[연구보고서 2022]

Work Together and Care Together? :
An Evaluation of How Children Affect Parents' Labor Supply in Korea

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Selim Choi, Seonho Shin, Yoon Jae Ro

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ISBN: 979-11-260-0605-2

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Abstract

Summary

The South Korean (hereafter Korean) government has called for the creation of a society where mothers and fathers work and care for their children together in its recent Low Fertility-Aging Society (LF-AS) strategic plans (revisions to 3rd and 4th plans in 2018 and 2020, respectively). Before then, policies aimed at tackling the downward fertility trend focused narrowly on inducing women to have more children.

The government's recent shift in focus, however, has not been adequately supported by empirical works investigating the relationship between children and parents' labor supply in the Korean context. In the previous policy approaches to the low fertility problem, policy makers did not consider the relationship between fertility choices and parents' labor market participation and outcome comprehensively.

Even though this change in policy direction seems reasonable in the face of the extremely low fertility rate and expected shortage of workforce in the near future in Korea, we need a clear picture of the status quo and to identify the areas requiring government intervention based on quantitative analyses.

To help broaden the insights into the relationship between parenthood and labor market participation, we propose an empirical analysis of three different topics related to children and parents' labor supply, using recent data from various sources.

The first empirical work in this research (Chapter 2) investigates the impact of children on the labor market trajectories of families using the 2006~2020 waves of Korean Longitudinal Survey of Women & Families

(KLoWF). Specifically, we estimate the effects of the birth of their first child on women's labor market outcomes (relative to that of men) using a quasi-experimental approach based on an event study framework.

According to our findings, children have a large and sharp impact on women's employment and earnings. At the moment of the arrival of their first child, a large drop in labor participation among women occurs. This employment shock remains until the fourth year after the birth of the first child and shows a modest recovery as the years pass. This impact of the birth of the first child on working hours insignificant. However, when looking at the trend only, there is a slight decline in the number of working hours after the birth of the first child, showing a slow recovery as the years pass. Women also start experiencing a decline in earnings after the third year following the birth of their first child. The magnitude of the coefficient becomes larger as the years pass.

We also find that women face a "child penalty" regarding employment and earnings when we consider the term as denoting how much women fall behind men due to children. The impact of children on men exhibits a different path from that on women. First, in contrast to the results for female employment, male employment does not show an immediate drop after childbirth. While insignificant, there is a small drop in labor supply right after the birth of the first child, which shows an increasing trend afterward. In terms of working hours, men increase their number of hours worked and decrease the amount of family time after the birth of their first child. This finding suggests the inequality of childcare burden within a household. In fact, there is no impact of childbirth on husbands' earnings. The coefficients of earnings after childbirth are close to zero for men, even if we ignore the insignificant nature of the estimated coefficients, meaning that men's earnings do not change compared to those of the year before childbirth.

In Chapter 2, we capture the differences in the pattern by mothers' age at first birth. While the dramatic child penalty is observed for the younger mothers (35 years and younger) who suffer greater and longer,

older mothers are not found to suffer as much. Interestingly, the husbands of the younger mothers also work more and spend less time with their families, echoing mothers' labor market decisions.

We hypothesize that heterogeneity comes through the composition of 3 different channels: 1) different perceptions of motherhood and gender norms, 2) different expectations of caregiving burden, and 3) qualitative differences in the labor market and opportunity cost. However, the experience of being raised by a working mother, nor holding a college degree, does not make mothers suffer less from the motherhood penalty.

The second work (Chapter 3) focuses on a point of time after childbirth. Using a sample of dual-earning couples with children extracted from recent waves of the Korea Labor and Income Panel Study (KLIPS; 2016~2019), we evaluate what happens to parents' relative allocation of time in the labor market when their children's demand for care time suddenly increases. In particular, we use the structural break in the childcare system in Korea between preschool and elementary school to evaluate the impact of a child ascending to 1st grade on parents' allocation of hours spent in the labor market.

Preschool-age children (0-5 years) in Korea are well cared for by full-time government funded preschools from 7am to 7pm, but once they enter elementary school, they are released just after lunch time. At least until 2019, there had not been adequate and reliable childcare options for such children.

As an increase in demand for childcare time as children enter elementary school is predictable, we rely mainly on a couple fixed effects model to estimate the effect of such an increase. That is, we assume that a couple's pre-adjustment behavior is mainly correlated with unobservable couple-specific norms and preferences such as its standard for judgment of children's maturity level, preference for how and by whom childcare should be provided, preference for a dual-earner family, etc.

The estimation results show that the increased demand for childcare

time caused by the structural break in the childcare system in Korea leads to less egalitarian allocation of parents' working time. The estimation results are significant in cross-sectional models and weakly significant in fixed effects models. A separate analysis on the number of working hours of mothers and fathers suggests that the effect of the demand for childcare time on parents' working time allocation is mostly driven by mothers reducing their number of working hours, while fathers remain unaffected. One interesting aspect of our results is that the negative effect of the structural break in the care system is large enough to completely offset the positive effect of children growing up on maternal labor supply and intrahousehold work time allocation.

We additionally perform a pooled cross-sectional analysis using a sample including single-earner couples using a Heckman-type selection correction method. However, we find that the mothers' selection into work does not complicate the relationship between changes in childcare time demand and parents' allocation of working hours.

The final work of this research (Chapter 4) concentrates on mothers' selection into work, analyzing all working-age women in Korea with respect to their fertility choices. To this end, the authors apply two prominent econometric models: those of Heckman (1979) and Arellano and Bonhomme (2017) (in combination with that of Machado and Mata (2005)). The analysis is performed on a nationally representative dataset—that containing data from Local Area Labor Force (LALF) survey(s).

The findings of Chapter 4 suggest that womens' overall selection pattern in the Korean labor market is positive, implying that women with higher (lower) earnings potential are more (less) likely to become employed and, thus, supply labor. According to the explanation of Mulligan and Rubinstein (2008), this pattern indicates that the non-working women are always the less productive ones (Shin, 2022a). Its long-term trend is evidently upward, with the pandemic-hit year 2020 being a remarkable exception. Furthermore, we find that the magnitude

of positive selection is more sizable for mothers.

Another important question concerns whether the selection pattern varies depending on mothers' specific situations—for example, the age of the youngest child, which largely determines the level of caring efforts. In this study, it is observed that the magnitude of (positive) selection substantially varies depending on the age of the youngest child; estimates suggest that positive selection becomes more pronounced for mothers whose child is younger. This could be driven by heavier use of mandated parental leave when child is younger or by the possibility that mothers with younger children put higher premium on caring responsibilities.

Chapter 5 conducts further investigation on mother's selection into work through location-specific analyses, which is the first attempt in the context of South Korea (Shin, 2022a). Estimates suggest that selection is more pronounced in the middle part of mothers' wage distribution; it is less sizable at the lower left and the upper right locations. A possible reason behind this finding might be that mothers in the middle part of the potential wage distribution are in a "borderline" situation. For mothers in this group, purchasing care services could be an option but more of a burden, compared to mothers belonging to the upper right part of the distribution.

Combining the findings of the three empirical works of this can help depict the overall situation that Korean parents experience as the following:

1. On the one hand, the birth of the first child affects parents' labor supply in the direction of mothers decreasing their number of hours spent in the labor market after childbirth. Fathers, on the other hand, are either unaffected or increase their number of hours spent in the labor market while decreasing or keeping the low level of family time. The same is true for earnings.
2. Korean parents experience or expect a "double shock" to labor supply per child. That is, parents' labor supply becomes affected

around the time of the birth of their first child and then again when their child turns 6 years old and enter elementary school.

3. As in the case of the birth of the first child, the second shock when a child enters elementary school causes parents' relative allocation of time spent in the labor market to become unequal by causing only mothers to reduce their number of working hours.
4. Working women in Korea are, in general, positively selected, but in the group of women with children, such positive selection is stronger. However, in terms of mothers' (realized or potential) wage distribution, positive selection is most pronounced for those in the middle of the distribution.

Policy Implications

The findings of this research suggest that the Korean government's goal of advancing to a society where mothers and fathers work and care for their children together is still far out of reach. It is evident that even in the case of a very recent cohort, mothers are the primary caregivers in households and, with such role, face significant hurdles to advancing, if not simply maintaining, their careers. One most concerning issue for Korean women is that given that the motherhood penalty at the time of the birth of the first child is commonly found in other countries as well, Korean women face another shock upon their child's entry to elementary school.

Normally, career interruption caused by childbirth alleviates as children grow up, with studies on other countries' experiences showing that women gradually recover their wages and labor supply over time (Goldin et al, 2022; Kahn et al, 2014). However, this situation is not the case for many Korean women. As described in Chapter 3, in Korea, while preschool-age children are cared for by the well-established public childcare system for a full day, at least until now, childcare for young school-age children is not well supported by schools or other childcare

services (private or public). Given that 1st~3rd graders in elementary school are released from school early in the afternoon, these children suddenly demand more care time outside of the public services offered.

The situation for school age children should be improved as soon as possible because it not only affects mother's labor supply directly at the time of shock, as seen in Chapter 3, but also can affect, if not have already been affecting, fertility choices, labor market participation and the quality of working female population.

For women who have just given birth, after the first career disruption, they may decide to delay their return to the labor market. Alternatively, they may put their career ambitions aside for a while, even if they decide to stay in the labor market, because they can foresee a second shock in the near future. If this is the case, then it results in the female labor force stopping human capital accumulation during their prime working age for an extended period, likely for a much longer period than that of the female labor force in other countries per child.

Chapter 4 shows that women in the middle of the wage distribution are the ones who are affected most in this way. For these women, the marginal value of maintaining work is not significantly larger than the marginal disutility from having to keep their children in an unreliable care system for an extended period. If publicly provided childcare or reliable private childcare is always available and covers the full working day of parents for all young children at least up to 8 years old, then, like in other countries, childcare time covered by parents should decrease monotonically as children grow up, gradually freeing mothers, even mothers of median productivity, from the burdens of childcare.

Moreover, for childless women, the experiences of other women with children, who drop off their career track or pause their career development for at least 6~8 years, suggest that childbirth is a significant compromise, if not a complete loss, in terms of personal achievements. Given that the utility of children to each individual is unknown ex ante, the easily observable experiences of female colleagues can significantly

depress the desire or preference to have a child among other women, hence negatively affecting fertility rates.

Summing up the implications drawn from the findings of this research, we come to least one clear policy recommendation for the Korean government. To boost female labor market participation, without undermining an individual's preference for fertility, the childcare system must be reformed and improved.

At the same time, the government should push for active labor market policies that can be effective in helping mothers retain their jobs as well as allowing fathers to be more involved with childcare. The findings of our study show that mothers and fathers do not equally care for children, even in the recent cohort, in which mothers have similar, if not higher, pre-labor-market human capital on average.

To reshape society so that mothers and fathers truly care for their children and work together, the government should consider incentivizing employers to adopt diverse and flexible working arrangements and promote their usage by both genders equally. According to a recent report, even during the pandemic period, only about 14 to 17% of total employed workers were able to use any kind of flexible working arrangement. The same report also show that the proportion of employed workers who wish to use a flexible working arrangement is more than the double of the usage rate.[1] This finding suggests that for a vast majority of workers, flexible working arrangements are a pure illusion.

The Korean government recently adopted a small tax incentive for firms that employ women who have had career interruptions due to childbirth and childcare. However, if the government must choose only one approach to solving this problem, then preventing career

[1] According to the report by Yonhap News (2022.9.14) titled "*유연근무 하고 싶어도 못하는 근로자 748 만명...활용인원의 2 배*," the proportion of employed workers who have used flexible working arrangment are 14.2% and 16.8% in Aug. 2020 and Aug 2021 surveys, respectively, and the demand rate for flexible working arrangement in Aug. 2020 and Aug 2021 surveys are 40.9% and 42.8%, respectively.

interruption among women through making the working environment flexible may be more effective. The changes in the work culture in the labor market triggered by the government's initial incentives can not only save those women at risk of falling out of the labor market after childbirth but also change the career expectations after childbirth for childless women. Unlike allowing mothers to fall out of the labor market and helping them get hired after a while, transforming work environments and supplying more flexible jobs to make the labor market more inclusive for all parents can have a permanent and resounding effect by lowering the barriers to labor market participation and updating the career expectations of women as mothers.

When the government makes well-targeted efforts to tackle the childcare issue and transform the labor market environment, and when achievements become tangible, only then may young Korean women start to rethink their life course with children.

Chapter 1

Introduction

Selim Choi

1. Background

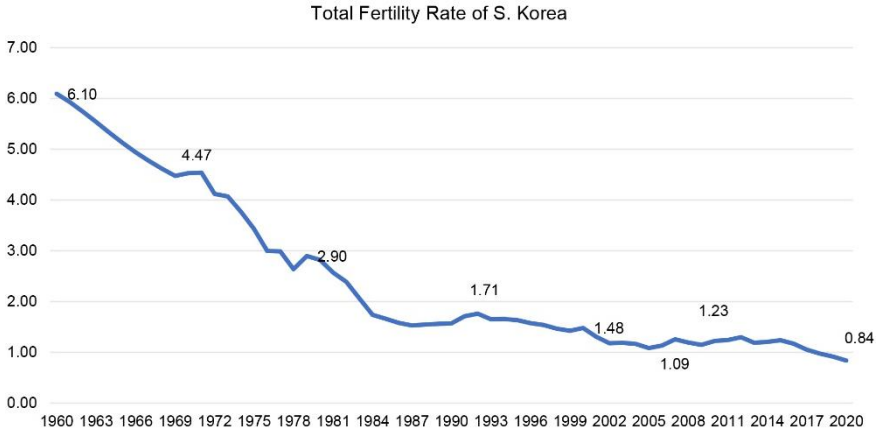
In 2021, South Korea (hereafter Korea) has recorded the lowest fertility rate in the world once again, with women having an average of 0.81 children in their lifetime (KOSIS, 2021). With a high life expectancy of 83.5 years, which is behind only Japan (84.7) and Switzerland (84.0) among Organisation for Economic Co-operation and Development (OECD) countries (OECD, 2021), Korea is expected to enter the stage of being a so-called super-aged society[2] within this decade (KOSIS, 2021).

Korea's fertility rate has been falling since its first record in 1960 by World Bank, as shown in Figure 1-1. This was due to active population-control policies that lasted until 1996. The government shifted their goal of population policy from population control to population quality improvement in 1996, but the fertility rate kept falling until reaching 1.09 in 2005.

Acknowledging the falling fertility trend as a serious threat to economic stability in the long run, since 2006, the national government of Korea has been setting strategic plans, called *low fertility and aging society (LF-AS) strategic plans* (저출산 고령사회 기본계획), every five years.

[2] Some international organization reports refer to a society with a proportion of the elderly population (aged 65+ years) over 20% as a "super-aged" society.

Figure 1-1. Total Fertility Rate of South Korea (1960~2020)



Source: World Bank. "Fertility Rate, Total (births per woman) – Korea, Rep."

Nevertheless, the fertility rates have, at best, stayed at a low level until 2015 and began to fall even further since 2016, setting a new world record every year until 2021[3].

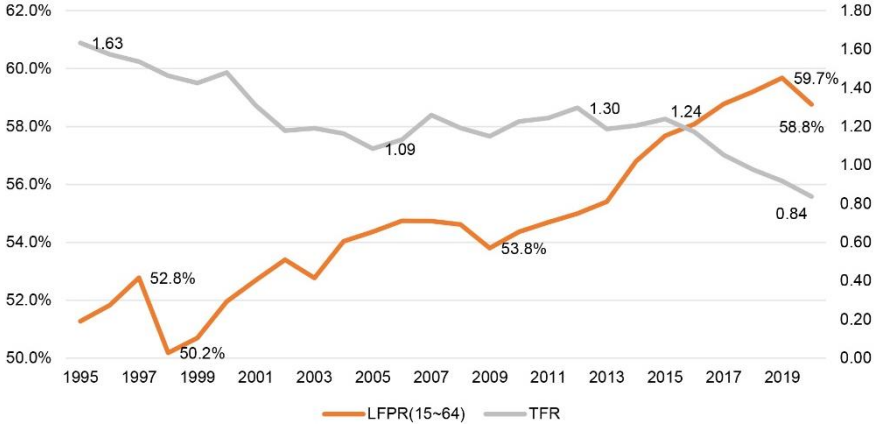
At the same time, the female labor participation rate (LPR), which is regarded as a key to population-shock-led economic shock, has been increasing, as shown in Figure 1-2 below, exhibiting a pattern of the growth of childless womens' labor market participation.

In terms of policy, critics point out that until recently, the LF-AS strategic plans have not paid much attention to the relationships among women's working life, career and childbirth.

The first three LF-AS strategic plans were close to a pronatalist approach, narrowly focusing policy efforts on inducing married couples to have children. That is, the policies under these plans were heavily oriented toward reducing the direct costs of childbirth and raising young children, instead of considering broadly of all the potential opportunity costs faced by women related to childbirth.

[3] International organizations have not updated the statistics for 2021, but based on Korean Statistical Information Service (KOSIS), the fertility rate of Korea was recorded as 0.81, lower than the world record of 0.84 in 2020.

Figure 1-2. Trend of the Fertility Rate and Female Labor Market Participation Rate



Source: Korean Statistical Information Service, "Survey of Economically Active Population," and World Bank. "Fertility Rate, Total (births per woman) – Korea, Rep."

For example, as summarized in Table 1-1, the key projects of LF-AS strategic plans included enhancing social responsibility (both in a financial and infrastructure-wide) of marriage, childbirth and child raising (1st LF-AS strategic plan); reducing the financial burden of marriage, childbirth and child raising (2nd plan); and enhancing housing support for newlyweds (3rd plan). Specifically, during these periods, from 2006 to 2018, the childcare system for preschool-age children had become universal and free, and in some schools, (almost free) after-school childcare had been introduced. Additionally, subsidies for the medical costs associated with pregnant women and babies increased significantly.

Back then, policies were designed to induce married women to have children because the policy makers of that time took the commonly observed family structure as given and tried to solve the problem based on such a model of family and society. At least until the early 2010s, the common form of an established family with a married couple[4] observed

[4] Policy makers of that time and even until very recently aimed their policy at making people get married and inducing people to have children once married.

Table 1-1. *Summary of the 1st~4th Low Fertility-aging Society Strategic Plan (2006~2025)*

1st Strategic Plan (2006~2010)	2nd Strategic Plan (2011~2015)
Target ① 2011-2020: Recover the fertility rate and successfully respond to the aging society ② 2006-2010: Construct a basis for an LF-AS response **Strategies** ① Create an environment suitable for childbirth and child raising - Enhance social responsibility related to marriage, childbirth and child raising - Create a work-life balance and family-friendly atmosphere and culture in society	**Target** ① 2011~2015: Gradual recovery of the fertility rate and establishment of a response system to the aging society ② 2016~2030: Recovery of the fertility rate to the OECD average and responding effectively to the aging society **Strategies** ① Create an environment suitable for childbirth and child raising - Reduce the (financial) burden of marriage, childbirth, and child raising - Make work-life balance a daily routine
3rd Strategic Plan (2016~2020)	**Revision to 3rd Strategic Plan (2019~2020)**
Target ① A happy society with children; TFR target ('14) 1.21 → ('20) 1.5 ② A productive and active society for elders; Elderly poverty rate target ('14) 49.6% → ('20) 39% **Strategies** ① Enhance policy for youth employment and housing - Boost youth employment - Enhance housing support for newlyweds ② Realize social responsibility for childbirth and infertility - Expand medical support for pregnancy and childbirth - Increase awareness of diverse family structures ③ Expand the customized childcare system and reform education - Expand customized childcare - Educational reform for happy children and parents ④ Improve blind spots for a work-life balance - Achieve an equal work-life balance for both genders - Create a suitable environment for raising children for workers of irregular/temporary contracts or in small and medium-sized firms	**Target** ① Improve quality of life ② Realize gender equality ③ Actively prepare for demographic change **Areas to work on** ① Create a society that works and cares together - Minimize the costs of childbirth and child raising - Maximize parents' time for their children - Establish a safe and comprehensive national childcare system - Form a stable basis for life for the 2040 generation
4th Strategic Plan (2021~2025)	
Target ① Improve individuals' quality of life ② A society of gender equality and fairness ③ Social innovation to respond to demographic change **Areas to work on** ① Create a society that works and cares together - Work-life balance for everybody - Create a society and labor market where women can work equally with men - Enhance social responsibility for childcare - Ensure and secure children's basic rights universally - Ensure and secure sex and reproductive rights throughout the life course ③ A society where everyone can do the best of his or her ability - Enhance the basis for women's career retention and growth	

Only the assignments related to fertility and female labor participation are extracted and summarized.

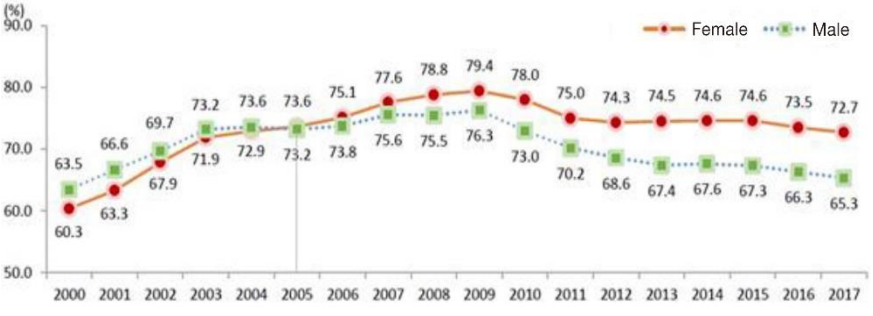
Source: The 1st, 2nd, 3rd plans and revisions to the 3rd and 4th LF-AS strategic plan documents by the Korean government (2006, 2010, 2016, 2019, and 2021, respectively) are summarized by the author

in their 40s was such that a father working mainly in the labor market to support the family and a mother working for supplementary income in the labor market and raising children. Taking this observed pattern of married couples with completed fertility choices as given, policy makers tried to identify and tackle the causes of the constrained fertility of married couples from this perspective.

However, such attempts have been proven short sighted and unsuccessful. Korea is characterized not only by a rapidly changing population structure but also by the fast-changing characteristics of the population. There is a large generational gap in terms of experience, culture, and perception of life within the population. Previously, policy makers have failed to take this into account.

