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Pro-natalist Cash Grants and Fertility: A Panel Analysis*

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By exploiting variations in pro-natalist cash grant amounts across 225 municipal districts in South Korea from 2005 to 2010, we estimated the causal impact of cash grants on fertility. After controlling for administrative district fixed effects, a system GMM analysis revealed a rise in grant amounts by 1,000 USD increased the crude birth rate by 4.4%. The results imply that the required grant amount for one extra birth increases with the parity of births. The sub-group analysis by maternal age suggests that the grant may have a significant permanent impact on the completed lifetime fertility.

JEL Classification: D1, H31, I38, J13
Keywords: Fertility, Pro-natalist Cash Grant, Subsidy, Policy Impact

I. Introduction

Low levels of fertility have been common since the 1970s. According to the World Fertility Report conducted in 2009 by the United Nations, all developed countries and many developing countries have a total fertility rate below the replacement level

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of 2.1 children per woman (United Nations 2011).[1] The fall in fertility of South Korea (Korea hereafter) is even more astonishing. Starting at the high level of 6.1 in 1960, the fertility level rapidly dropped to the replacement level in 1983 and it continued to plunge to the remarkably low rate of 1.08 by 2005. In recent years, the level has been around 1.2, one of the lowest in the world. Such persistently low fertility levels and a population aging trend have dramatically increased the dependency ratio for the population aged 65 and over, and decreased the working-age population. Consequently, this has caused various socioeconomic issues such as the drop in productive potential, reduction in the tax base, and rise in social security expenditures to support the retired population. To counter declining fertility, many countries in North America and Western Europe adopted pro-natalist policies either explicitly or implicitly through childcare support.

As the country that experienced one of the most precipitous fertility rates drops of recent decades, the Korean government initiated “The First Basic Plan on Low Fertility and Aged Society” in 2006. The government invested approximately 17.7 billion USD from 2006 to 2010 to this nationwide program that spans a wide variety of policies including extended maternal/fraternal leave, health subsidies for childbirth, pro-marriage policies, and a child education subsidy for children under the age of 6.[2] In addition to such national level programs that are uniformly and identically administered in each district, municipal districts (counties in this paper) have provided cash grants to mothers of all newborn babies within the respective districts. This program is unique in that municipal governments provide universal cash grants in varying amounts per parity of births independent from, and in addition to, the nationwide program.[3] We exploit the variations in district level cash subsidy, in addition to identically applied national program to study the impact of cash grant on fertility.

In January of 2003, three of the 260 administrative districts first started providing universal cash grants for new births within the district. By end of 2011, most districts (229 out of 260) were providing such cash grants.[4] Local parliament of each district determine the availability and the amount of grant based on its current fertility and the past impact of its own or its neighboring districts’ past cash grants. This introduces endogeneity and we use GMM and county fixed effect specification to identify the impact of the cash grant on fertility.

[1] Among the 102 countries classified as developing nations by the United Nations, 32 countries have below replacement level fertility.

[2] The second wave of the program immediately followed the first wave that ended in 2010 and the similar set of policies is currently ongoing.

[3] Municipal districts require the residency for over typically 2 years to receive the grant.

[4] Administratively, Korea is divided into nine provinces and seven metropolitan cities. The provinces and major cities contains 260 sub-districts called “si,” “gun,” or “gu,” roughly translated as county.

The aforementioned pro-natalist programs aim to encourage births by reducing the cost of childrearing. The economic analysis of fertility inspired by Becker (1960) treats children as home-produced consumption goods. Thus, the theory predicts that the reduction in the cost of marginal child would result in an increase in fertility. However, this theoretical link may be empirically insignificant, depending on the magnitude of cost reduction. Children are expensive and discrete; hence, substantial subsidy amounts may be required to significantly increase the fertility level. Therefore, it is essential to empirically evaluate policies that aim to reduce childrearing costs. There are some empirical literatures that evaluate pro-natalist policies. The most notable studies include the evaluation of Canadian universal cash grants in Quebec province (Milligan 2005), and the evaluation of the Israeli child subsidy program (Cohen et al. 2013) and the Spanish universal child benefit program (González 2015). Milligan (2005) uses the natural experiment setting in a pro-natalist cash transfer for a newborn baby; Cohen et al. (2013) exploited the unanticipated variation in the child subsidy's degree for the third and higher parity births to identify the subsidy's impact on fertility; and González uses the universal and unexpected child cash benefit in Spain to identify the subsidy impact on fertility, expenditure and women's labor market participation. All studies find a statistically significant and economically substantial impact of child subsidies on fertility. (We discuss previous research in detail in section 2.)

This study contributes to the policy evaluation papers above that make causal inference between pro-natalist grants and fertility by utilizing monthly variation in per parity cash grant amount of over 200 municipal districts in South Korea for five-year period. Given the ample variation in cash grants, the analysis is not limited to bivariate comparisons of fertility outcomes between before and after a policy variation. Rather, we estimate the exact cost for an extra child per parity, using district fixed effects and GMM analysis, by exploiting an abundant local variations in subsidy amount and the timing of the onset of subsidy.

We construct district-by-month level panel data of Korea's cash grant for 2005-2010. Using the constructed dataset, this study accomplishes the following. First, we make causal inferences between fertility and the grant, addressing the endogenous selection issue. In particular, we control for time invariant district fixed effects, and used GMM for analysis. Second, we estimate the dollar amount necessary for the birth of a marginal child per birth parity. We utilize the variations in grant amount per parity to estimate the implied cost of a marginal child per parity of birth. Finally, we indirectly evaluate whether cash grants may increase completed fertility (i.e., permanent effect). We estimate the policy impact based on the mother's age to examine if older mothers, who are likely to have completed the lifetime target fertility, are affected by the cash grant.

To summarize our findings, cash grant increases of 1,000 USD increase the crude birth rate by 4.4%. Omitted variable bias in the OLS model is negative, as the impact increases when endogenous selection and missing variable issues are addressed. The cash grant amount necessary to engender extra childbirth increases by birth parity. The cash grant amount per extra child ranges from 596 USD for the first birth parity to 59,299 USD for the fifth and higher birth parity. The maternal age analysis reveals that the cash grant had significant impact on the crude birth rate of mothers aged 35 and older (for age ranges 35-39, 40-44, and 45-49), implying a significant permanent effect.

The rest of the paper is organized as follows: in section II, we introduce related literature; in section III, the dataset is explained; section IV details the identification strategy, results, and discussion; and section V discusses the subsequent policy implications of our findings.

II. Literature Review

In neoclassical fertility models pioneered by Becker (1960), children are considered a home-produced consumption good. Thus, household consumption of children is affected by income and the price of marginal children. The theoretical discussion of the income effect recognizes that both quantity and quality are important components of a child (Becker and Lewis 1973). According to this view, the combined child quality and quantity is normal and only one of the two components may increase with income.

