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The Fertility Effect of Natural Disaster: Evidence from the 1968 Drought in South Korea

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The Fertility Effect of Natural Disaster: Evidence from the 1968 Drought in South Korea

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Abstract

This paper examines the effect of the 1968 drought in South Korea on childbearing behavior of farm households. Using the 1966–1985 Census 2 percent sample, we construct an original data on fertility from 1952 and combine it with agricultural output data. Identification exploits the difference between farm households and non-farm households, the variation of the severity of the drought, and time variance. The triple differences results show that the probability of giving birth among farm households decreased more in districts that suffered severely from the drought than in districts that suffered less from the drought. The negative effect appeared after 2 years of the drought and lasted for about 1–3 years.

Keyword : fertility, crop shock, drought
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1. Introduction

Ever since the Malthusian Theory of Population was proposed, the relationship between population and economic growth, as well as factors that affect the size or composition of populations, have been of interest. Natural disasters are among the main factors that cause demographic changes such as changes in death, birth, and migration rates, and health status. It is predicted that natural disasters will occur more frequently in the future due to increased extreme weather, global warming, and increasing population densities in vulnerable areas, which makes research into disaster-related demographic changes more important (Frankenberg et al., 2014). Natural disasters may also have indirect long-term effects — to those who were not directly exposed to the disaster. For example, a compositional change in local area population induced by a disaster can change the marriage or labor market within a few decades.

Studies on the effects of natural disasters on demography can show how individuals respond to unexpected negative shocks, evaluate the effectiveness of public interventions before or after a natural disaster implying which policies are needed, estimate the human capital outcomes affected throughout the life course by a disaster, and provide insights to policy designers who develop social programs with the goal of reversing the trajectories.[1]

Abundant literature that examines the fertility effect of disasters has accumulated, but the results are mixed, and the mechanisms do not have a consensus. It has been found that fertility increased after some deadly natural disasters such as the 2001 Gujarat earthquake in India, the 2004 Indian Ocean tsunami, and Hurricane Mitch in Central America in 1998 (Nandi et al, 2018; Nobles et al, 2015; Davis, 2017; Finlay, 2009). Some possible explanations are that parents may want to replace their children who died in a disaster (the replacement effect), and that parents may

[1] See Foster (1995) and Maccini and Yang (2009) for examples.

produce more children than wanted because they anticipate further risk (the extra−familial effect). The fact that children can be used to supplement household income may also induce an elevation in fertility (Finlay, 2009).

However, there are also numerous empirical findings which show fertility decreasing after natural disasters. Using historical data, Lin (2010) shows that earthquakes and tsunamis in Japan and Italy had negative impacts on fertility. Zhao and Reimondos (2012) found that fertility declined after the 1958−1961 Chinese Famine. Potential mechanisms could be that the opportunity costs of childbearing increase. This could happen if individuals allocate more time to precautionary activities or if individuals expect an uncertain flow of income and need more time to finance childbearing costs (Evans et al., 2010). Also, parents might decide to delay or give up childbearing to smooth consumption (Jung, 2019).

Most of the studies that focus on rural farm households suggest that decreases in agricultural outputs lower fertility, as do temperature and climate shocks.[2] For example, Alam and Pörtner (2018) shows how households that experienced crop loss in Tanzania delayed childbearing and increased the use of contraceptive methods. Jung (2019) suggests that when income of rural households is damaged due to a decrease in rainfalls and rice yields, abortion of girls increases among parents with a sex preference in Vietnam. Sellers and Gray (2019) show that women of farm households in Indonesia are more likely to apply family planning and less likely to give birth after climate shocks.

In this paper, we focus on the fertility effect of natural disasters by examining the case of the 1968 drought in South Korea (hereafter: Korea). We generated original micro−level data which include information on whether a woman gave birth to a child during 1952 to 1980 by applying the Own−Child Method (OCM) on census sample data. Then we combined this with historic data on district−

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[2] Grimm(2019) finds that high variance in rainfall caused higher fertility rates of farm households during the late 18th century and early 19th century.

level agricultural outputs from Lee (2019). Identification exploits the difference between farm households and non-farm households, the variation of the severity of the drought, and time variance. The results of triple-difference estimates suggest that the probability of giving birth among farm households decreased more in districts that suffered severely from the drought than in districts that suffered less from the drought. This is under the assumption that farm households would have been more affected by the drought. Farm households often suffer from the disasters through income loss (Jung, 2019; Sellers and Gray, 2019).

This paper adds to the literature on natural disasters and fertility by examining a Korean case. There are some advantages to examining the fertility effect of natural disasters in Korea. First, Korea was a rapidly developing country during the 1960s and 1970s. According to Korean Statistical Information Service (KOSIS), the share of farm households was 53% in 1960 and 46% in 1970, and the agricultural income among farm households accounted for 76% in 1970. Although agriculture was a huge industry, a sectoral shift, advances in technologies, and cultural changes were radical, and fertility was also under a rapid transition. Therefore, the case of Korea can provide meaningful implications to how fertility responds to a negative shock during a demographic transition.

Second, the 1968 drought in Korea allows for an investigation of a relatively mild shock. Although the drought caused physical and financial damage, it did not cause casualties. The severity of the drought was serious in Jeollanam-do, but other provinces such as Jeju-do and Chungcheong-do could afford to support the most affected areas. It would be valuable to investigate mild shocks, which are much more common.

This paper also contributes by extending the period of fertility analysis in Korea earlier, to the 1960s. Birth records data in Korea are only available from 1981, so regional and age variations in fertility rates before 1981 are unknown. By generating original data using the OCM, we can study fertility rates in the past. These fertility estimates may have measurement errors and may not be as precise as the fertility rates calculated with birth records, although it is the most detailed among the available data.

