.341*** (020)	.325*** (.035)	-.223*** (.045)	.853*** (.230)	.951*** (.234)
Age	.395*** (.038)	.214** (.086)	.176*** (.045)	.029 (.054)	-.227* (.133)
Age^2	-.004*** (.0005)	-.002 (.001)	-.0006 (.0005)	-.0001 (.001)	.003* (.002)
Education (Years)	-.092*** (.007)	-.007 (.036)		-.035*** (.009)	-.102** (.050)
Secure job	.001 (.036)	.001 (.037)	.031 (.034)	-.068* (.039)	-.061** (.029)
Part time job	-.159*** (.056)	-.153*** (.057)	-.087** (.043)	-.096** (.047)	-.037 (.037)
Tenure (Month)	-.015*** (.0003)	-.015*** (.0002)	-.014*** (.0007)	-.006*** (.0005)	-.006*** (.0003)
Metropolitan city	.198*** (.033)	.198*** (.033)	.034 (.027)	.071* (.037)	.062** (.031)
IMR		1.616** (.694)			2.310** (.918)
Optimal IV [First stage F-stat]				[42.62]	[30.83
Year dummies	X	X	X	X	X
R-Squared	0.249	0.249	0.633 (Within)	0.236	0.205

Table 32. Effect of Presence of Children on Job Change Frequency by Number of children

Job number N=8,069	FE	FE
Any Child	-.223*** (.045)	
One Child		-.217*** (.045)
Two or More Children		-.423*** (.072)
Age	.176*** (.045)	.223*** (.048)
Age^2	-.0006 (.0005)	-.001** (.0005)
Secure job	.031 (.034)	.031 (.034)
Part time	-.087** (.043)	-.085** (.043)
Tenure (Months)	-.014*** (.0007)	-.014*** (.0006)
Metropolitan city	.034 (.027)	.037 (.026)
Year dummies	X	X
R-Squared (Within)	0.633	0.635

3.4. Conclusion

This paper attempted to quantify the career cost of children to mothers by estimating the family gap in pay and job change frequency. In the estimation, sample selection bias was the main challenge. There are two concerns for the sample selection bias: the selection into work status and the selection into motherhood. Unlike previous studies that mainly focus on the selection bias due to work status, this paper tries to address both channels of selection bias by instrumenting for the presence of children with an instrumental variable constructed based on the error structure, following Klein and Vella (2010). This paper also checks the robustness of the IV estimation by comparing the results of another IV specification that instruments for the number of children with the age of the husband.

The IV estimates show that if a woman has any children, her pay decreases by 37% from her pay potential. This means that a mother earns about 37% lower pay than what she could have earned if she had never become a mother. This estimate, however, is significantly larger than the estimates from the fixed effect models, which are most often used in the literature. Based on the fixed effect model, Korean women earn about 7~9% lower pay if they have any children. This implies that the endogeneity of the fertility decision is still significant even when individual-specific heterogeneity is controlled for.

The source of endogeneity includes the possibility that potential mothers choose lower paying but less intensive jobs. This paper, however, argues that since these job changes can be 'voluntary' rather than 'unwilling', and if this is the case, then the fixed effect estimates will be closer to what the Korean mothers feel about the cost of children to their career. Therefore, the career cost felt by the Korean women will lie somewhere between the 37%~ 7% of their pay gap.

In terms of the relationship between job changes and children, this paper finds that the presence of children increases a woman's job change frequency by almost one more job, when controlling for the endogeneity of the fertility decision. However, when the model allows for the endogeneity channel in which women with jobs that don't require job changes after childbirth have more children (the fixed effect model), then mothers changed jobs less frequently than they would have without children. This implies two things. The first is that the number of children choice is seriously endogenous. Women who do not have to change jobs after childbirth are probably having more children, and this causes serious bias in the estimation. The second implication is that although motherhood is

associated with more cumulative job changes, these changes occur mostly before having the first child, usually as soon-to-be mothers switch to less intensive jobs. Once women have a child, they are less likely to change jobs.

Meanwhile, as other studies have also shown, this paper finds that the estimated size of the family gap in pay decreases as information related to job retention during the early child rearing period, such as job tenure and the number of job changes, gets included in the estimation model. Therefore, it seems that job retention during the child rearing period is an important factor of the family gap in pay in South Korea as well. In addition, this paper finds that the family gap as shown in the fixed effect method results differs by the number of children a woman has, which is comparable to other studies. As in the other country's case studies, in South Korea, the family gap in pay is largest for women with two or more children, but it is less than double the size of the family gap for mothers with one child.

As a final remark, although this paper makes some contribution of estimating the impact of children on mother's labor market outcome controlling for the endogeneity from the selection into motherhood, there are some limitations. Most notably, due to the limited availability of instrumental variables, only the impact of the presence of children, rather than the impact of the children by the number of children, is estimated. Since the marginal cost of each child, rather than the cost of being a mother itself, may be a more important consideration for potential mothers, to yield more concrete policy implications about the low fertility problem of South Korea and its association with the career cost of motherhood, which motivated this study, follow up research on the marginal cost of children to mothers

is needed.

3.5. Appendix

Table 33. Simple Regression Result of Family Gap in Pay

Average Monthly Salary	2002	2007	2012
Children	9.42***	16.02***	-2.38
	(1.98)	(2.92)	(2.73)
Age	-3.16	15.32***	19.87***
	(3.48)	(5.19)	(5.58)
Age Squared	.062	-.219***	-.269***
	(.050)	(.07)	(.078)
Education	10.29***	15.47***	16.75***
	(.68)	(1.17)	(1.22)
R-Squared	0.202	0.178	0.145
N	628	759	822

* The unit of average monthly salary is 10,000KRW (approximately USD 10).

Table 34. Over-identification Test[35] Results from Fully-controlled structural model

H0: At least one of the instruments are valid (excluded from the estimation equation)

Excluded Variables	Hansen's J-Statistic	P-value
Spouse Age, Marriage Duration	0.111	0.7394
Spouse Age, age at first marriage	0.123	0.7259
Spouse Age, Spouse Income	0.899	0.3431

* Using these combinations of excluded variables and without inverse Mills ratio included in the model, the estimated coefficient of the 'children' variable is around -0.16~-0.26.

[35] This over-identification test is based on Sargan (1988) and Hansen (1982).

Table 35. Effect of the Number of children on Mother's Pay

Log(salary) N=8,069	OLS	OLS-Heckman	FE	FE-Heckman	IV	IV-Heckman
Children	.015***	.010	-.062***	-.074***	-.234*	-.306**
	(.005)	(.007)	(.017)	(.024)	(.134)	(.154)
Age	.021**	-.019	.019	.0006	.046**	.538**
	(.011)	(.016)	(.025)	(.032)	(.023)	(.251)
Age^2	-.0003**	.0001	-.0002	-.0002	-.0006**	-.008**
	(.0001)	(.0002)	(.0002)	(.0003)	(.0003)	(.004)
Education (Years)	.062***	.048***			.048***	-.184
	(.002)	(.003)			(.006)	(.119)
Secure job	.233***	.223***	.098***	.074***	.256***	.263***
	(.012)	(.014)	(.018)	(.021)	(.023)	(.021)
Part time	-.481***	-.473***	-.384***	-.381***	-.471***	-.474***
	(.019)	(.021)	(.031)	(.037)	(.022)	(.024)
Tenure (Months)	.005***	.005***	.002***	.002***	.005***	.005***
	(.0002)	(.0003)	(.0004)	(.0005)	(.0004)	(.0004)
Tenure^2	-.00001***	-.00001***	-.00001**	-.000002*	-.000004***	-.000004***
	(.000001)	(.000001)	(.000001)	(.000001)	(.000001)	(.000001)
Job number	-.045***	-.033***	.092***	.094***	-.046***	-.050***
	(.008)	(.009)	(.028)	(.034)	(.011)	(.001)
Job number^2	.004***	.003***	-.002	-.002	.005***	.005***
	(.001)	(.001)	(.002)	(.002)	(.001)	(.001)
Metropolitan city	.034***	.031***	-.001	.001	.009	.007
	(.010)	(.012)	(.016)	(.025)	(.018)	(.015)
IMR		.655***		-.061		2.05*
		(.149)		(.113)		(1.18)
Spouse age (SE) [F-stat]					.014*** (.003) [18.26]	.010*** (.003) [12.81]
Year dummies	X	X	X	X	X	X
R-Squared	0.549	0.542	0.326 (within)	0.327 (within)	0.399 (Centered)	0.321 (Centered)