Empirically establishing causal relationships between income and quantity of children is difficult because income level and the number of children are endogenously determined within households. Lindo (2010) uses the husband's job displacement as an exogenous income shock and finds that job displacement causes fertility decrease. The positive relationship between income and completed fertility is also shown in Black et al. (2013), which exploited the exogenous income shock in the Appalachian coal-mining regions following the price increase of coal in the 1970s. Lovenheim and Mumford (2013) use housing price variation as a proxy for wealth, and with data from the Panel Study of Income Dynamics, they show that housing wealth increases have a significant impact on fertility. In an empirical test of the impact of opportunity cost on fertility, the experiment study in rural India by Jensen (2010) makes a causal inference. He shows that women facing increased job opportunities have fewer children, comparing villages where recruiters visited and assisted in women's job searches with control villages that did not have such visits.

This paper is in line with the empirical literature that investigates the price effect on fertility. Although there is a clear theoretical link between the price of a marginal child and fertility, the actual impact and its magnitude poses an innately empirical question as children are discrete and expensive. In the United States, the government does not implement exclusive pro-natalist programs such as paid maternity leave or family allowances, but the implicit tax exemption program provides financial incentive for each marginal child. In addition, welfare recipients' cash assistance amounts per child have been varied in several states, with reform policies widely known as the "family cap" or "child exclusion." However, studies find that tax exemption or welfare reforms have little to moderate impact on fertility (Whittington et al. 1992; Acs 1996; Kearny 2004). Using French tax incentives, Chen (2011) also finds statistically significant but economically insubstantial results. Four recent papers find strong positive impacts of exclusively pro-natalist subsidies on fertility, using individual level datasets. Milligan (2005) uses the universal cash baby bonus in the province of Quebec, Canada as a natural experiment. Laroque and Salanié (2008) assess the variation in tax credits and benefits in France. Cohen et al. (2013) exploits the unanticipated annual policy changes in the Israeli baby bonus program for the third and higher parity births as a natural experiment. Finally, González (2015) exploits unexpected introduction of universal child cash subsidy in Spain as a natural experiment.

III. Data

There are nine provinces and seven major cities in Korea, which are comparable to state-level governments; each province consists of dozens of municipal districts. To examine municipal pro-natalist cash grants' effect on fertility, we use panel data constructed across 225 municipal districts for every month in 2005-2011.[5] Although some municipal districts began providing pro-natalist programs in 2002, it was more actively adopted beginning in 2006, when the Korean central government initiated a national policy named "The First Basic Plan for Low Fertility and Aged Society" that lasted until 2010. As a result of the national effort, most municipal districts adopted the cash grant program by 2010. In most municipal districts, a one-time cash transfer to any household that gives birth, typically varying by birth parity, is the primary policy tool.[6] We compiled the municipal month level cash grant dataset through telephone surveys with the government officials overseeing the program in each municipal government. In particular, we surveyed the year and month when

[5] The total number of municipal districts was 260 in 2010. Some large districts within the same province have been split over the years; some small districts form one large city were combined as one municipal government. We dropped these districts because we cannot obtain consistent fertility rate and childbirth grant measures. We also excluded some districts that did not have a complete set of control variables. Eventually, 225 districts were chosen with which to construct the panel data.

[6] The cash grant requires recipients to be in registered residences in the district for at least one year. As such, selective migration may be a concern. However, considering the required explicit and implicit moving cost, the probability of selective migration may not be substantial. On the other hand, some of the municipal districts provide secondary non-pecuniary services including vaccination support, and some districts provide cash subsidies in installments over a one to five year period.

the program was introduced and revised, the grant amount by birth order, and grant changes from 2005 to 2010.

Then, we matched grants with monthly fertility rates after 12 months during 2006-2011. We included the time delay as it takes time for pregnancy decisions to be made in response to grant amount changes. Accordingly, one-year-lagged matching reflects the time difference between childbearing planning and actual childbirth. A one-year lag was selected because fertility rates responded more substantially to the grant amount one year before childbirth than at any other time lag (we will revisit this issue in Section 4.1.). In summary, we utilized monthly variations in the grant and following year's fertility rate in order to examine the causality between the two variables.

As a proxy for fertility, we calculated the monthly crude birth rate per 1,000 women (CBR) for each municipal district. The rate was measured as the total number of newborn babies born to mothers aged 20-39 in a given month, divided by the total number of female residents aged 20-39 in the corresponding month. Fertility data per county per month was calculated using the complete birth records data from Statistics Korea, and age-specific female population per county was from the current residence vital statistics data from the Ministry of Government Administration and Home Affairs. We also measured CBR by birth parity (from first child to fifth child), using the total specific parity number of newborn babies as the numerator in the above calculation. Some may argue that total fertility rate (TFR)—the average number of children that would be born to a woman over her lifetime—is a better fertility rate measure. However, the total fertility rate has been annually reported at the municipal district level, and its monthly value does not exist. Thus, we mainly use crude birth rate in the monthly data analysis. In section 4.4, we conduct annual data analysis by employing total fertility rate and show that the effect of the cash grant program is similar in both cases.

Finally, in an attempt to include more years prior to the implementation of the policy we found the total female population per county per year which dates back to 1992. However, the complete birth records per county only dates back to 1997. Therefore, we divide the total number of babies per county per year by the total female population per county per year back to 1997 and test if the policy impact is robust to per county time trend as well.

Table 1 shows the summary statistics of the variables used in this study, including the counties that had zero subsidy. Panel A shows the monthly crude birth rate per 1,000 women. Across parities, the fertility level in 2007 and 2010-2011 is above the six-year average, but there is no apparent pattern. Panel B shows the one-year lagged pro-natalist grant amount for newborn babies; each value is the annual average of monthly variables across municipal districts. The variable is measured in constant 2010 USD for better interpretation.[7] The "average amount" of pro-natalist

[7] We first changed the nominal value of pro-natalist grants measured in KRW into real values using

[Table 1] Summary Statistics

Variables	Mean	S.D.	Annual Average					
Panel A: Monthly crude birth rate per 1,000 women aged 20-39 / Monthly variable								
Year			2006	2007	2008	2009	2010	2011
Total CBR	5.13	1.42	4.68	5.35	5.03	4.97	5.34	5.39
First child	2.52	0.76	2.31	2.73	2.51	2.45	2.53	2.60
Second child	1.97	0.68	1.81	1.99	1.92	1.94	2.10	2.07
Third child	0.55	0.37	0.49	0.55	0.52	0.50	0.59	0.62
Fourth child	0.07	0.11	0.06	0.06	0.06	0.06	0.08	0.08
Fifth child	0.02	0.06	0.01	0.01	0.01	0.01	0.04	0.03
Panel B: One-year-lagged pro-natalist cash grant (USD 1,000) / Monthly variable								
Year			2005	2006	2007	2008	2009	2010
Average grant	0.24	0.42	0.05	0.09	0.24	0.29	0.35	0.43
First child	0.08	0.24	0.02	0.03	0.08	0.09	0.11	0.15
Second child	0.26	0.54	0.05	0.08	0.27	0.32	0.39	0.46
Third child	0.79	1.24	0.15	0.31	0.74	0.97	1.15	1.40
Fourth child	0.90	1.46	0.18	0.34	0.81	1.09	1.33	1.67
Fifth child	0.99	1.69	0.21	0.37	0.86	1.16	1.45	1.86
Panel C: One-year-lagged control variables / Annual variable								
Year			2005	2006	2007	2008	2009	2010
Childcare infrastructure								
Childcare facilities (num. per 1,000)	0.18	0.17	0.12	0.16	0.17	0.21	0.22	0.22
Financial independence (%)	29.19	16.88	30.28	28.79	27.87	28.15	28.66	31.41
Demographic factors								
% of elderly (age > 65) populations	14.03	6.91	12.48	13.06	13.75	14.46	14.93	15.51
Marriage rate per 1,000	5.93	1.19	5.73	6.10	6.30	5.97	5.61	5.89
International marriage rate per 1,000	0.29	1.05	0.25	0.27	0.23	0.25	0.46	0.30
Divorce rate per 1,000	2.34	0.45	2.44	2.40	2.38	2.21	2.37	2.25
Economic factors								
% of welfare budget	8.31	6.20	7.71	7.42	7.39	8.08	9.48	9.80
Unemployment rate (%)	3.05	0.98	3.26	2.96	2.83	2.81	3.20	3.27
Female unemployment rate (%)	48.87	2.80	48.84	49.24	49.36	49.19	48.41	48.20
House price index	87.68	9.20	80.97	83.57	88.34	89.19	90.83	93.20
House rent index	83.23	8.23	76.96	79.71	83.49	84.89	85.74	88.59