The female college enrollment rate exceeded that of men in 2005 and has diverged since then (see Figure 1-3). Moreover, the share of the female population that invests more in human capital than does the men increased rapidly. In particular, the cohort of women born around and after 1985, who make up most of reproductive-age female population today, are observed to have invested more in human capital than their male counterparts until graduating college and entering the labor market (Yoon et al, 2018).

Figure 1-3. College Enrollment Rate by Gender (2000~2017)



Red line: Female, *Green line*: Male.

Source: Ministry of Education and Korean Educational Development Institute (KEDI), Annual reports of Educational Statistics "교육통계연보"

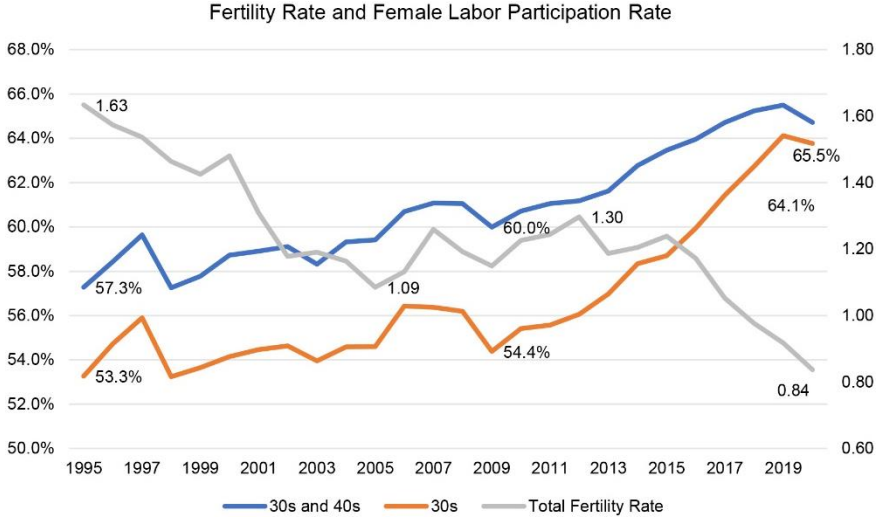
This cohort has seen what had happened to previous women after marriage and childbirth: they had to leave the labor market or stay at bay of career advancement. Nevertheless, these women chose to heavily invest in their human capital. If the younger generation of Korean women are not irrational, then this suggests that they do not perceive a life course with children as a necessity anymore. In fact, government-funded research by Kim et al. (2019) surveyed randomly sampled 6,350 individuals (female N =3,049) from the 1980s and 1990s birth cohorts regarding their perspectives on the life course, finding that younger women, on average, put more weight on work (career) than on personal life, partnership and children. This finding is not absurd given the patterns of human capital investment by young women.

In the labor market, women in their thirties and forties, who make up the largest share of child-raising mothers and potential mothers [5], increased their participation gradually until the early 2010s and then rapidly afterward (see Figure 1-4). The growth is steeper for women in their thirties than for those in their thirties and forties combined, implying that the recent growth of the female LPR of prime-age women (in their 30s and 40s) has largely been led by the rapid growth of the LPR among women in their thirties. At the same time, the fertility rate has been falling since 2012 and then at an accelerated pace since 2015, which is just about the time that the cohort of women who invested more human capital than men began entering their 30s.

Realizing the changed perspectives on life course by younger-generation women and their emphasis on work and career life, the Korean government shifted its policy objective from inducing women to have more children to improving the quality of life for all generations in the revision to the 3rd LF-AS strategic plan (Table 1-1). The reasoning behind such a change was that if quality of life is improved in all

[5] This is given that the average age of women at the birth of their first child has been over 30 years since 2010; it was 30.10 years in 2010 and 32.61 years as of 2021 (KOSIS 2021).

Figure 1-4. Labor Participation Rate of Women in Their 30s and 40s and Total Fertility Rate



Source: Korean Statistical Information Service, "*Survey of Economically Active Population*," and World Bank. "Fertility Rate, Total (births per woman) – Korea, Rep."

aspects and for all generations, then the barrier to parenthood might be lowered.

Following the shift in policy direction, the government called for active youth employment policy to make the transition from school to work and from work to family formation faster and improve the quality of life of younger generations. Moreover, the specific mission of the low fertility solution part of the revised LF-AS strategic plan and the following plan (4th) was set as "creating a society where (men and women) work together and (men, women, and the government) care together" (See Table 1-1).

The revised 3rd LF-AS strategic plan and the 4th plan started to emphasize the importance of gender equality both at home and in the workplace as an important starting point for achieving a society where parents work together and care for their children together.

It is perhaps too early to assess the impact of the changed direction

of LF-AS strategic plans, but, at the least, we have observed a plummeting fertility rate just before and after coronavirus disease 2019 (COVID-19). Therefore, it seems that the strategic plans and government efforts have not induced any positive changes just yet.

2. Objective and Organization of this Study

In light of recent changes to LF-AS strategic plans, this study aims to increase our understanding of what really happens to men and women in Korea who choose to have children. In particular, we consider how childbirth and child raising affect parents' labor supply in reality. Are Korean mothers and fathers "working together and caring together?" We also want to draw some important policy implications and considerations for future government plans.

This research is composed of three independent chapters of empirical works. The organization of the chapters is as follows. In the next chapter, we evaluate how parents' labor supply changes after the birth of their first child using data from all waves of the Korean Longitudinal Survey of Women and Families (2006~2020). We adopt an event study method and try to examine the diverse aspects of the impacts of the birth of the first child on parents' labor supply to enhance the understanding of the patterns of the consequence of childbirth on parents.

Next, in Chapter 3, we evaluate directly how the time demand for childcare affects parents' allocation of time in the labor market using the recent waves of a couple matched sample from Korea Labor and Income Panel Studies. The analysis in Chapter 3 uses a structural break in the childcare system of Korea, which generates a sudden increase in the demand for childcare, and estimates how parents react to such changes in terms of the allocation of time spent in the labor market.

Chapter 4 focuses on working age female population and mothers. It

tries to model econometrically and evaluate the selection of women in childbearing age into work. In particular, assuming women's potential and realized wages can be a proxy for productivity, it analyzes the pattern of women's selection into work by diverse aspects including aspects related with their fertility choices.

With these three independent analyses, we strive to deepen our understanding of the recent patterns of childbirth, mothers and fathers' work and the pattern of the growth of childless female labor participation in Korea.

The last chapter of this study summarizes the findings of our analyses and discusses the policy implications for the future.

Chapter 2

Motherhood and the Labor Market Penalty: Discussion on Perceptional Change[6]

Yoon Jae Ro

1. Introduction

South Korea's total fertility rate (TFR) fell to 0.81 in 2021, breaking its record for the world's lowest TFR and rerecording itself as having the lowest TFR among OECD countries. Many researchers and policy makers suggest that socioeconomic and political factors, including gender inequality, high living costs, evolving family structures, extreme competition in society, and difficulty in achieving a work-life balance, all play a role in the low birth rates in South Korea.

Among the many factors that cause a low birth rate in South Korea, the difficulty faced by mothers when working while having children can be particularly problematic for policy makers. Indeed, according to the statistics provided by Statistics Korea, 43.2% of married women aged 15-54 years said that they were not able to come back to their jobs due to childcare, 27.4% quit their jobs due to marriage, and 22.1% quit their jobs because of pregnancy and childbirth.[7]

Maintaining a job during the first few years of childbirth is likely to be

[6] For this chapter, technical assistance for the empirical analyses was provided by Jeonghwan Yun (Associate research fellow, KIEP).

[7] Statistics Korea, 2022 Local Area Labor Force Survey(https://www.index.go.kr/unity/potal/main/EachDtlPageDetail.do?idx_cd=3039)

a challenging aspect of motherhood. While most women in Korea and other OECD countries work before motherhood, mothers' labor supply has changed over time. In Korea, the female labor force participation rate rose rapidly until 1997 and has since plateaued until recently. When we divide the female labor force participation rate by a 5-year age interval, it shows a bimodal structure that peaks in the early 20s and late 40s. The drop in range of 25-35 years suggests that many women give up market work for nonmarket work, typically childbirth, childcare, and domestic duties. This pause in the career path of mothers can be described as a "motherhood penalty", which may account for a significant proportion of gender inequality.

In this study, we investigate the impact of children on the labor market trajectories of families. We estimate the impact of childbirth on women (relative to that on men). We adopt a quasi-experimental approach based on event studies that use changes around the birth of the first child. We find a large effect of children on women for labor market outcomes. Children have a large and sharp effect on women's employment and earnings. We also find that women experience a "motherhood penalty" in terms of employment and earnings when we define the term as how much women fall behind men due to having children. In contrast to the results for women, men do not show a decline in employment and earnings due to childbirth. In fact, men increase their number of hours worked and decrease their amount of family time after the birth of their first child, which can be indirect evidence of inequality in terms of the childcare burden with the household. In addition to labor market outcomes, we study women's ability to anticipate the costs of motherhood by looking at the change in moms' attitudes toward work after childbirth. Examples of motherhood costs might include both the emotional and monetary costs of childcare services. Using panel data of women and event study analysis, we answer the following question: Does having a baby change a woman's understanding of motherhood?

Looking at the heterogeneity of this impact, we find that the

experience of being raised by a working mother and that of not holding a college degree do not make mothers suffer any less from the motherhood penalty. While we are not fully able to disentangle the impact from all the plausible channels, we additionally suggest that the unexpectedness related to the motherhood burden may have resulted in the intensive motherhood penalty in this context.

Our study contributes primarily to the literature on gender inequality in the labor market. As reviewed by Blau and Khan (2017), many researchers focus on education, discrimination, occupation, and parenthood in explaining the gender gap. Our study is most closely related to Bertrand et al. (2010), which show that career discontinuity and flexible work hours for female Master of Business Administration (MBA) graduates from the Chicago Booth School of Business are associated mainly with motherhood. Moreover, our study is closely related to the papers by Angelov et al. (2016), Kleven et al. (2019), and Kuziemko et al. (2020), which estimate child penalties in terms of labor market outcome for mothers and use an event study approach. The remainder of this study is organized as follows. Chapter 2 describes the data. Chapter 3 discusses the event study methodology, and Chapter 4 shows the main results and discusses the heterogeneity and potential mechanism. Chapter 5 concludes the paper.

2. Data

To investigate the impact of having a child on mothers, we need a sample of individuals observed before and after the birth of the first child and answers to a variety of questions regarding labor market outcomes. The Korean Longitudinal Survey of Women & Families (KLoWF) is a longitudinal survey of women that runs bi-annually from 2006 through 2020. The KLoWF started interviewing 9,997 women

between the ages of 19 and 64 years in 2006, and the questionnaire covers a vast range of their life and work. Thus, the data contain rich information on childbirth events, earnings, labor supply, occupation, education, and many other variables.

We use an event-study analysis to investigate the proposed research question and adopt sample restrictions with that specification in mind. Our primary event study approach is based on births of the first child, where women are observed both before and after. While we do not require the sample to be perfectly balanced over the analysis period, our preferred sample includes only those who we observe at least once before and after the "event" of the birth of a first child. Additionally, we restrict the cohort to five years before having a child and ten years after.

The sample restrictions described above leave us with a total of 671 women. On average, in our analysis sample, we observe individuals 5.8 times overall—2.1 times prebirth and 3.7 times postbirth—meaning that we observe individuals several times before and after the birth of their first child and minimize the effect coming from the composition change. Table 2-1 displays the summary statistics for our preferred sample. On average, the women in our sample are 33 years old, and their age at the birth of their first child is approximately 30 years old. Sixty-eight percent of women are currently married, and 43% of women have a college degree.

Table 2-1. *Summary Statistics*

Variables	Mean
Age	33.05
Has college degree	0.43
Years of schooling	14.48
Currently married	0.68
Age at birth of first child	30.79
Observations	3,546

The main research question of this work is how having a child affects labor market outcomes. We estimate the impact of childbirth on women's employment, earnings, and hours worked. In addition to the labor market outcomes of mothers, we also look at the effect of having a child on the same outcomes of fathers. Many studies in the literature have already proven that childbirth is detrimental to mothers' employment. Having a child already puts a pause on mothers' careers, and because of childbirth, mothers are not (able to) return to work. Moreover, in most countries, this is not true for fathers, even in Northern European countries, where paternity leaves are implemented in the most advanced form. Kleven et al. (2018) shows the stark difference between the employment pattern of women and men after the birth of their first child. The employment shares closely follow each other, but the pattern diverges right after the birth of the first child. We want to see if we can witness the same trend in South Korea. Before moving on to the main analysis, we present the descriptive evidence of gender inequality in South Korea. We depict the share of employed women and men by event time in Figure 2-1. Event time equal to 0 is the year of the birth of the first child, meaning that event time from -1 to -5 is the prebirth period, and that from 1 to 10 is the postbirth period. Before childbirth, nearly 100% of men are employed, which drops to 91% at the time of the birth of the first child. While men's employment rate returns to 93% and 97% in the long run, women's employment rate does not return to that in the prebirth period.

This dataset asks questions about gender norms in repeated interviews, which are then used to measure the change in beliefs. These questions are in the form of statements about the proper role of women in the household, and respondents are asked to state their agreement with each statement on a 1-4 scale. If needed, we reverse the order of the responses so that each answer is increasing in the pro-female employment direction. Table 2-2 shows the questionnaire used in the survey.

Figure 2-1. Employment around the Event of the Birth of the First Child

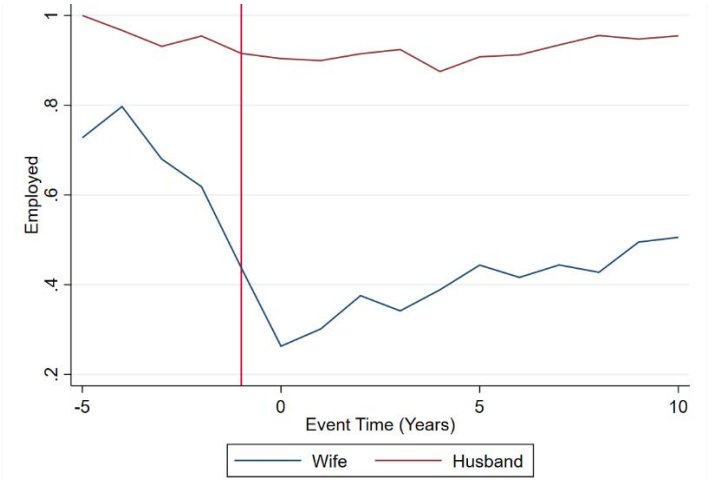


Table 2-2. *Questionnaire on Gender Roles*

	Question
1	Men should have a job, and women should stay in the house.
2	To be equal as a married couple, women also need to have a job.
3	If a mother works, then it would adversely affect her preschool children.
4	Working husbands and wives should divide the household chores equally.
5	Husbands and wives should take care of their own earnings.
6	Husbands and wives should buy a house together.

We then standardize each of these variables so that each variable's standard deviation is one, making us able to compare across the 6 questions. To measure how beliefs change, we make use of all questions, but we focus on one question (If a mother works, then it would adversely affect her preschool children). All other answers to the questionnaire either do not show a parallel trend or do not have any effect.

3. Empirical Methodology

3.1. Event-Study Specifications

We use an event study specification to investigate the impact of having children. Studying the impact of having children on mothers (and fathers) cannot avoid the bias coming from the endogeneity of childbirth. Thus, researchers have proposed and used instruments for the number of children such as twin births, sibling gender mix, and sex of the first child. As our primary goal is to estimate the impact of children on family labor supply, we adopt an event study approach that uses the sharp changes that arise around the birth of the first child, particularly for mothers. Although fertility choices are not free from being endogenous, the event of giving a birth to a first child generates sharp changes in labor market outcomes. These sharp changes are orthogonal to the unobserved determinants of those labor market outcomes. Moreover, with the event study approach, we can trace the full dynamic trajectory of these effects.

Following Kleven et al. (2018) and Kuziemko et al. (2020), we define the year of birth of the first child as the "event". Specifically, we model a given outcome, y_{it}, for person i in year t as follows:

$$y_{it} = \sum_{\tau=-5,\neq-1}^{\tau=10} \beta_\tau \cdot 1[\tau = t - c^i] + \sum_a \gamma_a \cdot 1[a = Age_{it}] + \delta_t + \epsilon_{it}$$

We index time relative to the birth of a child by τ. And c^i denotes the calendar year in which person i had their first child, and thus, $1[\tau = t - c^i]$ is an indicator for person i in year t having had their first child τ years ago or having a first child $|\tau|$ years in the future. In our specification, event time τ runs from -5 to +10. We omit the event time indicating one year before the birth of the first child, so that the event time coefficients measure the impact of children relative to the year just before the childbirth. We include a full set of year and age dummies. This

specification normalizes the event time $\tau = -1$ to zero. We investigate the evolution of a wide set of labor market outcomes and perceptions on childbearing as a function of event time. We present our results by plotting the β_τ coefficients in order to show the trend of our outcome variables relative to the event, conditional on year and age fixed effects.

3.2. Heterogeneity

This subsection aims to examine heterogeneity along the dimensions related to our hypothesis. Here, we estimate the difference in employment responses by distinct and mutually exhaustive groups X=1 and X=0, where X is a dummy variable such as college completion and age at the birth of the first child. We run separate regressions and report the results for each group. First, we check whether human capital formation is related to future labor supply. We use college completion as the measure of human capital. Second, to check the age effect, we use the mother's age at the birth of the first child. We divide the sample into two groups—that between the ages of 20 and 34 years and that 35 years and older—and conduct the same analysis. Finally, we look at whether having a working mother affects female employment.

4. Main Results

4.1. Impacts on the Labor Market Outcomes of Mothers

Figure 2-2 plots the event study coefficients from Equation (1), which are the impacts of children on mothers' labor market outcomes across event time. As defined above, these are outcomes at event time t relative to the year before the birth of the first child (t=-1), controlling for age and time trends. The figure includes 95% confidence intervals around the event study coefficients.

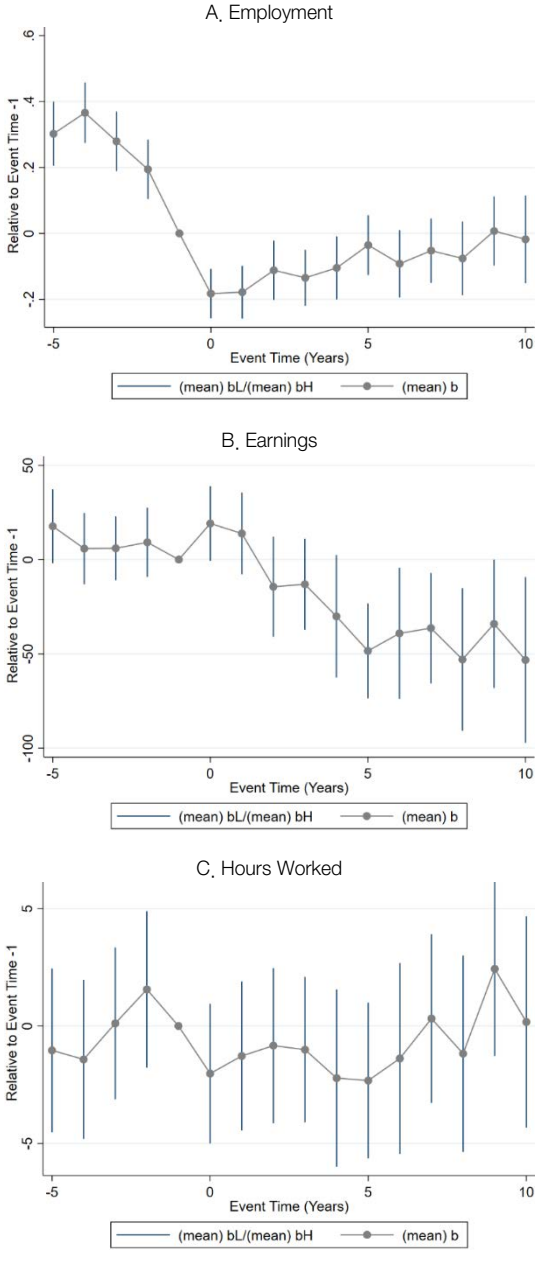
In our analysis, employed women are all those women who did any work at all as paid employees at least 18 hours per week during the survey year, excluding those workers who (a) worked fewer than 18 hours a week and (b) were nonpaid (family work) employees. Panel A in Figure 2-2 shows the impact of childbirth on female employment. At the moment of the birth of the first child, women experience an immediate drop in their labor supply. The figure shows an 18-percentage-point decline in the female labor supply in the year of the birth of the first child. The employment shock stays until the fourth year after birth and shows a modest recovery as the years pass.

Panel B shows that women start experiencing a decline in earnings after the third year after the birth of their first child. The magnitude of the coefficient becomes larger as the years pass. The earnings impact can come from different margins: hours worked, labor force participation (employment), and occupation change. While we cannot check all the margins due to data limitations, we are able to see the change in the number of hours worked and the rate of labor force participation (employment). The results for labor force participation show the same trajectory as do those for employment. The impact on the number of working hours shows insignificant results, but looking at the trend only, there is a slight decline in the number of working hours after the birth of the first child, which shows a slow recovery as the years pass.

Exploring both intensive and extensive margins, we can conclude that women experience an immediate drop in employment after childbirth and a delayed drop in earnings, the latter of which may be due to them reducing their number of hours worked.

In the years following the initial drop, the employment and earnings of women do not converge back to their original level. The fact that employment slowly recovers as the years pass but earnings keep falling means that women are returning to work but not to the original level. This finding can mean that women are either coming back to low-wage

Figure 2-2. Labor Market Outcomes around the Event of the Birth of the First Child (All Mothers)

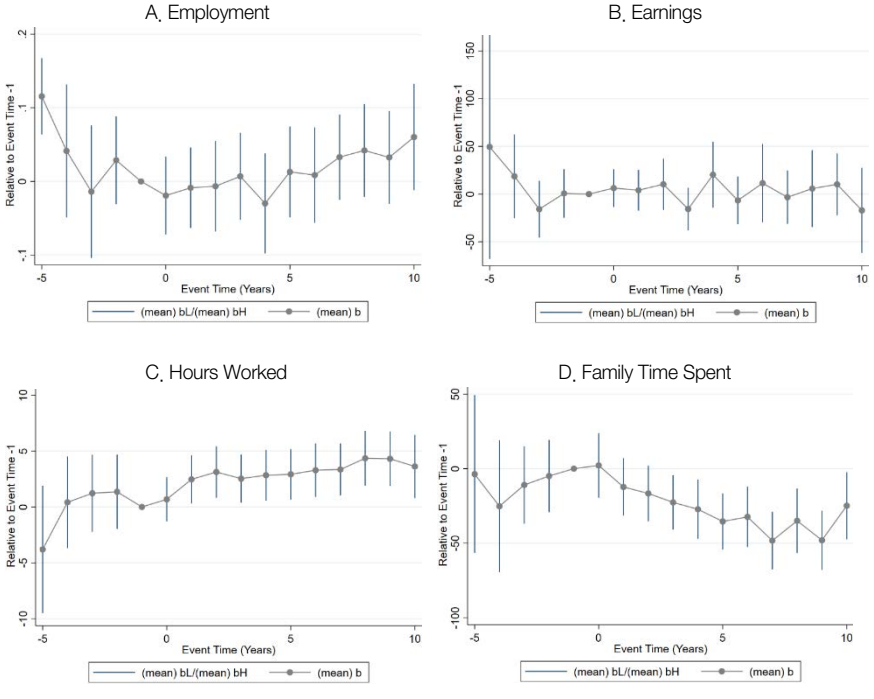


jobs or reducing their number of work hours (including changing to flexible jobs).

