School Entry Cutoff Date and the Timing of Births

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Abstract

I examine how the timing of births responds to school entry cutoff date. Many countries require children to reach a certain age by a specified date in the calendar year in order to start kindergarten/primary school. There is a clear trade-off for parents to time a birth *after* the school entry cutoff date; births just after cutoff date may benefit children from being older among the school cohort, which is shown to provide the children with academic advantage, while parents have to bear an additional year of child care costs. Using the universe of births during 1974–2010 in Japan, I find that more than 1,800 births per year are shifted roughly a week before the cutoff date to a week following the cutoff date. The overall shifts in births, however, may mask heterogeneous responses of mothers. In fact, I find that mothers with low-skilled jobs (and hence low-income) tend to give more births *before* the school entry cutoff date while mothers with medium- and high-skilled jobs give births *after* the cutoff date. These findings imply that a very common rule set by the government made children born just before the cutoff date suffer from "double" deficits, which may potentially contribute to intergenerational immobility. This study may also have implications for growing literature that assumes births around the school entry cut-off dates are random.

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1. Introduction

Economists and policy makers have long been interested in intergenerational mobility, and there is a large literature that documents the persistence of many outcomes such as earning, education, and health between parents and children (e.g. Black and Devereux, 2011). Much of the recent effort is devoted to better understand the causal mechanisms that underlie these correlations.

In this paper, I examine how the timing of births responds to school entry cutoff date to shed light on this question. Most countries require children to reach a certain age by a specified date in the calendar year in order to start primary school. Parents who plan to have children face a trade-off to time a birth *after* the school entry cutoff date. The benefit of shifting births after the school entry cutoff date is that academic performance, and later labor outcome, are shown to be better for the older children within an academic cohort including the case of Japan, a setting in this study (e.g., Bedard and Dhuey, 2006). However, there is a cost for parents because parents need to retain their children longer before sending to school, and thus bear one additional year of child care costs.[2]

I argue that this unintended trade-off created by a very common government rule may partly contribute to the persistence of the intergenerational immobility. One on hand, parents who care about their children's academic performance, know such an academic advantage of older children, and can afford additional year of child care cost, may time a birth after the school entry cutoff date. On the other hand, mothers with low SES may end up giving a birth before the cutoff date, to avoid the child care cost, at the expense of their children's academic performance. Thus there is a possibility that children born just before the school entry cutoff date may suffer from two disadvantages: academic disadvantage as younger children, and being born by low SES mothers.

Japan is an interesting setting to examine such a trade-off since the stake of the timing of births is very high for parents because the school entry cutoff date is strictly enforced. In fact, the delay of the entry into primary school is very rare in Japan. For example, Kawaguchi (2012) documents that only 0.03 percent of primary school age children are exempted from the mandatory starting age in Japan.[3] Therefore the timing of births indeed decides when the children start primary schools later. This setting is in contrast to the case in the US where significant fraction of children defer school entry by a year, making them the oldest students (Deming and

[2] There is some convincing evidence that availability of kindergarten affects mother's labor supply (e.g., Berlinski and Galiani, 2007; Cascio, 2009; Gelbach, 2002; Schlosser, 2011). These findings suggest that kindergarten implicitly serve as a child care center.

[3] Note, however, that this is not only unique to Japan. Bedard and Dhuey (2006) lists four countries for which there is little or no evidence of early/late starting or grade retention: England, Iceland, Japan, and Norway.

Dynarski, 2008).[4]

Since whether parents react to the incentives, and if so which incentive dominates is an empirical question, I first present the results on overall shifts of births. Using universe of birth certificate records 1974–2010 in Japan which reports exact date of births, I find that more than 1,800 births per year are shifted roughly a week before the school entry cutoff date to a week following the cutoff date.[5] This finding of delaying births suggests that *on average* parents care more about children's academic performance than additional cost of child care at least in Japanese setting.

Because I observe a gradual decline and a subsequent gradual increase in the number of births around the cutoff date, this shift of births is more consistent with real shift instead of manipulation or misreporting. Also I observe that the birth weight of children born after the cutoff date is slightly heavier, and the probability of overweight (>4000 grams) is also slightly higher. Further, I use the insurance claim data and find that elective C-sections, that the day of the operation can be to some extent chosen by mothers, are shifted after the cutoff date, while I do not observe any shifts for emergency C-sections. While some of the shifts may include the manipulation of birthdate given the magnitude of the shifts I find, my finding supports the claim that part of the shifts is indeed real.