Note: The table presents variable sample means. The total number of district-by-month samples is 16,200. Crude birth rate (CBR) is measured over 2006-2011. Total CBR is measured by summing all the CBRs by birth parity. The variables in panels B and C are one-year-lagged and so measured over 2005-2010. Average grant amount is measured by the weighted average of the pro-natalist grant by birth parity, using the ratio of newborn babies by parity as weights. The CBR and grant variables are measured at the monthly level; those in panel C are measured at the annual level. The base year and month for house price and rent indexes is December 2008. The nominal pro-natalist cash grant amount was converted in constant 2010 US dollars after adjusting inflation with monthly consumer price indexes. More information on each variable is discussed in the text.

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the monthly consumer price index (*source*: Korean Bureau of Statistics, Dec. 2010 = 100). Then, we converted values into US dollars using the 2010 average currency exchange rate (*source*: Bank of Korea, 1 USD = 1,134.8 KRW).

grants, which will be used as a key variable to measure the overall effect of the program, is estimated as a weighted average of each birth parity's grant amount, using the ratio of newborn babies by parity as weights. It is observed that the average grant amount increases by birth parity. In addition, the average value rises over time; in 2005, approximately 50 USD was given per birth on average, but the average value increases by eight-fold to approximately 420 USD in 2010.

A more detailed description of crude birth rates and cash grants is shown in Figure 1. According to panel (a), the monthly CBR shows no apparent trend over the time period considered. For example, there seems to be a tendency toward more births in January over December, perhaps driven by parental preferences.[8] The trend in the average grant in panel (b) also displays discontinuity in January because most municipalities typically enact new codes in this month. There is a slight continuous increasing trend during the year but a discrete jump in January is apparent. Panel (c) shows that, along with the average grant, the number of municipal districts providing the grant also increases over time. In panel (d), we show a potential association between crude birth rate and grants. We plot the one-year lagged average grant on the residuals from an OLS analysis that takes the month-by-district-level crude birth rate as the dependent variable on month, district and province-by-year fixed affects.[9] The crude birth rate, unexplained by time or local characteristics, increases over the lagged average grant, strongly suggesting a positive influence of pro-natalist cash grants on improving the crude birth rate. The jump between 2007 and 2008 is clearly noticeable, as in panel (b), the average grant amount rose precipitously between 2006 and 2007. There is a slight drop since 2010, when almost all counties started the grant program.

In addition to the cash grant amount, we controlled for various municipal district level factors that can account for fertility rate variation. They include 1) the number of childcare facilities per 1,000 populations, 2) financial independence index (%) measured by the percent of municipal tax revenue relative to annual municipal budget, 3) percent of the population aged over 65 out of the total population, 4) crude marriage rate per 1,000, 5) crude international marriage rate per 1,000,[10] 6) crude divorce rate per 1,000, 7) percent of municipal budget related to welfare programs, 8) unemployment rate (%), 9) female unemployment rate (%), 10) house

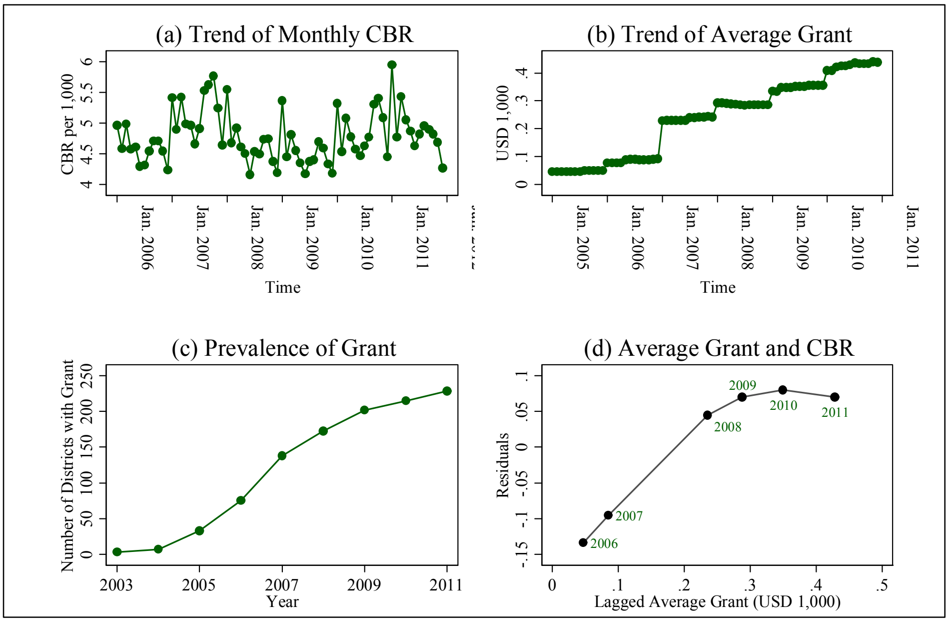
[8] In South Korea, age is counted by calendar year. Everyone who is born in the same calendar year is considered to be of the same age. Therefore, a child born on January 1st of a given year is considered one year younger than a child born a day earlier, on December 31st of the previous year. Therefore, parents may prefer to give birth in January than in December, given a choice, to make their offspring a year younger. Additionally, the month cutoff for school enrollment is February, giving parents incentive to have babies in January and February in order to send them to school a year earlier.

[9] We use the square root of total female populations aged 20-39 as the regression weight.

[10] The crude marriage rate is the total number of marriages in the year divided by the mid-year total population. Crude international marriage rates and crude divorce rates are similarly defined.

price index, and 11) house rent index.[11] Each variable above is measured annually at the district level rather than monthly; house and rent price indexes are measured at the province level using 2008 as the base year. Their mean values by sample year are reported in Table 1.

[Figure 1] CBR and Pro-natalist Grant Trends and Relationship



Note: Panels (a) and (b) show the monthly total CBR trend and average pro-natalist grant amount, respectively, across municipal districts. Note that CBR is measured over 2006-2011, but the pro-natalist grant is measured over 2005–2010. The definition of each variable and conversion into real variables are discussed in the note for Table 1. Panel (c) shows how the number of municipal districts with the pro-natalist program changed during 2003-2011. In 2011, all of the sample districts had the program. For panel (d), we ran an OLS regression of monthly CBR on month, district, and province-by-year fixed effects. Then, we plotted the one-year-lagged average grant in Table 1, panel B against the annual average of the residuals estimated from the above regression.