4.2. Impacts on the Labor Market Outcomes of Fathers

Despite the fact that the gender wage gap has narrowed over the last century, gender inequality persists in all countries. The gender wage gap is the result of many factors including education and discrimination. Among these many factors, the motherhood wage penalty can be a simple explanation for the persistent gender inequality that cannot be explained by human capital and discrimination. In this chapter, we check whether the motherhood wage penalty is true in Korea. The KLoWF asks several questions about men's labor market outcomes. In our analysis, to compare the results for men with those for women, we use employment, earnings, and work hour variables. However, information on men is limited since the data contain information on them based on their wives' answers. The employment of husbands is defined as whether they did any work at all during the survey year, which includes those who worked not only as paid employees but also as self-employed workers. Self-employment earnings are recalculated as a monthly salary so that they are comparable to the earnings of wage earners. Figure 2-3 plots the event study coefficients, which are the impacts of children on fathers' labor market outcomes across event time. The impact of children on men exhibits a different path than does that on women. First, in contrast to the results for female employment, male employment does not show an immediate drop after the birth of the first child. While it is insignificant, there is a little drop in labor supply right after the first birth, but it has an increasing trend after. There is no impact of childbirth on husbands' earnings. The coefficients of earnings after childbirth are close to zero, even if we ignore the insignificant nature of the estimated coefficients. This finding means that husbands' earnings do not change compared to those the year before the birth of the first child. These two

Figure 2-3. Labor Market Outcomes around the Event of the Birth of the First Child (All Fathers)



graphs consist of evidence that the penalty for having a child only for mothers and not for fathers. The arrival of a first child creates persistent gender inequality within the labor market.

Additionally, we can find some indirect pieces of evidence of the division of childcare in the household by looking at the impact of the birth of the first child on the number of hours worked and amount of family time of husbands. Husbands increase their number of hours worked after the birth of their first child, a finding that is echoed by the decline in the amount of family time. Since there is no impact on employment and earnings, this situation can be considered as husbands spending more time at work rather than picking up an additional job.

4.3. Heterogeneity and Mechanism

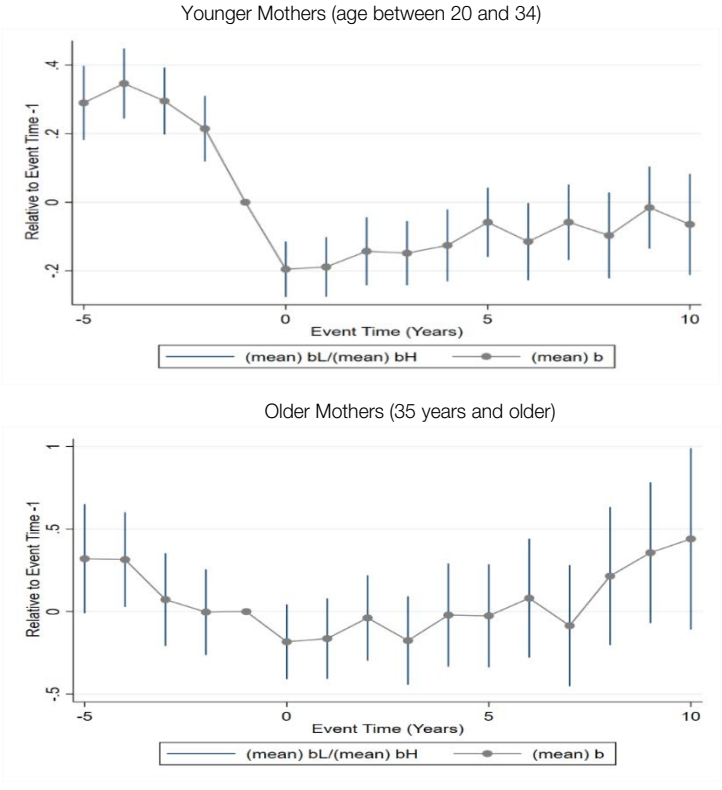
In the previous section, we found that mothers experience an apparent cessation in their career paths in terms of their employment and earnings after the birth of their first child. While the motherhood penalty in terms of employment seems to recover after a few years, that in terms of earnings prevails and worsens throughout our study period. This finding implies that a representative mother does go back to her career path but never accomplishes the full capacity that she had achieved prechildbirth. Before discussing a plausible mechanism driving such patterns, it is worth considering whether such a pattern is uniformly prevalent in all mothers in our sample.

We first consider the heterogeneity in labor patterns around the birth of the first child. Figure 2-4 shows how the employment pattern differs between mothers younger than 35 years at the time of the birth of their first child and those older than 35 years at the birth of their first child. The difference in the pattern seems substantial. Compared to the older generation, the younger generation suffers more intensively from the motherhood penalty.

Notably, while the slow recovery from the motherhood penalty is shown in both age groups, the impact of the first four years after giving birth to a first child seems to place young mothers away from the labor market more significantly. However, the comparison in Figure 2-4 does not mean that mothers in the older generation do not face a motherhood penalty. The older generation of mothers, just like their younger counterparts, seem to separate from work 3 to 4 years before the actual birth of their first child, which may lead to a less abrupt drop in this group around the actual birth of the first child.

Turning our attention to the intensive margin, the event study coefficients on earnings show a similar pattern between mothers in both age groups (Figure 2-5). However, the decline in earnings is still more

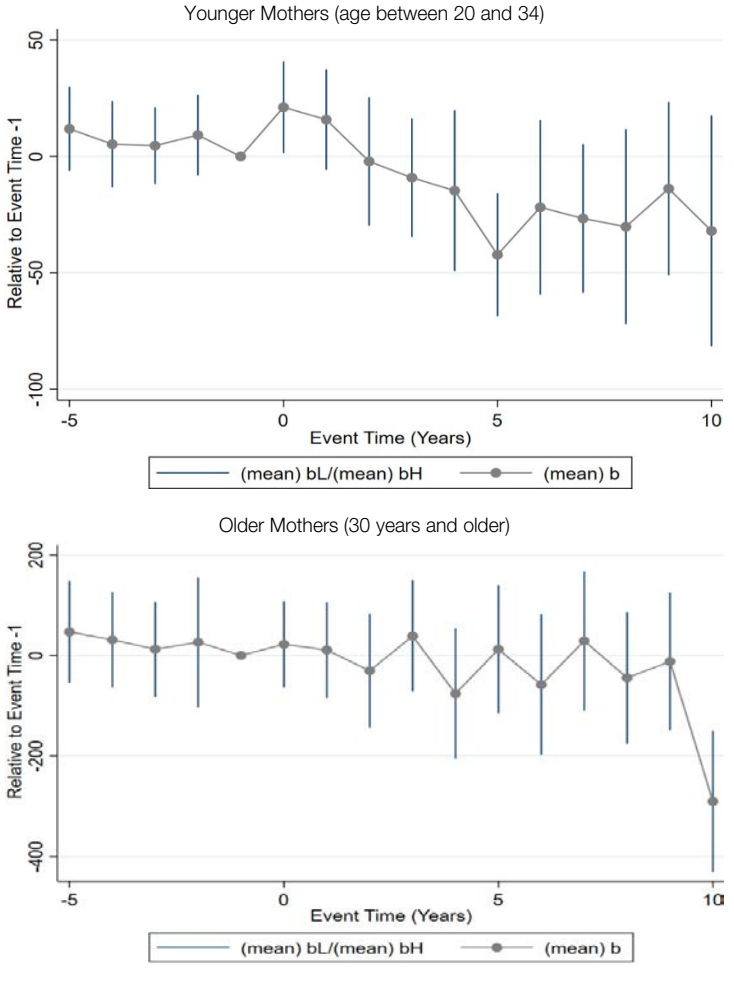
Figure 2-4. Employment around the Event of the Birth of the First Child (by Age)



significant and steady for younger mothers than for older mothers. While standard errors are generally large over the whole period for both groups of mothers, younger mothers suffer larger and longer from the motherhood penalty, and their earnings do not seem to fully recover, even nine years post-birth.

Such heterogeneity by age may have come from three different sources. One possibility is that younger mothers have a different perception of motherhood. Older mothers may have a stronger intrinsic motivation to pursue their careers, even after having a child; they may face fewer motherhood penalties because they believe that mothers should not sacrifice their careers after childbirth. Another possibility is

Figure 2-5. Earnings around the Event of the Birth of the First Child (by Age)



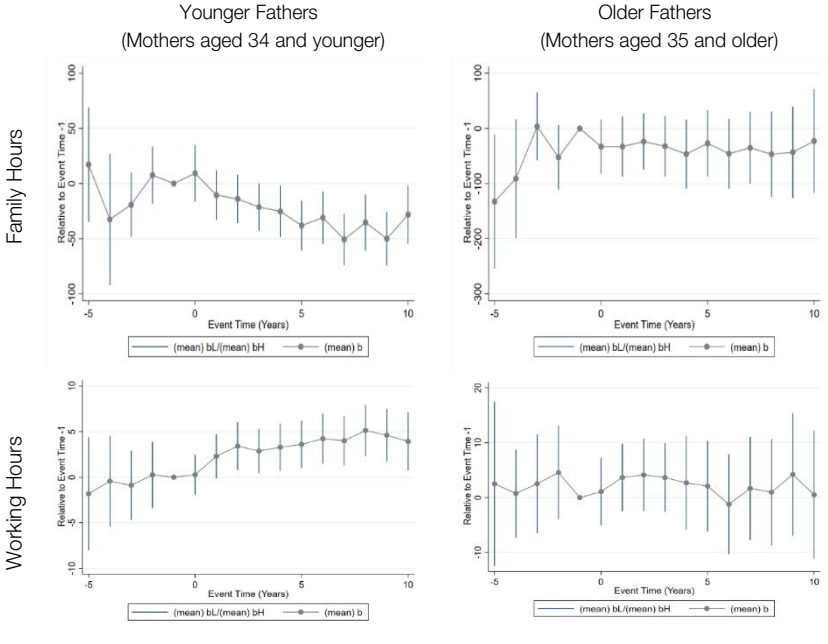
that expectations about the burden of the caregiving role may differ across the ages of mothers. Older mothers may be more sophisticated and forward looking in their family decision, while younger mothers may be more naïve and underestimate the motherhood penalty. To naïve younger mothers, motherhood may be more hostile and unexpected, which may lead to a more dramatic adjustment in labor market decisions after giving birth to their first child. These two sources are both related

to mothers' understanding of motherhood and may still lead to heterogeneous responses, even if labor market conditions are the same for older and younger mothers.

The time use pattern of the husbands of younger mothers (hereafter, fathers) is shown in Figure 2-6. Interestingly, fathers' time use pattern echoes that of mothers. Younger fathers work significantly more after the birth of their first child and spend less time with their families, and such a specialization pattern is intensified over a 10-year window. Older fathers do not adjust their time use after the child is born. This observation supports the second hypothesis about unexpected parenthood but goes against the first hypothesis about gender roles if men and women commonly share the responsibility of childcare.

The third possibility is that younger mothers face a larger motherhood penalty compared to older mothers because they are initially in their early

Figure 2-6. Fathers' Time Use around the Event of the Birth of the First Child (by Age)

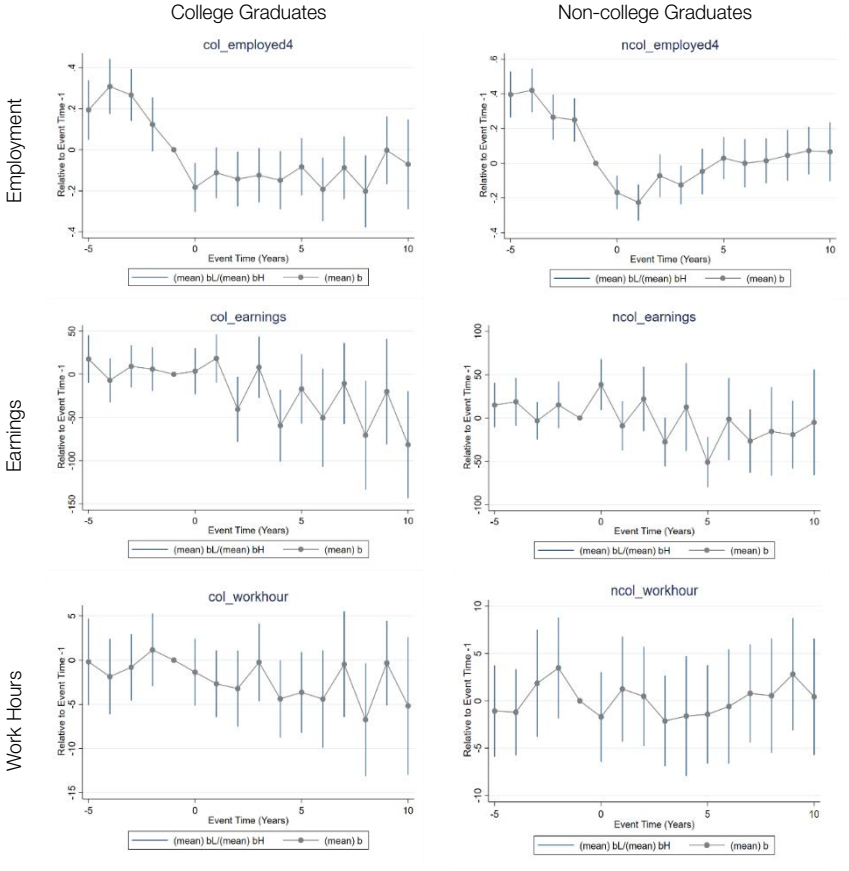


career path. Because younger mothers are more likely to have a lower level of human capital due to little work experience or a lower education level, the opportunity cost of becoming a full-time caregiver is lower than that for older mothers. Similarly, older mothers are likely to be in a stable position in a more family-friendly environment, which may allow them to easily go back to their original careers. Such explicit differences in opportunity costs is directly related to conventional rational decision arguments subject to mothers' human capital, regardless of perception or expectations about caregiving or gender norms within a family.

If a mother's decision to work varies due to differences in labor market conditions, such differences are likely to appear depending on the educational level. Figure 2-7 shows the pattern of the motherhood penalty. Given that college graduates have higher labor income, they may find larger opportunity costs and try to avoid suffering from the motherhood penalty. Similarly, suppose that a forward-looking mother expects a motherhood penalty. In such a case, she may be able to utilize her educational advantage to work in a more family-friendly occupation, resulting in highly educated mothers suffering less after giving birth to their first child. Adversely, if a female college graduate with a higher opportunity cost chooses not to have a child, then our sample suffers from selection bias by including only mothers with lower opportunity costs. In such cases, the highly educated mothers in our sample might suffer even more. However, we do not find direct evidence that the labor market conditions faced by mothers of different educational backgrounds create significant heterogeneity in terms of the motherhood penalty.

A mother growing up with her working mother (hereafter, grandmother) in her childhood may shift her perception of motherhood responsibility. Such a woman may have felt a deficiency in terms of the lack of presence of her mother; otherwise, she may feel less guilt or concern about mother's absence. In such cases, the channel of gender norms may differ depending on grandmothers' labor market participation,

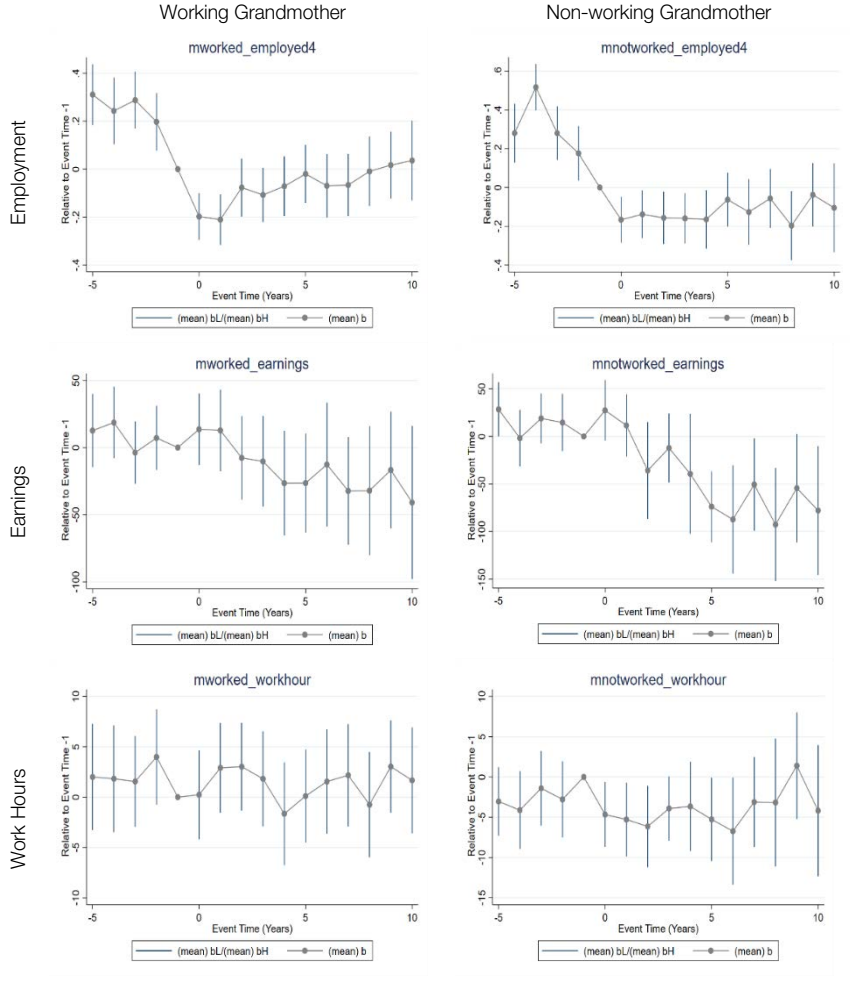
Figure 2-7. Mothers' Work Decision around the Event of the Birth of the First Child (by Education)



in turn also affecting mothers' labor market decisions.

From Figure 2-8, however, we do not find indirect evidence of a change in gender norms. Both types of mothers with different childhood experiences show dramatic adjustments to their employment status but slowly recover over time. It seems that having had working mothers leads mothers to go back to work more and/or earlier, which may still be due to perceptional changes in the significance of a mother's role in raising her child. However, the magnitudes of the initial drop in employment status

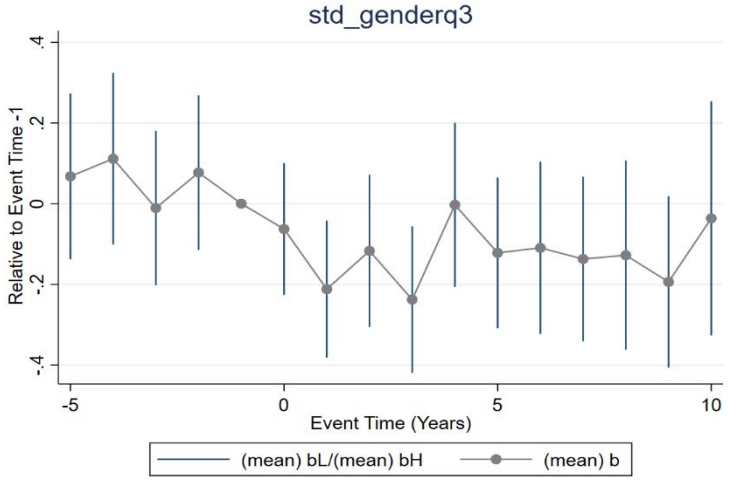
Figure 2-8. Mothers' Work Decision around the Event of the Birth of the First Child (by Grandmothers' Labor Market Participation)



are similar between the two groups, and there is no visible difference in earnings pattern.

The limited effect of such perceptions on motherhood responsibility as a caregiver becomes more obvious with another event study analysis. Figure 2-9 shows the event study result with a dependent variable rating how much of a negative impact a working mother would have on her

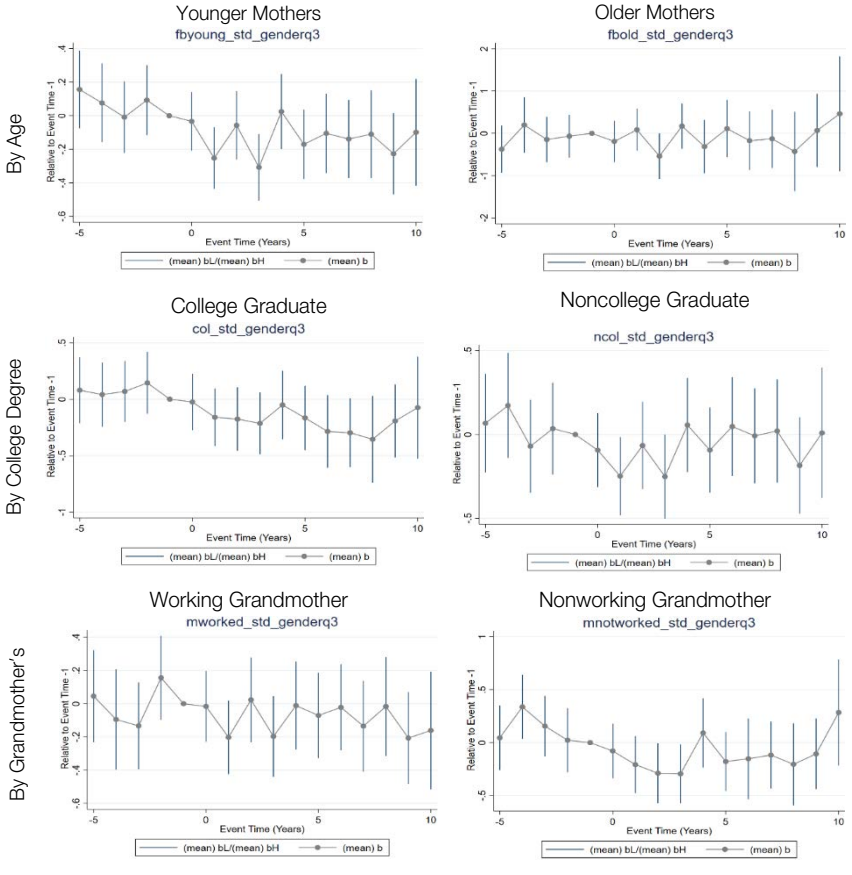
Figure 2-9. Perceptional Change in Motherhood Responsibility around the Birth of the First Child



child. From the whole sample, we see that new mothers update their belief about the motherhood penalty after giving birth to their first child, realizing that there is more intense demand for caretaking for the younger child.