The remainder of this paper is organized as follows: Section 2 introduces the background of the 1968 drought in Korea. In section 3, we discuss the data and the construction of variables – childbearing decisions, severity of the drought, and control variables. Section 4 presents the empirical strategy and results, and section 5 is a discussion of the study. Section 6 concludes the paper.

2. Background

According to the Korean National Drought Information Portal, drought is defined as a period when water supply is scarce, and it usually occurs when precipitation is below the average level. Drought differs from other natural disasters in that it lasts for a relatively longer period and that the starting and ending points are indefinite. Other natural disasters such as earthquakes and tsunamis destroy the area immediately and the damage is obvious. These factors make it difficult to estimate the cost of drought and to design policies that can avoid future damage. Criteria, including meteorological, agricultural, hydrological, and socioeconomical, are thus needed to study drought, and in this paper, we focus on the agricultural impacts of drought.

This study focuses on the drought of 1967–1968 in Korea, which is evaluated as the most severe one after independence. Much water resource management of today is based on this drought. It is hard to precisely identify the starting and ending point of this drought, but precipitation was the lowest in 1967 — 740mm in the Yeong-san River (mean: 1,237mm, SD: 268mm) and 673mm in the Seom-jin River (mean: 1,293mm, SD: 283mm) (Korean Institute of Construction Technology, 1996). The estimated cost of damage was highest in 1968 (Korean National Disaster Management Research Institute). It is also recorded in the White Paper of the 1968 drought that agricultural yields also decreased most in 1968. Approximately 27.1% of the farm area in Korea was affected by the drought, and the damage was greatest in Jeollanam-do.[3]

There are some articles that recorded the severity of the drought in 1968. According to historical articles of Kangjin News, it was reported that farmers in Kangjin-gun were in a dispute over water. Countermeasures to overcome the drought such as *homimo* — seeding with hand plows where the land is dry — and *deulsem-pagi* — to dig springs — were proposed by the local government, but these turned out to be a failure. Many farmers left Jeollanam-do for Jeju Island after giving up farming due to the drought.[4]

Although there is difficulty in defining the 1968 drought, it seems clear from the historical records that the 1968 drought in Korea devastated many farm households, especially in Jellanam-do. Also, it delivered a physical and financial blow even though it did not increase death rates or cause a famine.

3. Data and Construction of Variables

3.1. Childbearing Decision

Detailed information on fertility in Korea during the 1960s and 1970s, such as age-specific fertility rate (ASFR), at the district level is unknown since data on birth records are only available from 1981. The OCM introduced in Cho (1974) and Retherford and Cho (1978) presents an alternative way to estimate ASFRs with the fewest variables in the survey data, such as the population census. The main

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[3] According to the White Paper of the 1968 Drought, the estimated damage cost of the drought in 1968 is highest in Jeellanam-do, amounting to 20.8M KRW, followed by 7.9M KRW in Kyungsangnam-do, and 5.7M in Jeonllabuk-do.

[4] In Gangjin-gun, the population peaked in 1967 (12,7170 people), but decreased 7% during 1968-1970, and from 1975, more than 10,000 people emigrated (Kangjin News, 2015.09.21.).

idea is to reconstruct birth history based on the age structure of the population in the year of the survey. This technique is useful especially when studying fertility rates of developing countries where data are not enough.

We exploit the 1966–1985 census 2 percent sample conducted every five years. The census 2 percent sample includes information such as district of residence, household number, relation to the head of the household, sex, age, and marital status. Using the relation to the head of the household, we match each possible mother's own children within a household. Then, using the age of the mother and the child in the census year, we can calculate the birth year of each child and the age of the mother at the birth of that child. We can also construct a dummy variable which indicates 1 for each woman if she gave birth to a child in a specific year prior to the census year.

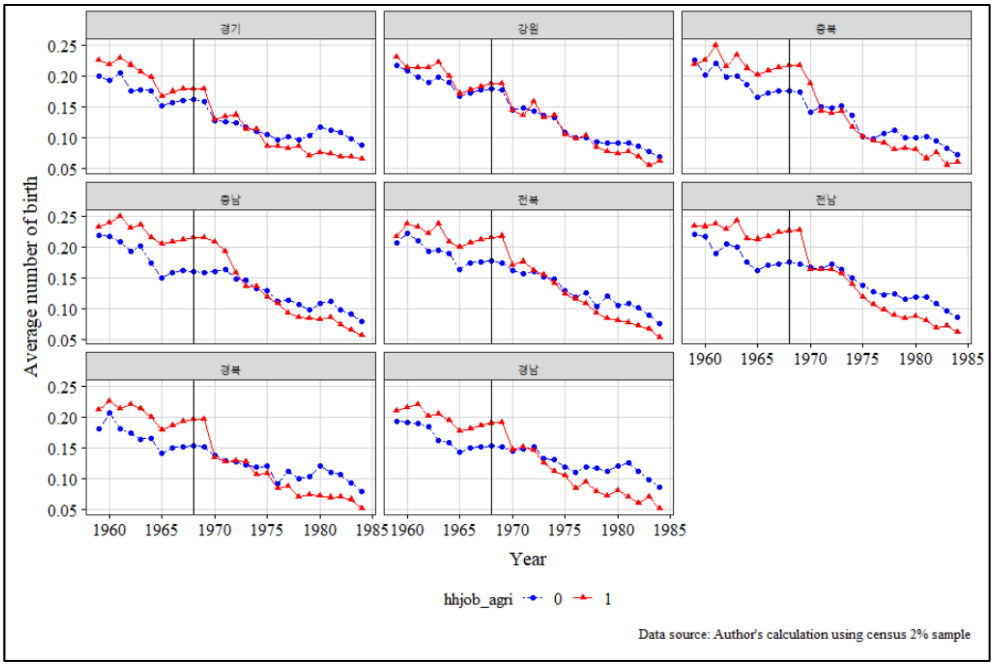
The method should consider infant mortality as well as the mortality of women during the rejuvenation period. Also, adjustments should be made for children who are not matched to a mother. However, due to lack of data on life tables in the 1960s and 1970s of Korea, we could not make these adjustments. Still, we argue that measurement errors due to absence of adjustments would be a minor problem, for two reasons mentioned in Cho (1974). First, Korea has low mortality, so the fertility estimates would not be sensitive to changes in mortality adjustments based on estimated life tables. Second, 98.2% of children under age 5 and 95.6% of children at age 5–9 live with their mother, so excluding non-matched children would not be a critical problem.[5]