I also examine the health outcomes measured as infant mortality. If the surge in the number of births right after the school entry cutoff date creates the congestion or overcrowding in hospitals, it could potentially harm the health of infants. On the other hand, it may not affect the infant health since hospitals can anticipate such a surge, and thus they are well prepared. Consistent with the latter view, I do not find that births born right after the school entry cutoff date reveal an excess infant mortality. Here it is important to note that mortality is just one of the health outcomes I could examine here, and other measures such as readmission rate can be affected.

The overall shifts in births, however, may mask heterogeneous responses of mothers. I find that mothers with low-skilled jobs are more likely to give births *before* the school entry cutoff date, while mothers with medium- and high-skilled jobs are more likely to give births *after* the

[4] Also, there is only one single school entry cutoff date that applies to all children in Japan. This is also in contrast to the case in the US; since each state has different school entry cutoff date, and inter-state migration is pretty common, parents may not know precisely which school entry cutoff date that they should refer to. For example, school entry cutoff date for California is December 1, and that for Texas is September 1. For school entry cutoff date in each state in the US, see Dickert-Conlin and Elder (2010). For international school entry cutoff date, see Bedard and Dhuey (2006). Note that most countries only have single school entry cutoff date unlike the case of the US.

[5] While delaying births is more medically difficult than hastening, the results are consistent with Gans and Leigh (2009), which found that over 1000 births were delayed so as to ensure that their parents were eligible for bonus payment in Australia.

school entry cutoff date. This result implies that for disadvantaged mothers financial burden of child care outweighs the importance of future academic advantage of children. Since I cannot link the birth data to long term outcomes such as test scores, I cannot decompose whether academic disadvantages of younger children come from either the relative age effects or mother's SES or combination of both. However, these findings imply that children born just before the school entry cutoff date suffer from "double" deficits, which may contribute to intergenerational immobility.

Finally, while the main focus in this paper is the timing of births instead of timing of conceptions, I also find that second or higher parity children are predominantly born in April–June possibly due to learning from the births of first child to make sure that second child is born after the cutoff date. While there are many other reasons to time conceptions (and hence deliveries) at certain period, it seems that school entry cutoff date affect both the timing of births, as well as conception of births.

This paper is related to several strands of literature other than intergenerational mobility, and inequality. First, this paper contributes to a literature which examines the impact of the incentives created by birth-related cutoff date on the timing of births. The use of birth-related cutoff to determine eligibility for policy programs due to governments' resource constraints is quite common across the world. Therefore past studies have analyzed the timing of births in response to a variety of cutoff date.[6] This paper is distinct from previous studies in two ways; while other papers investigate the short-term financial incentives created by birth-related cutoff date such as tax benefits or monetary bonuses, this paper shows that the incentives that may potentially affect the long-term outcomes of children can also influence the timing of births; also while other studies examine the incentives that go only one direction (either delaying or hastening), this paper analyzes the case where there is a clear trade-off in the incentive structure.

Second, this paper provides some evidence on the power that parents exert on the timing of births. While there is ample evidence that a certain number of births can be indeed timed, it is generally not clear whether this timing is chosen by doctors/hospitals or parents.[7] Since doctors/hospitals certainly prefer not to have congestions, this surge in the number of births right after the school entry cutoff date suggests that parents have some influence over doctors/hospitals on the timing of the deliveries.

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[6] Some papers find the evidence on shifts in the timing of births, while others do not. For example, shifts of birth timings are found in tax incentives in the US (Dickert-Conlin and Chandra, 1999; Maghakian and Schulkind, 2012; LaLumia et al., 2013); tax incentives in Japan (Kurenishi and Wakabayashi, 2008); bonus payment in Australia (Gans and Leigh, 2009); parental leave benefit reform in Germany (Tamm, 2012, Neugart and Ohlsson, 2013); while shifts are not found in expansion of job-protection leave in Germany (Dustmann and Schonberg, 2012); extending the leave duration in Austria (Lalive and Zweimuller, 2009).

[7] For instance, using my data from birth certificates I observe that the number of births that occurs on weekends or holidays is lower by around 25 percent than on weekdays.