Figure 2-10 shows how such an update happens in the same pattern found in the labor market decisions of mothers. Younger mothers fiercely update their understanding of their motherhood role as a caregiver, while older mothers do not do so as much. However, there is no such obvious difference in the level of perceptional change depending on educational background or childhood experience. While we do not exclude the possibility of other channels playing a role in the motherhood penalty, unexpected motherhood responsibility likely plays a major role in structuring the motherhood penalty in our context so that mothers realize the burden only after having their first child.

Figure 2-10. Perception of Motherhood Responsibility around the Event of the Birth of the First Child



5. Conclusions

The 2022 World Economic Forum global gender gap report ranks South Korea 99th out of 146 countries in an index that examines jobs, education, health, and political representation. South Korea's gender gap in labor market outcomes persists even as the economy grows. Women's labor force participation in South Korea has risen over the sample period, but it is far behind that of its high-income OECD peers. South Korea

has been ranking at the top in the gender wage gap for over 30 years since joining the OECD in 1997: women are paid one-third less, on average, than are their male counterparts in Korea. There are many study results that try to figure out the cause of this persistent gender wage gap. Long full-time hours and low levels of part-time work make it difficult for Korean women with children to remain employed, given that they are responsible for nearly all childcare and household activities. Additionally, the strong zeal for education in Korea has likely increased the burden placed on mothers.

Using panel data from South Korea and an event study approach, we show that the motherhood penalty in terms of wages exists for mothers. We present two main sets of results. First, we show that the impacts of children on women's employment and earnings are persistent, while, at the same time, men are unaffected. Children have a large and sharp impact on women's employment and earnings. At the moment of the birth of the first child, women experience an immediate drop in their labor supply. Women start experiencing a decline in earnings after the third year following the birth of their first child. The magnitude of the coefficient becomes larger as the years pass. Moreover, the impact on the number of working hours shows insignificant results. However, looking at the trend only, there is a slight decline in the number of working hours after the birth of the first child, showing a slow recovery as the years pass. The impact of children on men exhibits a different path from that on women. First, in contrast to the results for female employment, male employment does not show an immediate drop in the number of hours worked after the birth of the first child. While it is insignificant, there is a little drop in labor supply right after the birth of the first child, but it has an increasing trend thereafter. There is no impact of childbirth on husbands' earnings. The coefficients of earnings after childbirth are close to zero, even if we ignore the insignificant nature of the estimated coefficients. This finding means that husbands' earnings do not change compared to those in the year before the birth of their first child. These

two graphs show that such a penalty is only for mothers and not for fathers. Thus, the arrival of a first child creates persistent gender inequality in the labor market.

Second, we explore the heterogeneity of the impact of having a child on previous outcomes. There are some differences in the pattern by mothers' age at the birth of their first child. While the dramatic motherhood penalty is observed for younger mothers (34 years and younger), who suffer more and longer, older mothers do not suffer as much. Interestingly, the husbands of younger mothers also work more and spend less time with their families, echoing mothers' labor market decision. We hypothesize that heterogeneity comes through the composition of 3 different channels: 1) different perceptions of motherhood and gender norms, 2) different expectations for the caregiving burden, and 3) qualitative differences in the labor market and opportunity costs. However, the experience of being raised by a working mother and not holding a college degree does not make mothers suffer less from the motherhood penalty. While we do not fully disentangle the impact from all the plausible channels, we additionally suggest that unexpectedness regarding the motherhood penalty may have resulted in its dramatic pattern in this context.

Our study indicates that despite women actively participating in the labor market, having children brings about discontinuity in their career path. Once mothers take a break from their jobs due to childbirth, probably followed by maternity leave, it is difficult for them to return to the same job later. Even if they succeed in returning to the same position, those jobs are associated with lower earnings due to reduced work or fewer benefits and lower wage rates. Until recently, policy makers proposed generous maternity leave and the assurance of a return to the same job to solve the problems of these "career-discontinued" women. While it is essential to ensure that women have those rights, this is not the perfect solution for mothers returning to less privileged jobs. Even with the assurance of being able to return to the same job, mothers are

doing so less due to the lack of work flexibility. For the first few years after a child is born, the division of childcare is still unequal. Thus, such a policy should target the need for help in reducing the motherhood burden so that mothers are able to return to their normal jobs after giving birth to their first child.

Chapter 3

Effect of Increased Demand for Childcare Time on Parents' Allocation of Working Hours

Selim Choi

1. Introduction

The arrival of a new child for a couple means a lot to their household; it brings joy and happiness to the family and adds a responsibility for the couple to handle the upbringing of their child until he or she becomes an adult.

In economic sense, a new child in a family means changes in the household or in each parent's utility function. The presence and quality of a child and, sometimes, time spent with him or her can generate the utility of parents or the household, while also meaning changes in the constraints faced by the couple. There will be additional consumption for child's quality and time demands for child care, not to mention the increase of home production hours for additional member of a household who cannot produce "homegoods" for him or herself.

Likewise, in family economics or labor economics, many studies have been conducted to identify the diverse relationships among fertility choices, labor market participation and outcomes, both at the individual and household levels.

This study also strives to analyze the relationship between fertility and parents' labor supply. The main difference between this analysis and

previous studies is that it specifically studies the case of South Korea, where miraculously low fertility rates have been recorded, hence setting a new world record every year. This study also differs from many studies in this literature in that it focuses on a couple's allocation of time between work in the labor market and at home.

In terms of the method of analysis, unlike most of the studies in the literature that rely on a structural modelling and simultaneous equation system, I use the structural break in the public childcare system that exists between preschool and elementary school in Korea. All young children demand their parents' time, and Korea offers high-quality all-day (7am to 7pm) preschool for all children at a very low cost (if any). However, once children enter elementary school, schools release young children of age 6~8 years early in the afternoon, but there are no sufficient childcare resources for them at that time of day.

Considering that 4~5 and 6~7 year olds demand the same amount of care time (although, qualitatively, the type of care they need may differ), a sudden drop in childcare time covered outside the home when children enter school forces parents to reallocate their time spent for work in the labor market and for home production.

Assuming that the hours spent out of work in the labor market are spent on home production, we use this change in care time demand to estimate its effect on parents' division of work, measured by the difference in the number of hours spent in the labor market between husband and wife. To do so, we generate an unbalanced panel of matched couples with children, extracted from recent waves of the KLIPS.

In the next section, previous studies in this stream of literature are discussed. Then, we briefly introduce Korea's childcare system, as it is used for the identification of this study. Next, we explain the source and structure of the data used for this study and the estimation model. This chapter ends with a presentation of the estimation results and policy implications.

2. Literature

Understanding the relationship between women's fertility and their labor market participation decisions is an important starting point for almost all studies on the female labor market. Naturally, this topic has long been popular in labor economics, and thus, there are countless studies on this topic. However, relatively few empirical studies are widely accepted, as it is almost impossible to disentangle the endogeneity of fertility decisions, labor market participation and labor market outcome.

Some studies have been successful in finding valid instrumental variables, like in the case of Angrist and Evans (1998), who use the sex composition of siblings as an instrument for the probability of having additional children, while other studies use twin births.

Regardless of the validity of instruments or the degree to which endogeneity is handled, one clear conclusion from many empirical studies is that at least at the individual level, fertility and maternal labor supply have a negative relationship.

In recent years, studies on female labor market participation and outcomes, which also acknowledge the endogeneity issue of fertility variables, no longer use the classical twin or sibling sex instruments. First, if one were to study female labor market outcomes, then the endogeneity of fertility, labor market participation and outcome requires at least two valid instruments, each of which is correlated with one variable and not with the other two variables. Therefore, it is impossible to identify such variables.

Second, due to the decreasing trend of fertility in many countries, twin births and those of multiple children in households are becoming less common.

Thus, recent studies rely mostly on the structural modelling technique, which can overcome the abovementioned two issues.

The benefit of structural estimation is that it can analyze various

relationship between labor-market-related variables and fertility, without concerns of the validity of the excluded variables. Many recent studies on fertility and parents labor supply use this approach.

For example, Hallberg and Klevmarken (2003) model a two-parent household decision model with consumption and time constraints to evaluate how the presence of children affects parents' time allocation. In their model, they acknowledge the difference between home-provided childcare by a parent and market-purchased childcare. Their analysis using the Swedish data(Swedish household panel study Household Market and Nonmarket activities) reveals that working mothers in Sweden engage in childcare more than their working partners, and yet changes in fathers' market work time has a greater effect on parents' time spent with their children than the changes in mother's market work time.

Couprie (2007) sets up a household model of leisure and private[8] and public[9] consumption. Instead of unitary decision making as a household, this author assumes household decision making to be a collective process; that is, a joint decision made by men and women. Based on such a model and using the British Household Panel Survey, they try to estimate the "sharing rule" between husband and wife for household total utility, which is generated from leisure time and consumption. They separated leisure time from time spent on the production of household public goods (such as the quality of children), so the sharing rule measures the share of household utility from leisure hours and consumption (in the Hicksian sense) enjoyed by men and women. The result indicates an approximate 40% share for women in a couple and that the intrahousehold wage gap is an important factor of this sharing rule, also emphasizing that not separating home production hours from leisure time and simply defining leisure time as the time left after market time lead to the overestimation of the sharing rule, as women tend to engage

8 As in products purchased from the market.
9 As in products shared within a household.

in home production more than do men within couples.

Kalenkoski et al. (2005) study how parents allocate time for children using the UK Time Use Study of 2000 and focus on the possible differences across family type—single parent, married couple and cohabiting couple—using only the sample of working adults and households with children younger than 18 years.

Using gender-specific correlated tobit equations, the authors find that the number of children younger than 11 years is an important factor of time use for childcare for both men and women. Moreover, other adults in the household (e.g., grandparents, relatives, or children older than 18 years) reduce the time used for childcare for both men and women. Interestingly, during weekends, women devote less time to childcare than they do on weekdays while men increase the time spent with their children on weekends compared to weekdays, suggesting the substitution of childcare time between couples across days of the week.

Evidence of a negative relationship between children and maternal labor supply is also found in Korea. Many domestic studies have shown such relationships (Lee & Choi, 2014; Shin 2022; Son & Kim, 2018). Nevertheless, there have not been many studies on parents' allocation of time in relation to the presence of children. One study by Choi and Bang (2018) evaluates how the birth of the first child affects parents' working hour allocation. Childbirth is usually endogenous with respect to mothers' labor market participation decisions. In the absence of a valid instrument, the authors rely on fixed effects model to estimate its effect and find that the birth of the first child leads to the less egalitarian division of work, with fathers increasing working hours, while mothers reducing their working hours.

In this study, unlike the previous study by Choi and Bang (2018), we use a sample of couples that already have children and evaluate how changes in the number of hours demanded for childcare affect dual-earning couples' allocation of time. Moreover, unlike previous study, we also attempt to use a larger sample that also includes single-earning

couples.

3. Background - Childcare System in Korea

Young children need care time. If we define "care time" for children as including not only the care work but also the supervision and presence around them, then parents' care time for young children would be at least as many hours per day that a child is supervised by either of his or her parents.

Who are 'young children' that demand such care time? There is no general agreement on what age children no longer need adult supervision. Nonetheless, borrowing from some legal standards adopted in three states in the US, children at least older than 8 years can stay alone at home without adult supervision[10]. That is, at the minimum, children younger than third grade should not stay alone, even at home, and, hence, demand care time in a broader sense.

Due to the prolonged low fertility problem, Korea has avidly expanded its public childcare system and tried to improve its quality over the past decade. As a result, Korea currently has one of the best public childcare system in the world; this system is mostly free, provides free meals and snacks, and offers high-quality educative programs.

Interestingly, however, the quality and quantity of public childcare differ by across children's ages. Currently, the childcare system for preschool-age children, governed by the Ministry of Health and Welfare, offers free[11] preschool and daycare programs for children ages 0 to 5

[10] Three states in the US have legal standards for the minimum age at which a child can be left alone at home: Maryland, 8 years old: Oregon, 10 years old; and Illinois, 14 years old. However, in all other states, if leaving a child alone at home is "dangerous" considering child-specific factors, regardless of the child's age, then it is considered neglect and child abuse in the legal sense (Children's Bureau, 2018).

[11] Basic fees, including meal costs, are covered by the government. For preschool-age children, those 3 to 5 years old, preschools can charge an additional monthly fee of up to KRW150,000 (approximately, USD125 at an exchange rate of $1 for KRW1,200) for

years from 7am to 7pm. Preschools and daycares were mostly privately serviced during 2000s, but after the government recognized the seriousness of the declining fertility trend in the mid-2000s, it set strategic plans every 5 years since 2006 to tackle the LF-AS problem. These plans call for making preschool-age childcare free through a series of steps.

From 2009 to 2012, childcare became free for parents meeting certain eligibility criteria and was provided at a low cost for other parents. Then, in 2013, childcare became free for all parents of preschool-age children. Since then, the Ministry of Health and Welfare has maintained its efforts to improve the quality, safety, and reliability of childcare service for preschool-age children. As a result, the childcare enrollment rate has increased significantly, and almost all preschool-age children are enrolled in childcare[12].

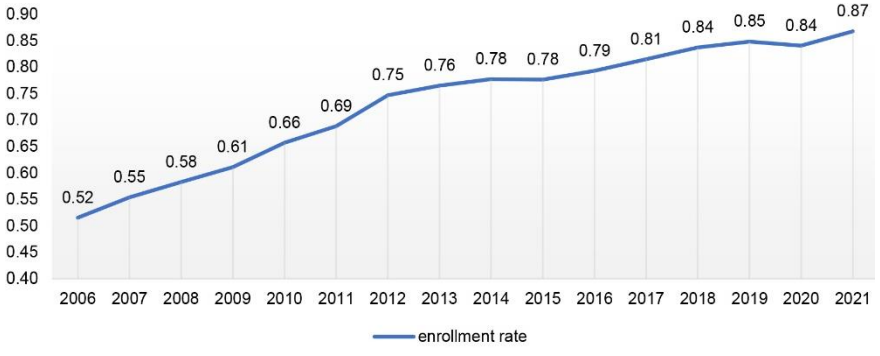
In contrast, for young school-age children (6-8 year olds), the government has been providing limited after-school childcare services. School ends at around 1pm[13] for first to third graders, which means that they may be left by themselves if both parents are working full time and if there is no other childcare option. Some schools in Seoul city adopted so-called "elementary care classes (초등돌봄교실)" for the 1st~3rd graders of working parents in 2008, but the Ministry of Education, which is in charge of any program operated in schools, was not passionate about

additional specialized programs, such as English, music, art, and coding. In reality, because free daycare does not have an eligibility condition of both parents participating in the labor market[11], many children return home before 3pm. Working parents can leave children until 7pm. As standard working time in Korea is from 9 to 6pm (including 1 hour for lunch), children of working parents are dropped off after 8am and leave before 7pm.

[12] For preschool-age children, those 3 to 5 years old, they can choose between preschool service governed by the Ministry of Health and Welfare and "kindergarten" governed by the Ministry of Education. There are private and public kindergartens, with the basic fee for kindergarten being funded by the government, but private kindergartens can charge higher fees due to their extra program offerings. Kindergarten hours used to be shorter than those of preschool, and children were given long vacations, and thus, parents can choose between preschool or kindergarten for their children.

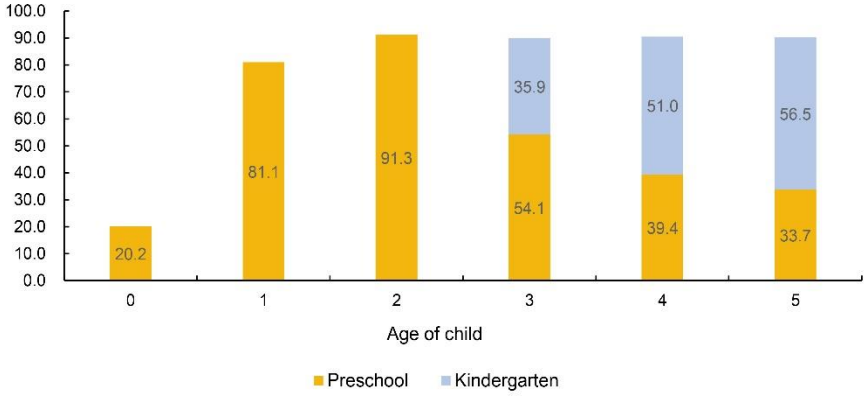
[13] For first and second graders, school ends at 1pm two days a week and at 1:40pm three days a week, and for third graders, school ends at 1pm one day a week and at 1:40pm four days a week.

Figure 3-1. Preschool (0-5) and Kindergarten (3-5) Enrollment Rate



Source: Enrollment rate calculated based on the following data sources. Ministry of Health and Welfare (2021), "*보육통계*," *Korea Educational Development Institute*, "*유치원 원아수*," *and Ministry of the Interior and Safety*, "*주민등록 인구 및 세대현황*."

Figure 3-2. Preschool and Kindergarten Enrollment Rate by Age of Child (2019)



Source: Ministry of health and welfare (2019), "*보육통계*"

increasing the numbers of care classes, not to mention the quality improvement of existing care classes. The reason behind such reluctance was that the majority of school headmasters and teachers simply did not believe that childcare, as opposed to child education, is something they should care about.

In the absence of reliable public childcare services for young school-

age children, there was effectively no reliable childcare service for them in the private market as well. Many young school-age children (1st~2nd graders) were enrolled in art and sports classes in private academies for the purpose of biding until parents came home from work[14]. As any class offered by a private academy lasts only, at most, a couple of hours per day, those children of working parents without other adults to look after them "hop to" private classes on their own (by car rides offered by private academies or on foot) after school, from around 1pm until their parents return home after work. The preschool system governed by the Ministry of Health and Welfare also authorized preschools to serve young school-age children after school, but currently, there is effectively no daycare that offers after-school programs. The Ministry of Health and Welfare does offer after-school full-day care service through "regional childcare centers (지역아동센터)", but they usually serve families with very low income or with a hindrance to work in the labor market (such as a disability).

Recognizing the seriousness of the continued downward fertility trend and the low LPR of women in their mid-30s and early 40s, in 2018, the national government of Korea set expanding after-school childcare for school-age children as a key mission in its LF-AS strategic plan. The plan focused mainly on 1) the integration of existing after-school programs and 2) the increase of the quantity of such programs. The government set the roadmap for program quantity increase,[15] and between 2017 and 2019, the number of children in the elementary school care class increased from 245,303 to 290,358. Interestingly, however, such an increase in childcare supply did not have a positive impact on mothers' employment in full-time or regular employment jobs according

[14] Choi et al.'s (2020) analysis of the Survey of Private Education Costs (2019, Korea Statistical Information Service) data show that approximately 43% of parents of 1st~3rd graders in elementary school send their children to private art and sport classes for "childcare" purposes.

[15] The goal was to increase the number of 1st~3rd graders using elementary school care classes from 240,000 in 2017 to 530,000 by 2022 (Korean Government, 2018).

to Choi et al.'s (2020) study.

According to Choi et al. (2020), as of 2019, elementary school care classes covered only about 35.2% of 1st~3rd graders with working mothers, and most of them serviced only until 5pm, while most full-time workers in Korea works at least until 6pm. Furthermore, based on the survey representing almost all school districts conducted in Choi et al.'s (2020) study, even in 2019, elementary school care class programs were limited to simply watching over children after school until they left for private academy class or home, thus making such programs not reliable and, hence, not preferable for full-time working parents, yielding no positive impact on their labor market participation decisions.

In short, even with the government's plan to increase the supply of young school-age children's after-school childcare, at least until 2020, there was a clear structural break in publicly provided childcare time between children aged 0~5 years (preschool) and those aged 6~8 years (elementary school).

We view this structural break as a "sudden" change in demand for childcare time as children move from preschool to elementary school, and we try to evaluate how parents adjust to this change in terms of couples' allocation of working hours in the labor market.

4. Data

4.1. Data Description

This analysis uses a sample of matched couples from the 2016~2019 waves of KLIPS. These waves include original sample households and individuals in the sample households from the first wave, 1998, as well as an added sample from the 2009 and 2018 waves. From this sample, we extract only dual-earning couples with both the husband and wife holding employed jobs (as opposed to self-employed jobs) and who have

children younger than 18 years old. The data take the form of an unbalanced panel.

There are total of 9,302 observations of matched couples with children in the 2016~2019 waves, but with the restriction of both the husband and wife holding employed jobs, as opposed to self-employment, this number decreases to 2,280. Removing those observations with missing values in the key variables leaves 2,018 observations[16]. The breakdown of the sample by survey year is given in Table 3-1.

We additionally propose the evaluation of the impact of increased care time demand on parents' allocation of time on the sample of dual-earning couples who had been working in the first period of the observation period. We further restrict the sample this way to prevent any confounding effects caused by some couples deciding to become dual earning when their children enter elementary school, believing that children in school are "old enough" to be left alone. Additionally, we want to focus on dual-earning couples with relatively stronger labor market attachment. The fact that such couples have dual-earning status even with children suggests that they have stronger labor market attachment. If we restrict the sample in this way, then 176 observations are dropped, leaving 1,842 observations in total.