We can apply the OCM to estimate fertility of farm households by using employment information in the census. A farm household is defined as a household where at least one household member is employed or working in agriculture. Figure 1 presents the estimated average number of children among farm households (red solid line)

[5] See Appendix for comparison between estimated Total Fertility Rate (TFR) using OCM and TFR announced from World Bank and KOSIS.

and non−farm households (blue dotted line) by province. There is a clear drop in farm household fertility in Jellanam−do.

Figure 1 Average number of children among farm households and non−farm households by province



3.2. Severity of the Drought

To measure the severity of the drought across districts, we use agricultural output data used in Lee (2019). The data in Lee (2019) originate from the Statistical Yearbook from 1945 to 1980. They include yields (kg) and areas (m^2) of various crops. Other information on agriculture, such farm population and livestock figures, is also available.

We use the difference between the rice yields in 1968 — the year when the drought was most severe — and the average rice yields in years prior to the drought, 1964 to 1966.[6] We define the

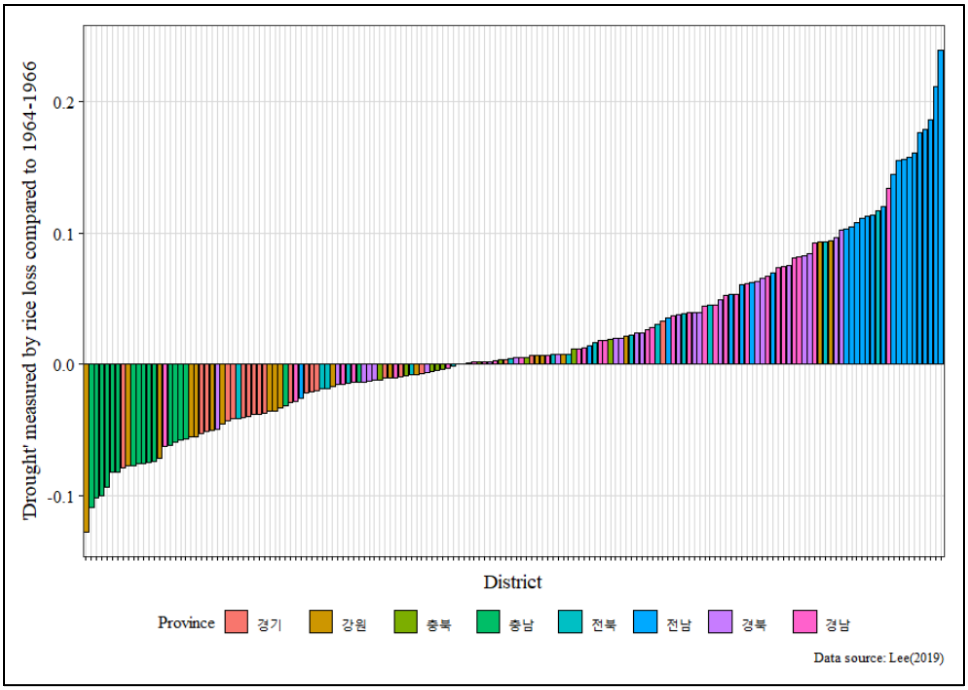
[6] Although we use $Drought_j$ as a proxy of the severity of the drought, it should be noted that this variable is subject to endogenous problems. For

following equation as the proxy for the severity of the drought:

$$Drought_j \equiv \frac{RiceYield_{j,1964-1966} - RiceYield_{j,1968}}{RiceArea_{j,1964-1966}} \qquad (1)$$

where j is district. Thus $Drought_j$ is higher for districts where rice yields dropped more in 1968. Figure 2 shows the distribution of the variable $Drought_j$.[7] Most of the districts with high $Drought_j$ are in Jeollanam-do. Consistent with historical records that Chungcheong-do was capable of supplying water to the most affected areas, most of the districts in Chungcheong-do did not experience damage in rice yields in 1968. The distribution and rank of $Drought_j$ among districts are similar when using 1963 to 1965 as the control group.

Figure 2 Distribution of the severity of the drought measured by rice loss



example, there is a possibility that rice loss does not represent the severity of the drought because some households could cope with or handle the drought in a better way.

[7] See Appendix for the change in rice yields and rice areas.

3.3. Control Variables

For control variables, we include individual and household characteristics derived from the census 2 percent sample. District characteristics such as population density are also included, which are calculated using the area and population variables from the Statistical Yearbook. The mean and standard deviation of each variable in the total, farm household sample, and non−farm household sample are presented in Table 1.