[11] The source of each control variable is as follows: 1) Korea Childcare Statistics; 2) KOSIS(KOrea Statistical Information Service: kosis.kr)-Financial Independence Index by municipal district; 3) KOSIS-Population statistics based on residence registration; 4) ~ 5) KOSIS-Population Statistics-Marriage; 7) Local Finance Integrated Open System (lofin.moi.go.kr); 8) ~ 9) KOSIS-Employment; and 10) ~ 11) KOSIS-National Housing Price Trend.

IV. Estimation Results

4.1. OLS Estimation

We first ran OLS regressions to estimate the correlation between pro-natalist cash grants and crude birth rate as follows:

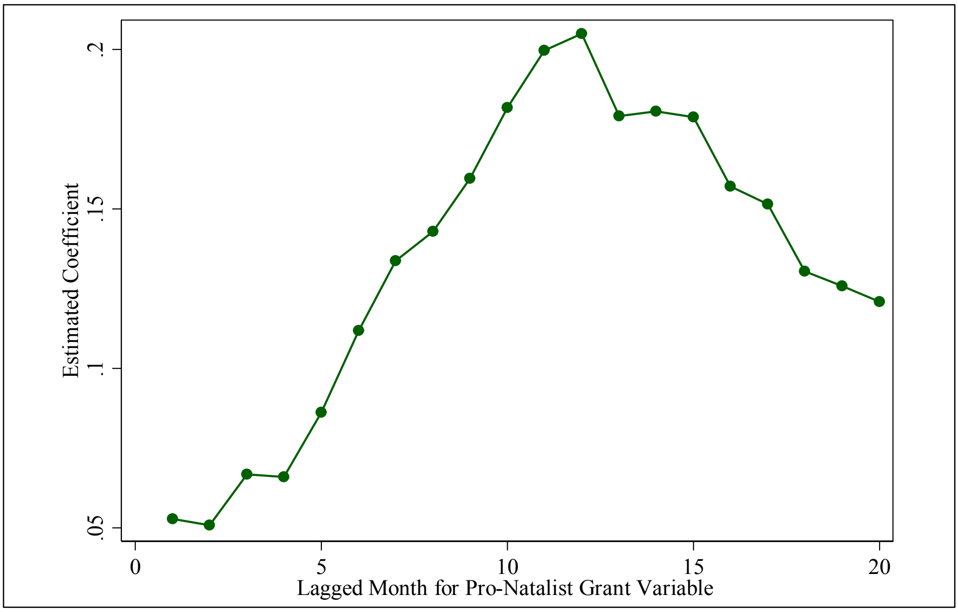
$$CBR_{ijt} = \alpha + \beta Grant_{ijt-12} + \sum_{k=6,12} \gamma_k CBR_{ijt-k} + X_{ijt-12}\Gamma + \delta_t + \delta_{j\times y} + \varepsilon_{ijt} \quad (1)$$

where i indexes the administrative district in province j and t denotes the month in year y. CBR_{ijt} indicates the total crude birth rate. We assume that total CBR at t depends on the 12-month-lagged average grant, $Grant_{ijt-12}$. We also control for six- and twelve-month-lagged CBR to reflect its trend as the AR(2) model does. X_{ijt-12} is a vector of twelve-month-lagged variables that show municipal-specific characteristics, which are listed in panel C of Table 1. δ_t and $\delta_{j\times y}$ denote month fixed effects and province-by-year fixed effects, respectively. They will capture the seasonality of fertility rates, and partially reflect province-or/and year-specific omitted variables such as alternative fertility promotion policies. Finally, the number of births and the number of females is considerably different across the municipal districts. Thus, we use the square root of the number of females aged 20-39 as the regression weight.[12]

Before discussing the estimation result, it is necessary to explain why we use the twelve-month-lagged specification. The association between the lagged grant and crude birth rate—i.e., β in equation (1) above—seems to peak in twelve months. Figure 2 shows the plot of the coefficient β using one- to twenty-month lagged grant variables, as shown on the horizontal axis. The coefficient is estimated by equation (1), varying the lagged terms. The correlation increases as longer lagged terms are employed, peaks at twelve months, and attenuates over time. This suggests that potential parents responded substantially to the grant provided one year before childbirth or, more likely, the pregnancy decision was made. Despite that human gestation lasts about 40 weeks, 12 weeks less than twelve months, figure 2 suggests that it takes a few months on average, before a successful conception.

[12] We use square root values as regression weights to adjust the scale of populations. We also used alternate weights, female populations aged 20-39 without square roots and total female populations. The estimation results are robust and qualitatively similar across weights.

[Figure 2] Effect of Lagged Pro-natalist Cash Grant by Specification



Note: The figure shows the plot of the coefficient β in equation (1) using one- to twenty-month-lagged grant variables, as shown on the horizontal axis.

The estimation results based on equation (1) are summarized in Table 2. Model (1), which controls only for lagged average grant and CBRs, shows a statistically significant, positive effect of pro-natalist cash grants. However, the coefficient becomes smaller and insignificant as we include additional explanatory variables in models (2)-(4). This means that total CBR is highly correlated with childcare infrastructure, demographic factors, and socioeconomic status at the district level as much as the lagged average grant. However, the effect of the cash grant becomes larger and statistically significant when month and province-by-year fixed effects are added in models (5) and (6). These models rule out various channels through which time and local characteristics are correlated with both CBR and pro-natalist grants. In the fully specified model (6), the magnitude of the coefficient suggests that a cash grant increase of 1,000 USD is correlated with an increase in the crude birth rate per 1,000 by 0.1810. According to Table 1, the average crude birth rate over the past six years is 5.13 per 1,000. Thus, the marginal effect implies an increase in the crude birth rate by 3.5%.[13] We discuss how to evaluate its magnitude in more detail in Section 4.3.

[13] 3.5% = 0.1810 / 5.13 x 100.

[Table 2] OLS Estimation: Effect of Average Pro-natalist Cash Grant on Total Crude Birth Rate