***** The unit of monthly salary is 10,000 KRW (approximately, USD 10).

Table 36. Fixed Effect Estimation Results of the Family Gap in Job change frequency

Job number N=8,069	FE	FE	FE	FE
Any Child	-.115**	-.118**	-.120***	-.220***
	(.053)	(.053)	(.052)	(.046)
Age	.243***	.243***	.217***	.287***
	(.051)	(.051)	(.060)	(.040)
Age^2	-.0008	-.0008	-.001	-.0004
	(.0006)	(.0007)	(.0006)	(.0005)
Secure job		-.039	-.034	.026
		(.037)	(.037)	(.033)
Part time		-.013	-.005	-.091**
		(.051)	(.051)	(.043)
Tenure (Months)				-.014***
				(.001)
Year dummies			X	
R-Squared (Within)	0.066	0.011	0.018	0.1822

Table 37. Effect of the Number of Children on Mother's Job Change Frequency

Job number N=8,069	OLS	OLS - Heckman	FE	IV	IV- Heckman
Children	.128***	.135***	-.146***	.937*	.969*
	(.018)	(.018)	(.040)	(.510)	(.527)
Age	.430***	.248**	.117***	.423***	.437
	(.042)	(.089)	(.034)	(.078)	(.510)
Age^2	-.005***	-.002	-.001*	-.005***	.007
	(.001)	(.001)	(.0006)	(.001)	(.007)
Education (Years)	-.087***	-.002		-.063***	.344
	(.007)	(.037)		(.019)	(.232)
Secure job	-.197***	-.199***	.007	-.181***	-.184***
	(.054)	(.054)	(.021)	(.065)	(.066)
Part time	-.323***	-.319***	-.099***	-.273***	-.267***
	(.075)	(.076)	(.030)	(.090)	(.091)
Tenure (Months)	-.015***	-.015***	-.024***	-.022***	-.016***
	(.0002)	(.0002)	(.001)	(.002)	(.001)
Metropolitan city	.196***	.196	.034	.276***	.268***
	(.033)	(.033)	(.036)	(.067)	(.060)
IMR		1.61*			7.76*
		(.698)			(4.10)
Spouse age (SE)				.012***	.011***
				(0.003)	(.003)

[F-stat]				[16.31]	[16.66]
Year dummies	X	X	X	X	X

Table 38. Effect of the Number of Children on Mother's Probability of Job Change

Job change Probability N=8,069	Probit	FE (LPM)	IV (Probit)	Probit	FE (LPM)	IV (Probit)
Children	-.062*** (.022)	-.052** (.022)	.593** (.293)			
Any Child				.036*** (.007)	-.049** (.024)	.211** (.102)
Age	-.015*** (.004)	.118*** (.026)	-.020*** (.007)	.033* (.020)	-.094*** (.018)	-.066 (.05819)
Education (Years)	-.069*** (.009)		.034 (.042)	-.005 (.008)		.001 (.001)
Secure job_{t-1}	-.071 (.051)	-.053*** (.020)	-.044 (.048)	.101*** (.013)	.022 (.014)	-.007 (.012)
Part $time_{t-1}$	.148** (.075)	.034 (.032)	.141* (.079)	.111*** (.019)	-.067*** (.023	.023 (.018)
$Tenure_{t-1}$ (Months)	-.009*** (.002)	.004*** (.001)	-.008*** (.002)	-.011*** (.0003)	-.016*** (.001)	-.011*** (.0001)
$Tenure_{t-1}$^2	-.00004*** (.00001)	.00002*** (.000005)	-.00005*** (.00001)	.00003*** (.000001)	-.00005*** (.00001)	.000004*** (.000002)
Metropolitan city	-.014 (.040)	-.029 (.021)	.044 (.061)	.001 (.006)	.002 (.013)	.016 (.012)
IMR	.632* (.398)		1.21* (.692)	-.047 (.185)		.525 (.400)
IV [First stage F-stat]			Spouse Age [17.97]			Optimal IV [27.74]
Year dummies	X	X	X	X	X	X

* The fixed effect model is based on the linear probability model, since probit models cannot accommodate the fixed effects. Fixed effect model with logit was attempted and yields similar results one provided above.

Chapter 4

The Role of Sex Discrimination in the Job Placement for new college graduates: An Evaluation of Open Recruitment of Large Corporations

4.1. Introduction

Gender differences in wage are common across the globe. Among OECD countries, South Korea has had the largest gender wage gap since it first entered the OECD. As of 2015, the gender wage gap for full-time workers in South Korea was 36.6%, 10 percentage points higher than those of the countries with the second highest wage gaps, Japan and Estonia (26.6%), and 21.3 percentage points higher than the OECD average, 15.3% (OECD).

This pattern is surprising given that Korean women have increased their human capital investment significantly in the recent years. In 2009, 2010 and 2011, more female students than male students enrolled college.[36] Women were also hired for government jobs of different ranks at a higher rate than men. Candidates for these government jobs are selected through various national civil-service exams, which count for over 90% of the selection process and therefore make government hiring relatively discrimination free.[37]

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[36] Based on the 2009, 2010 and 2011 'statistical year book' of South Korea

[37] Any government employees or government-paying job holders, such as public administrators, police, fire fighters, diplomats, teachers…etc. are hired through the so-called 'civil service exam' of various kinds. The exam varies by the position a candidate applies for. There are designated civil service exams for teachers, diplomats, high ranking government officials, police…etc. The exam takes about 90~95% of the assessment of the candidate. So, it is in a way, non-discriminative recruitment process. Recently, the competition for government jobs increased significantly, so it usually takes at least a year of preparation to pass the exams.

For example, in 2014, 29 out of 41 diplomats hired through the civil-service exam were female, and 3 out of 12 male diplomats were hired through the 'equal opportunity employment target' program, which balances the gender composition of newly hired government officials.[38] This shows that the younger generation of Korean women have significantly improved their human capital investment and in a discrimination-free environment, they may perform better than men.

Nevertheless, the gender wage gap is still significantly high and has not narrowed much. Between 2000 and 2015, the gender wage gap only narrowed by 5 percentage points (about 12%) while the average rate of gender gap convergence of OECD countries during the same period was 28% (OECD). Given that Korea started off with a very high gender wage gap and Korean women have rapidly increased their human capital during this period, this slow narrowing of the gender wage gap in South Korea is a mystery.

One reason for the high gender wage gap may be that women have difficulty getting a 'good' first job. First job placement is a critical determinant of future career path and accordingly, the evolution of pay. If women tend to be placed in first jobs that are not as 'good,' then this may explain the observed pay gap between men and women. As it will be shown in more detail in the next section, indeed, even in the very recent cohorts of women, who have accumulated similar level of human capital as men, a smaller fraction of female college graduates than males are placed in 'high-quality' jobs. Also, in the

[38] Also, Based on the reports by the ministry of the interior, which manages human resources of the government. Some news articles also discuss about the recent trends of women excelling men in various kinds of civil service exams. See Kang and Sim (2016) and Lee (2016).

descriptive statistics analysis, the observable male-female wage gap in the first job decreases significantly when the qualitative characteristics of first jobs held by male and females are controlled for in addition to their pre-labor market characteristics. This suggests that even for recent cohorts, male-female difference in the job quality is not marginal and this difference may explain a significant part of the observed gender differences in pay.