Table 1 Summary of Control Variables

Variable	Total	Farm Household	Non−farm Household
Age at birth	28.484 (9.242)	30.582 (9.421)	27.405 (8.96)
Labor force participant	0.367 (0.482)	0.629 (0.483)	0.233 (0.422)
Sex ratio	0.4 (0.359)	0.407 (0.341)	0.397 (0.367)
Marital single	0.084 (0.278)	0.052 (0.222)	0.101 (0.301)
Marital married	0.796 (0.403)	0.832 (0.374)	0.778 (0.416)
Marital widowed	0.109 (0.311)	0.112 (0.316)	0.107 (0.309)
Marital divorced	0.011 (0.103)	0.004 (0.06)	0.014 (0.119)
Educ less than primary	0.214 (0.41)	0.416 (0.493)	0.11 (0.313)
Educ completed primary	0.786 (0.41)	0.584 (0.493)	0.89 (0.313)
Family size 1−3	0.208 (0.406)	0.176 (0.381)	0.224 (0.417)
Family size 4−6	0.591 (0.492)	0.518 (0.5)	0.628 (0.483)
Family size 7+	0.201 (0.401)	0.306 (0.461)	0.148 (0.355)
1 Generation family	0.051 (0.219)	0.046 (0.21)	0.053 (0.224)
2 Generation family	0.686 (0.464)	0.598 (0.49)	0.731 (0.443)
3 Generation family	0.224 (0.417)	0.323 (0.467)	0.173 (0.378)
Other family type	0.039 (0.194)	0.033 (0.179)	0.043 (0.202)
N	746,455	410,550	335,905

Notes. The sample is restricted to women aged 15−65 in the Census year and aged 15−49 in the rejuvenation period. Women living in Seoul, Pusan, and Jeju are excluded.

One of the individual characteristics of the women is age in the rejuvenation year, so it would be age at birth for women who gave birth to a child. Others include marital status (never married, married, divorced, widowed), education attainment (completed primary school or not), and labor force participant dummy.

Since household characteristics are derived from the census 2 percent data, only family members who are living together are considered. There is thus a possibility that some adult children may not be captured. Family size is a categorical variable that indicates 1–3 family members, 4–6 family members, or 7 or more family members. Family type is also a categorical variable that indicates 1 generation family, 2 generation family, 3 generation family, and others. Sex ratio among the children in the household is also considered. Sex ratio is calculated by the number of girls out of the total number of children in the household. The value is 0 if there is no children.

Table 1 shows that the characteristics of farm households and non–farm households are different. Women in farm households work more, are less educated, and belong to a big family. The share of ever–married women is also bigger among the women in farm households. These differences between the two groups suggest that we should include control variables.

4. Empirical Strategy and Results

4.1. Triple Differences

The estimation strategy in this paper relies on the difference between farm households and non–farm households, the variance of the severity of the drought, and time variance. We restrict the sample to women aged 15–65 in the census year and aged 15–49 in the rejuvenation period. Women living in Seoul, Pusan, and Jeju are excluded since minute farm area and crop yields may cause bias when measuring the damage of the drought.

We estimate the following equation

$$
\begin{aligned}
B_{ijt} = \sum_{t=1965}^{1975} [\gamma_t(Farm_{ijt} \times Drought_j \times year_{it}) \\
+ \beta_t(Farm_{ijt} \times Dought_j) + \alpha_t(Farm_{ijt} \times year_{it}) \\
+ \delta_t(Drought_j \times year_{it})] + \theta_t + \theta_j + X_{ijt}\Gamma + \epsilon_{ijt}
\end{aligned}
\tag{2}
$$

where i is woman, j is district, and t is year. B_{ijt} is a dummy variable indicating 1 if woman i in district j gave birth in year t.

$Farm_{ijt}$ has value 1 if the woman' s household has at least one family member working or employed in agriculture. $Drought_j$ is as defined in equation (1), and $year_{it}$ is a dummy variable if the year is t. θ_t and θ_j include year−fixed effects (or quadratic and cubic of year) and district−fixed effects, respectively. X_{ijt} is a set of control variables as described in section 3.3. ϵ_{ijt} are standard errors which are clustered at the district level, and sampling weights are applied. γ_t are the coefficients of interest. A negative value of γ_t would mean that farm household fertility in districts where rice yields were more damaged in 1968 decreased in year t.

4.2. Main Results

Table 2 shows the estimates of triple differences defined in Section 4.1. Column (1) is the result without time trend or year and district fixed effects. The results of adding fixed effects are in column (2), and column (3) includes time trend (quadratic and cubic of year) in addition. In columns (1) and (2), the estimates of triple differences have negative and statistically significant values in 1970 and 1971. The coefficient of the triple differences in 1971 in column (1) is −0.027 which implies that fertility of farm households in districts where the drought was hit hard had a significantly lower fertility in 1971 compared to 1965. Given that it takes about 9 months to give birth from the childbearing decision and that it takes time for farm households to harvest, it seems reasonable that the impact of the drought in 1968 would occur after 1−3 years. When we included the time trend as in column (3), the estimates have significant negative values from 1971 to 1972. The coefficients of the interaction terms are −0.0142 and −0.0184 for 1971 and 1972 respectively. The values correspond to 8.0%−10.4% of the average fertility rate. The results suggest that the fertility decrease was ephemeral. Since the income of farm households are often directly damaged by natural disasters, farm households may have delayed childbearing (Jung, 2019).