Dependent variable: Crude birth rate (CBR) per 1,000 at *t**

Control variables at *t*-12	Lagged CBR	Child care Infra-structure	Demo-graphic factors	Economic factors	Month FE	Province-by-year FE	Annual analysis with time trend by county
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Average pro-natalist grant	0.1197**	0.0577	0.0557	0.0906	0.0981*	0.1810***	0.8675***
	(0.0480)	(0.0476)	(0.0573)	(0.0565)	(0.0568)	(0.0402)	(0.2021)
6-month lagged CBR	0.4542***	0.4403***	0.4232***	0.4208***	0.5093***	0.4455***	
	(0.0222)	(0.0193)	(0.0209)	(0.0200)	(0.0212)	(0.0158)	
12-month lagged CBR	0.4207***	0.4146***	0.3952***	0.3989***	0.2951***	0.3494***	
	(0.0173)	(0.0193)	(0.0184)	(0.0179)	(0.0157)	(0.0157)	
Childcare facilities		-0.0382	-0.0411	0.0154	0.0149	-0.0825	
		(0.1052)	(0.1125)	(0.1164)	(0.1160)	(0.1090)	
Financial independence		-0.0063***	-0.0073***	-0.0073***	-0.0074***	-0.0082***	
		(0.0014)	(0.0017)	(0.0017)	(0.0017)	(0.0018)	
% of elderly populations			0.0141***	0.0176***	0.0175***	0.0158***	
			(0.0030)	(0.0040)	(0.0040)	(0.0039)	
Marriage rate			0.0719***	0.0713***	0.0793***	0.1530***	
			(0.0246)	(0.0252)	(0.0255)	(0.0296)	
International marriage rate			0.0085	0.0094	0.0091	0.0046	
			(0.0078)	(0.0086)	(0.0085)	(0.0091)	
Divorce rate			0.0530	0.0315	0.0316	-0.0361	
			(0.0508)	(0.0527)	(0.0525)	(0.0617)	
% of budget for welfare				0.0054*	0.0051*	-0.0011	
				(0.0032)	(0.0030)	(0.0025)	
Unemployment rate				0.0284	0.0195	-0.0006	
				(0.0303)	(0.0303)	(0.0565)	
Female unemp. rate				-0.0017	-0.0016	0.0527**	
				(0.0085)	(0.0085)	(0.0261)	
House sale index				-0.0018	-0.0015	0.0053	
				(0.0029)	(0.0029)	(0.0035)	
House rent index				-0.0083***	-0.0084***	-0.0062*	
				(0.0031)	(0.0030)	(0.0032)	
Constant	0.6284***	0.9704***	0.4415**	1.2157**	1.8585***	-1.8526	
	(0.0828)	(0.1092)	(0.1765)	(0.5276)	(0.5276)	(1.4909)	
Adj. R-squared	0.612	0.618	0.622	0.625	0.652	0.706	0.931

Note: We estimate the effect of pro-natalist cash grants on crude birth rate, per equation (3). The total sample size is 16,200. All the control variables are twelve-month lagged. We additionally included explanatory variables from models (1) through (6), which are indicated in the model specification headings. Standard errors clustered at the district level are reported in parentheses. A single asterisk denotes statistical significance at the 90% confidence level, double asterisks 95%, and triple asterisks 99%. *In specification (7), the dependent variable is the number of birth out of total female population per county per year. The specification only includes year; year interacted with county fixed effects; the quadratic terms of the interaction terms; and annual average pro-natalist grant as regressors.

Model (7) is an OLS estimate that dates back to 1997, as it is the earliest year that per county birth record is available. We use annual crude birth rate as the dependent variable. In this model, we include the year, year by county fixed effects and their quadratic terms with the annual average subsidy amount as regressors to determine the impact of subsidy on fertility, controlling the time trend per county. The result shows that the subsidy has significant and positive relationship with fertility after controlling for year, county fixed effects, and year by county fixed effects. Considering that the dependent variable is annual births over the total female population, the magnitude of coefficient on subsidy is quite similar to other models.[14]

The coefficients of six-month- and twelve-month-lagged CBRs are statistically significant and positive across models, indicating a municipality-specific time trend in the crude birth rate. Financial independence is negatively correlated with birth rate; this seems to reflect urbanization's fertility patterns as most municipal districts with a good financial status are located in urban areas. The positive coefficient of the percentage of elderly population seems to indicate that potential caregivers reduce the cost of childrearing. This may also be indicate that districts with more elderly population are predominantly rural, and the female opportunity cost may be smaller in those areas than in urban areas. Marriage rate is also positively correlated with the crude birth rate across specifications, but international marriage rate is not. Higher ratios for welfare budget led to higher crude birth rates, probably reflecting the role of various social programs. Model (6) suggests that women's work can reduce the fertility rate. Finally, the negative coefficient of the rent index means that housing cost can be a key factor in fertility decision making.

4.2. Panel Analysis

Two types of selection are possible in the above analysis. Districts that are more concerned about low fertility rates would provide more pro-natalist cash grants. Districts with higher incomes would not only have higher fertility rates due to income effects, but also a greater capacity to provide grants. Although we controlled for lagged crude birth rate and the level of financial independence in the previous regressions, the existence of potential omitted variables systematically related to fertility may escalate the problem of endogeneity.

Minimizing the potential selection problem, we try to identify the causal relationship between neonatal program and crude birth rate by utilizing two panel-analysis approaches. The first approach is to add municipal district fixed effects in equation (1) above. This captures time invariant district specific omitted variables. In the second approach, we ran the system GMM estimation, which uses all of the

[14] For model (7) we expand our analysis back to 1997 when the first complete birth record data is available. The age-specific female population data, however, is unavailable back to 1997 hence we are limited to using the total female population per county per year to calculate CBR.

lagged dependent and independent variables as the instrumental variables. For example, in equation (1), the endogenous independent variable $Grant_{ijt-12}$ will be instrumented using the lagged dependent and independent variables up to the period $t-13$. This is another attempt to alleviate the selection bias by controlling for the county-specific characteristics, similar to the fixed effect approach. For the GMM analysis, we use annual district level data because the computational demand is extremely high when monthly data are used. Annual data was constructed by summing up monthly crude birth rate by district, taking the monthly average of the grant, and taking the annual values for other variables.

[Table 3] District Fixed Effects and System GMM Estimations

Dependent variable: Crude birth rate (CBR) per 1,000

	Monthly Data Analysis		Annual Data Analysis		
	OLS	County FE	OLS	County FE	GMM
Estimation model:	(1)	(2)	(3)	(4)	(5)
	Panel A: Baseline				
Lagged grant	0.1810***	0.2260***	1.7296***	2.3731***	2.5210***
	(0.0402)	(0.0572)	(0.4413)	(0.7207)	(0.6605)
Sample size	16200	16200	1350	1350	1350
Adj. R-squared	0.706	0.760	0.884	0.912	
	Panel B: Only using counties with non-zero grant				
Lagged grant	0.2321***	0.2993***	2.1567***	2.9246**	3.2476***
	(0.0482)	(0.0736)	(0.5106)	(1.1288)	(0.7667)
Sample size	9740	9740	826	826	826
Adj. R-squared	0.738	0.807	0.911	0.949	

Note: Panel A uses all the month-county or year-county sample, regardless of the size of grant. Panel B uses only the counties with non-zero grant. Model (1) is a regression per equation (1); model (2) adds municipal-district fixed effects. Models (3)-(5) use annual panel data aggregated across months for each district. Model (3) represents an OLS regression, whose specification is the same as equation (1). Model (4) also includes district fixed effects. Finally, model (5) uses system GMM, where we employ all the lagged dependent and independent variables as the instrumental variables. In all of the models, we report only the coefficient of lagged pro-natalist cash grant and standard error, clustered at the district level, in parentheses. For the GMM estimation in model (5) of Panel A, the p-value for the AR(1) test is 0.000, and 0.082 for the AR(2) test, which suggests the existence of endogeneity. A single asterisk denotes statistical significance at the 90% confidence level, double asterisks 95%, and triple asterisks 99%.