This study, therefore, tries to evaluate the male-female difference in the probability of getting jobs that are commonly regarded as 'good jobs' in Korea – the large corporation jobs.[39] Annually, these corporations in Korea hire large numbers of fresh graduates from four-year universities through a system called '*Gong-Chae*,' or open recruitment (OR) in direct translation. Although the details of the *Gong-Chae* or OR vary slightly by companies, such as the weights on different criteria of evaluation, almost all companies use a two-step process that includes resume screening and interviews.

Using the Youth Panel 2007 of South Korea and its rich information on college seniors' labor market outcomes and pre-labor market plans and characteristics, this study restricts the sample to the college seniors who indicated that they planned to seek large corporation jobs through their annual OR. Then, it decomposes the male-female difference in the probability of passing a large corporation OR into two components: the part that can be explained by sex differences in the average characteristics and the part that cannot be

[39] Usually, large corporation jobs or government jobs are considered as good jobs because they either promise high pay or high job security. However, as will be discussed later, the labor market for public and private sector jobs are separated in Korea. I consider only the 'good job' in the private sector of the labor market, which are the large corporation jobs.

explained by these differences in the characteristics. In particular, I attribute most of the unexplained part of the male-female difference in the probability of passing the OR to sex discrimination by employers, assuming that within the narrowly restricted sample of college seniors who indicated the preference for particular employers, large corporations, the unobserved gender differences in characteristics, such as ambition for future career paths or taste for jobs, do not vary significantly.

This study focuses on the labor market outcome of college graduates' first job. Doing so can minimize the impact of unobservable factors that contribute to the gender gap in the labor market outcomes other than the discrimination. For example, female workers tend to make lower human capital investments after the start of their careers. They may accumulate lower experience or tenure due to career breaks for caring roles at home, or they may compromise their career advancement by changing jobs after childbearing to accommodate their role as mothers (Gangl and Ziefle 2009; Amuedo-Dorantes and Kimmel, 2008). They may also work less intensively than their male colleagues in the same position. All of these factors will affect women's relative labor market outcomes but are difficult to observe and account for in the statistical analysis. Even if one finds a large unexplained part of the gender wage gap or gender difference in the probability of employment within the total working population, it will be controversial to blame this on labor market discrimination.

On the contrary, upon entering the labor market, both male and female students have not made any on-the-job human capital investments. At least in the case of the labor market outcome of the first job, controlling for the pre-labor market human capital

investments, the male-female labor market outcome gap should not be very large. If there is a noticeable gap, then one can reasonably suspect that a large part of it comes from labor market discrimination. Therefore, considering the first labor market outcomes of new college graduates allows for a clearer delineation of the extent of labor market gender discrimination.

Then, why can there be the labor market discrimination for new college graduates? Theoretically, employers or employees can discriminate based on taste (Becker, 1971) or statistical discrimination (Phelps, 1973). Due to the low participation of women in the workforce, especially within the older generation of women, corporations have significantly more male employees and thus they have a male-dominated culture. Furthermore, most Korean men serve in the military, which generates a unique culture in any male-dominated group. Employers and their potential co-workers, who are usually male, may prefer to work with men even though gender or the experience in male-dominated corporate culture is irrelevant to an employee's productivity. Also, statistical discrimination may occur if employers set a higher bar against women for employment or advancement because female employers have been more likely to take career breaks or quit due to the lack of family policies that can accommodate working mothers.

This paper finds that the probability of passing an OR of large corporations is seven percentage points lower for women than men. Six percentage points of this gap cannot be explained by differences in the pre-labor market human capital investments and characteristics, which indicates the presence of sex discrimination in the recruitment process.

In the next section, I will explain the '*Gong-Chae'* system or the open recruitment (OR) of Korean large corporations and some peculiar trends in the supply side of labor market that allows for the discussion of sex discrimination. In Section III, I describe the data and analyze the male-female wage gap in the first job after college to show the importance of sex difference in the job placement on the gender wage gap. In Section IV, the method of evaluation is explained. Section V presents the result of the analysis, which is followed by the conclusion of this paper in Section VI.

4.2. Background: The Open Recruitment System of South Korean Large Corporations

First, I define the large corporations I refer to in this paper. There is no unique definition of 'large corporations' in South Korea. Large corporations are defined legally[40] as the corporations that have total asset value greater than 10,000,000,000,000 KRW (approximately, US$10 billion) and are designated as the '*group of corporations restricted of mutual equity exchange*' (상호출자제한기업집단)' by the Fair Trade Commission of Korea.[41] These corporations are so-called 'chaebol' corporations or large family-

[40] Based on '*Basic Law on the Small and Medium Sized Firms'* (중소기업기본법)

[41] Each year the Fair Trade Commission of Korea assigns large firms into 'the group of corporations restricted of mutual equity exchange' and monitor their financial management. Such list of firms usually include around 30 conglomerates and was first introduced after the 1997 financial crisis of South Korea which was caused by mutual equity exchanges among firms that are owned by same family members (so-called 'chaebol' corporations). Their practice of mutual equity exchanges, where one firm invests (buys stock of other firms) on the other family member's firm, which in turn invested back to the firm that made an investment, bloated the level of equity of the involved firms and allow the chaebol firms to expand without financial sustainability.

dominated conglomerates. On the other hand, the group of 'large corporations' that are big enough to be widely known by the public and which provide high quality jobs include some non-chaebol large corporations which are not included in the '*group of corporations restricted of mutual equity exchange*'. These additional large non-chaebol companies operate in similar manner as large chaebol corporations in terms of pay and benefits to the employees, and also do large-scale recruitment through the '*Gong-Chae'* system.[42] Therefore, throughout this paper I refer to 'large corporations' as both the large chaebol corporations and the large non-chaebol corporations, in particular, those that have more than 1,000 full-time employees. I set the threshold for a 'large corporation' as 1,000 full time employees because in the Youth Panel of 2007 data that I use, I can identify whether an employer's business is greater than 1,000 full time employees.[43]

I now describe the '*gong-chae'* system of large corporations in South Korea. Large Korean corporations such as the Samsung group hire a sizable pool of college graduates annually through '*gong-chae'*, or open recruitment (OR). For example, in 2016, the Samsung group hired 14,000 college graduates through its spring and fall '*gong-chae'*, Hyundai Motors hired 10,000 college graduates and the LG group hired 4,000 college graduates. Also, '*gong-chae'* is the only official route for new college graduates (as no-

[42] For example, Nong-Shim food corporation which is not included in the definition of large corporation by the government, is one of the dominating companies in the food industry and pays much more than the industry average.

[43] The data set, the youth panel of South Korea, asks students whether they intend to get a job in a 'large corporations' when they are in senior years of college, without specifically defining which types of firms it refers to as large corporations. I use this information to restrict the sample of college seniors to those who seek 'large corporation jobs.' On the other hand, once they get a job in the future surveys, they are asked to characterize the employer. One of the questions asks the size of business/organization that they are working for and the category for the largest firms is 'more than 1,000 full-time employees.'

experience hires) to be hired as a full-time, non-temporary employee in companies. Companies often hire extra workers on contracts with terminating dates, fewer benefits and significantly lower pay to flexibly manage human resources. However, these temporary positions do not serve as the starting point for a career in large corporations because it usually ends without career advancement within the corporation. Therefore, these positions are not considered 'good jobs' and not sought after as a top choice for job seekers.

The '*gong-chae'* or open recruitment, is, as its name suggests, a process designed to hire the college graduates objectively, based on merit. There are two rounds to choose the candidates. In the first round, like the college admission system in the U.S., candidates are chosen based on their pre-labor market human capital investments such as their GPA, relevant experiences such as internships experiences and study abroad, certifications and personal statements. In the second stage, selected candidates go through one or two rounds of interviews. A few companies like Samsung sift out applicants by a basic aptitude test, called SSAT, devised by the company's HR department to increase efficiency. Otherwise, they receive too many applications. Only those who pass the test can participate in the Samsung's OR, but usually around 90% applicants pass the test.[44]

The 'g*ong-chae'* is the only official route to get a non-temporary full-time large corporation job and recruitment is supposed to be based on candidates' objective qualities. Therefore, if it is possible to obtain the sample of college students who participated in this process, then much of male-female gap in the probability of passing the '*gong-chae'*,

[44] In 2013, Samsung had 100,000 applicants for the SSAT and about 90,000 passed the test.

controlling for their characteristics, would be because either 1) women are less likely to pass the resume screening, which is discrimination or 2) men do 'better' on the interviews, where the subjectivity of interviewers can play an important role in evaluation.