Third, this paper may have an implication for growing body of literature that exploits the identification strategy that assumes that births around the school entry cutoff date are random.[8] Researchers indeed examine the distribution of births or compare the characteristic of parents around the school entry cutoff date as outcomes or in the process of verifying the underlying assumption in their regression discontinuity (RD) setting, to make sure that underlying assumptions are satisfied. While my results in Japan may be very country specific, this is the first paper that documents the births around the school entry cutoff date may reflect the differences in mother's characteristics as well as mother's preferences, and provides a cautionary tale for assuming the randomness of birth timing in some settings.[9]

Relatedly, this paper is linked to a literature that examines the underlying mechanism on the timing of conception. Notably, a recent paper by Buckles and Hungerman (2013) show that winter births are disproportionally realized by teenagers and the unmarried in the US.[10] Also, Dehejia and Lleras-Muney (2004) show that high-SES women are more likely to conceive when unemployment is higher. I find that births at the higher parity are more likely to be born during April–June, possibly highlighting the importance of learning by mothers.

Finally, this paper is related to a literature that investigates parents' differential treatment of children by gender of children.[11] I find that male births are more likely to be delayed than female births in response to school entry cutoff date. While I cannot completely separate "son preference" from "son weakness", this result may imply one subtle form of son preference at postnatal stage instead of prenatal stage such as sex-selective abortion observed in many other Asian countries (Sen, 1990, 1992).

The remainder of this paper is organized as follows. Section 2 provides background information on the school system. Section 3 describes the data used herein, and the identification strategy. Section 4 reports main results, and Section 5 examines heterogeneous responses of mother to investigate the incentives of parents behind the shifts of timing. Section 6 discusses the

[8] See e.g., Bedard and Dhuey(2006, 2012), Berlinski et al. (2011), Black et al. (2008, 2011), Cascio and Schanzenbach (2007), Crawford et al. (2007), Datar (2006), Dhuey and Lipscomb (2010), Dobkin and Ferreira (2010), Elder and Lubotsky (2009), Fertig and Kluve (2005), Fredriksson and Öckert (2013), Leuven et al. (2010), McCrary and Royer (2011), McEwan and Shapiro (2008), Muhlenweg and Puhani (2010), Puhani and Weber (2007), Stipek (2002), and Strom (2004).

[9] Following papers specifically examined the distribution of births around the school entry cutoff date in each country, but none of them find the evidence of sorting of births around the cutoff date: Dickert-Conlin and Elder (2010) in the US, McEwan and Shapiro (2008) in Chile, and Berlinski et al. (2011) in Argentine.

[10] Buckles and Hungerman (2013) also question the validity of the instruments used by Angrist and Krueger (1991) that use the quarter of births as the instrument for years of schooling. For the instruments to be valid, instruments have to satisfy two conditions: exclusion restrictions and relevance. Most of past literature questions the relevance, i.e., weak instrument, such as Bound et al. (1995). Here the issue is about exclusion restrictions.

[11] See e.g., Dahl and Moretti (2008), Lhila and Simon (2008), Baker and Milligan (2013), and Bharadwaj and Lakdawala (2013).

implications of the findings, and Section 7 concludes.

2. Background

2.1 School System

In this sub-section, I briefly describe the school system in Japan. The school entry cutoff date in Japan have been set April 2 since 1947, and it has not changed since then. The school system in Japan is legally defined in the School Education Law (SEL) enacted in 1947. SEL article 22 mandate parents to send their children to primary schools as soon as their children turn age six before the school starting day, which is April 1 in Japan. However, according to Japanese law, people reach the additional age a day before their birthday. This means that actual school entry cutoff date is April 2 instead of April 1; children born on April 1 enter primary schools on their 6th birthday, while those born on April 2 enter primary schools on a day before their 7th birthday. So there is about a 1-year age difference at the maximum among primary school students in the first grade. Importantly, the fact that April 2 instead of April 1 is the school entry cutoff date help me isolate the effect of school from other potential mechanical confounders such as 1st day of the month effects. To my knowledge, nothing other than school entry cutoff date lies on this specific day.[12] Kindergartens follow the same academic year as primary schools.

This rule is strictly enforced in Japan and thus students rarely delay or start primary school earlier than scheduled date. Indeed, SEL Article 23 allows a delay in school entry due to a child's illness or underdevelopment, but this exception is rarely applied. According to Kawaguchi (2010), the percentage of exemption is 0.03 percent.[13] This is not surprising as parents need to formally apply for an exception together with the proof of underdevelopment/illness from the doctors specified by the local educational advisory board (SEL article 34).

The fact that almost all children start attending school without delay contrasts with the situation in the US, where postponing entry to kindergarten (or referred to "redshirting") became popular especially among educated parents.[14] Also Japanese educational system is known for social promotion system, where automatic promotion occurs from one grade to the next. The SEL Article 23 also does not prohibit students from learning in the grade above the scheduled grade, but the advancement is also very rare.