Panel A in Table 3 summarizes the estimation results of these two approaches using total crude birth rate. Models (1) and (3) present the corresponding OLS regression results using monthly and annual data, respectively. Models (2) and (4) control for district fixed effects. Model (5) is based on the system GMM analysis. Comparing the results from model (2) and model (5), they show that a rise in the grant amount of 1,000 USD increases the crude birth rate by 4.4% and 4.1%, respectively. These findings highlight several key points. First, in both the monthly and annual analysis, the result of district fixed effects suggests that the OLS estimation can slightly underestimate the effect of pro-natalist cash grants on birth rates. This implies that the districts with (omitted) characteristics negatively correlated with the fertility rate have provided more grants for childbirth, i.e., negative selection. Second, the comparison of coefficients shows that the estimated effect on annual crude birth rate is similar with that of monthly crude birth rate after adjusting the time period twelve months.[15]

On the other hand, we conduct the same regressions in Panel B only using counties that provide the subsidies. They are useful for measuring the marginal effect the counties that provide non-zero subsidies. The estimated coefficients are higher across estimation models than their counterparts in Panel A. The coefficient of model (2) in Panel B implies that a rise in the grant amount of 1,000 USD increases the crude birth rate by 5.8%. This suggests that there is a non-linear relationship between grants and CBR. In this paper, we focus on measuring average effect considering the difference between counties with and without grants.

4.3. Analysis by Parity and Magnitude

In Sections 4.1 and 4.2, we examined whether the average grant amount had significant impacts on total crude birth rates. In this section, we estimate the effect by birth parity. As discussed in Section 3, the grant amount is increasing with birth parity; accordingly, the marginal effect of pro-natalist grants on birth rates may vary by the parity of birth. Each panel of Table 4 employs birth-order specific crude birth rates and grants, but uses the same model specifications with those used in Table 3.

Table 4 clearly shows that the impact decreases with each subsequent parity of birth across models. For example, in model (2) that uses monthly data and district fixed effects, the impact of pro-natalist grants on the monthly crude birth rate is quite strong for the first and the second child. The impact, however, is either statistically insignificant or too small in magnitude for the higher birth parities. The same pattern is found in the annual data analysis.

[15] For example, the coefficient in model (2) suggests that the 1,000 USD increase in childbirth grants increases the monthly crude birth rate by 0.2260 per 1,000, or annual crude birth rate by 2.7120 per 1,000 (0.2260 × 12 months). This is similar with the coefficients in models (4) and (5).

[Table 4] Estimated Effect of Pro-natalist Cash Grant on CBR by Birth Parity

Dependent variable: Crude birth rate (CBR) per 1,000

	Monthly Data Analysis		Annual Data Analysis		
	OLS	District FE	OLS	District FE	GMM
	(1)	(2)	(3)	(4)	(5)
	Panel A: First Child				
1st child:	0.2409***	0.2487***	1.9031***	2.5130***	3.3115***
Lagged grant	(0.0452)	(0.0776)	(0.3892)	(0.8958)	(0.6861)
	Panel B: Second Child				
2nd child:	0.0881***	0.0965***	0.6496***	0.9619***	0.9302***
Lagged grant	(0.0249)	(0.0282)	(0.2245)	(0.3140)	(0.3553)
	Panel C: Third Child				
3rd child:	0.0101**	0.0072	0.0353	0.0599	0.1210*
Lagged grant	(0.0041)	(0.0044)	(0.0317)	(0.0633)	(0.0635)
	Panel D: Fourth Child				
4th child:	0.0029***	0.0025**	0.0290***	0.0347**	0.0494***
Lagged grant	(0.0009)	(0.0012)	(0.0093)	(0.0169)	(0.0161)
	Panel E: Fifth Child				
5th child:	0.0004	0.0002	0.0040	0.0022	0.0107*
Lagged grant	(0.0003)	(0.0003)	(0.0027)	(0.0034)	(0.0059)

Note: This table uses the same estimation models as Table 3, but each panel denotes the specified birth order (from first child to fifth child). Thus, here we use birth-order specific crude birth rate and pro-natalist cash grant factors. Other control variables are the same with those in Table 3. In each model, we report only the coefficient of lagged pro-natalist cash grant and standard error, clustered at the district level, in parentheses. A single asterisk denotes statistical significance at the 90% confidence level, double asterisks 95%, and triple asterisks 99%.

To evaluate the effectiveness of the cash grant across birth parities, we measured how many extra babies were born per 1,000 USD and what grant amount is sufficient to induce additional childbirth in Table 5. We conducted this analysis up to the third birth parity, as the fourth and fifth birth parities are quite rare, as is shown in Table 1. The numbers in row (A) are the coefficients estimated in model (2) of Table 4 per birth parity and in model (2) of Table 3 for the total. Row (B) shows the 2005-2010 average grants among the districts that provided non-zero cash grant amounts. For example, the average grant for the first parity of birth was 238.6 USD. Thus, the average extra number of first children in districts with the program is estimated as 0.0593 per 1,000 (= 0.2487 × 0.2386) as shown in row (C). Because the average first-child crude birth rate during 2006-2011 is 2.5223 per 1,000 (row (D), approximately 2.35% of newborn first children were marginally instigated by the cash grant as presented in row (E). We can also estimate the total municipal expenditures for the cash grants by multiplying the number of newborn babies and the amount of the grant, using the monthly raw data. Row (F) shows that the 225 sample districts granted about 36.8 million USD in the first parity births during

2005-2010. Row (G) shows that the number of newborn first children in the sample districts from 2006 to 2011 was 1,361,587. We use the marginal effect of 2.35% from row (E) to estimate that about 32,038 newborn first children (i.e., 2.35% out of total newborns) would be affected by the pro-natalist program conducted in 2005-2010 (row (H)). Finally, we divide rows (H), the total extra number of newborn first children by row (F), the total cash grant for the first child, to estimate that about 0.87 extra first children were born per 1,000 USD additional cash grant funds. The corresponding number is 0.03 for the second child and 0.006 for the third child. The effectiveness of the program substantially declines for higher parities, particularly from the third child on. Row (J) shows that 1,149 USD was required to instigate an additional first child. The value substantially increases in birth parity such that 156,852 USD was needed for an additional third child.

[Table 5] Estimating the Effectiveness of the Pro-natalist Cash Grant

	Variables and description	First	Second	Third
(A)	Coefficient in model (2) of Table 4	0.2487	0.0965	0.0072
(B)	Average pro-natalist grant among districts with the programs (USD 1,000)	0.2386	0.0821	0.2613
(C)	Implied marginal effect (=A × B)	0.0593	0.0079	0.0019
(D)	Average CBR from Table 1	2.5223	1.9731	0.5450
(E)	How many births were affected by the pro-natalist program? (%) (= C / D × 100)	2.35	0.40	0.35
(F)	Total expenditure of the grant over 2005-2010 (USD 1,000)	36,806	128,661	119,602
(G)	Total number of newborn babies over 2006-2011	1,361,587	1,006,346	220,927
(H)	How many babies were born because of the benefit of the program? (= E × G / 100)	32,038	4,041	763
(I)	how many babies were born per USD 1,000 (= H / F)	0.8705	0.0314	0.0064
(J)	How much grant was needed for additional childbirth? (USD) (= USD 1,000 / I)	1,149	31,842	156,852

Note: In the table, we calculate how many babies were born per 1,000 USD or how much grant was needed for additional childbirth. In the second column, we explain the definition, source, or formulas of variables used for the calculation. More details are discussed in the text. Note that this analysis was only conducted for 225 sample districts over 2005-2011.