And, in the latter case, if the distribution of ability is similar between men and women, but men are more likely to pass the interview process, then it is highly likely that the potential employee's personality and attitudes, the distribution of which may differ by sex, are important in the interview.[45] Assuming that these characteristics are irrelevant to one's ability and productivity, this paper interprets the male-female gap in the probability of passing the '*gong-chae',* after controlling for the differences in human capital investments accumulated by men and women, as discrimination.

Going back to the premise for estimating the size of gender discrimination, the sample must be restricted to students who participated in large corporation '*gong-chae'* events. This paper restricts the sample of senior students in college to those who are highly likely to have participated in large corporation ORs. This is possible because the Youth Panel specifically asks the students whether they plan to get a job within a year and what type of employer they seek, the choice of which includes large corporations. Therefore, assuming that 1) not very many students, especially not a disproportionate number of students by sex, change their targeted jobs within a year of the survey, and 2) the

[45] This is particularly true for Korea because almost all men serve military duty for about two years, during which time they get accustomed to the military culture that emphasizes the hierarchy and observation to superiors. Korean firms are also usually male-dominated and hence their cultures are affected by the residues of the military culture. Therefore, employers may prefer the type of personality that is predominately found in men, even though it is not correlated with productivity or ability of workers.

unobservable characteristics related to job search or productivity are not significantly different by sex, the sample created by the answers to the aforementioned survey questions can be studied to examine the presence of sex discrimination in the recruitment stage of large corporations in South Korea.

The two assumptions that enable the sex-discrimination interpretation of the male-female difference in the probability of passing the OR of a large corporation after observable characteristics are taken into account are not too unrealistic. The Korean labor market for new college graduates has some unique features that implies those assumptions are likely to hold in reality. First of all, college seniors in the job market who indicate that they were seeking large corporation jobs aren't likely to change their plans, because large corporation jobs are the best types of jobs in the private sector in terms of their pay and benefit levels. Also, college seniors are unlikely to expand or change their search to public sector jobs because the job market for private sector jobs and public sector jobs is highly segregated in Korea.

The South Korean job market for new college graduates is divided into private and public sectors because the recruitment process of the two sectors are completely different. Once the desired career path is determined, one most often focuses on one of the two paths, unless he or she wants to start up a business. To get any job in the public sector, for instance, as a teacher, police officer, fire fighter, government official, etc., one must pass the relevant civil service exam, which takes a preparation period of at least one year. The civil service exam counts for over 90% of the candidate evaluation for the public sector and other characteristics of candidates, such as their GPA, are not determinants of employment. So,

at least employment in the public sector is almost discrimination-free. Nevertheless, as the civil service exam requires quite a long preparation time, job seekers enter either the job market for the public sector or for the private sector. By the senior year in college, a student who indicated that they were seeking employment within one year in a public sector job would already be already preparing for the civil service exam at the time of survey. These students can be identified by another survey question that asks whether they is preparing for this exam. Therefore, among the sample of students who are seeking large corporation jobs and are not preparing for the civil service exam, few if any would be likely to change their career paths.

This segregated labor market and the attraction of large corporation jobs imply a potential sample selection issue, if those who seek public-sector jobs are different from those who seek private sector jobs. On one hand, this is beneficial for the analysis of sex discrimination. The divide in the job market implies the students who choose one of the two paths should be relatively homogenous in terms of some unobservable characteristics that may be related with productivity, such as career ambition or attitudes towards jobs. This makes it less controversial to blame sex discrimination for the male-female differentials in the probability of employment by large corporations, even though this result cannot be generalized to the whole labor market. Nevertheless, large corporations take initiative in HR management and are regulated most by the government among private sector employers. One can therefore conjecture that the level of sex discrimination in smaller size firms or in the overall private sector will be larger than what is calculated for large corporations in this paper.

On the other hand, the fact that the public-sector job opportunities are effectively discrimination-free may lead a larger number of highly competitive female students– those who are confident to compete with male students even in the face of potential sex discrimination- to choose career paths in large corporations rather than public sector jobs, creating a positive selection. If this is the case, then the calculated size of sex-discrimination in this paper will be only a lower bound of the actual magnitude of sex-discrimination.

Additionally, for the data on this male-female probability gap to be meaningful, there should not be significant difference in job search behavior by sex. For instance, if male students tend to apply for more ORs of large corporations than female students, or male students tend to prefer large corporations in certain industries with more openings while female students prefer industries with fewer job openings, then this may generate a male-female gap in the probability of passing an OR of a large corporation that cannot be explained by average differences in the characteristics.

Because it is very competitive to get jobs in large corporations, however, anyone who seeks such jobs should apply for as many opportunities as possible. The number of jobs applied for can differ by college major because there will be a different number of opportunities available for students with different college major backgrounds. However, job application numbers are unlikely to vary by sex among those who hold similar majors. At the same time, job offer acceptance behavior or preference can differ by sex among students who have multiple offers. For example, female students may prefer large corporations in certain industries. But regardless of their personal preferences, in order to

maximize their chances for success, they will have to apply for as many positions across all industries as other graduating seniors. So, assuming that those who are offered at least one large corporation job offer will accept one, evaluating the male-female gap in the probability of getting a job in large corporation within one year of senior year can approximate the size of labor market sex discrimination. In terms of the number of job offers, if male students who got the large corporation jobs received more job offers than female students, then this paper will underestimate the true size of sex discrimination in the recruitment of large corporations.[46]

4.3. Data and Sample

I use the Youth Panel 2007 of Korea, which was constructed by surveying youth age between 15~29 in the households sampled for the Korea Occupational Employment Statistics. The Youth Panel of Korea surveys qualitative and quantitative information regarding one's education history and the labor market outcomes, with the stated goal of aiding studies about individuals' transitions from school to the labor market. In particular, it asks not only about labor market outcomes, but also about students' career plans before they enter the labor market, allowing the extraction of a subsample of youth by their desired career paths. This survey follows up the original sample of 2007, and data from each year up to the 9th survey (2015) is available.

[46] There are few waves that asks the number of job offers, but there are too many no-responses which makes it unreliable to evaluate.

4.3.1. Data Construction and Descriptive Statistics

To evaluate the presence of discrimination in the process of '*gong-chae'* or open recruitment (OR) of new college graduates, an ideal data set should have enough information to identify the pool of individuals who participated in the '*gong-chae*,' and also have the information about the result of the '*gong-chae*.' The Youth Panel of South Korea meets these conditions.

First, it asks detailed questions that allows restriction of the sample to those who are highly likely to have participated in the '*gong-chae.*' It asks the plans of seniors within one year into the future, the choice of which including entering labor market, going to graduate school, study abroad, etc. Then it asks those who indicated they would enter the labor market the type of employer they are seeking. The students could choose from large corporation jobs, government or public sector jobs, general small and medium sized firm jobs, specialized small and medium sized firm jobs, and starting a business. I restrict the sample to the seniors who plan to get a job within a year and seek large corporation jobs. Then, since the only official way to get full time, non-temporary jobs in large corporations is through the '*gong-chae*,' or the OR, most of seniors classified this way would have participated.