Table 2 Estimated coefficients of equation (2)

	Dependent variable: Dummy Give Birth		
	(1)	(2)	(3)
Farm×Drought×1966	−0.0478 (0.0354)	0.0324 (0.0322)	−0.0334 (0.0191)
Farm×Drought×1967	0.0061 (0.0274)	−0.0161* (0.0087)	−0.0261 (0.0115)
Farm×Drought×1968	−0.0131 (0.0228)	−0.0271 (0.0109)	−0.0182 (0.1549)
Farm×Drought×1969	−0.0108 (0.0229)	−0.0164 (0.0131)	−0.0142 (0.0156)
Farm×Drought×1970	−0.0598* (0.0294)	−0.0241* (0.0139)	−0.0102 (0.0153)
Farm×Drought×1971	−0.0272*(0.0734)	−0.0223** (0.0109)	−0.0142* (0.0100)
Farm×Drought×1972	−0.0266 (0.0681)	−0.0103 (0.0404)	−0.0185** (0.0077)
Farm×Drought×1973	−0.0407 (0.0650)	−0.0277 (0.0411)	−0.0151 (0.0125)
Farm×Drought×1974	−0.0410 (0.0651)	−0.0135 (0.0378)	−0.0201 (0.0152)
Farm×Drought×1975	−0.0292 (0.0623)	0.0019 (0.0329)	−0.2920 (0.0623)
Dep var mean	0.178	0.178	0.178
Time Trend	No	No	Yes
Year, District FE	No	Yes	Yes
Control Variables	Yes	Yes	Yes
Observations	746,455	746,455	746,455
Adjusted R2	0.0943	0.0943	0.0943

Notes. *p<0.1; **p<0.05; ***p<0.01. Standard errors clustered at district level in parentheses. Sampling weights are applied.

Table 3 presents the results by sub groups — age at the rejuvenation period. Estimation model in column (3) of Table 2 is applied. The results in column (1) is for women who are 20−29 at the rejuvenation period, so it would be the age at birth if the woman gave birth to a child in the specific year. Similarly, column (2) and (3) are for women who are 30−39 and 40−49 respectively. Column (2) shows that fertility of women in their thirties were most affected by the drought and that the effect lasted longer than other age groups. The magnitude of the coefficient of $Farm \times Drought \times 1971$ is −0.0402 and is commensurate with 27% of the probability of giving birth among women in their thirties.

Table 3 Sub group analysis by age at the rejuvenation period

	Dependent variable: Dummy Give Birth		
	Age 20−29	Age 30−39	Age 40−49
	(1)	(2)	(3)
Farm×Drought×1966	−0.0639 (0.0114)	−0.0356 (0.0428)	−0.0581 (0.0602)
Farm×Drought×1967	0.0125 (0.0124)	−0.0135 (0.0129)	0.0109 (0.0164)
Farm×Drought×1968	−0.0435 (0.0121)	−0.0031 (0.0097)	0.0066 (0.0242)
Farm×Drought×1969	0.0006 (0.0093)	−0.0005 (0.0014)	−0.0037 (0.0344)
Farm×Drought×1970	−0.0472* (0.0282)	−0.0047** (0.0032)	−0.0491 (0.0372)
Farm×Drought×1971	−0.0512** (0.0241)	−0.0402** (0.0261)	−0.0610** (0.0303)
Farm×Drought×1972	−0.1187 (0.0802)	−0.0214*** (0.0090)	−0.0258 (0.0393)
Farm×Drought×1973	−0.1400 (0.9120)	−0.0307 (0.0311)	−0.0209 (0.0387)
Farm×Drought×1974	−0.0198 (0.4134)	−0.0085 (0.0155)	−0.0382 (0.0388)
Farm×Drought×1975	−0.0124 (0.0147)	0.0096 (0.0628)	−0.0117 (0.0397)
Dep var mean	0.215	0.148	0.089
Time Trend	Yes	Yes	Yes
District FE	Yes	Yes	Yes
Control Variables	Yes	Yes	Yes
Observations	303,277	418,379	270,582
Adjusted R2	0.031	0.065	0.102

Notes. *p<0.1; **p<0.05; ***p<0.01. Standard errors clustered at district level in parentheses. Sampling weights are applied.

4.3. Robustness Checks

We conduct some robustness checks by using alternative measures of the severity of the drought.[8] Instead of using the continuous variable, ***Drought***, as defined in equation (1), we use a dummy variable indicating high severity of the drought (Column 1 of Table 4). Also, we use a dummy indicating 1 if woman i resides in Jeollanam-do (Column 2 of Table 4). None of the estimates in column (2) are statistically significant, but the absolute values in 1971-1973 are higher than other years. Second, we regress a difference-in-differences analysis for farm households only and the results are summarized in Table 5. When using DID for the women of farm households, the effect of the drought on fertility seems to last longer.

Table 4 Results using alternative measures of 'Drought'

	Dependent variable: dummy Give Birth	
	Top 50% dummy	Jeonnam dummy
	(1)	(2)
Farm×Drought×1966	0.0042 (0.0066)	−0.0087 (0.0123)
Farm×Drought×1967	−0.0031* (0.0018)	−0.0040 (0.0031)
Farm×Drought×1968	0.0014 (0.0023)	0.0014 (0.0028)
Farm×Drought×1969	−0.0278 (0.0023)	−0.0019 (0.0046)
Farm×Drought×1970	−0.0045* (0.0025)	−0.0008 (0.0038)
Farm×Drought×1971	−0.0060** (0.0025)	−0.0237 (0.0182)
Farm×Drought×1972	−0.0171 (0.0096)	−0.0018 (0.0167)
Farm×Drought×1973	−0.0183** (0.0087)	−0.0201 (0.0123)
Farm×Drought×1974	−0.0144* (0.0085)	−0.0110 (0.0128)
Farm×Drought×1975	−0.0081 (0.0088)	−0.0078 (0.0121)
Dep var mean	0.178	0.178
Time Trend	Yes	Yes
District Fixed Effects	Yes	Yes
Control Variables	Yes	Yes
Observations	746,455	746,455
Adjusted R2	0.0943	0.0943

Notes. *p<0.1; **p<0.05; ***p<0.01. Standard errors clustered at district level in parentheses. Sampling weights are applied.