The results imply that the first child is dramatically less expensive than higher parity births. This may be driven by a shift in the timing of childbirth, as the grant may have reduced the initial cost for childless households. It is much rarer for households to stop at zero births rather than nonzero hence the childless households at the margin could be encouraged to have a child with a relatively smaller cash subsidy amount than households with children. This also suggests that it requires greater grant amounts to engender households with children to have an extra child. This may be related to the implicit long-term financial commitment of the parents with the preexisting children. Thus, it would be more difficult to stimulate births for households with children.

4.4. Additional Analyses

The impact of pro-natalist cash grants may also depend on different municipal characteristics. To examine potential disparities, we ran district fixed effects and system GMM estimations on various districts' subgroups, equally divided on the basis of population density, percentage of elderly population, amount of local tax revenue, and international marriage rate (marriage between an individual with Korean nationality and an individual with non-Korean nationality) in 2005. For example, we ranked all districts according to population density in 2005, and defined the top 50% as "urban" and the bottom 50% as "rural." Then, we reported only the grant coefficients in Table 6. This analysis employs total crude birth rate as the dependent variable and the average grant amount across birth parities, as did Table 2.

The results in panel A indicate that the impact of the grant is greater in more urbanized districts than in rural ones. This result may reflect the higher cost of having babies and raising children in urban areas. The results in panel B can be explained similarly. People in slow-aging districts (i.e., districts with lower ratios of elderly population), are more sensitive to the childbirth grant program. This may imply that districts with less auxiliary caregivers are more heavily impacted by the cash grant, if more elderly population provides childcare service to their children who happen to live in the same district. However, it may also be likely that the children of elderly population live in different, urban districts and this subgroup analysis results may show the tendencies that the urbanites are more sensitive to the cash grants.

Panel C shows that the crude birth rate is slightly more responsive to grants in poor districts than in rich districts in terms of tax revenue. This partially suggests that childbirth grants are more effective for those with lower socioeconomic status. Finally, panel D suggests that those in the districts with higher rates of international marriage are more responsive to childbirth grants. Most international marriages in South Korea are generally initiated by males. The '2015 Marriage and Divorce Statistics' from Statistics of Korea shows that since 1995 to 2015, Korean male international marriage has been two to three times greater than that of females (p.

14). As well, most of these males marry women from developing countries, Vietnam and China making up for 62.7 percent of all foreign brides (p.15). The districts with more international marriage, therefore, may represent the districts with relatively lower average socioeconomic status. Thus, panel D also supports the effectiveness of pro-natalist grants, depending on the district's socioeconomic status.

[Table 6] Difference in the Effect of Pro-natalist Program by District Characteristics

Dependent variable: Crude birth rate (CBR) per 1,000

	Monthly-Data Analysis	Annual-Data Analysis	
Group of Districts	District FE	District FE	GMM
	(1)	(2)	(3)
Panel A: Based on population density in 2005			
Urban districts	0.3995***	5.5194***	4.7428***
	(0.1227)	(1.8396)	(1.2622)
Rural districts	0.1523**	1.7760**	2.7270***
	(0.0648)	(0.8688)	(0.8781)
Panel B: Based on % of elderly populations in 2005			
Fast-aging districts	0.1587**	1.8858**	2.7714***
	(0.0629)	(0.8294)	(0.8997)
Slow-aging districts	0.3232**	5.1576**	5.5879***
	(0.1589)	(2.5436)	(1.5067)
Panel C: Based on local tax revenue in 2005			
Rich districts	0.1636***	1.6387**	1.7679**
	(0.0498)	(0.7300)	(0.7913)
Poor districts	0.2548***	2.3799**	3.1731***
	(0.0871)	(1.0114)	(0.8290)
Panel D: Based on international marriage rate in 2005			
High-rate districts	0.2849***	3.5031***	4.2534***
	(0.0823)	(1.1801)	(1.0793)
Low-rate districts	0.2226**	1.9231*	1.2465*
	(0.0885)	(1.0712)	(0.6884)

Note: We estimate the effect of "average" pro-natalist grants on "total" crude birth rate. We chose only the estimation models of district fixed effects and system GMM from Tables 3 and 4. Then, each regression was conducted for different district groups as specified in each panel. We divided sample districts evenly into two groups according to the specified variable. In each model, we report only the coefficient of lagged pro-natalist cash grant and standard error, clustered at the district level, in parentheses. A single asterisk denotes statistical significance at the 90% confidence level, double asterisks 95%, and triple asterisks 99%.

Municipal district-level total fertility rate, which is a frequently used measure in population studies, is only available annually, not monthly. In Table 7, as a robustness check, we take this annual dataset and replicate estimation models (3)-(5) in Table 3, using total fertility rate as an alternate measure of fertility and our dependent variable. In panel A, we find that the pro-natalist grants significantly affect total fertility rate, and that OLS estimation may underestimate the actual effect, as the estimation is based on the crude birth rate. Model (2) in panel A implies that the additional 1,000 USD of grant funds increases the total fertility rate by approximately 3.9%.[16]

[Table 7] Effect of Pro-natalist Cash Grant and Its Duration on Total Fertility Rate

Dependent variable: Total fertility rate in year = *t*

Key control variable	Annual Data Analysis		
	OLS	District FE	GMM
	(1)	(2)	(3)
Panel A: Total Fertility Rate			
Lagged grant	0.0328***	0.0497***	0.0466***
	(0.0101)	(0.0159)	(0.0148)
Panel B: Significance of Persistence			
Continued years when the grant had been provided.			
Duration of grant	0.0218***	0.0278***	0.0018
	(0.0053)	(0.0031)	(0.0031)
With the amount of one-year lagged grant			
Lagged grant	0.1059***	0.0643***	0.0498***
	(0.0355)	(0.0166)	(0.0154)
Duration of grant	0.0125**	0.0220***	-0.0029
	(0.0053)	(0.0029)	(0.0029)

Note: Because total fertility rate is only reported annually for each district, we employ annual data. The sample size is 1,350. Model specifications are identical with those of models (4)-(6) in Table 3. Out of the control variables, we report only the coefficients of lagged pro-natalist cash grant or/and duration of the grant, and their standard errors clustered at the district level, in parentheses. A single asterisk denotes statistical significance at the 90% confidence level, double asterisks 95%, and triple asterisks 99%.

The impact of pro-natalist grants on marginal fertility rates may depend on cash grant continuity due to the expectation of potential parents. In districts that continue the cash grant program over an extensive period of time, parents may build confidence about the policy's continuation. Such confidence reduces parents' concern about the potential cessation of the cash grant program during pregnancy. In addition, some households may plan to have multiple births due to the grant, which takes a number of years. Therefore, increases in the assurance about the program's continuation may positively affect fertility. In panel B, we use a variable that indicates the number of years that the grant was continuously given out. For example, if a district started the cash grant program in 2007 and continued it until 2010, the number for the district would be 0, 1, 2, 3, and 4, respectively, from 2006 to

[16] The average total fertility rate from 2006 to 2011 is 1.28, which means that a woman has 1.28 children over her lifetime. The marginal effect of pro-natalist grants on TFR is estimated to be 0.0497 in Table 7, model (2). This suggests that a 1,000 USD grant may increase TFR by about 3.9%.