As for the job search results, the follow up surveys ask various questions about the employer type. It does not specifically ask if a student got a job in a 'large corporation', but it asks the size of the company, for example, whether it has more than a thousand full time workers, and how the student got the job, in particular whether one passed a '*gong-*

chae.' So, I identify those who got a job in a company that has more than 1,000 full time employees, which would be a large corporation or a branch of it, through the '*gong-chae*.' Then, I use this information to analyze the male-female gap in the probability of passing the '*gong-chae'* of large corporations, assuming that all those who specifically indicated to seek large corporation jobs will apply for as many opportunities as possible.

To attribute the part of the male-female gap that is unexplainable by the male-female differences in characteristics, it is necessary to have the information on the characteristics of individuals that recruiters consider. In the case of open recruitments for new college graduates in South Korea, for the resume screening stage, three commonly examined criteria are GPA, certifications such as various computer skill certifications, and relevant experiences such as internship.[47] Also, the name of a students' college, college majors, and English proficiency matter in the first round of the '*gong-chae*.' The Youth Panel includes information about these factors. It keeps records on GPA, college major, and some types of relevant experiences such as internship and study abroad. It does not have direct information on the name of the college attended or English proficiency. However, it has records on one's performance in the standardized college entrance exam, based on which the rank of the college attended can be approximated. This information is also correlated with English proficiency, since the standardized college entrance exam includes English as one of its mandatory subjects.

[47] Korea Ministry of Employment and Labor with Korea Employment Information Service jointly conducted a survey to HR managers of 500 firms in 2014, which is published in a guidebook for job seekers in 2017. According to this survey results, in the resume screening stage, GPA, certifications and relevant experiences were importantly considered by recruiting managers of companies (Chun, 2017).

Therefore, I create a pooled cross-section of college seniors in the following way. I first extract college seniors who indicated that they planned to get a job in a large corporation within a year from the second to eighth year of the survey.[48] Then, I link their labor market outcome in the next one and two year's surveys. Note that since data is only available up to the 9th wave, the seniors in the eighth wave will only have labor market outcome of one year into the future. Next, I trace back their records on the college entrance exam from the 2nd~ 5th wave. The Youth Panel first asked about one's college entrance exam result in the second wave, questioning all college students in the sample at that time, then asking only the freshmen in future surveys. The summary of how the data is linked is provided in Table 39. I use the cross section of 929 observations linked this way. My sample is composed of 419 male students and 510 female students.

Table 39. Data Formation and Number of Observations

Cohort	College Entrance Exam Results	Characteristics at the time of Senior	Labor Market Outcome within 1 year	Labor Market Outcome Within 2 years	Large Corporation Job Seekers (Male, Female)
2008 Seniors	2008 Survey	2008 Survey	2009 Survey	2010 Survey	175 (103, 72)
2009 Seniors	2008 Survey	2009 Survey	2010 Survey	2011 Survey	97 (47, 50)
2010 Seniors	2008 Survey	2010 Survey	2011 Survey	2012 Survey	86 (37, 49)
2011 Seniors	2008 Survey	2011 Survey	2012 Survey	2013 Survey	78 (15, 63)
2012 Seniors	2008, 2009 Surveys	2012 Survey	2013 Survey	2014 Survey	137 (50, 87)
2013 Seniors	2008, 2009, 2010 Surveys	2013 Survey	2014 Survey	2015 Survey	184 (82, 102)

[48] I exclude the first wave because one's college entrance exam record is not available for those who were seniors in the first wave.

2014 Seniors	2008, 2009, 2010, 2011 Surveys	2014 Survey	2015 Survey	N/A	172 (85, 87)
Total observations					929 (419, 510)
Total observations without 2014 Seniors					757 (334, 423)

Summary Statistics of the sample of college students who are seeking large corporation jobs are provided in Table 40. On average, male students are about two years older than their female counterparts, reflecting their two years of mandatory military duty.[49] Other than that, in terms of human capital investment in the senior year, male and female students are not very different. Female students have about 0.04 points higher average GPA and slightly longer study abroad experiences. On the other hand, about 1% more male students have internship experience and they performed marginally better in the college entrance exam. Female students have more certifications than male students. The distribution of undergraduate majors differs widely, though. While only 36% of female students in the sample majored in science or engineering, 58% of the male students majored in these subjects.

In terms of job search results, more male students than female students are employed within one year, but by the second year after college, more female students than male students are employed. In terms of salary, male students earn about 19% more than female students. Although this 19 percentage point male-female college graduates' first salary gap seem surprisingly large, about 10 percentage points of the mean salary difference is attributed to the Korean labor market's custom of rewarding men who served the mandatory military duty for about 2 years.[50] So, technically, there is about a 9 percentage

[49] All Korean men are required to serve the military duty for about two years, unless one has an legally accepted excuse for exception such as mental or physical disability. Most men serve the military duty after graduating Highschool and before entering labor market. (So, for college students, before they graduate college, mostly between first and second year of college.)

[50] The 9-10% wage gap due to military service is based on the official pay scale that applies to all government employees (including teachers, police officers, government officials…etc.). The government's

point mean difference in the male-female pay gap in the first job after college. From here on, I refer to the observed or estimated male female pay gap after subtracting the 10% military effect as the effective gender wage gap. Besides the pay gap, about 4% more male students pass large corporations' *'gong-chae'* in the first year after graduation. By the second year after graduation, increased number of female students get hired by large corporations through OR, but still, a larger fraction of male students than female students passes *'gong-chae*'.

pay scale is public information (published by Ministry of Personal Management) and usually it is the standard for the pay-scale system for private companies. Almost all Korean companies have the 'pay scale' system for pay. Small innovative firms such as IT firms and start-ups may have different way of setting pay, for example, negotiation, but still the pay-scale system is the standard for most firms. Firms' pay-scales set the base rate-salary (excluding bonuses) for employees categorized by their tenure, the track (how they got hired- through OCR or irregular recruitment). So, even though the pay-scale chart for private companies are unavailable, if assume that the growth rate in the private companies' pay scale by tenure is close to what the government does, then approximately 9-10% of pay gap between male and female would be explainable by the returns to military service, which is counted as two years of tenure in the pay-scales.

Table 40. Summary Statistics: Sample of college seniors who want Large Corporation Jobs

	Female		Male	
Male N= 419 Female N= 510	Mean	Standard Deviation	Mean	Standard Deviation
Age	22.94	1.18	25.06	1.32
Military	0	0	0.89	0.31
Human Capital Investment				
GPA	2.33	0.55	2.29	0.56
Internship	0.07	0.26	0.08	0.27
Study Abroad (Months)	0.29	1.34	0.25	1.25
Number of Certifications	1.01	1.24	0.87	1.15
Major				
Humanities and Social Science	0.43	0.50	0.37	0.48
Science and Engineering	0.36	0.48	0.58	0.49
Education	0.01	0.11	0.00	0.05
Medical/Nurse/Pharmacy	0.12	0.33	0.02	0.12
Fine Arts or Sports	0.07	0.25	0.02	0.15
College Entrance Exam Record[51]	2.37	0.80	2.25	0.76
Labor Market Outcome				
Employed within 1 year	0.46	0.50	0.49	0.50
Employed within 2 years	0.58	0.50	0.50	0.50
Salary	196.00	80.45	240.35	83.08
Passed gong-chae by Large Corporation within 1 year	0.21	0.41	0.25	0.43
Passed gong-chae by Large Corporation within 2 years	0.23	0.44	0.26	0.44

4.3.2. Contribution of Quality of Jobs to the Male-Female Wage Gap in the First Job

This paper's evaluation of sex discrimination in the recruitment process of large corporations is motivated by the idea that the large observed gender wage gap in South Korea is attributed to men holding better jobs. Korean men may hold better jobs than

[51] Usually the grade for the college entrance exam is reported in the raw score, normalized score, and the percentile rank, and colleges use these ranks to set the basic qualification standard for admission. In the table, reported college entrance exam result is given as the average of the percentile rank for each of the four subjects – Korean, English, Math, a subject of Science or Social study. There are ranks, 1~5, 1 being the top achievers, and 5 being the students at the tail. So, top students have the number close to '1' for this variable.

similar women in two ways: they may be more likely to be promoted, and/or they may be more likely to win labor market competition for ‘good jobs’, or jobs that pay more, have better benefits, and more stable. If either case is true, then this may explain the observed wage gap. I search for an evidence of the latter scenario in this paper. Before moving on to the evaluation of the presence of sex discrimination in the recruitment process of large corporations, to provide necessary context for this paper, I conduct a brief descriptive statistical analysis of the contribution of male-female difference in job placement on the male-female wage gap in the first job after college.