[8] Another possible alternative measure could be the difference between expected rice yields and actual rice yields in 1968. We can estimate the expected rice yields by using agricultural input data such as farm labor, capital, and land from Lee (2019). However, we need to be specific on the production function. Preliminary results of this attempt seemed to be sensitive to the specification.

Table 5 DID estimates for farm households

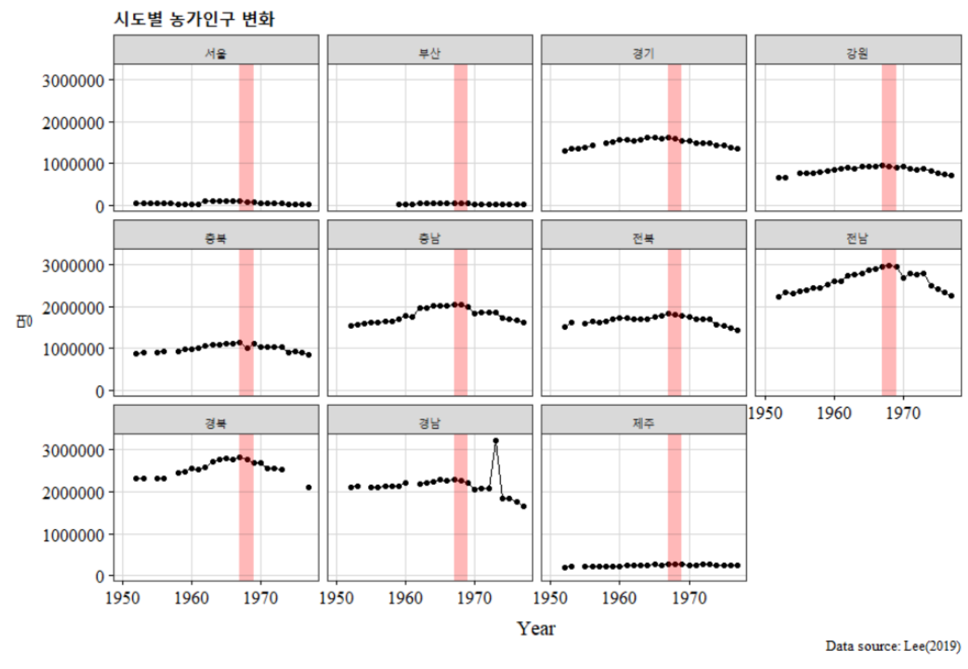
	Dependent variable: dummy Give Birth			
	All Ages	Age 20−29	Age 30−39	Age 40−49
	(1)	(2)	(3)	(4)
Drought×1966	0.002 (0.007)	−0.002 (0.011)	−0.006 (0.010)	0.001 (0.008)
Drought×1967	−0.002 (0.007)	−0.003 (0.012)	−0.005 (0.011)	0.004 (0.007)
Drought×1968	−0.003 (0.007)	0.008 (0.012)	−0.002 (0.010)	0.006 (0.008)
Drought×1969	−0.003 (0.007)	−0.006 (0.010)	−0.001 (0.012)	−0.001 (0.007)
Drought×1970	−0.015* (0.008)	−0.004 (0.009)	−0.002 (0.012)	0.001 (0.007)
Drought×1971	−0.022*** (0.007)	−0.024* (0.014)	−0.010 (0.010)	0.001 (0.010)
Drought×1972	−0.018** (0.008)	−0.024* (0.014)	−0.021** (0.009)	−0.014* (0.008)
Drought×1973	−0.018** (0.008)	−0.021 (0.014)	−0.018** (0.008)	−0.012 (0.009)
Drought×1974	−0.015** (0.007)	−0.010 (0.012)	−0.020* (0.012)	−0.011 (0.007)
Drought×1975	−0.018 (0.021)	−0.020 (0.014)	−0.015 (0.012)	−0.017** (0.008)
Dep var mean	0.181	0.186	0.204	0.141
Time Trend	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes
Control Variables	Yes	Yes	Yes	Yes
Observations	410,550	154,567	164,229	138,076
Adjusted R2	0.0991	0.0884	0.0877	0.0489

Notes. *p<0.1; **p<0.05; ***p<0.01. Standard errors clustered at district level in parentheses. Sampling weights are applied.

6. Discussion and Conclusion

A possible mechanism of the fertility decrease because of the drought is income loss. Although income data in the 1960s and 1970s in Korea is not available, abundant literature show that environmental shocks lead to income loss especially in the farm households or rural areas (Alam and Portner, 2018; Jung 2019; Sellers and Gray, 2019; Grimm, 2019). In the case of Korea, there was a drop in the size of the population in Kangjin−gun of Jeollanma−do in 1970 and there are historical records which report that numerous farm households migrated out of the rural areas after the 1968 drought due to income loss (Kangjin News). We can also find a drop in the farm population in Jeollanam−do in the agricultural data from Lee (2019) which is presented in Figure 3.

Figure 3 Changes in farm population by province



In this paper, we examine how fertility of farm households responds to natural disasters using the case of the 1968 drought in Korea. We provide reduced-form estimates for the effects of the drought. We find that the probability of giving birth among farm households decreased more in districts that suffered severely from the drought than in districts that suffered less from the drought. The negative effect which corresponds to 10~30% of the average fertility rate in the analysis period appeared after 2 years of the drought and lasted for about 1-3 years.

This paper contributes to the literature in some respects. First, we contribute to the literature on the relationship between natural disasters and fertility by examining the Korean case. By examining the case of Korea, we can provide evidence on how farm households change their childbearing behavior due to a relatively mild shock during demographic transition. Results are consistent with studies that focused on the fertility effect of crop loss, climate or temperature shock in farm households or rural areas.