Also there is no systematic variation in years of schooling based on the timing of births unlike the US (Angrist and Kruger, 1991); compulsory schooling in Japan is not defined by the

[12] For example, tax year is January 1 to December 31 in Japan. See Kurenishi and Wakabayashi (2008) on taxes and timing of births in Japan.

[13] In 2004, 7,200,933 children at the primary school age (ages 6–12) attended primary schools, while 2,261 did not, according to Kawaguchi (2010).

[14] See e.g., Datar (2006), Elder and Lubotsky (2009), Cascio and Schanzenbach (2007), and Dobkin and Ferreira (2010).

age when students can leave, but by the length of the years; 9 years of education (6 years in primary school and 3 years in junior high school) is uniformly required for all children.[15]

2.2 Birth Registration

The birth certificate is written by the physicians if births occur at the either hospitals or clinics, while it is written by midwives in case of deliveries at home. In Japan, hospitals are defined as medical institutions with more than 20 beds, while clinics are defined as those with less than 20 beds or no bed. According to the birth data described in detail below, 99.4 percent of births occur at medical institutions (either at hospitals or clinics) during 1974–2010, and thus none of our results shown later can be driven by home deliveries.

Parents are then required to bring the birth certificate signed by the physician (or midwife) to register the birth at the near-by public health center (Hokenjyo). The newborns need to be registered within 14 days after births; otherwise parents need to pay a fine. Since the birth certificate is indeed signed by attending physician, it is unlikely that manipulation of birthdate occurs at the reporting stage at the public health center. Thus if the manipulation indeed takes place, it is more likely to happen at the stage of filling in the birth certificates at hospitals before signed by physicians.

3. Data and Identification Strategy

3.1 Data

I use three datasets in this analysis: birth data, death data, and insurance claim data. The primary data for this analysis are birth records compiled by Ministry of Health, Labour and Welfare. The data cover the universe of births occurred in Japan during 1974–2010. The key variable in the birth data is the exact date of births. Combining 1974–2010 birth data together provides me with information on over 50 million births. The data are of high quality in that only 4,935 observations (less than 0.01 %) are missing birthdate information, and I drop these observations. The birth data also contains information on exact hour of births, which is rare in the public-version of birth certificates available to researchers. Otherwise specified, the main outcome is the number of births at daily level than hourly level since most of past studies uses the daily observations, and thus comparable across these studies.

The birth data also collect very limited mother's characteristics such as exact age of mothers at the time of births. Unfortunately, they do not collect key mother's characteristics (e.g., education of mothers), delivery method (e.g., C-section and inducement), complications of

[15] This also means that parent in Japan do not face a well-known tradeoff in schooling in the US where though students who are the youngest in their school cohort typically have poorer academic performance, on average, they have slightly higher educational attainment (Dobkin and Ferreira, 2010).

births, and Apgar scores of infants. However, fortunately, for every five years, the birth certificates collect information on working status of mothers at the time of delivery (not at the time of conception), and roughly 10 categories of mother's job types for those working. I divide the 10 categories of job types into high-skilled jobs, medium-skilled jobs and low-skilled jobs. Appendix Table A summarizes the occupational categories. These measures are used to examine the heterogeneous responses by mother's job types, which may serve as a proxy to the income.

I also examine a number of child characteristics collected in the birth certificates to investigate whether the shifts in the timing of births are indeed real rather than pure manipulation of birthdate by looking at the birth weight of newborns as well as gestational length of mothers. I also examine the gender of a child, and the parity of a child (1^{st} birth or 2^{nd} and above).

In addition to birth certificates, I use the death certificates to examine the infant mortality. The death certificates contain all death records occurred in Japan, which include information about the decedent's exact date of death, exact date of birth, gender, and cause of death (ICD8–10). While the birth and death certificates are not linked in Japan, I can still calculate the infant mortality rate on each birthdate, where the number of deaths for births born each birthdate from death certificates is the numerator, and the number of births for each birthdate from birth certificates is the denominator. Summary statistics is reported in Appendix Table B.

Finally, I complement the analysis on birth records with the insurance claim data from roughly 500 hospitals for 2011–2012. The unit of observation in this data is mother instead of child. Thus while exact date of *admission* for delivery is available, exact date of *birth* is not available. However, the data also include the exact date of *surgery*. Thus assuming that surgery date is equivalent to birthdate for C-section births, I examine the timing of the C-sections births in response to school entry cutoff date. I examine the emergency C-sections, and elective C-sections separately. Since the C-sections involve some physical risks for both mothers and children, I expect to see the shifts of births only for elective C-sections if any.