2010. The impact of grant duration on fertility is significant and positive in the model that includes only the duration variable as the key independent variable, and also in the model that includes both grant duration and grant amount. This suggests that potential parents' confidence about the grants' continuation has a significant impact on fertility.

Finally, the estimated impact of cash grants on fertility may include both a tempo effect and permanent effect on lifetime fertility. Tempo effect means that the cash grant marginally influences households to have babies that they would have had with or without the grant, but earlier than planned.[17] Permanent effect means that the cash grant marginally increases lifetime fertility. Therefore, given the expensive and discrete nature of children, it would be easier to motivate tempo effects rather than permanent effects. We can indirectly test whether the impact includes permanent or tempo effects by estimating the impact of cash grants on age-specific crude birth rates. The probability of achieving lifetime target fertility would increase with maternal age. Therefore, if age-specific fertility of older women is significantly affected by cash grants, it would strongly imply that a substantial part of the impact on fertility is due to a permanent as well as tempo effect.

In Table 8, we estimate the impact of cash grants on age-specific fertility. We used annual municipal level age-specific total fertility rates. The results are consistent with other analyses in that negative selection was found. The GMM analysis shows that the impact of the policy is insignificant for those aged 15-19. The impact is significant and positive starting from the 20-24 age group and the number increases and peaks for the 30-34 group. For all three age groups over 35, who are more likely to have met their lifetime fertility goal, the coefficient is positive and significant, although the magnitude decreases. However, the impact of the cash grants increases with age in terms of the percentage of the age-specific fertility level. On the basis of the coefficient in model (3), for the 35-39 age group, an extra 2.37 babies per 1,000 women are born per 1,000 USD of cash grant funds, which is approximately 8.6% of the total 35-39 age specific total fertility rate. For 40-44 age group, the increase is 14.9% and 30.6% for the 45-49 age group.[18] This strongly suggests that at least part of the impact of the cash grants on fertility is permanent because even the oldest age group (45-49) is significantly affected by the cash grants.

[17] In estimating TFR or the crude birth rate, a tempo effect may also have a permanent effect because children born earlier than planned without the cash grant could continue to have children earlier than planned, and the process would continue permanently.

[18] Age-specific TFRs for 15-19, 20-24, 25-29, 30-34, 35-39, 40-44, and 45-49 age cohorts were 1.28, 2.74, 24.00, 96.15, 99.68, 27.50, 3.85, and 0.21, respectively.

[Table 8] Pro-natalist Cash Grant and Various Fertility-Related Aspects

	(1)	(2)	(3)
		Annual Data Analysis	
Dependent variable:	OLS	District FE	GMM
Panel A: Crude birth rate per 1000 women by maternal age			
CBR (age 15-19)	0.1019	0.3242	0.1843
	(0.1169)	(0.2779)	(0.1329)
CBR (age 20-24)	1.2923***	1.1219	1.8779***
	(0.4468)	(0.8650)	(0.6767)
CBR (age 25-29)	2.4885**	4.1452*	3.3431**
	(1.1630)	(2.2725)	(1.6402)
CBR (age 30-34)	3.7860***	4.7869***	5.7469***
	(1.3291)	(1.5006)	(1.9050)
CBR (age 35-39)	1.4029**	1.1311	2.3697***
	(0.6409)	(0.8094)	(0.8097)
CBR (age 40-44)	0.4218**	0.4107	0.5738***
	(0.1787)	(0.2746)	(0.2117)
CBR (age 45-49)	0.0402	0.1299*	0.0642*
	(0.0318)	(0.0664)	(0.0358)
Panel B: Other dependent variables			
Average maternal age	0.0196	0.0529	0.0346
	(0.0252)	(0.0540)	(0.0342)
Marriage rate	-0.0160	0.0538	-0.0561
	(0.0328)	(0.0779)	(0.0446)
Female unemployment rate	-0.0013	-0.0051	-0.0021
	(0.0037)	(0.0139)	(0.0039)
Age at first marriage	-0.0298	0.0073	-0.0278
	(0.0284)	(0.0426)	(0.0321)
Average age at delivery	0.0188	0.0548	0.0379
	(0.0255)	(0.0533)	(0.0347)
Average age at first delivery	0.0442	0.1124*	0.0833**
	(0.0346)	(0.0663)	(0.0408)
Average age at second delivery	-0.0181	-0.0298	-0.0090
	(0.0337)	(0.0793)	(0.0434)
Average age at third delivery	0.0302	0.1099	0.0586
	(0.0711)	(0.1242)	(0.0895)
Ratio of birth mothers	-0.0044*	-0.0118**	-0.0043
with less than university degree	(0.0024)	(0.0059)	(0.0028)

Note: We varied the dependent variables specified in the first column. Thus, each cell presents the result of a separate regression. Because the dependent variables in panel B are available only at the annual level, we employed an annual data analysis. The model specifications are identical with those in models (3)-(5) of Table 3. In each model, we report only the coefficient of lagged pro-natalist cash grant and standard error, clustered at the district level, in parentheses. A single asterisk denotes statistical significance at the 90% confidence level, double asterisks 95%, and triple asterisks 99%.

In panel B, we take other non-fertility dependent variables such as average maternal age, marriage rate, female unemployment rate, age at first marriage, average age at delivery, and the ratio of birth mothers with less than a university degree. We find little evidence that the fertility specific pro-natalist grants have secondary impacts at the margin. The significant increase in the average age at first delivery and significant decrease in mothers with low educational attainment may stem from the increase in fertility of older mothers, shown in panel A.

V. Conclusion

This paper uses a cash grant by district-by-month-level per birth parity dataset—with various district-level childcare infrastructure, and demographic and economic control variables—to investigate the impact of pro-natalist cash grants on fertility. We find that grant increases of 1,000 USD result in a 4.4% increase in the crude birth rate. The results also show that the ability of grant funds to engender extra births varies greatly by parity. The mother's age subgroup analysis reveals that there is a significant permanent effect. Finally, the district-level subgroup analysis reveals that the impact varies by district-specific demographic and economic characteristics. We confirm the significant empirical influence of the price of marginal children on fertility.

The results of this study have several important policy implications. Considering the cost of children, the pro-natalist grant has a substantial impact on marginal fertility, making it a viable policy option. From a policy design perspective, the first and second parity of births costs less than higher parities. The subsidy amount required for an extra child precipitously increases for the third higher parity of birth and the increase in fertility level is not statistically or economically significant for the third and higher parity births. This may be driven by the diminishing marginal utility of children as consumption goods. In addition, three or more children may not be an option for the majority of families due to income constraints; an extra grant certainly would not be sufficient to cover the income required to raise three or more children. The estimate of cost per extra child also supports concentration of grant efforts on the first two parities of birth. Therefore, the results imply that the grant may focus mainly on the lower parities of births because the higher parities may not be substantially influenced by cash grants. Granting cash for extra children also seems to have a permanent impact on fertility rates. A substantial part of the fertility increase may be interpreted as an increase in completed fertility, as women older than 35 and even women aged 45-49 are significantly affected by these grants.

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