Second, we also contribute to the literature on fertility in Korea by expanding the period of analysis to the past. The low fertility rates in Korea is not a recent one; it has been an ongoing transition since the 1960s and looking into the changes in fertility in the past would give implications to the low fertility trap in Korea.

There are some limitations in this paper and the primary one is measurement error. For the fertility data, I could not adjust for mortality due to lack of data on life tables during the period of analysis. This not only underestimates the actual fertility, but also may induce selection problems. For example, the decreased fertility may be a result of increased abortion or miscarriage due to income loss rather than the decreased intentions of parents to give births.

Also, because we use census data to estimate fertility which is not a panel data, we cannot consider migration, which can also lead to selection bias. For example, those who experienced a more severe drought may migrate with a higher possibility. Therefore, only those who were capable to cope with the drought may had remained in the region which was hit by a drought. In addition, our estimated fertility rates are underestimated because we excluded unmatched children from our sample when estimating fertility rates. In addition, data on agricultural outputs are also prone to errors since they are collected from historical data. Even with these fallbacks, we argue that these are at least the best among currently available data.

Another limitation is that we lack evidence on providing possible mechanisms. For example, when trying to identify if there was a causal relationship between the difference between the expected rice yields and the actual in 1968, we need an estimate for the expectation level. However, the results were sensitive depending on the production function used to estimate the expectation level. These issues should be addressed in further research.

It should be noted that the results presented in section 4 are preliminary and need to be complemented. As mentioned in section 3.2, the measure of the severity of the drought is subject to endogenous problems because the response to the drought may affect the amount of rice yields. Therefore, we could exploit rainfall data in district−level to estimate the severity of the drought which could be considered exogenous. In future research, we should also be meticulous in controlling the time trend since fertility was changing radically in the period of analysis. Fertility trends by region and by cohorts should be considered. Furthermore, migration rates need to be examined with respect to increased urbanization if there are available data on migration.