Table 3-1. *Sample Size by Survey Year*

Year	2016	2017	2018	2019	Total
N	465	522	528	503	2,018

4.2. Summary Statistics

The summary statistics of some key variables for the main sample

[16] Of these 9,302 couples, only 4,698 wives were working, and of these working wives, 3,728 wives were holding employed jobs. The additional drop in the sample is mostly due to husbands holding self-employed jobs and some not holding any jobs in the labor market.

(sample 1) and the subsample of couples who had worked in the first period of the study period (sample 2) are presented in Table 3-2. On average, the difference in the number of working hours between husbands and wives (Hoursdiff1 = husband's number of working hours per week - wife's number of working hours per week) is 5.54 hours for sample 1 and 5.17 hours for sample 2. As sample 2 represents couples with relatively more labor-market-oriented wives[17], a smaller difference in the number of working hours between husbands and wives in this group is observed.

In the sample, about 27~28% of observations have children of age 6 to 8 years old (Child68), or 1st~3rd graders in elementary school. The average age of the youngest child (chage_youngest) is 9.36 years for sample 1 and 9.44 years for sample 2. The age of the youngest child is slightly older for sample 2, compared to sample 1, likely because women with older children tend to be more labor market oriented.

The average age of wives (age) is around 40.8 years for both samples, and that of fathers' age (dad_age) is around 43.3 years. Both husbands and wives in sample 2 have slightly higher levels of education. Wives' average years of education (eduyr) is 14.2 years for sample 1 and 14.28 years for sample 2, and husbands' average years of education (dad_eduyr) is 14.56 years for sample 1 and 14.64 years for sample 2. For both samples, about 16% of couples have other adults at home (extra_adult) who may possibly help with childcare.

Average real[18] hourly wage earned in the most recent past survey upto 5 years ago[19] for wife (recentpastwage) is 12,200 KRW for sample 1 and

[17] This is because wives' labor market participation in extensive and intensive margins generates most of variations in the difference in the number of working hours between couple's working hours.

[18] Measured in terms of the 2015 price.

[19] This variable records the real value of the hourly wage of an individual (husband or wife) in the most recent survey in the past 5 years in which the individual was observed as working and has information on earnings from the labor market. If an individual was observed to be working in the previous survey, then the real value of hourly wages in the previous survey is recorded in the variable. If an individual was not working 1 year ago but worked 3 years ago,

Table 3-2. *Summary Statistics of Key Variables*

Variable name	Sample 1 N=2,018		Sample 2 N=1,842	
	Mean	SD	Mean	SD
hoursdiff1	5.54	11.28	5.17	10.97
child68	0.28	0.45	0.27	0.45
chage_youngest	9.36	5.20	9.44	5.25
age	40.75	5.32	40.78	5.23
dad_age	43.27	5.87	43.31	5.77
eduyr	14.20	2.11	14.28	2.10
dad_eduyr	14.56	2.19	14.64	2.21
extra_adult	0.16	0.36	0.16	0.37
recentpast_hrwage1	1.28	0.67	1.31	0.68
dad_recentpast_hrwage1	1.88	0.86	1.90	0.87
employertype				
1. temporary/irregular employment	0.32	0.47	0.30	0.46
2. regular employment in small (<100) private firm	0.39	0.49	0.39	0.49
3. regular employment in large (>=100) private firm	0.12	0.32	0.13	0.33
4. regular employment in public sector	0.17	0.37	0.18	0.39
dad_employertype				
1. temporary/irregular employment	0.16	0.37	0.15	0.36
2. regular employment in small (<100) private firm	0.42	0.49	0.42	0.49
3. regular employment in large (>=100) private firm	0.24	0.43	0.24	0.43
4. regular employment in public sector	0.18	0.38	0.19	0.39

13,100 KRW for sample 2. Recent past hourly wage for husband (dad_recentpast_hrwage1) is 18,800 KRW for sample 1 and 19,000 KRW for sample 2.

Finally, we view that husband and wives' employer-employment type (employertype and dad_employertype, respectively) are important factors. In Korea, the availability and difficulty of the utilization of family policies, such as mandated parental leave or parental working hour

then the variable keeps the real value of hourly wages earned 3 years ago. This variable is a proxy for "market hourly wage", which affects the decision of the number of working hours..

reduction, differ across employer or employment type[20]. The summary statistics on the distribution of husbands and wives by employer type are presented in Table 3-2, according to which most wives are employed as regular employees in small private firms. In samples 1 and2, 39% of wives are employed in such firms. The second largest share of employer type for wives is temporary or irregular employment, with 32% of wives in sample 1 and 30% of wives in sample 2 holding this type of job. Wives holding regular employment jobs in large private firms or regular employment jobs in the public sector account for 12% and 17% in sample 113% and 18% in sample 2, respectively.

Husbands' employer type is distributed similarly to that of wives. More husbands than wives hold regular employment jobs in large private firms and public sector and fewer hold (by almost half) husbands hold temporary or irregular employment jobs. Yet, for husbands also, biggest group is those working for small private firms; 42% husbands in sample 1 and sample 2 are in this category.

5. Estimation Method

In this chapter, we are trying to estimate mainly the effect of increased time demand for childcare due to children moving from preschool to elementary school on parents' labor supply, particularly the relative allocation of hours spent in the labor market.

To do so, we can compare 1) parents with children that do not ascend to 1st grade and 2) parents with children that move on to 1st grade during the observation period.

The age of a child is a given variable and exogenous. The difference

[20] For example, Parental Leave Statistics by Korea Statistical Information Service (2020) report that parental leave usage rates increase with increasing firm size, with 68.6% of fathers and 62% of mothers who use parental leave working for firms with more than 300 employees.

in the childcare service offered between preschool and elementary school is also a given and exogenous factor. Nevertheless, parents can (almost perfectly) predict this situation before children enter elementary school. Thus, they can adjust their behavior before the changes occur or make appropriate arrangements (e.g., finding a nanny, having family members help them, or finding an after-school private academy) to ensure that their children going into 1st grade does not affect their labor-market-related choices. This means that to estimate the effect of "exogenous" changes to childcare time demand, we need a situation where such changes are unpredictable or find a way to control for the factors that are correlated with both couples' adjustment behavior and division of work.

Assuming that couples' pre-adjustment behavior is highly correlated with the couple-specific tendency and preference, we use a panel fixed effects model for estimation[21]. If time-invariant unobservable couple-specific norms and preferences, such as couples' standard for judgment of children's maturity level, preference for how and by whom childcare is to be given, preference for dual-earner family, etc., are key factors of pre-adjustment, then not controlling for these factors can cause bias in the estimators.

Using a couple fixed effects model on the sample of couples with children of age that need parents' care time, we can estimate the effect of childcare demand change due to the structural break in the care system between preschool and elementary school on parents' allocation of time. Note that we restrict the study period to pre-COVID-19 years, as the effect of COVID-19 shock cannot be disentangled from the effect generated by the structural break in the childcare system.

We propose the estimation of the following equation:

[21] At first, we attempt to use the COVID-19 shock that affected the childcare system differently by children's age[21]. We try to extract a sample of parents that are similar to those parents whose children would be going into 1st grade in 2020. Parents with children of age 5 years in 2020 have similar time-allocation trends as those of parents with children of age 6 years in 2020 before COVID-19 shock, but the sample size was too small for evaluation.

$$y_{c,t} = \alpha \ \text{Child68}_{c,t} + X'\gamma + c_c + t_t + e_{c,t}$$

where $y_{c,t}$ is the difference between the number of working hours of husbands and wives' per week ($y_{c,t} = husband'sworking\ hour - wife'sworking\ hour$) and the $\text{Child68}_{c,t}$ variable takes a value of 1 when a sample couple has school-age children (1st~3rd grade) and zero otherwise. Vector X contains the set of independent variables, which include the age of the youngest child, age and age squared of the wife[22], years of education of the husband and wife, and the recent hourly wages of the husband and wife. We additionally control for husband and wife employer type in some models. Vectors C and T capture couple and year fixed effects, respectively. In the fixed effects estimation, the variable of interest, Child68, turns on and changes when couples' child enters school, and its coefficient, α is practically measuring the effect of the change in care time demand due to the structural break in the childcare system between preschool and elementary school, net of couple-specific heterogeneity (such as preference for the "traditional" allocation of couples' time).

We additionally perform cross-sectional estimation using a full sample of couples with children and in which at least the father is working in the labor market,[23] as our main analysis uses only a specific type of couples. If dual-earning couples in the sample and those who are not selected in the sample due to the mother's decision to stay out of labor market differ in terms of the relative allocation of the number of hours worked in the labor market when children ascend to elementary school, then cross-sectional estimation using only the selected sample is biased. Although the couple fixed effects model is probably free of this problem as such selection is likely to be driven by couple-specific unobserved time-invariant characteristics, we want to check whether sample selection

[22] Husband's age is perfectly collinear with wife's age.
[23] Korean men's rate LPR in their prime age (30-40s) is over 90%. Therefore, we try to control for the selective labor market participation of mothers.

is important in the cross-sectional analysis.

We check the issue of sample selection by comparing the estimation results from simple ordinary least squares (OLS) regression and those from a model controlling for the selection term in a Heckman manner (Heckman, 1979). The Heckman selection model requires an exclusion restriction for consistent estimation. We use the presence of other adults in the household as the excluded variable. The presence of other adults at home is likely to affect mothers' labor participation positively yet, given the participation decision, is unlikely to affect directly how many hours husbands work relative to their wives[24].

In the next section, we present the estimation results from the simple OLS model, a model with selection terms, and fixed effects model for samples 1 and 2.

6. Results

The estimation results are presented in Tables 3-3 and 3-4. In Table 3-3, the results for sample 1 are presented, and in Table 3-4, the results for the subsample of couples who have been observed to be dual earning in the first appearance within the study period are presented. Models 4~6 additionally control for husband and wife employer type. Columns 1-2 and 4-5 report the estimation results based on pooled cross-sectional analysis, while columns 3 and 6 report the fixed effects results. The above organization is also used in Table 3-4.

Focusing on the effect of children in 1st~3rd grade of elementary school, where limited childcare and child supervision options are available, couples with such children tend to have more unbalanced working hours in the labor market. According to fully specified cross-

[24] In fact, in the initial stage of this research, we included an extra adult variable in the main models. However, in any of the many specifications we tested, the variable was not statistically significant neither by itself nor jointly with other variables.

sectional models (Models 4 and 5), when a child is in 1st~3rd grade of elementary school, holding the age of youngest child in the household and each parent's employer type and other variables in the model fixed, the difference in the number of working hours between husband and wife in the labor market is about 1.43 hours greater than that for couples with children in different age groups. Note that the sample-selection bias from sample selection is insignificant, comparing results from Models 4 and 5 and insignificant selection term (mills).

When the couple-specific unobserved time-invariant factors are controlled for (Models 3 and 6), the size of the coefficient decreases to about half the size to 0.75 hours and keeps the same sign but loses significance. This result implies that a large part of the unbalanced allocation of working hour when children are in 1st~3rd grade of elementary school may be driven by couple-specific heterogeneity and pre-adjustment.

Some other variables included in the model exhibit interesting patterns. The age of the youngest child (chage_youngest) has a weakly significant and negative sign in the cross-sectional analysis, meaning that in general, parents who have a youngest child that is older tend to have fairer allocation of time in the labor market, likely to be driven by mothers increasing their number of working hours as their children grow up. Interestingly, however, in Models 1, 2 and 4, six (for six years old) times the size of its coefficient is smaller than the coefficient on the child68 variable. This finding implies that a child entering elementary school may have additional intrahousehold time allocation effects that can offset the positive (in terms of intrahousehold gender equality) impact of the youngest child getting older. This result is not shown in the fixed effects models.

In all models, mothers' recent hourly wage (recentpast_hrwage1) is negatively correlated with couples' division of working hours. The coefficient is significant in the fixed effects models, implying that an increase in a mother's recent hourly wage leads to a more equal division

of working hours within the couple. This result is opposite in the case of a father's recent hourly wage; when his wage increases, the couple's time allocation in the labor market becomes less equal. However, interestingly, a father's recent wage variable has different signs in the cross-sectional and panel models. In cross-sectional comparison, fathers with higher recent hourly wages tend to have more balanced working hour division in their households, but within couples, the increase in recent working hour wages leads to an unbalanced division of working hours. This result is probably because in the cross-sectional comparison, fathers in low hourly wage jobs (such as those working in manufacturing or menial jobs) often have frequent overtime work or may have to work many hours to secure enough income for their family, hence prompting a larger gap in the working hours within the couple.

Parents' working hour division seems to differ across parents' employer type. In the cross-sectional comparison, (columns 4 and 5) mothers holding regular contract jobs (categories 2, 3, and 4) have a relatively fairer working hour division than do those holding temporary or irregular jobs (category 1). This is a predictable result given that there are not many regular contract jobs that are part time, while many temporary or irregular jobs are less than full-time jobs. Of regular contract jobs, couples with mothers in large private firms have the most egalitarian division of hours spent for market work. This result is robust in a fixed effects model as well. When a mother moves to a large private firm for a regular contract job, that couple's division of working hours becomes much fairer; the couple's working hour gap decreases by almost 5 hours per week. In contrast, fathers' employer type does not have as much of an effect compared to that of mothers, likely because most fathers work full time in Korea, regardless of employment or employer type. Nevertheless, in the cross-sectional analysis, it is shown that in couples with fathers holding regular contract jobs in large private firms, fathers' working hours relative to those of mothers are significantly longer, by 2.8 hours per week. Fathers changing job types (within) does

not significantly affect parents' division of working hours.

Table 3-3. *Estimation Results for Sample 1*

Sample 1						
	1	2	3	4	5	6
	OLS	Heckman	FE	OLS	Heckman	FE
child68	1.801** (0.73)	1.795** (0.72)	0.721 (0.51)	1.430** (0.67)	1.425** (0.66)	0.747 (0.51)
chage_youngest	-0.204* (0.12)	-0.253* (0.15)	0.33 (0.25)	-0.224** (0.1)	-0.278 (0.2)	0.328 (0.25)
age	0.619 (0.76)	0.506 (0.81)	0.2 (1.55)	0.048 (0.71)	-0.075 (0.83)	0.461 (1.57)
age2	-0.006 (0.01)	-0.004 (0.01)	-0.014 (0.02)	0 (0.01)	0.002 (0.01)	-0.016 (0.02)
eduyr	0.078 (0.25)	0.026 (0.27)	-0.538 (1.33)	0.13 (0.24)	0.073 (0.29)	-0.564 (1.33)
dad_eduyr	-0.334 (0.24)	-0.334 (0.23)	-0.856 (1.5)	-0.228 (0.23)	-0.228 (0.23)	-0.08 (1.66)
recentpasthrwage	-0.471 (0.86)	-0.463 (0.86)	-1.271* (0.77)	1.174 (0.75)	1.183 (0.75)	-1.395* (0.77)
dad_ recentpasthrwage	-0.912* (0.47)	-0.817 (0.51)	1.160** (0.53)	-1.09*** (0.4)	-0.98* (0.51)	1.231** (0.54)
employer type 2.				-7.91*** (0.89)	-7.91*** (0.88)	-4.14** (1.71)
employer type 3				-9.931*** (1.17)	-9.913*** (1.16)	-4.983** (1.99)
employer type 4				-7.62*** (1.12)	-7.63*** (1.12)	-2.459 (1.91)
Dad employer type 2				1.891 (1.24)	1.856 (1.24)	0.55 (1.79)
Dad employer type 3				2.859** (1.28)	2.824** (1.29)	0.271 (1.87)
Dad employer type 4				-0.515 (1.37)	-0.553 (1.37)	-0.964 (2.2)
mills		-0.907 (1.91)			-1.002 (3.15)	

Employer type categories are defined as following: category 1(omitted) includes individuals working in a temporary/irregular employment position; category 2 includes those holding a regular employment position in a small(fewer than 100 employees) private firm; category 3 includes individuals holding a regular employment position in a large(more than 100 employees) private firm; category 4 includes individuals holding a regular employment position in public sector.

Table 3-4. *Estimation Results for Sample 2*

Sample 2						
	1	2	3	4	5	6
	OLS	Heckman	FE	OLS	Heckman	FE
child68	2.094*** (0.77)	2.094*** (0.76)	0.854 (0.53)	1.785** (0.7)	1.784** (0.7)	0.880* (0.52)
chage_youngest	-0.225* (0.12)	-0.229* (0.12)	0.359 (0.25)	-0.243** (0.11)	-0.251** (0.11)	0.362 (0.25)
age	0.406 (0.86)	0.394 (0.86)	0.22 (1.6)	-0.094 (0.79)	-0.117 (0.8)	0.519 (1.61)
age2	-0.003 (0.01)	-0.003 (0.01)	-0.013 (0.02)	0.002 (0.01)	0.003 (0.01)	-0.016 (0.02)
eduyr	0.063 (0.26)	0.059 (0.26)	-0.621 (1.34)	0.091 (0.25)	0.084 (0.25)	-0.648 (1.34)
dad_eduyr	-0.342 (0.24)	-0.342 (0.24)	-0.895 (1.51)	-0.222 (0.24)	-0.222 (0.24)	-0.017 (1.71)
recentpasthrwage	-0.076 (0.88)	-0.074 (0.88)	-1.445* (0.78)	1.354* (0.78)	1.357* (0.77)	-1.583** (0.77)
dad_recentpasthrwage	-0.859* (0.47)	-0.860* (0.47)	1.093** (0.52)	-1.06*** (0.41)	-1.06*** (0.41)	1.168** (0.53)
employer type 2				-7.42*** (0.96)	-7.42*** (0.96)	-4.65*** (1.7)
employer type 3				-9.48*** (1.23)	-9.48*** (1.23)	-5.60*** (2.)
employer type 4				-7.28*** (1.18)	-7.28*** (1.18)	-3.01 (1.9)
Dad employer type 2				2.330* (1.34)	2.327* (1.33)	0.253 (1.83)
Dad employer type 3				3.054** (1.38)	3.051** (1.37)	0.008 (1.94)
Dad employer type 4				-0.151 (1.47)	-0.153 (1.47)	-0.936 (2.23)
mills				-0.434 (0.92)		-0.785 (1.17)

Employer type categories are defined as following: category 1(omitted) includes individuals working in a temporary/irregular employment position; category 2 includes those holding a regular employment position in a small(fewer than 100 employees) private firm; category 3 includes individuals holding a regular employment position in a large(more than 100 employees) private firm; category 4 includes individuals holding a regular employment position in public sector.

The estimation results from the subsample analysis (sample 2) show similar patterns, except that the estimated effects of children entering elementary school are larger than those in sample 1, and in the fully specified fixed effects model (column 6), the coefficient turns weakly

significant. Moreover, as in sample 1, the negative coefficient on the youngest child's age is not large enough to completely offset the effect of the child entering elementary school at age 6 years.

With the sample of greater labor market attachment, parents' working hour adjustment when children enter elementary school is larger and more prominent. This finding could be due to the result being less affected by couples who choose to become dual earners as their children enter elementary school, believing that children in schools are mature enough to be alone. In any case, in this sample, a large decrease in the size of the coefficient when couple fixed effects are controlled imply that heterogeneous pre-adjustment behavior largely drives the observed unbalanced allocation of the working hours of parents.

Based on the estimation result from the fixed effects model, which is identified by within changes in couples' allocation of the working hours, children entering elementary school causes the division of the working hours between mothers and fathers to become less equal, where fathers work more in the labor market than mothers. In fact, a separate estimation of the working hours of mothers and fathers on sample 2, with the same set of controls but with each parent's working hours as the dependent variable (Table 3-5), shows that such a change in the allocation of time is largely driven by mothers reducing working hours while fathers barely change theirs.

The coefficient on child68 in the cross-sectional analysis for mothers' working hours is negative and significant, and that in the fixed effects estimation is not significant at the 10% level, but the p-value is approximately 0.11, implying that for some observations, this effect may indeed exist.

In the analysis of mothers' working hours, in the cross-sectional model, the age of the youngest child has a positive and significant coefficient, implying that mothers with older youngest children supply more hours in the labor market. However, when unobserved mother-specific heterogeneity (model 5) is present, the youngest child's aging

Table 3-5. *Effect of Children Entering Elementary School on Each Parent's Number of Working Hours*

	Sample 2				
	Father	Father	Mother	Mother	Mother
	OLS	FE	OLS	Heckman	FE
child68	0.43 (0.48)	0.3 (0.42)	-1.35*** (0.5)	-1.56*** (0.5)	-0.54 (0.34)
chage_younest	0.06 (0.07)	0.19 (0.18)	0.25*** (0.08)	0.19** (0.09)	-0.11 (0.17)
age	0.46 (0.62)	-0.11 (1.19)	-0.09 (0.5)	0.03 (0.49)	-0.15 (1.04)
age2	-0.01 (0.01)	-0.01 (0.01)	0 (0.01)	0 (0.01)	0 (0.01)
eduyr	-0.11 (0.15)	-0.12 (1.05)	-0.2 (0.16)	-0.25 (0.16)	-0.35 (0.46)
recentpast_hrwage	-1.73*** (0.39)	0.98** (0.46)	-1.24* (0.67)	-1.12* (0.63)	1.96*** (0.56)
employmenttype 2	1.39 (0.85)	0.67 (1.24)	7.55*** (0.76)	7.10*** (0.74)	5.63*** (1.32)
employmenttype 3	2.69*** (0.92)	-0.09 (1.35)	8.83*** (1.07)	8.44*** (1.04)	5.94*** (1.56)
employmenttype 4	0.56 (0.93)	-0.34 (1.38)	8.54*** (1.01)	8.06*** (0.98)	4.95*** (1.4)
mills				-0.75 (1.47)	

Employer type categories are defined as following: category 1(omitted) includes individuals working in a temporary/irregular employment position; category 2 includes those holding a regular employment position in a small(fewer than 100 employees) private firm; category 3 includes individuals holding a regular employment position in a large(more than 100 employees) private firm; category 4 includes individuals holding a regular employment position in public sector.

does not affect the mother's labor supply. That is, changes in the mother's working hours as the child grows up is determined largely by her unobserved time-invariant characteristics (such as preference for work-family lifestyle, preference for method of childcare, and career ambition, ability).

In terms of the recent hourly wages of mothers and fathers, in the cross-sectional analysis, mothers and fathers with higher recent hourly

wages supply fewer hours in the labor market. However, when within changes are considered, the increase in recent hourly wages is shown to increase the working hours for both mothers and fathers. This finding implies that on average, the substitution effect is larger than the income effect. Additionally, given that mothers' coefficient is more than two times larger than that of fathers, mothers have a stronger substitution effect than do fathers. This pattern may be explained by the fact that mothers, on average, work fewer hours in the market than fathers.