For this purpose, I use the sample of all college seniors who seek employment within one year. They share a similar pattern as the sample of large corporation job seekers, although the sample of college students who seek large corporation jobs seem to be positively selected. As shown in Table 41, female students are about two years younger than male students because of men’s mandatory military service. Female students, overall, have more human capital investments. They have a higher average GPA, and are more likely to have internship experience, study abroad experiences, and certifications. The majority of female students are, however, humanities or social science majors, while most of the male students are natural science or engineering majors. Also, male students did slightly better on the college entrance exam than female students.

In terms of labor market outcomes, male college graduates, on average, seem to do better than female college graduates. Slightly more male students than female students get a job within the first year after graduation. Also, female students receive lower average salaries. Male students’ average salary in the first job is 2,188,100 Korean Won, while

female students' average salary in the first job is 1,772,300 Korean Won, which is about 81% of a male student's salary, or a 19% pay gap. Therefore, accounting for men's longer tenure associated with military service, there is effectively a 9% wage gap between men and women.

Within two years after graduating college, female students in the sample tend to hold jobs associated with lower pay, as shown in Table 42. More male students than female students hold jobs in larger businesses, whereas more female students work for foundations or organizations, which usually pay less. Since the size of business is positively correlated with the pay levels and benefits, this implies that male students are more likely to hold 'better' jobs. Also, more female students hold 'temporary' jobs, which are contract-based and have terminating dates. These jobs have low job security and may not fully promise the basic benefits such as retirement pay. They also usually pay much less than non-temporary jobs, which are filled through the open recruitments. Reflective of this, female students' jobs' total number of available benefits out of seven different types of benefits commonly provided by employers is slightly lower than their male counterparts.[52]

[52] These benefits include 'four basic benefits' promised by social insurance – health insurance, pension, employment insurance, industrial hazard insurance, and three commonly adopted benefits – overtime pay, paid vacation, retirement pay.

Table 41. Sample of College Seniors planning to enter labor market within one year

	Female		Male	
Female N=918 Male N=777	Mean	Standard Deviation	Mean	Standard Deviation
Age	22.60	1.23	24.58	1.58
Military	0	0	0.89	
Human Capital Investments				
GPA	2.28	0.58	2.20	0.57
Internship	0.05	0.21	0.04	0.19
Study Abroad (Months)	0.30	0.46	0.24	0.43
Number of Certifications	0.92	1.20	0.88	1.12
Major				
Humanities and Social Science	0.52	0.50	0.36	0.48
Science and Engineering	0.26	0.44	0.54	0.50
Education	0.04	0.20	0.02	0.12
Medical/Nurse/Pharmacy	0.07	0.25	0.02	0.15
Fine Arts or Sports	0.10	0.30	0.06	0.23
College Entrance Exam Record	2.45	0.77	2.36	0.84
Labor Market Outcome				
Employed within 1 year	0.42	0.49	0.38	0.49
Employed within 2 years (2008~2013 Cohorts)	0.56	0.50	0.55	0.50
Salary	165.57	68	212.67	82.19

Table 42. Job Characteristics of Sample of College Seniors planning to enter labor market within one year

Female N=918 Male N=777	Female		Male	
	Mean	Standard Deviation	Mean	Standard Deviation
Job Characteristics, all employed persons by the second year, at the time of first employment				
Employer type				
Private company or businesses	0.66	0.47	0.77	0.42
Foreign company	0.02	0.15	0.02	0.12
Public institutions	0.12	0.33	0.09	0.28
Foundations/organizations	0.12	0.33	0.07	0.26
Government	0.05	0.21	0.05	0.22
Miscellaneous	0.02	0.15	0.01	0.11
Corporate Size (Number of employees)				
1~4	0.10	0.30	0.07	0.26
5~9	0.12	0.32	0.13	0.33
10~29	0.19	0.39	0.15	0.36
30~49	0.08	0.27	0.09	0.29
50~99	0.14	0.34	0.05	0.22
100~299	0.14	035	0.15	0.36
300~499	0.06	0.24	0.09	0.29
500~999	0.06	0.24	0.05	0.22
>1000	0.11	0.32	0.17	0.37
Temporary Employment	0.11	0.32	0.07	0.25
Benefit Sum	2.02	1.95	2.05	1.96

* Benefit sum is the total number of available benefits out of seven different types of benefits commonly provided by employers. These benefits include 'four basic benefits' promised by social insurance – health insurance, pension, employment insurance, industrial hazard insurance, and three commonly adopted benefits – overtime pay, paid vacation, retirement pay.

When the male-female wage gap is compared controlling for the individual's characteristics and their job characteristics, the raw observed pay gap decreases significantly. As shown in Table 43, the raw pay gap, controlling for only the cohort effect, is 22%, but as the information about the human capital level is controlled for, the raw pay gap decreases to 18%, a 4 percentage point decrease. After addition of three variables that roughly show the job characteristics, an indicator for a temporary job, an indicator for a full-time large corporation job, and a representation of the level of benefit – a proxy for the

quality of the job, –the raw wage gap decreases to 12%. Accounting for men's two years of extra labor market experience from military service, female students effectively receive about 2% lower pay than male students with same characteristics holding similar type of jobs.

The relative importance of male-female differences in the characteristics of jobs in the observed wage gap is also confirmed when more specified job cells are defined and male-female wage gaps are analyzed within these cells. As shown in Table 44, the 22% male-female wage gap, controlling only for the cohort effect, decreases to 13%, or an effective gender pay gap of 3%, when it is calculated within twelve job cells defined by the type of employer and indicators for temporary employment.[53] When individuals' characteristics are further controlled for, the effective pay gap within job cells falls to 1%. Comparison of this figure with the effective wage gap of 8% when only the cohort effect and individual characteristics are controlled for, as shown in Column 5 of Table 43, implies that within job cells, or among those who hold jobs with similar quality, there is almost no gender wage gap, while there is not a negligible size of gender wage gap in the cross section of students holding different jobs. Therefore, the male-female imbalance of job placement is an important factor of gender wage gap in South Korea. In the following sections, I analyze whether sex discrimination plays any role in job placement by probing the case of

[53] The twelve job cells are non-temporary workers of large corporations (more than 1,000 employees), so-called '*jung-gyeon'* corporations (direct translation, 'important' corporations, which are larger than medium sized firms but not as large as large corporations, typically hire more than 300 workers), medium size firms, small size businesses; temporary workers of large corporations, 'important' corporations, medium size and small size businesses; non-temporary and temporary workers of foundations or organizations; non-temporary and temporary workers of public sector.

large corporation recruitment processes in South Korea.