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Appendix

Figure A1. Single−year TFR across different sources

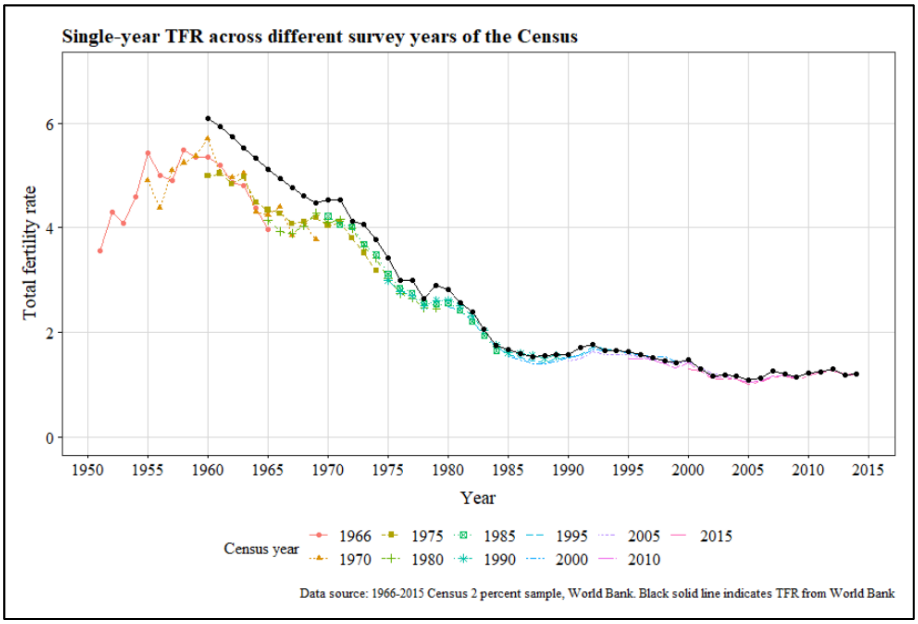


Figure A2. ASFR across different sources from year 1993

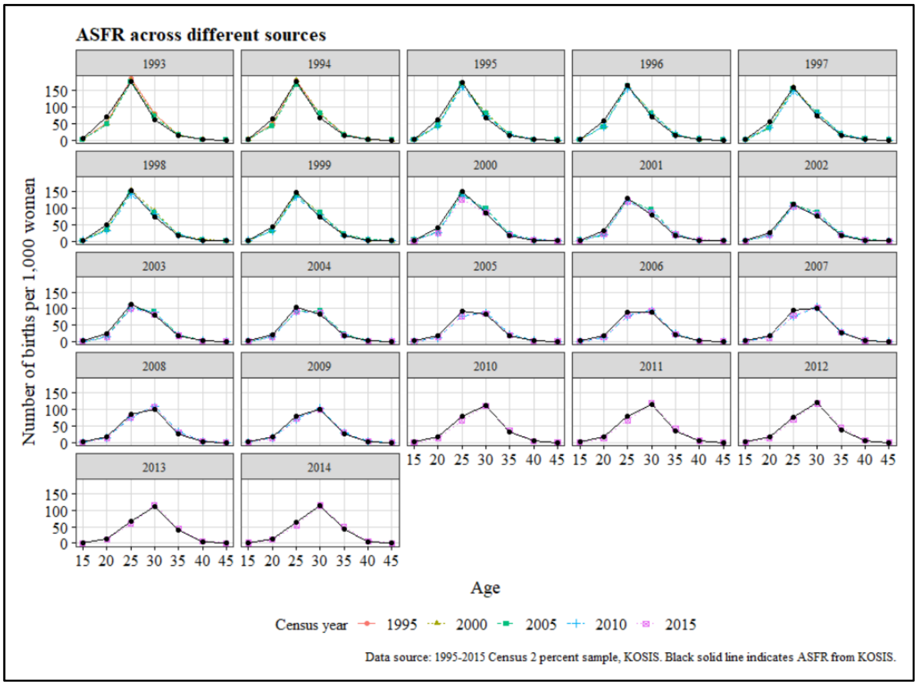


Figure A3. Changes in rice yields by province

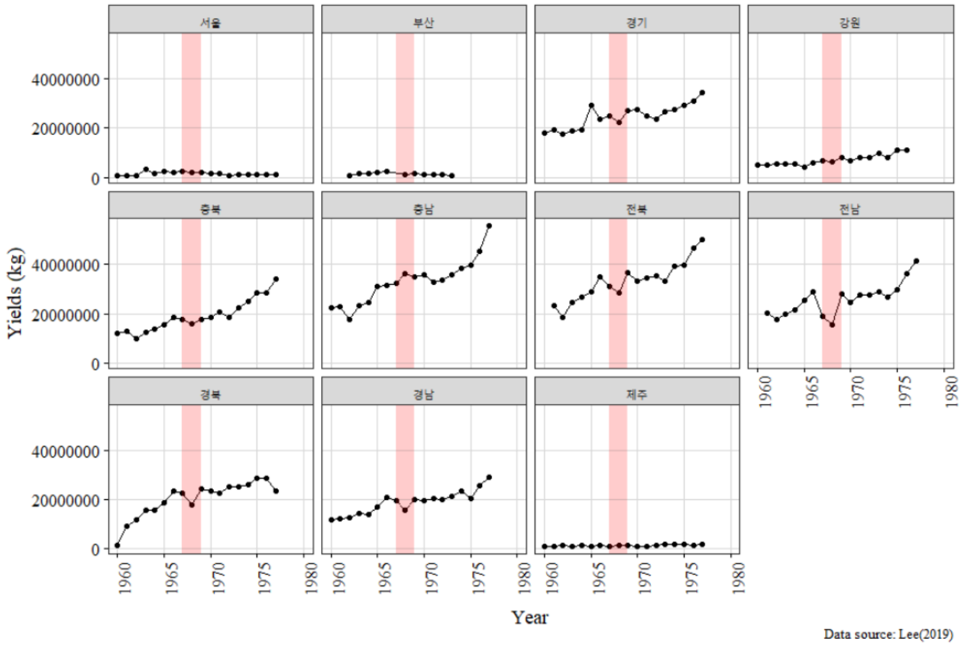
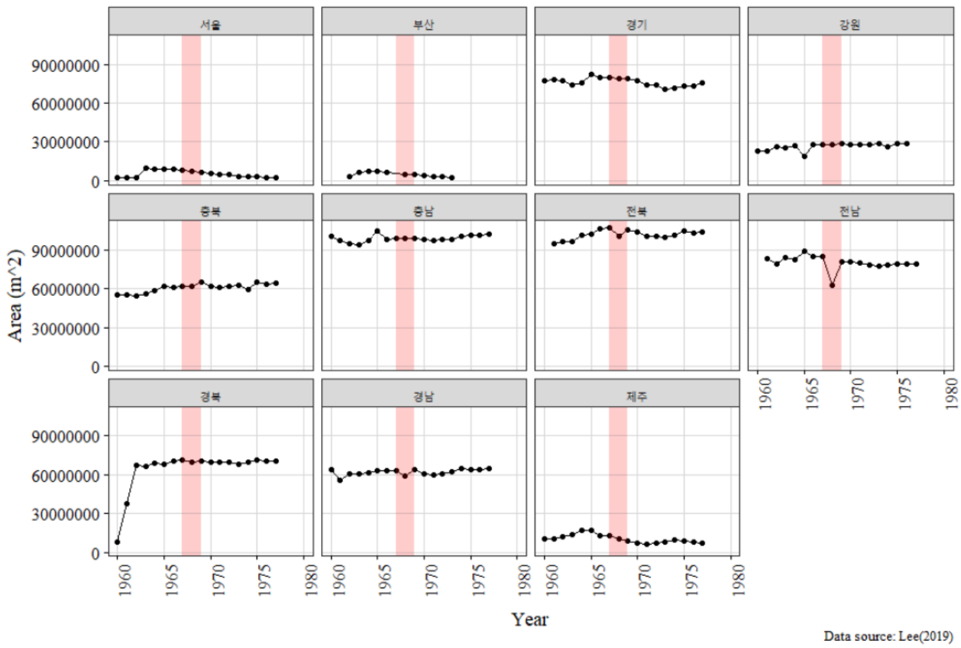


Figure A4. Changes in rice areas by province



국 문 초 록

자연재해는 인구 크기와 구조, 인적 자본 등을 변화시키는 경로를 통해 경제성장에 영향을 줄 수 있어 중요한 연구주제임에도 한국의 사례에 대해 알려진 바가 많지 않다. 이 논문은 우리나라 1968년 가뭄이 농가 출산율에 미친 영향을 분석하는 것을 목적으로 한다. Own-Child Method를 인구총조사 2프로 표본에 적용하여 추정한 1959년-1979년 출산율과 지역별 통계연보의 농업 관련 자료를 연결한 데이터를 사용하였다. 농가와 비농가, 지역별 가뭄의 피해 정도와 시간 등의 변이를 이용한 삼중차분 분석 결과는 가뭄의 피해가 컸던 지역의 농가에서 가뭄이 발생한지 1-2년 후에 출산율이 더 많이 감소하였으며 그 효과가 약 2-3년 동안 지속되었음을 보인다.

주요어: 출산 결정, 농작물 피해, 가뭄

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