7. Conclusions

This chapter tries to evaluate what happens to couples' division of work, between the labor market and home, when the time demand for childcare increases. Using the structural break in the childcare system in Korea between preschool and elementary school, we evaluate the impact of children ascending to 1st grade on parents' allocation of the n hours spent in the labor market. Through a cross-sectional comparison and estimation using the within variation of dual-earning couples with children, we find that the increased demand for childcare time caused by the structural break in the childcare system leads to less egalitarian allocation of parents' number of working hours.

This change in working hour allocation is mostly driven by mothers reducing their working hours, while fathers barely change theirs. Moreover, the structural break in the childcare system yields a large enough negative effect on maternal labor supply and working hour division such that it offsets the positive effect of children growing older on maternal labor supply and parents' division of work.

The main findings of this chapter suggest the following implications for policy makers.

First, the absence of reliable and sufficient childcare acts as a

hindrance to mothers' labor supply in Korea.

Second, such absence also causes an unbalanced division of the working hours of dual-earning couples, and the effect is more pronounced for dual-earning couples with stronger labor market attachment than for those with weaker attachment.

Third, the absence of a childcare system for school-age children prevents the monotonic improvement of maternal labor supply with respect to the age of the youngest child. That is, women in Korea are facing two phases of career interruption per child: that upon childbirth[25] and that 6 years later when the child enters elementary school. If each interruptive event in the career path requires a certain amount of recovery time and loss in human capital (in an absolute or relative sense with respect to colleagues), then two foreseen interruptive events per child's birth for Korean women should mean something. It would not be an exaggeration to say that these two predictable career interruptions per child are related to Korea's low fertility rate and low LPR among women in their 30s and 40s.

[25] This is shown in the previous chapter and in Choi and Bang's study(2018) study.

Chapter 4

Mothers' Selection into Work in South Korea

Seonho Shin

1. Introduction

To many other countries, South Korea is known as a miraculous case, a country that rose from the ashes of the Korean war and has become one of the world's top economic, industrial, and cultural leaders (Shin, 2021; Yang, 2021). However, the "once-a-miracle" country is now confronted with a "life-or-death" quagmire, having (by far) the world's lowest fertility rate (Shin, 2021). While the average fertility rate across the world's most advanced economies is 1.6, that for South Korea dropped to 0.81 in 2021—down from 0.84 in the previous year [26] —and experienced its sixth consecutive decline (Mao, 2022). The impact of this decline in the fertility rate is already being felt; it startled people that South Korea recorded more deaths than births (i.e., a net population loss) in 2020 for the first time ever (Shin, 2021; Yoon, 2021). When it comes to the primary reason, many argue that for South Korean women, it is very difficult to attain a balance between work and other life demands, such as having a child and coping with caring responsibilities (Yoon, 2021). In South Korean society, the current situation is knotty, with many aspects being complexly intertwined. South Korean women show above-

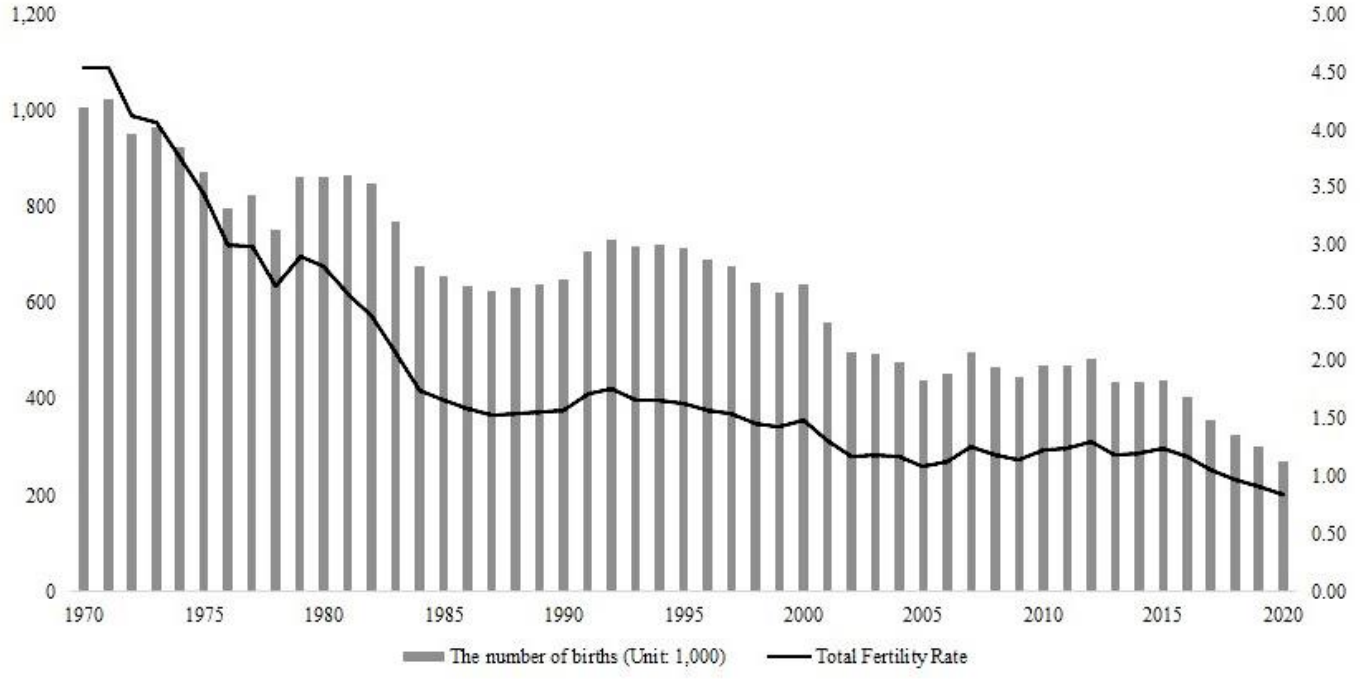
[26] See Figure 1.

average OECD-Programme for the International Assessment of Adult Competencies (PIACC) scores, and the nation's younger women attain a higher level of education than do their male peers (OECD, 2017; Shin, 2021, 2022a). Despite a high level of female tertiary education, however, the country's female labor force participation rate is 20 percentage points lower than that of men,[27] and its gender wage gap is relentlessly at the top of the list among all OECD countries (Shin, 2021; Dynan et al., 2022; Shin, 2022a). Because of deeply rooted social norms and practices, most of the housework and childcare still falls unevenly on women, making them leave the labor market after having children; therefore, these women are forced to juggle two conflicting choices—having a career (but no child) versus having a child (but sacrificing a career) (Mao, 2022). Indeed, these women are at the intersection of many-fold predicaments.

Considering the seriousness of the current situation, there is a growing body of literature that delves into the female labor market in South Korea; especially, several attempts have been made to explain the country's low female labor force participation rate and enormous gender wage gap. Examples include Monk-Turner and Turner (1994), Berger et al. (1997), Seguino (1997), Monk- Turner and Turner (2001), Monk-Turner and Turner (2004), Cho (2007), Cho et al. (2010), Cho et al. (2014), Cho and Lee (2015), Tromp (2019), Jung and Cho (2020), and Tromp and Kwak (2021), to cite a few (Shin, 2021; Shin, 2022a). However, until now, far too little attention has been paid to the question of how labor supply decisions are made among mothers in South Korea, which requires their nonrandom, systematic pattern of "selection into work" to be taken into account. Despite the importance of this topic, to the best of our knowledge, no studies have addressed this issue. Motivated by this paucity, the current study investigates the pattern of South Korean mothers' selection into employment—particularly in terms of their wage potential. It is hoped that the present research contributes to

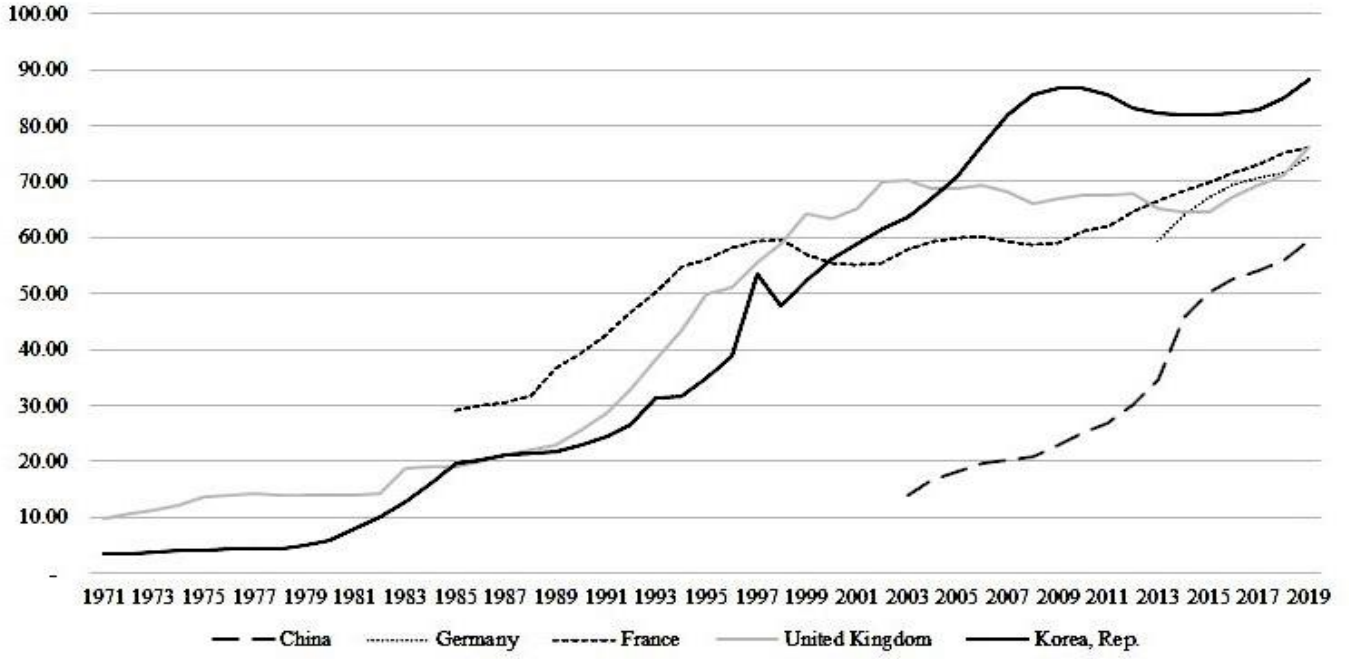
[27] Moreover, the gap is closing very slowly (Lee, 2020) .

Figure 4-1. Number of Births and Total Fertility Rate – South Korea, by Year



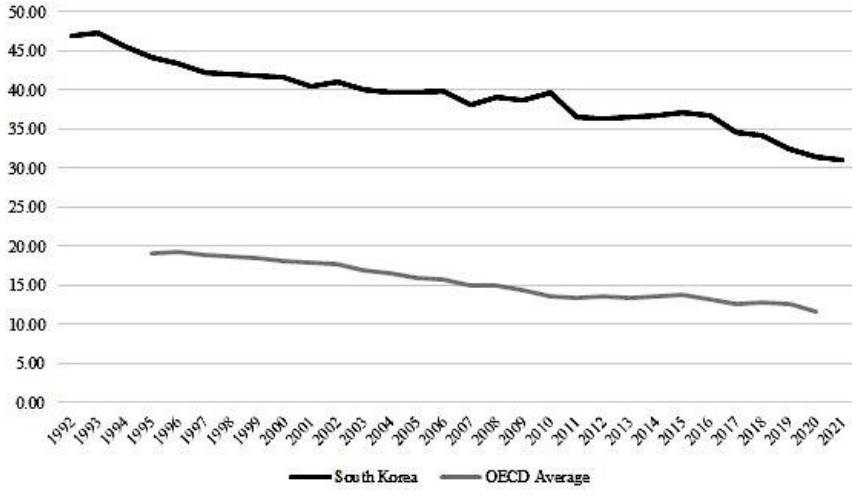
Source: Statistics Korea (www.index.go.kr), Graph by the author, Note: The number of births (Left scale) and Total Fertility Rate (Right scale).

Figure 4-2. School Enrollment, Tertiary, Female (% Gross) – by Year and Country



Source: World Bank and UNESCO Data (https://data.worldbank.org/indicator/SE.TER.ENRR.FE), Graph by the author, Note: According to （World Bank, 2021), the gross enrollment ratio is the ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the level of education shown. Tertiary education, whether or not to an advanced research qualification, normally requires, as a minimum condition of admission, the successful completion of education at the secondary level(World Bank, 2021).

Figure 4-3. Gender Wage Gap – by Year, South Korea vs. OECD Average



Source: OECD (2022), Gender wage gap (indicator). Doi: 10.1787/7cee77aa-en (Accessed on 30 July 2022). Note: The gender wage gap is defined as the difference between the median earnings of men and women relative to median earnings of men (OECD, 2022). This graph is excerpted from Shin (2022a).

a deeper understanding of the female labor market in South Korea by providing new insights into the country's labor force composition among mothers, an important (but often uninvestigated) driver of economic growth through the channel of human capital.

In the economics literature, selective labor market participation has started to received methodological attention since Gronau (1974), Heckman (1976), Heckman (1979), and Barnow et al. (1981), and such econometric advancements have continued until recently—for example, see Buchinsky (1998), Smith (2003), Arellano and Bonhomme (2017), and D'Haultfoeuille et al. (2018). These methods have been applied to diverse empirical settings by a myriad of studies; however, it should be noted that most of such studies are simply interested in selection-correction (often in the context of wage regressions) and that selection patterns per se (i.e., directions and magnitudes of selection) remain

largely neglected. In this regard, Mulligan and Rubinstein (2008), Dolado et al. (2020), and Shin (2022b) are noteworthy in that they deduce meaningful implications from selection patterns and their temporal changes. The current study also aims to do so with mothers at the center of its investigation. For this purpose, the counterfactual wages of the non-employed should be constructed, which requires using selection-correction estimators. Hence, this study applies two distinct methods, that of Heckman (1979) and that of Arellano and Bonhomme (2017) (in combination with that of Machado and Mata (2005)), to the *Local Area Labor Force* (LALF) survey(s) for the period 2016–2021, which is nationally representative and one of the officially designated (national) statistics approved by the South Korean government.

The remainder of this paper is organized as follows. Section 2 discusses the theoretical framework that underpins the current study. Data used during investigation (i.e., LALF datasets) are introduced in Section 4, and the estimation results are reported and discussed in Section 5. Section 6 concludes the paper.

2. Theoretical Framework

This section explains the theoretical framework that underpins the empirical investigations of the present study. In doing so, we follow the extant relevant literature such as Ermisch and Wright (1994), Mulligan and Rubinstein (2008), Borjas et al. (2019), and Shin (2022b) and start by defining individual productivity:

$$\pi_i = f(s_i, h_i) \tag{1}$$

and two distinct (logged) wage equations—namely, a reservation wage (i.e., asking wage) equation and a market wage (i.e., wage offer) equation.

As is done in Borjas et al. (2019), in a bid to simplify the presentation, we, in the current section, focus on a single observable skill component, that is, s_i, while high dimensional covariates are included in later parts for empirical investigation. h_i refers to productivity-related unobservable components.[28] The market wage refers to how much employers are willing to pay for one hour of work (Borjas and Van Ours, 2010; Shin, 2022b); the (potential) market wage equation, in an additively separable form, is expressed as

$$\log w_{1i}^{\text{Market}} = \alpha_1 + \gamma_1 s_i + \varepsilon_{1i}, \tag{2}$$

where s_i refers to an observable feature, γ_1 gives the rate of return to s_i (i.e., price), and ε_{1i} reflects the factors that are unobservable but affect the wage offer of individual i. In a similar manner, the reservation wage is expressed as

$$\log w_0^{\text{Reservation}} = \alpha_0 + \gamma_0 s_i + \varepsilon_{0i}, \tag{3}$$

where γ_0 gives the rate of return to s_i and ε_{0i} reflects the factors that are unobservable but affect the reservation wage of individual i. Subscript i, which indexes a particular person, is hereafter suppressed for simplicity (unless required for clarification).

To proceed, three distributional assumptions are imposed as follows:

$$s = \mu_s + \varepsilon_s \quad \text{with} \qquad \varepsilon_s \sim N(0, \sigma_s^2) \tag{4}$$

$$\varepsilon_1 \sim N(0, \sigma_1^2) \tag{5}$$

[28] The concept of h_i is often intentionally left abstract but includes various unobserved components, such as capabilities, skills, intelligence, productivity, perseverance, reputation, personal traits, motivation, and taste for work and additional learning (Weiss, 1995; Taber, 2001; Dostie and Léger, 2009; Shin, 2022b). For more on this, see Shin (2022b).

$$\varepsilon_0 \sim N(0, \sigma_0^2) \tag{6}$$

Following Borjas et al. (2019), we, simply for analytical convenience, also assume that

$$\mathrm{Cov}(\varepsilon_0, \varepsilon_s) = \mathrm{Cov}(\varepsilon_1, \varepsilon_s) = 0, \tag{7}$$

which is less realistic but does not change the qualitative meaning of the model. The correlation between two error terms, ε_0 from Equation (3) and ε_1 from Equation (2), is denoted by

$$\mathrm{Corr}(\varepsilon_0, \varepsilon_1) = \rho_{01}. \tag{8}$$

Note that ε_s is i-specific and has the same value for the same person in both equations. Parameters $\{\alpha_0, \alpha_1, \gamma_0, \gamma_1\}$ are equation-specific, and unobservables $\{\varepsilon_0, \varepsilon_1\}$, to be decomposed below, are both equation- and individual-specific.

In order for an individual person to obtain employment, two conditions should be satisfied. First, $\pi_i > w_{1i}$ should hold, which means that a firm hires i if and only if there is a positive surplus from hiring i. In the current study, this labor demand condition is assumed to hold. Second, according to Heckman (1974), a (labor supply) decision to enter employment, $D \in \{0,1\}$, depends on a comparison of the market wage (2) and reservation wage (3). In addition, there are search costs C. For analytical convenience, C, as in Borjas et al. (2019), is assumed to be a constant, that is, $\bar{C}$.[29] Then, an individual's employment decision is determined by

[29] In reality, search costs vary among persons. See Borjas et al. (2019) for a further discussion.

$$\begin{aligned}\mathbb{I} &= \log\left(\frac{w_1}{w_0+\bar{C}}\right)\\ &= [\alpha_1+\gamma_1 s_i+\varepsilon_{1i}]-[\alpha_0+\gamma_0 s_i+\varepsilon_{0i}+\bar{C}]\\ &= [(\alpha_1-\alpha_0)+(\gamma_1-\gamma_0)\mu_s-\bar{C}]+[(\gamma_1\varepsilon_s+\varepsilon_1)-(\gamma_0\varepsilon_s+\varepsilon_0)]\\ &= \triangle\mu+(v_1-v_0),\end{aligned} \tag{9}$$

where $\triangle\mu$ refers to an *average* (in terms of both s and ε) person's surplus stemming from entering employment; that is, $D=1$. Note here that in Equation (9), whole individual variations are captured by (v_1-v_0) with $v_1 \equiv \gamma_1\varepsilon_s+\varepsilon_1$ from Equation (2) and $v_0 \equiv \gamma_0\varepsilon_s+\varepsilon_0$ from Equation (3). A person decides to enter employment if and only if $\mathbb{I}>0$ is the case: namely,

$$D^{\text{Employment}} = \mathbf{1}[\mathbb{I}>0] \in \{0,1\}. \tag{10}$$

With $\text{Var}(v_1-v_0)=\sigma_v^2$ assumed to follow a standard normal distribution, (individual-specific) employment probability can be modeled by the following single-index probit link function:

$$\begin{aligned}\Pr(D=1|\mathbf{w}) &= \Pr(\mathbb{I}>0|\mathbf{w})\\ &= \Pr\left(\frac{v_1-v_0}{\sigma_v} > -\frac{\triangle\mu}{\sigma_v}|\mathbf{w}\right)\\ &= \Phi(\mathbf{w}_i'\boldsymbol{\gamma}),\end{aligned} \tag{11}$$

where Φ refers to the conventional standard normal cumulative distribution function (C.D.F.). Based on high-dimensional observable characteristics $\mathbf{w}$ being conditioned on Equation (11), $\Pr(D_i=1)=\Pr(\mathbb{I}_i>0)$ can be calculated for each individual i, which is hereafter denoted as $\widehat{\Pr}(D_i=1|\mathbf{w})$.