Table 43. Wage Regression Result for those who are employed within 2 years for all college seniors who entered job market

Log(Salary) N=1,695	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Female	-0.22*** (0.03)	-0.24*** (0.04)	-0.20*** (0.04)	-0.17*** (0.04)	-0.18*** (0.04)	-0.17*** (0.04)	-0.13*** (0.04)	-0.12*** (0.03)
Human Capital Investment								
GPA		0.10*** (0.03)	0.10** (0.03)	0.10** (0.03)	0.09*** (0.03)	0.10*** (0.03)	0.06** (0.03)	0.04 (0.03)
Science or Engineering Major			0.16*** (0.04)	0.14*** (0.04)	0.13*** (0.04)	0.12*** (0.04)	0.12*** (0.03)	0.05* (0.03)
College Entrance Exam				-0.02*** (0.00)	-0.02*** (0.00)	-0.02*** (0.00)	-0.02*** (0.00)	-0.02*** (0.00)
Internship					0.13 (0.08)	0.13 (0.07)	0.11 (0.07)	0.09 (0.06)
Study abroad (months)					-0.00 (0.01)	-0.00 (0.01)	-0.00 (0.01)	-0.00 (0.01)
Labor Market Outcome and Job Characteristics								
Temporary Employment						-0.28*** (0.04)	-0.28*** (0.04)	-0.14*** (0.04)
Large Corporation, full time job							0.29*** (0.04)	0.19*** (0.04)
Benefit Sum								0.10*** (0.01)
Cohort Effect	X	X	X	X	X	X	X	X
R-Squared	0.05	0.07	0.09	0.13	0.14	0.19	0.25	0.41

Table 44. Within-Job Cell Wage Regression Result for those who are employed within 2 years for all college seniors who entered job market

Log(Salary) N=1,695	(1)	(2)	(3)	(4)	(5)	(6)
Female	-0.22*** (0.03)	-0.13*** (0.03)	-0.14*** (0.03)	-0.12*** (0.03)	-0.11*** (0.03)	-0.11*** (0.03)
GPA			0.04 (0.02)	0.04* (0.02)	0.05* (0.03)	0.04* (0.02)
Science or Engineering Major				0.07*** (0.03)	0.06** (0.03)	0.06** (0.03)
College Entrance Exam					-0.01*** (0.003)	-0.01*** (0.003)
Internship						0.06 (0.06)
Study abroad (months)						-0.001 (0.01)
Job Cells		X	X	X	X	X
Cohort Effect	X	X	X	X	X	X
R-Squared	0.05	0.28	0.30	0.30	0.32	0.32

4.4. Method

This paper aims to evaluate the male-female gap in the probability of passing an open recruitment or *'gong-chae'* held by large corporations. In particular, it tries to calculate how much of this gap can be explained by the male-female differences in characteristics relevant to productivity, and how much cannot be explained by these differences. To achieve this, I use a variation of the regression decomposition method originally proposed by Blinder and Oaxaca (Oaxaca, 1973; Blinder, 1973).

They proposed that the male-female difference in the population mean of a labor market outcome variable (for example, earnings) can be decomposed into the part that is generated by differences in average characteristics, or the 'endowment effect', and the part that is generated by differences in the coefficient or the 'return' of those characteristics. So,

assuming that women are discriminated against in the labor market, and men do not face this discrimination, the Blinder-Oaxaca decomposition method calculates the size of 'discrimination' as the difference between what a woman would have earned if the return to her characteristics were the same as that of men who have the same characteristics, and what she actually earns.

In mathematical expressions, the Blinder and Oaxaca method is given as the following.

Let D be the mean difference between Men (M) and Women (F) of outcome Y. That is,

$$D = E(Y_M) - E(Y_F).$$

Assuming a linear model of outcome Y,

i.e. $Y_g = X_g'\beta_g + \epsilon_g$, where $g \in \{M, F\}$, X_g is vector of characteristics, and $E(\epsilon_g \vee X_g) = 0$,

The mean difference in the outcome between men and women, D, can be re-written as

$$D = E(Y_M) - E(Y_F) = [E(X_M) - E(X_F)]'\beta \quad + [E(X_M)'(\beta_M - \beta \ ) + E(X_F)'(\beta_F - \beta \ )]$$

where β is the discrimination-free rate of returns to variables in X_g. Blinder and Oaxaca assume that this rate is the coefficients from men's regression of outcome variable.

Further, denoting $[E(X_M) - E(X_F)]'\beta$ = Q, Q represents the part of mean difference in the outcome that is associated with the mean differences in the characteristics of men and women, or the "Explained Part." Denoting, $E(X_M)'(\beta_M - \beta \ ) + E(X_F)'(\beta_F - \beta \ )$ = U, U represents the part of mean difference in the outcome that is generated by the difference in the rate of return to characteristics or the "Unexplained Part." Hence, the mean difference

in the outcome between men and women, D, is decomposed into $D = Q + U$.In this paper, I interpret 'U' as the size of the discrimination in the probability of women passing an open recruitment by large corporation.

Note that while the classical Oaxaca-Blinder decomposition method assumes that the non-discriminatory rate of return in the labor market is those of males, I assume that in the absence of discrimination, the discrimination-free rate of return to characteristics will not be the same as the observed rate of return for males. Following Reimers (1983), I set the discrimination-free rate of return as the average rate of return of male and female rather than from males only. This is because if discrimination favorably rewards males for their characteristics in the labor market, it must be at the cost of those who are discriminated against, the females (Cotton 1988). And if there is no discrimination, by the general equilibrium effect, the rate of return for both sexes will converge to somewhere between the rate of return of both sexes in the labor market with discrimination. Note, however, that if the discrimination-free coefficients are actually close to those of males or if we are more interested in the impact of discrimination felt by females, the estimates from this variation of Oaxaca-Ransom method will be only a conservative measure of discrimination.

To implement the decomposition method, I run two separate regressions for men and women, then calculate the size of the 'explained part' and the 'unexplained part' of the male-female gap in probability of recruitment. To that end, I set the dependent variable as a binary variable, which takes value one if the observed individual passed an OR by a large corporation within one year after the senior year, and zero otherwise. Since the dependent variable is non-linear, I implement the probit version of the Oaxaca-Ransom decomposition

method, following Yun (2004). The variables included in the regression are spec-related variables - GPA, an indicator for science or engineering major, an indicator for humanities or social science major (the effect of other majors will be absorbed by constant terms), an indicator for internship experience, the length of study abroad experience, the average percentile rank of the standardized college entrance exam and the number of certifications the student has. I also include the cohort indicator to absorb any business cycle effects.

I repeat the same analysis with the result of '*gong-chae'* by the second year after the student's senior year in college. I do this because many students who didn't pass the open recruitment by large corporations the first time try again in the next year. Analyzing the job search results by the second year after senior year may more thoroughly represent the results of the job search. However, since those attempting the *'gong-chae'* the second time may have increased their human capital investments and because those updated characteristics are unmeasurable, some part of the 'unexplained' male-female gap in the probability of passing the OR might be from this effect rather than from discrimination.

4.5. Results

Male female gap in the probability of passing an OR within a year

The results of the decomposition analysis are provided in Table 45. The average male-female difference in the probability of passing the OR among the college seniors who specified their desired employer to be large corporations is seven percentage points. Of the seven percentage point difference, only one percentage point comes from the male-female

differences in the average characteristics and the other six percentage points are attributed to the male-female differences in the returns to those characteristics, or discrimination. This means that men are favored by the large corporation employers and they have a 6% higher chance of passing a large corporation's '*gong-chae*' compared to female students with similar characteristics.

In detail, this 6% discrimination is generated from unequal returns to characteristics by sex. For example, while the coefficient on GPA is 0.05 for men, it is 0.04 for women. That is, a one point higher grade point average increases the probability of passing a '*gong-chae'* by 5% for men but the same increases the probability by only 4% for women. There is no significant sex difference in the probability of passing an OR by college major. The returns to the college entrance exam result, which is a proxy for the ranking or name of college, is higher for men. A lower average percentile rank, for example by one rank, is associated with 8% higher chance of passing a '*gong-chae'* for men, while it is associated with 6% increase in the probability of passing '*gong-chae'* for women. Also, the internship experience was more appreciated by large corporation for male students than female students. For the other factors, the size of the coefficients are the same between men and women.

This finding suggests that men are rewarded more for the human capital investments they make during college years. If they make an investment, they increase the probability of achieving their goal of getting a large corporation job. For women, human capital investments still increase the likelihood of achieving the same kind of goal, but not as much as they do for men. This means that in order to have a similar chance of passing a

'*gong-chae'* for a large corporation, female students need to make more human capital investments than men while they are in school. They must be relatively more qualified than men to have a similar chance of getting hired by the same type of corporation.