As articulated in Shin (2022b), most selection models are often referred to as models of 'selection on unobservables', with "selection on

observables" being implicit or neglected (Cameron and Trivedi, 2005) because they, as discussed in Section 1, are often applied to wage regressions with the aim of estimating wage function parameters with "selection on unobservables" being a target to correct. Likewise, many studies use "selection" as an economic terminology for describing selection on unobservables (e.g., Dolado et al. (2020)). However, it should be noted that there exist three distinct concepts of selection. Recall that, as defined above in (2), a person's market wage level is determined by his/her observed characteristics and unobserved features. Therefore, selection into work can be made (and thus can be measured) based on each of the former and latter ones and their combination: namely, (i) selection on observables, (ii) selection on unobservables, and (iii) selection on total productivity, which is the weighted average of (i) and (ii). In the given context of this paper, "selection on total productivity" is of primary interest, which is measured by $\mathrm{Corr}(v_1, v_1 - v_0)$ and can be re-expressed in the following manner.

$$
\begin{aligned}
\mathrm{Corr}(v_1, v_1 - v_0) &= \frac{\mathrm{Cov}(v_1, v_1 - v_0)}{\sigma_{v_1}\sigma_v} \\
&= \frac{\mathrm{Var}(\gamma_1\varepsilon_S + \varepsilon_1) - \mathrm{Cov}(v_0, v_1)}{\sigma_{v_1}\sigma_v} \\
&= \frac{\gamma_1^2\sigma_S^2 + \sigma_1^2 - \mathrm{Cov}(\gamma_0\varepsilon_S + \varepsilon_0, \gamma_1\varepsilon_S + \varepsilon_1)}{\sigma_{v_1}\sigma_v} \\
&= \frac{\gamma_1^2\sigma_S^2 + \sigma_1^2 - (\gamma_0\gamma_1\sigma_S^2 + \rho_{01}\sigma_0\sigma_1)}{\sigma_{v_1}\sigma_v} \\
&= \frac{\sigma_{v_1}}{\sigma_{v_1}}\left\{\frac{\gamma_1^2\sigma_S^2 + \sigma_1^2 - (\gamma_0\gamma_1\sigma_S^2 + \rho_{01}\sigma_0\sigma_1)}{\sigma_{v_1}\sigma_v}\right\} \\
&= \frac{\sigma_{v_1}}{\sigma_v}\left\{\frac{\gamma_1^2\sigma_S^2 + \sigma_1^2 - (\gamma_0\gamma_1\sigma_S^2 + \rho_{01}\sigma_0\sigma_1)}{\sigma_{v_1}^2}\right\} \\
&= \frac{\sigma_{v_1}}{\sigma_v}\left\{\frac{\gamma_1^2\sigma_S^2 + \sigma_1^2 - \gamma_0\gamma_1\sigma_S^2 - \rho_{01}\sigma_0\sigma_1)}{\sigma_{v_1}^2}\right\} \\
&= \frac{\sigma_{v_1}}{\sigma_v}\left\{\frac{\gamma_1^2\sigma_S^2 - \gamma_0\gamma_1\sigma_S^2 + \sigma_1^2 - \rho_{01}\sigma_0\sigma_1)}{\sigma_{v_1}^2}\right\} \\
&= \frac{\sigma_{v_1}}{\sigma_v}\left\{\frac{\gamma_1\sigma_S^2(\gamma_1 - \gamma_0) + \sigma_1^2(1 - \rho_{01}\sigma_0\sigma_1\sigma_1^{-2})}{\sigma_{v_1}^2}\right\} \\
&= \frac{\sigma_{v_1}}{\sigma_v}\left\{\frac{\gamma_1^2\sigma_S^2}{\sigma_{v_1}^2}\left(1 - \frac{\gamma_0}{\gamma_1}\right) + \frac{\sigma_1^2}{\sigma_{v_1}^2}\left(1 - \rho_{01}\frac{\sigma_0}{\sigma_1}\right)\right\}
\end{aligned}
\tag{12}
$$

Because of $v_1 \equiv \gamma_1 \varepsilon_s + \varepsilon_1$ and $\sigma_{v_1}^2 = \gamma_1^2 \sigma_s^2 + \sigma_1^2$,

$$\frac{\gamma_1^2 \sigma_s^2}{\sigma_{v_1}^2} + \frac{\sigma_1^2}{\sigma_{v_1}^2} = 1$$

holds, and thus, the term $\{\cdot\}$ in the last row in Equation (12) can be thought of as the weighted average of $(1 - \gamma_0/\gamma_1)$ and $(1 - \rho_{01} \cdot \sigma_0/\sigma_1)$; each is weighted by $\gamma_1^2 \sigma_s^2/\sigma_{v_1}^2$ and $\sigma_1^2/\sigma_{v_1}^2$, respectively. To estimate $\mathrm{Corr}(v_1, v_1 - v_0)$, each of v_1 and $v_1 - v_0$ should be computed for each i in the given sample. For the latter, each individual's conditional employment probability should be predicted, which is the point at which $\widehat{\Pr}(\cdot)$ from Equation (11) is used. On the other hand, for the former, potential market wages should be constructed for all $\{i|D_i \in \{0,1\}\}$—irrespective of whether i actually works or not at the time of data collection, and this requires using selection-correction models.

3. Econometric Method

3.1. Two-step Estimator of Heckman (1979)

This section compactly explains how potential market wages can be constructed for all $\{i|D_i \in \{0,1\}\}$ with non-random selection taken into account, and in doing so, some parts are borrowed from Shin (2021), Shin (2022a), and Shin (2022b). Suppose that there is a latent variable, z_i^*, that determines an individual's employment (i.e., labor supply) decision $D_i \in \{0,1\}$:

$$z_i^* = \mathbf{w}_i' \boldsymbol{\gamma} + u_i,$$

in which $\mathbf{w}_i$ is the vector of observable characteristics and u_i

represents those factors that are unobservable but affect z_i^*. Compactly,

$$D_i = \mathbf{1}[z_i^* = \mathbf{w}_i'\boldsymbol{\gamma} + u_i > 0] \in \{0,1\}$$

explains how i decides whether to work or not. We can think of z_i^* as (9), the difference between i's market wage (2) and reservation wage (3), net of search costs: see Heckman (1974). An individual's potential market wage (i.e., wage offer) is

$$y_i = \mathbf{x}_i'\boldsymbol{\beta} + \varepsilon_i,$$

in which $\mathbf{x}_i$ is the vector of observable characteristics. ε_i represents unobservable factors that affect y_i. Recall that we never observe y_i for the non-employed, $\{i|D_i = 0\} = \{i|\mathbf{w}_i'\boldsymbol{\gamma} + u_i \leq 0\}$, which is the essence of the sample selection framework in labor economics. Because only the wages of the employed are observed, conventional measures of wage gaps or wage inequality (without considering the endogenous selection) may be biased and, thus, provide a distorted picture (Arellano and Bonhomme, 2017).

Economists have long considered selection-related issues, and thus, diverse sample selection models exist since many ways exist in which to generate a "selected" (or "truncated") sample, which refers to a nonrandomly chosen subsample based in part, intentionally or unintentionally, on the values taken by a dependent variable (Cameron and Trivedi, 2005; Shin, 2022b). To model $\mathbb{E}[y_i|D_i = 1, \mathbf{x}_i, \mathbf{w}_i]$, most existing studies use either the bivariate sample selection model of Tobin (1958) or the two-step estimator of Heckman (1979). The selection model of Tobin (1958) supposes the following bivariate normal distribution with zero means:

$$\begin{bmatrix} u \\ \varepsilon \end{bmatrix} \sim N\left[\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} \mathrm{Var}(u) = \sigma_u^2 & \mathrm{Cov}(u,\varepsilon) = \sigma_{u,\varepsilon} \\ \mathrm{Cov}(u,\varepsilon) = \sigma_{u,\varepsilon} & \mathrm{Var}(\varepsilon) = \sigma_\varepsilon^2 \end{bmatrix}\right] \tag{13}$$

and

$$\rho_{u,\varepsilon} = \frac{\mathrm{Cov}(u,\varepsilon)}{\sigma_u \sigma_\varepsilon},$$

and its likelihood function is

$$L = \prod_{i=1}^{N} \{\Pr[z_i^* \leq 0]\}^{1-D_i} \{f(y_i | z_i^* > 0) \times \Pr[z_i^* > 0]\}^{D_i},$$

where $f(\cdot)$ refers to the conditional probability of y_i given $z_i^* > 0$. Note that L is the product of two distinct contributions: the discrete contribution from $\{i|D_i = 0\}$ and the continuous contribution from $\{i|D_i = 1\}$ (Lee, 2009). In light of the restrictiveness of Equation (13), the two-step estimator of Heckman (1979) requires a weaker condition—the linear relationship of two errors—as follows:

$$\varepsilon = \varphi u + \xi.$$

Then, according to Heckman (1979), $\mathbb{E}[y_i | D_i = 1, \mathbf{x}_i, \mathbf{w}_i]$ is estimated by the following "augmented" regression form:

$$\begin{aligned} \mathbb{E}[y_i | D_i = 1, \mathbf{x}_i, \mathbf{w}_i] &= \mathbf{x}_i'\boldsymbol{\beta} + \mathbb{E}[\varepsilon_i | D_i = 1, \mathbf{x}_i, \mathbf{w}_i] \\ &= \mathbf{x}_i'\boldsymbol{\beta} + \rho\sigma_\varepsilon \frac{\phi(\mathbf{w}_i'\boldsymbol{\gamma}/\sigma_u)}{\Phi(\mathbf{w}_i'\boldsymbol{\gamma}/\sigma_u)} \\ &= \mathbf{x}_i'\boldsymbol{\beta} + \rho\sigma_\varepsilon \lambda_i, \end{aligned} \tag{14}$$

where $\phi(\cdot)$ refers to the standard normal probability density function (p.d.f.) and $\Phi(\cdot)$ denotes the standard normal cumulative distribution function (C.D.F.). In Equation (14), correcting for sample selection involves adding a selection factor, λ_i, as an additional control term (Arellano and Bonhomme, 2017). The underlying stochastic relationship of Equation (14) is

$$y_i | z_i^* > 0 \quad = \mathbf{x}_i'\boldsymbol{\beta} + \rho\sigma_\varepsilon\lambda_i + v_i,$$

in which v_i has a mean of zero but is not normally distributed (Stolzenberg and Relles, 1997).

In using Equation (14), despite its computational simplicity, a caveat exists in that it depends strongly on the model being correct: it is much more sensitive to a misspecification problem than is the OLS model. If Equation (14) is misspecified, then λ_i may pick up the misspecified regression function, leading to a false conclusion (Lee, 2009). This is the point at which the two-step estimator of Heckman (1979) faces a practical problem, and one way in which to mitigate this issue is to use an exclusion restriction variable, that is, z, which (substantially) affects $D_i \in \{0,1\}$ without directly affecting y_i (i.e., the exogeneity condition). Therefore, $\mathbf{x} \subset \mathbf{w} \equiv \{\mathbf{x}, z\}$ holds. Imposing z in Equation (14) has two benefits: (i) more credible identification becomes possible, and (ii) a probable collinearity issue may be reduced. However, as articulated in Lee (2009), although an exclusion restriction variable helps alleviate identification and multicollinearity problems, there always exists a chance that the exclusion restriction itself is false, and thus, it is very difficult, if not impossible, to find a defensible exclusion restriction variable (Puhani, 2000; Shin, 2022b). Furthermore, the exogeneity condition (i.e., no direct impact on y_i) per se cannot be directly tested (Shin, 2022b). For further discussion, see Vella (1998), Marra and Wyszynski (2016), and Shin (2022b). As mentioned above, the current study requires potential

market wages to be modeled and constructed for all $\{i|D_i \in \{0,1\}\}$—regardless of whether or not i actually works at the time of measurement. If we have no information about i's employment status, then simply $\mathbb{E}[y_i|\mathbf{x}_i, \mathbf{w}_i]$ is the best predictor, which does not condition on D_i (Breunig and Mercante, 2010). However, in the context of the present study, i's employment status is known, and this information should be utilized to predict his/her wage. For those individuals who are employed, the conditional prediction of wages can be computed based on

$$\mathbb{E}[y_i|D_i = 1, \mathbf{x}_i, \mathbf{w}_i] \quad = \mathbf{x}_i'\boldsymbol{\beta} + \rho\sigma_\varepsilon \frac{\phi(\mathbf{w}_i'\boldsymbol{\gamma}/\sigma_u)}{\Phi(\mathbf{w}_i'\boldsymbol{\gamma}/\sigma_u)}. \tag{15}$$

Moreover, for those individuals who are non-employed, their counterfactual wages can be constructed by using

$$\mathbb{E}[y_i|D_i = 0, \mathbf{x}_i, \mathbf{w}_i] \quad = \mathbf{x}_i'\boldsymbol{\beta} + \rho\sigma_\varepsilon \frac{-\phi(\mathbf{w}_i'\boldsymbol{\gamma}/\sigma_u)}{1-\Phi(\mathbf{w}_i'\boldsymbol{\gamma}/\sigma_u)}. \tag{16}$$

Note that $\boldsymbol{\gamma}/\sigma_u$, $\boldsymbol{\beta}$, and $\rho\sigma_\varepsilon \equiv \boldsymbol{\beta}_{\boldsymbol{\lambda}}$ should be estimated so that $\hat{y}_i$ can be acquired.

3.2. Three-step Estimator of Arellano and Bonhomme (2017)

As briefly discussed in Section 1, to construct the counterfactual wages of nonemployed mothers, this study uses two methods: the two-step estimator of Heckman (1979) and the three-step estimator of Arellano and Bonhomme (2017). The key difference between these two estimators lies in the fact that the latter addresses correcting entire outcome distributions for (nonrandom and endogenous) selection in a nonadditive way (i.e., not just means or medians) (Shin, 2022a).

In correcting for sample selection in quantile regression models, the

essence of the Arellano and Bonhomme (2017) estimator is as follows: (i) to suppose a copula representation of two error terms,[30] the percentile error in an outcome (i.e., wage offer) equation and the error in a participation (i.e., employment) decision; (ii) to estimate copula parameters by minimizing a method of moments criterion; (iii) to readjust the percentile levels (i.e., observed distributional ranks) of the outcome to correct for selection; and (iv) to estimate quantile parameters by minimizing a rotated check function, which preserves the linear programming structure of the standard linear quantile regression of Koenker and Bassett (1978) (Shin, 2022a). For full details, see Arellano and Bonhomme (2017) and Shin (2022a).

4. Data

For empirical investigations, the current study uses the LALF survey,[31] which is one of officially designated (national) statistics approved by the South Korean government.[32] LALF data are managed by Statistics Korea, a governmental organization, and collected from repeated cross-sections. The LALF cross-sections are collected semi-annually every April and October. The data aim to produce and disseminate basic information on detailed employment situations (at regional levels) needed for making regional employment-related policies. Its target population is members of sample households who are staying in the households during the survey reference period and who are 15 years or older: approximately 200,000 representative samples of households (Baek and Park, 2022). Its reference period is one week

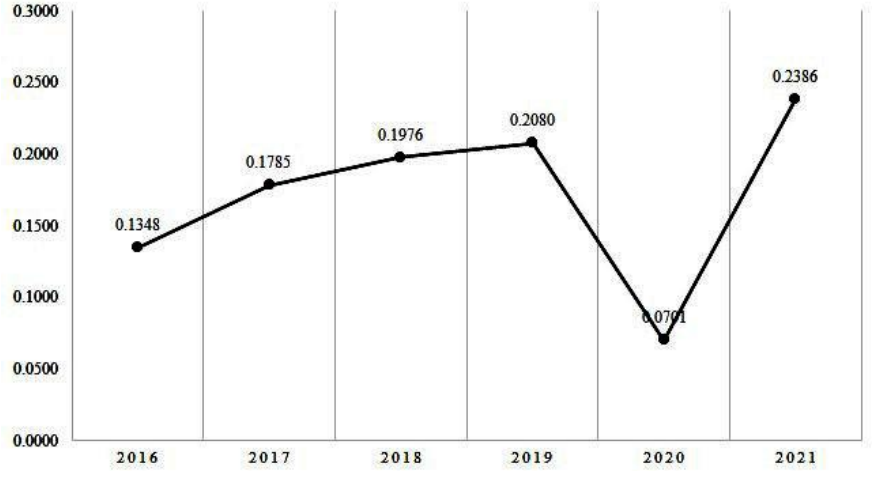
[30] For a general overview on copula, see Nelsen (2006). .
[31] The author uses the same data for several studies in the context of the South Korean labor market. Thus, the current section borrows from Shin (2022a), which is based on the same dataset.
[32] Approval No.: 101067.

(seven days; Sunday to Saturday) of every month, which includes the 15th of the month; its data collection period is (in general) two weeks following the week of the reference period (Statistics Korea, nd). The number of respondents in each wave is approximately 400,000, and the LALF survey(s) focuses mainly on the economic activity of respondents—such as their employment status and weekly working hours—along with their microlevel sociodemographic information (e.g., age, sex, education level, marital status, and location of residency; Baek and Park, 2022).

There are several substantial advantages in using the LALF data to address the research question of the present study. First, the number of observations is large enough to apply the Arellano and Bonhomme (2017) method, and the LALF data can be considered a nationally representative sample. Second, in the context of the current study, mothers' wages should be modeled with a proper specification, which requires high-dimensional (individual-level) variables—the case for the LALF data. Furthermore, recent relevant studies underscore the importance of college major choices (on top of final education level) in explaining wages: the LALF data contain this information, which is missing from many other survey data. Third, the Arellano and Bonhomme (2017) method requires an exclusion restriction variable, which (substantially) affects employment without (directly) affecting wage outcomes, and child-related information, though controversial, is often used for women in empirical investigations. To the best of our knowledge, the LALF data are the only nationally representative, large-scale survey data that include a variable concerning "the age of the youngest child", which functions as an exclusion restriction variable in the present study.[33]

[33] For further discussion on the role of the exclusion restriction variable in the selection-correction context, see Vella (1998), Marra and Wyszynski (2016), and Shin (2021).

Figure 4-4. Women's Selection into Employment – by Year, South Korea



Source: Estimation by the author, Graph by the author, Note: Selection on total productivity (both observables and unobservables considered; Positive selection means that mothers with higher earning potential and productivity are more likely to go into work and supply their labor than are other mothers (Shin, 2022b)).

5. Estimation Results

5.1. Overall Selection Patterns

Before proceeding to the discussion of mothers' selection into work in South Korea (in later sections), I briefly summarize females' overall selection pattern as a primer. As can be seen in Figure 4-4, the selection pattern is estimated to be positive,[34] which means that women with higher (lower) earnings potential are more (less) likely to enter employment and supply their labor in the South Korean labor market. Furthermore, the long-term trend is shown to be evidently upward in Figure 4-4, with pandemic-hit 2020 being a conspicuous exception. This finding indicates that positive selection is becoming more solidified

[34] The 95% bootstrapped confidence intervals do not include zero.

among South Korean women as time passes; combined with the fact that the female employment-to-population ratio is increasing in the nation, Figure 4-4 hints that some high-potential women are newly entering employment. Such positive selection for women is corroborated by the substantial volume of empirical studies, such as Mulligan and Rubinstein (2008), Olivetti and Petrongolo (2008), Albrecht et al. (2009), and Shin (2021) (Shin, 2022a).

Moreover, another noteworthy aspect in Figure 4-4 concerns the enormous drop observed for 2020, which was heavily affected by the COVID-19 pandemic. Additionally, Figure 4-4 indicates that the female labor force composition in South Korea has been substantially influenced by pandemic-driven socioeconomic changes; more specifically, the "less sizable" positive selection implies that while the overall employment-to-population ratio understandably decreased in 2020, those with higher earnings potential were more likely to leave the labor force than were those with lower earnings potential. A primary reason for this change may reside in the fact that COVID-19 was considered a "childcare" crisis; some previously working mothers had to stop working (either temporarily or permanently) to take care of their children during the pandemic situation and resultant lockdown periods. It is noteworthy that the estimate for 2021 seems to be back on the long-term trend again, thus exhibiting a quick recovery.

5.2. Children's Age and Selection

While the overall selection pattern among South Korean women, as can be observed in Figure 4-4, is positive, another important question concerns whether the pattern varies according to mothers' specific situations. Especially, this chapter delves into whether "the age of the youngest child" strengthens (or conversely mitigates) her mother's selection-into-work pattern. This aspect should be considered important in the sense that mothers' caring efforts (e.g., the amount of time

required) highly depend on the age of the child.

To empirically investigate this facet, the relevant variable in the LALF dataset is used, which is categorized as follows: Group 1 (0–3 years old), Group 2 (4–7 years old), Group 3 (8–13 years old), Group 4 (14–19 years old), and Group 5 (20+ years old). In the South Korean education system, Groups 3, 4, and 5 correspond to primary, secondary, and tertiary education, respectively. Based on this classification, samples are restricted to mothers, and each group's selection pattern is separately estimated: the results are presented in parallel in Figure 4-5.

While the overall pattern (for mothers) is similar to that in Figure 4-4 (for all women) (i.e., being positive and depicting upward trends), the magnitude of selection is more sizable for mothers, except for those mothers whose youngest child is 20+ years old (i.e., those in Group 5). This finding implies that (i) working women are systematically different from nonworking women in terms of their wage potential and productivity and (ii) this difference becomes larger when the comparison is confined to mothers only. In plain terms, it can be said that mothers tend to *more selectively* enter employment than do nonmothers in the South Korean labor market.

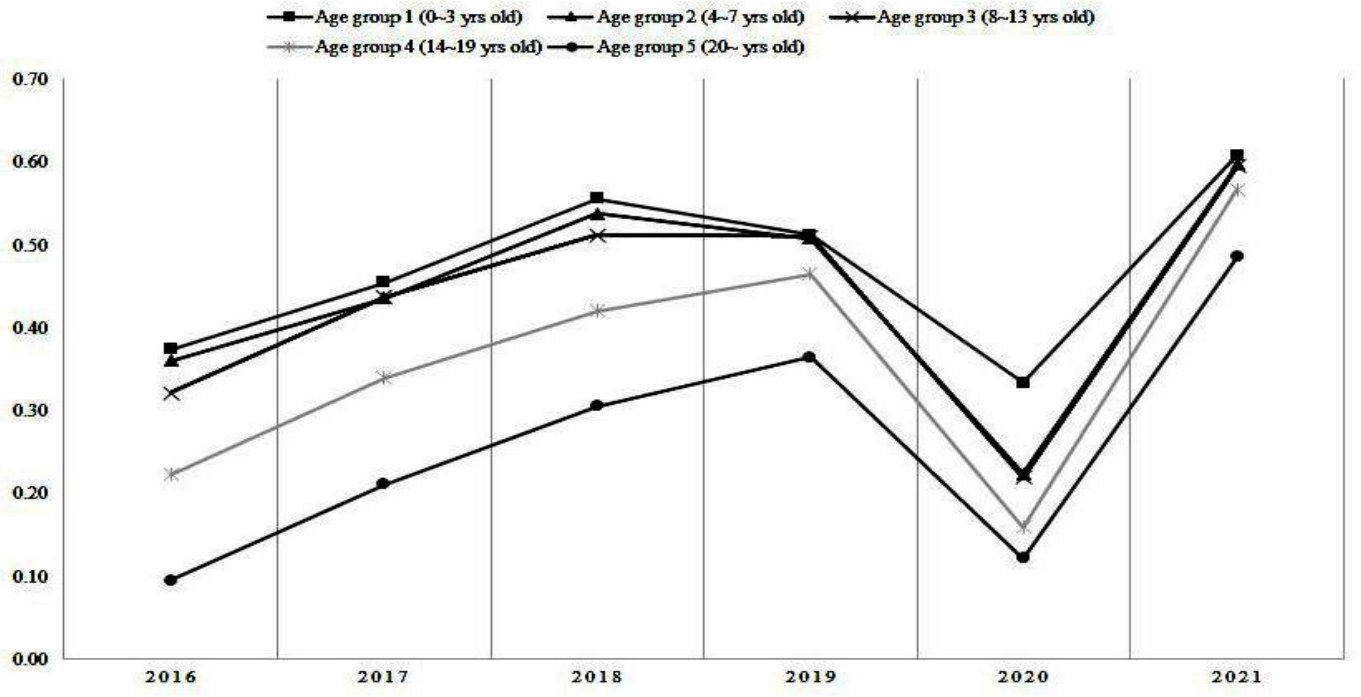
A more interesting finding concerns the heterogeneity shown in Figure 4-5: evidently, the magnitude of selection substantially varies depending on the age of the youngest child. According to Figure 4-5, positive selection becomes more pronounced for mothers with younger children. Especially, the difference is conspicuous as a mother falls into Groups 4 and 5, which, as mentioned above, correspond to secondary and tertiary education, respectively. To the best of our knowledge, this heterogeneity has not been properly investigated in the economics literature.

Then, what is the reason for such evident heterogeneity observed in Figure 4-5? Several factors, albeit hypothetical, can be discussed. Most importantly, it goes without saying that caring responsibilities are more demanding when children are younger; therefore, it is probable that

mothers with younger children "more seriously" consider the option of not working (or stopping working). Furthermore, in making a decision between working versus nonworking, these mothers may put more of a premium on caring responsibilities; hence, unless the market wage they are offered is attractive enough, they are more likely to choose the option of not working (and carrying out caring tasks). In contrast, for those mothers whose offered wage is high, they are more likely to choose the option of working because they can instead purchase care services from private providers, which is affordable for them due to their (higher) disposable income. Considering this aspect, it can be said that the market wage, as an economic factor, plays an important role in mothers' labor supply decisions. Moreover, its importance is even greater for mothers with younger children. This leads to and solidifies the positive selection into working among mothers.

If we take this aspect into account, then the remarkable differences for Groups 4 and 5 seen in Figure 4-5 are simply understandable because, for mothers in those groups, their youngest child is in secondary or tertiary education, reducing the associated caregiving burdens. Moreover, in interpreting Figure 4-5, a caveat is that we cannot rule out the possibility that the observed heterogeneity is driven by cohort effects: mothers belonging to Groups 4 and 5 are older than those belonging to Groups 1–3. However, when the same analysis is applied to narrower age intervals (e.g., mothers aged between 30 and 40 years), it leads to the same heterogeneity pattern, which is comforting.

Figure 4-5. Mothers' Selection into Work - by Year and the Youngest Child's Age, South Korea



Estimation by the author, Graph by the author, Note: Selection on total productivity (both observables and unobservables considered; Positive selection means that mothers with higher earnings potential and productivity are more likely to go into work and supply their labor(Shin, 2022b).)

5.3. Location-specific Selection

In labor economics literature, most of previous studies that allow for systematic selection correct it through Heckman (1979)-type mean expectation functions; however, the aim of the current section lies in implementing location-specific analyses (Shin, 2022a). For this purpose, we apply the three-step estimator of Arellano and Bonhomme (2017) to the LALF datasets in combination with the method of [36]. The results (for 2017 as an example) are portrayed in Figure 4-6.[35] The red solid (left scale) line denotes mothers' selection-uncorrected wage distribution.

$$Q_\tau[y_i|D_i = 1, \mathbf{x}_i, \mathbf{w}_i], \qquad \tau \in (0,1). \tag{17}$$

The blue solid line (left scale), in contrast, denotes mothers' selection-corrected wage distribution.

$$Q_\tau[y_i|\mathbf{x}_i, \mathbf{w}_i] \qquad \tau \in (0,1). \tag{18}$$

Note that the former is above the latter, which points to the positive selection into work among mothers.[36] The green dotted line (right scale) is the gap between those two distinct wage distributions (i.e., vertical differences).

$$Q_\tau[y_i|D_i = 1, \mathbf{x}_i, \mathbf{w}_i] - Q_\tau[y_i|\mathbf{x}_i, \mathbf{w}_i],$$

and it serves as a proxy for selection-into-work patterns.

In the present section, we should look at how selection (i.e., green

[35] See the Appendix for more graphs.

[36] The former is simply based on wages conditional on employment; to compute the latter, the decision-corrected quantile (i.e., location-specific) regression coefficients are estimated by using the Arellano and Bonhomme (2017) estimator, and then, wage distribution is simulated by the method of Machado and Mata (2005) (Arellano and Bonhomme, 2017) (Shin, 2022a).

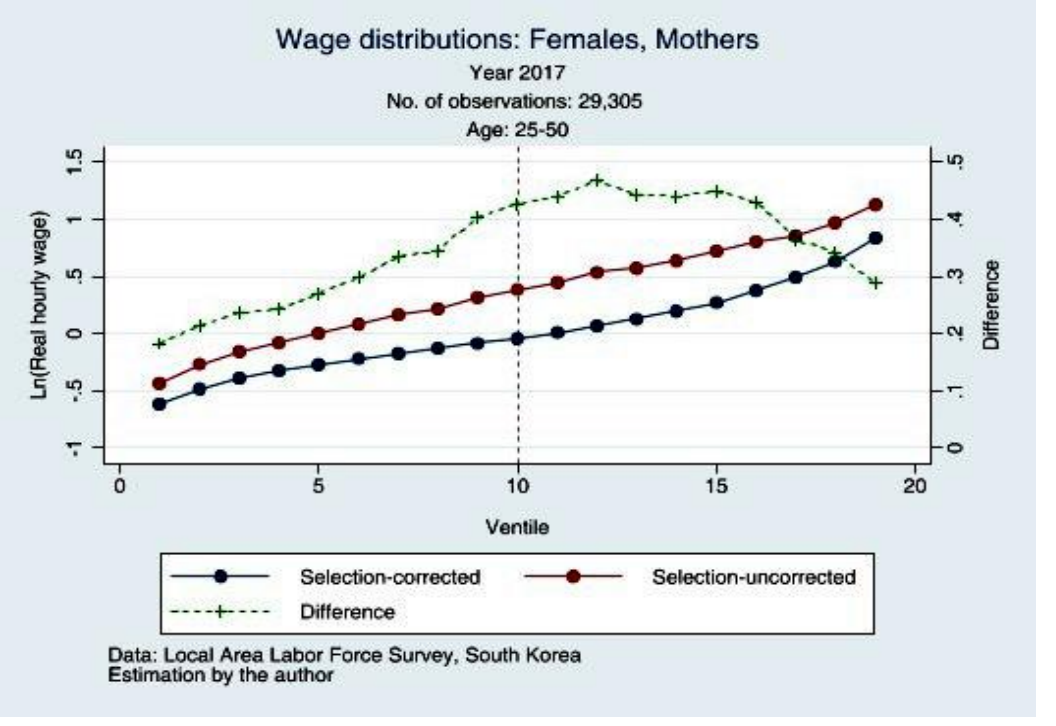
dotted line) varies as we move across the wage distribution (i.e., x-axis; ln (realhourlywage) ventiles). In Figure 4-6, it seems that positive selection is more pronounced in the middle part of the distribution.[37] Moreover, selection is less sizable at the lower-left and the upper-right locations. This finding means that working and nonworking mothers are systematically different in terms of their earnings potential, and the difference is greater for mothers falling into groups around the median; see ventiles 10–15 in Figure 4-6.

Why is selection less pronounced at the upper-right part of the distribution? It is likely that for mothers belonging to the upper-right part (i.e., mothers with higher earnings potential), labor supply decisions are more affected by noneconomic (i.e., nonwage) factors. Assortative mating, which is rampant within the marriage market in South Korea (Park and Smits, 2005; Shin, 2022a), may explain this facet; if high-potential women are matched with high-potential men, then mothers belonging to the upper-right part of the distribution may consider wage factors (relatively) less and nonwage factors (relatively) more in deciding whether or not to work—due to higher spousal income. In contrast, why is selection also less pronounced in the lower-left part of the distribution? If assortative mating is the case, then it is liable that women with lower wage potential are married to men in lower-paying jobs (Shin, 2022a). Hence, a substantial fraction of mothers falling into the lower-left part simply need to work for their livelihoods.

Mothers in the middle part of the potential wage distribution are in a "borderline" situation. If we think in terms of the assortative mating framework, then the level of their spousal income may be neither very high nor very low. Therefore, wage factors play an important role in affecting the labor supply decisions of these mothers. Mothers with attractive market wage offers choose to enter employment themselves,

37 According to the explanation of Mulligan and Rubinstein (2008), this pattern indicates that the nonworking women are always less productive than are working women (Shin, 2022a).

Figure 4-6. Mothers' Selection into work, 2017, Based on Arellano and Bonhomme (2017) and Machado and Mata (2005)



Estimation by the author, Graph by the author, Note: Selection on total productivity (both observables and unobservables considered), Estimation based on Arellano and Bonhomme (2017) in combination with Machado and Mata (2005)

whereas mothers with unsatisfactory wage offers choose to take care of their children. Furthermore, for mothers falling into the latter group, purchasing care services is a potential option but more of a burden, compared to mothers belonging to the upper-right part of the distribution. Therefore, if average spousal income is assumed, then mothers consider purchasing childcare services only when their market wages are sufficient to cover the associated costs.

6. Conclusions

Despite the fact that South Korean women show above-average OECD-PIACC scores and that the nation's younger women attain a higher level of education than that of their male peers (Shin, 2021, 2022a), South Korea's female labor force participation rate is 20 percentage points below that for men, and its gender wage gap is relentlessly at the top of the range among OECD countries (Dynan et al., 2022; Shin, 2021, 2022a). Considering the seriousness of the current situation, there is a growing body of literature investigating the female labor market in South Korea. However, until now, far too little attention has been paid to the question of how labor supply decisions are made among mothers in South Korea, which requires that their nonrandom, systematic pattern of "selection into work" to be empirically investigated. Despite the importance of this topic, to the best of our knowledge, no studies address the question. Thus, the current study delves into the pattern of mothers' selection into employment. For this purpose, the present study applies two distinct methods, that of Heckman (1979) and that of Arellano and Bonhomme (2017) (in combination with the method of Machado and Mata (2005)), to the nationally representative *LALF* survey(s) for the period 2016–2021.

According to the findings of this study, women's overall selection

pattern in the South Korean labor market is estimated to be positive (i.e., positive selection into work), implying that women with higher (lower) earnings potential are more (less) likely to enter employment and supply their labor. According to the explanation of Mulligan and Rubinstein (2008), this pattern indicates that nonworking women are always less productive than their working counterparts (Shin, 2022a); its long-term trend is evidently upward, with pandemic-hit 2020 being a remarkable exception. Furthermore, the magnitude of positive selection into work is more sizable for mothers than for women in general. Another important question concerns whether the selection pattern varies depending on mothers' specific situations—for example, the age of the youngest child, which largely determines the level of caring effort required. In this study, it is observed that the magnitude of (positive) selection substantially varies depending on the age of the youngest child; estimates suggest that positive selection becomes more pronounced for mothers whose children are younger. This finding hints that mothers with younger children "more seriously" consider the option of not working because they may put more of a premium on caring responsibilities. This aspect should be taken into careful account by policy makers.

In the labor economics literature, most of the previous studies that allow for systematic selection correct it through Heckman (1979)-type mean expectation functions; however, the present study conducts location-specific analyses and, thus, to the best of our knowledge, is the first attempt in the context of South Korea (Shin, 2022a). Estimates suggest that selection is more pronounced in the middle part of mothers' wage distribution; it is less sizable at the lower-left and upper-right locations. A possible reason for this is that mothers in the middle part of the potential wage distribution are in a "borderline" situation. For mothers falling into this group, purchasing care services is a potential option worth considering but more of a financial burden, compared to mothers belonging to the upper-right part of the distribution. Thus, it is

expected that a substantial fraction of mothers in this group consider entering work if the country's level of support for young children's care can be improved. Additionally, because selection is more pronounced for mothers whose children are younger (as discussed above), government support for early care is needed to attract more mothers into the labor market.

Chapter 5

Conclusions

Selim Choi, Seonho Shin, Yoo Jae Ro

1. Summary of Findings

This research investigates the relationship between children and parents' labor supply. In particular, we try to touch upon the complicated relationship between children and parents' labor supply, outcome and relative allocation of time. To this end, we focus on three different areas in the topic of children and parents' labor supply using recent data from various sources.

The first empirical work investigates the impact of the birth of the first child on the labor market trajectories of parents using an event study framework. The second work focuses on a point in time after the birth of the first child birth. It studied a sample of dual-earning couples with children and what happens to parents' relative allocation of the working hours in the labor market when their children's demand for care time suddenly increases. The last work concentrates on mother's selection into work, analyzing all working-age women in Korea with respect to their fertility choices, exploiting two prominent econometric models.

The three empirical works of this research find interesting evidence regarding working parents in Korea, which can help depict the overall situation faced by them.

To summarize some key findings, first, on the one hand, we find that the birth of the first child affects parents' labor supply in the direction

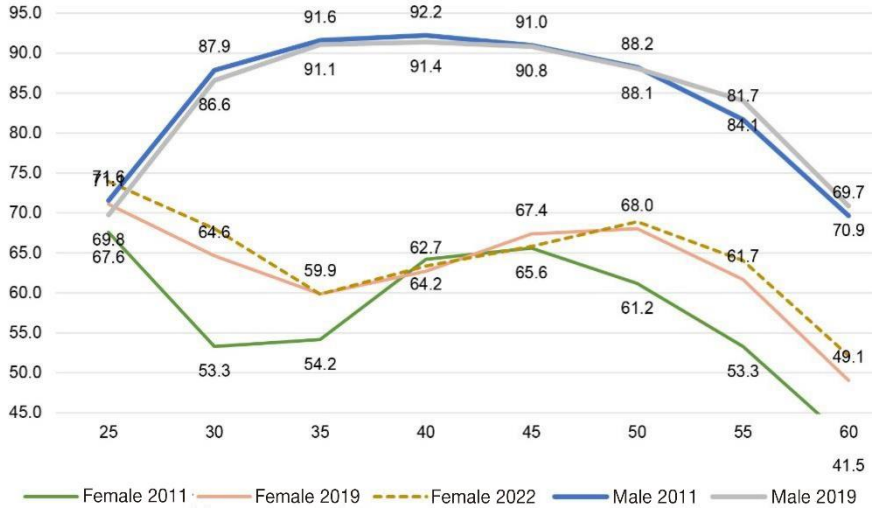
of mothers decreasing their hours spent in the labor market afterwards. Fathers, on the other hand, are either unaffected or increasing the hours spent in the labor market, while decreasing or maintaining their low level of family time. Second, after the birth of the first child, mothers experience a decline in earnings, while fathers remain unaffected.

Third, Korean parents experience a "double shock" to labor supply decisions per child. That is, parents' labor supply is affected at around the time of the birth of the first child and then again when their child turns 6 years and enters elementary school. As explained in detail in Chapter 3, this is because Korea's public childcare system is well established for preschool children, effectively supporting dual-earning parents, but there is no adequate and appropriate childcare system for young children in elementary school.

Fourth, as in the case of the first shock to parents' labor supply prompted by the birth of the first child, the second shock when the child enters elementary school causes parents' relative allocation of the working hours in the labor market to become unequal, mostly by making only mothers reduce their working hours.

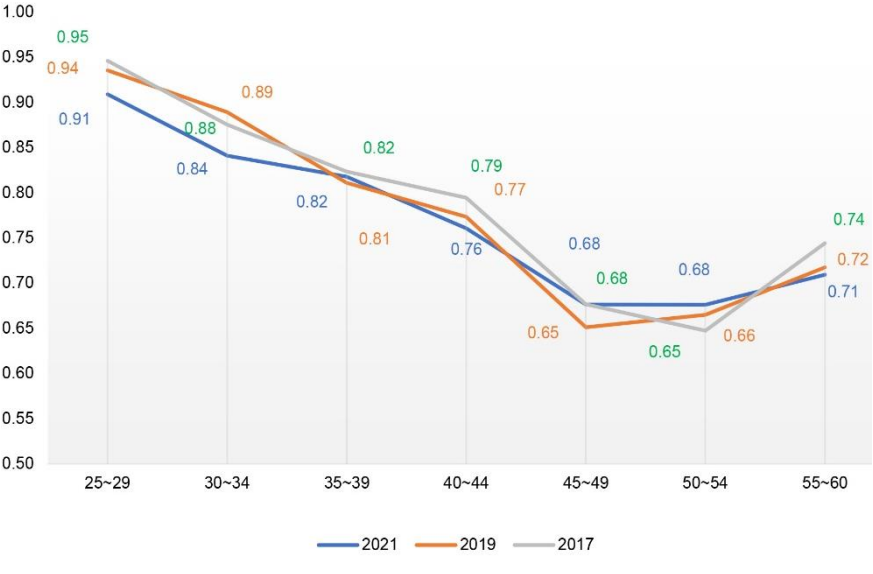
Associating this finding with those from Chapter 1 (on what happens after the birth of the first child), we can easily envision an image of gender inequality in the labor market as follows. Once a working woman becomes a mother, she reduces her labor supply (whether or not as a benefit of maternity leave or parental leave), and then, soon after she returns to the labor market or recovers her previous working hours, she has to reduce her labor supply once again. At the same time, her partner, and further on, fathers in the labor market, increase working hours after the birth of the first child and remain unaffected afterwards. Interestingly, this image is in line with the macroeconomic patterns we observe about Korean women in the labor market: (1) the bimodal shape of the age-employment curve (Figure 5-1) and (2) the drastically falling age-gender wage curve (Figure 5-2).

Figure 5-1. Employment Rates by Age Cohort and Gender in Selected Years



Source: Korean Statistical Information Service, "Survey of Economically Active Population".

Figure 5-2. Gender Wage Gap by Age Cohort in Selected Years



Source: Korean Statistical Information Service, "Addendum to Survey of Economically Active Population", (August).
Gender wage gap is measured as the ratio of female wages to male wages.

Fifth, working women are in general positively selected but in the group of women with children, positive selection is stronger. Sixth, within group of mothers, positive selection is stronger for those with younger children, potentially because of availability of maternity and parental leave for those in "good jobs".

Finally, in terms of mothers' productivity distribution measured by realized and predicted wages, positive selection is most pronounced for those in the middle of the distribution. The findings of the last work are related to those of other works in this research, in that they suggest which type of women are most affected by the shocks associated with arrival of children into a family. Mothers of young children and middle-productivity are likely to be those most affected.

2. Policy Implications

The findings of this research suggest that the Korean government's goal of advancing to a society where mothers and fathers work and care for children together is still far out of reach. It is evident that even in the case of this very recent cohort, mothers are the primary caregivers in households and, with such role, face a significant hurdle to advancing, if not barely maintaining, their careers. One most concerning issue for Korean women is, given that motherhood penalty at the time of child birth is commonly found in other countries as well, that Korean women are facing another shock upon the child's entry into elementary school.

Normally, career interruption caused by childbirth alleviates as children grow up and studies on other countries' experiences have shown that women gradually recover their wages and labor supply (Goldin et al, 2022; Kahn et al, 2014).

However, this is not the case for many Korean women. As described in Chapter 3, in Korea, while preschool-age children are cared for by the

well-established public childcare system for full days, at least until now, childcare for young school-age children is not well supported by schools or other childcare services (private or public). With 1st~3rd graders being released from school early in the afternoon, children of this age group suddenly demand more care time outside of the public service offered.

The childcare situation for school-age children should be improved as soon as possible because it not only affects mothers' labor supply directly at the time of the shock, as seen in Chapter 3, but also can affect, if not having already been affected, fertility choices, labor market participation and the quality of the working female population.

For women who just gave birth, after the first career disruption, they may decide to delay the return to the labor market. Alternatively, they may put their career ambitions aside for a while, even if they may decide to stay in the labor market, because they can foresee a second shock in the near future. If this is the case, then it results in the female labor force stopping human capital accumulation in their prime working age for an extended period, likely for a much longer period than that of the female labor force in other countries per child.

Chapter 4 of this research has shown that women with median productivity are those women affected most in this way. For them, the marginal value of maintaining work is not significantly larger than the marginal disutility from having to keep their children in an unreliable care system for an extended period. If publicly provided childcare or reliable private childcare were always available and covered the full working hours of parents for all young children at least up to 8 years of age, then, like in other countries, care time covered by parents should decrease monotonically as children grow up, gradually freeing mothers, even mothers of median productivity, from the burdens of childcare.

Moreover, for childless women, the experiences of other women with children, who drop off their career track or pause their career development for at least 6~8 years, suggest that childbirth is a significant compromise to personal achievement, if not losing it all together. Given

that the utility of children to each individual is unknown ex ante, easily observable experiences of female colleagues can significantly depress the desire or preference to have a child among childless women, hence negatively affecting fertility rates.

Summing up the implications drawn from the findings of this research, we come to least one clear policy recommendation for the Korean government. To boost female labor market participation, without undermining individuals' preference for fertility, the childcare system must be reformed and improved.

At the same time, the government should push for active labor market policies that can be effective in helping mothers retain their jobs as well as in allowing fathers to be more involved with childcare. The findings of our study show that mothers and fathers are not equally caring for children, even in the recent cohort, in which mothers have similar, if not higher, pre-labor-market human capital on average.

To reshape society so that mothers and fathers really care for their children and work together, the government should consider incentivizing employers to adopt diverse flexible working arrangements and promote their usage equally by both genders. According to a recent report, even during the pandemic period, only about 14 to 17% of total employed workers were able to use any kind of flexible working arrangement. The same report also show that the proportion of employed workers who wish to use a flexible working arrangement is more than the double of the usage rate[38] This finding suggests that for a vast majority of workers, flexible working arrangements are a pure illusion.

The Korean government recently adopted a small tax incentive for

[38] According to the report by Yonhap News (2022.9.14) titled "*유연근무 하고 싶어도 못하는 근로자 748만명…활용인원의 2배*," the proportion of employed workers who have used flexible working arrangement are 14.2% and 16.8% in Aug. 2020 and Aug 2021 surveys, respectively, and the demand rate for flexible working arrangement in Aug. 2020 and Aug 2021 surveys are 40.9% and 42.8%, respectively.

firms that employ women who experienced career interruption due to childbirth and child caring. However, if the government must choose only one approach, then preventing career interruption for women through making the working environment flexible may be more effective. The changes in the work culture in the labor market triggered by the government's initial incentives can not only save women at the margin of falling out of the labor market but also change the career expectations after the birth of the first child for childless women. Unlike letting mothers fall out of the labor market and helping them get hired after a while, transforming work environments and supplying more flexible jobs to make the labor market more inclusive for parents can have permanent and resounding effects by lowering the bars to labor market participation and updating career expectations for women as mothers.

When the government takes well-targeted efforts to tackle childcare issues and to transform the labor market environment and when such achievements become tangible, only then may young Korean women start to rethink their life course with children.

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ISBN 979-11-260-0605-2