Table 45. Decomposition of Male-Female Gap in the Probability of passing a Large Corporation OR within one year

Probability of Passing an OR within a year Male N=419 Female N=510	Means		Coefficients		Explained	Unexplained
	Male	Female	Male	Female	Total	Total
Aggregate Decomposition						
	0.21*** (0.03)	0.14*** (0.02)				
	0.07** (0.03)				0.01 (0.02)	0.06* (0.03)
Detailed Decomposition						
GPA	2.29	2.33	0.05* (0.03)	0.04* (0.0)	-0.001 (0.002)	0.04 (0.13)
Science or Engineering Major	0.58	0.36	0.06 (0.05)	-0.03 (0.05)	0.003 (0.01)	0.04 (0.03)
Humanities or Social Science Major	0.37	0.43	-0.06 (0.11)	-0.04 (0.05)	0.001 (0.002)	-0.01 (0.05)
College Entrance Exam Record	2.25	2.37	-0.08*** (0.03)	-0.06** (0.03)	0.005 (0.004)	-0.05 (0.10)
Internship	0.08	0.07	0.17* (0.09)	0.15** (0.07)	-0.002 (0.003)	0.001 (0.01)
Study abroad (months)	0.25	0.29	0.02 (0.02)	-0.01 (0.01)	-0.001 (0.001)	0.01 (0.01)
Number of Certifications	0.87	1.01	0.02 (0.02)	-0.01 (0.01)	-0.001 (0.002)	0.02 (0.02)
Cohort Effect			X	X	0.01 (0.01)	-0.01 (0.02)
Constant			0.19 (0.14)	0.26 (0.19)		-0.002 (0.18)

* The reported number is the magnitude of total explanatory power of cohort dummies together.

Male-Female Gap in the Probability of Passing an OR within two years

When the job search result up to two years after graduation is pooled, as shown in Table 46, both men and women have higher rates of passing a large corporation's OR. 29% of the male students who indicated their intent to seek employment in a large corporation pass a '*gong-chae'* and get a large corporation job, while 21% of female students with the same goal get this type of job. This generates eight percentage points difference by sex in the probability of passing a '*gong-chae'*. Of this eight percentage point gap, seven percentage points are unexplained by the differences in the human capital level by the senior year. Among the characteristics, one's performance in the college entrance exam and internship experience are still important factors for large corporation employment. However, again, the returns for these characteristics are lower for females, generating a male-female gap that cannot be explained by the average differences in the characteristics.

Compared with the male-female gap in the probability of passing an OR within one year after the senior year in college, the unexplained part of the gap increased slightly when the labor market outcome up to the second year after senior year is used. This may be attributed to increased human capital investment by students who try out for the OR in the second year, which is not controlled for. Nevertheless, unless the recruiters' degree of sex discrimination differs for those who participate in the OR in the a year after senior year in college than those who participate in the OR in the senior year, a level of sex discrimination similar to the OR result within the first year after college (6%) should be present within the 7% 'unexplained' gap.

As in the case with the probability of passing a large corporation's OR within one year after the senior year in college, male students are rewarded more for their investments

during college years than female students. This again implies that female students have to make more human capital investment during their college years to have similar chances of getting large corporation jobs. As discussed in the methodology section, however, the estimated size of sex discrimination is only a lower bound for what the female students feel in the labor market. This is because the 'unexplained' gap in this paper is calculated off of the sex difference in the size of estimated coefficients from the average of the coefficients between sexes rather than from the coefficients of the favored sex, males. Moreover, if female students who seek large corporation jobs rather than the discrimination-free public sector jobs are positively selected in terms of their competitiveness, the size of sex discrimination in large corporation OR processes is underestimated. Also, although the findings of this analysis is limited to large corporation recruitments, since the large corporations manage human resources most efficiently and are regulated most by the government, which pushes for the equal opportunities in employment, the overall size of sex discrimination in the private sector labor market as a whole will be larger than what is calculated in this study.

Table 46. Decomposition of Male-Female Gap in the Probability of Passing a Large Corporation OR within two years

Probability of Passing an OR within 2 years Male N=419 Female N=510	Means		Coefficients		Explained	Unexplained
	Male	Female	Male	Female	Total	Total
Aggregate Decomposition						
	0.29*** (0.03)	0.21*** (0.03)				
	0.08** (0.04)				0.01 (0.02)	0.07* (0.04)
Detailed Decomposition						
GPA	2.29	2.33	0.05 (0.05)	0.04 (0.04)	-0.001 (0.002)	-0.15 (0.17)
Science or Engineering Major	0.58	0.36	0.001 (0.15)	-0.06 (0.05)	-0.005 (0.01)	0.02 (0.03)
Humanities or Social Science Major	0.37	0.43	-0.001 (0.15)	-0.04 (0.07)	-0.0002 (0.001)	0.02 (0.07)
College Entrance Exam Record	2.25	2.37	-0.09** (0.04)	-0.05* (0.03)	0.01 (0.01)	-0.09 (0.12)
Internship	0.08	0.07	0.21* (0.12)	0.07 (0.10)	-0.0003 (0.003)	0.01 (0.01)
Number of Certifications	0.25	0.29	0.03 (0.03)	-0.01 (0.02)	-0.002 (0.003)	0.03 (0.03)
Cohort Effect	0.87	1.01	X	X	0.01 (0.01)	-0.02 (0.02)
Constant			0.53*** (0.18)	0.32* (0.16)		0.21 (0.23)

4.6. Conclusion

This paper seeks to find evidence for gender discrimination in the South Korean labor market. Based on the observation that one of the important factors of the male-female wage gap is that men tend to hold better jobs, I try to examine whether women have more difficulty or being discriminated against in the recruitment process of one class of the high paying employers, large corporations.

To minimize the contribution of unobservable factors, such as work intensity and

career interruptions for family care, to the unexplained part of the male-female gap (by the differences in the observable characteristics) in the labor market outcome, I probe the pattern of first job placement after college, particularly the placement into large corporation jobs. At this point in their lives, both men and women have not accumulated any work experience or developed different tastes for jobs, since women may change their job preference after they form a family.

To evaluate the presence of gender discrimination in the job placement or recruitment process, I focus on the male-female difference in the probability of getting a large corporation job in Korea through their unique recruitment process called '*gong-chae*' (open recruitment (OR) in direct translation), through which these corporations hire a large number of college graduates annually. *'Gong-chae'* is a recruitment process which is supposed to be fair and merit-based. By utilizing rich information about college seniors' education history, their plans for the job market and the job characteristics of the obtained jobs, this paper identifies the individuals who are highly likely to have participated in a large corporation OR. By focusing on their first labor market outcome, this paper attempted to discern the level of gender discrimination in employment of large corporations in the Korean labor market for fresh college graduates.

This paper finds that there is a significant difference between men and women in the average probability of passing a large corporation's OR. On average, in the sample of students who are highly likely to have participated in an OR (those who indicated they would seek large corporation jobs), male students are 7% more likely to pass the OR within first year after college. Of the mean difference in the probability of passing the OR, 6

percentage points are ‘unexplained’ by the average sex differences in the accumulated human capital by the senior year in college, and are instead generated by the difference in the returns to the characteristics. Men have generally higher returns to their human capital investments, showing women need to accumulate more human capital than men to pass an OR. This paper views this unexplained part of the male-female gap as a rough estimate of the degree of gender discrimination by Korean large corporations at the employment stage for college graduates with no experience. This is because at the starting point of careers, there is no male female difference in the level of on-the-job human capital investments, and because those who seek the similar kinds of jobs are also likely to be similar in unobserved aspects.

In sum, among South Korean men and women who seek similar types of jobs, in particular the large corporation jobs, and have similar characteristics, men are placed in better jobs than women. This indicates the existence of gender discrimination by employers, who set higher hurdles for women. Considering that large corporations in South Korea are usually the earliest adapters of new trends or regulations of human resource managements among private sector employers, gender discrimination in the smaller firms at this stage of employment is expected to be larger than the 6% unexplained male-female gap estimated in this paper.

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