3.2 Identification Strategy

Let $birth_{dy}$ be counts of births for day d in year y. Days are organized in relation to the April 2 for each year. Given this structure for the data, the econometric model I estimate is:

$$birth_{dy} = \alpha + \beta After_{dy} + \sum_{j=1}^{6} DOW(j)_{dy}\gamma_j + \sum_{k=1}^{N} Holiday(k)_{dy}\delta_k + \theta_y + \varepsilon_{dy} \quad (1)$$

$$\ln(birth_{dy}) = \alpha + \beta After_{dy} + \sum_{j=1}^{6} DOW(j)_{dy}\gamma_j + \sum_{k=1}^{N} Holiday(k)_{dy}\delta_k + \theta_y + \varepsilon_{dy} \quad (2)$$

where $After_{dy}$ takes one if the birthday d is after April 2 in each year y. $DOW(j)$ is one of six dummy variables for each weekday, and $Holiday(k)$ is one of K dummy variables for each holiday. θ_y captures year effects, and ε_{dy} is an idiosyncratic error term. The year indicators are included to account for time trends in the overall number of births.[16] The coefficient of interest is β. Using the log number of births in equation (2) provides a measure of the proportion of births shifted.

I change the windows around April 2, from 7 days to 28 days following Gans and Leigh (2008). Widening the window has two purposes. First, it allows for births to have been moved by more than one week even though as I show later, birth shifting is concentrated within a week from the cutoff date. Second, it allows for the possibility of "attempted but unsuccessful moves", where some parents may have attempted to delay their births until April 2, but instead only could move the birthdate from mid-March to late-March. Also, if capacity constraints are binding, some births that would have taken place in the early-April may be shifted to mid-April. Both of such moves attenuate the estimates from focusing on a narrow window.

I also examine the child characteristics around the school entry cutoff date. Here I use the individual birth as a unit of observation instead of counts at each birthdate. The equation I estimate is:

$$\mathrm{Y}_{idy} = \alpha + \beta After_{idy} + \sum_{j=1}^{6} DOW(j)_{idy}\gamma_j + \sum_{k=1}^{N} Holiday(k)_{idy}\delta_k + \theta_y + \varepsilon_{idy} \quad (3)$$

for each outcome Y for individual birth i born in year y, and day d. To account for common characteristics within the same birthdate, the standard errors are clustered at the birthdate.

4. Basic Results

4.1 Shifts in the Timing of Births

Before running formal statistical analysis, a simple histogram reveals the striking pattern. Figure 1 displays the mean daily number of births throughout the year using the pooled 1974–2010 birth data. The markers with cross sign correspond to the holidays. Note once again that school entry cutoff date is April 2 instead of April 1.

Figure 1 displays that there is clearly a heap on April 2, and relatively high frequency of births on subsequent days. In fact, April 2 is the day with the highest number of births throughout the year, and April 1, a day before the cutoff date, is the third lowest. Table 1 reports the top 5 and bottom 5 days of mean daily number of births, together with the relative number of births, computed as the average births on a given day divided by the average births across all days. Thus, a value of 1.1 represents a 10 percent increase in the daily births compared to the average

[16] I also tried to include day of week*year fixed effect to allow each week day to have differential impact by each year. The results are very similar.

in the year. April 2, and April 3 see 20 and 10 percent more births than average, while April 1, a day before the cutoff date, sees 15 percent less births than average. This graph also shows the importance of controlling for holidays in the estimation. There is also variation in the weekdays vs. weekends, but pooling many years of data smooth out such an effect in the figure. In the regression, I include the day of the week fixed effects to control for the within week fluctuations.

A closer look at births around the cutoff date is provided in Figure 2 that plots the mean daily number of births around April 2. To provide symmetry, I report the 28 days prior to the April 2 (March 4–April 1), and the 28 days after April 2 (April 2–April 29). Again, the markers with cross sign correspond to the holidays. Figure 2A simply displays the mean daily number of births. Starting about 10 days before April 2, daily number of births gradually declines, and falls to roughly 2,800 per day on April 1, a day before the school entry cutoff date. The number of births then sharply increases to roughly 4,500 on April 2. Note that other dips around March 20 and April 29 are the result of holiday: Spring Equinox Day (either March 20 or 21), and Greenery day (April 29), respectively. Figure 2B accounts for weekend, and holidays by plotting the residual of regressions of the daily number of births on weekday and holiday fixed effects. This graph shows the similar pattern as Figure 2A without noises.

Table 2 summarizes the results from formal statistical test of estimating equation (1) and (2). First column in Panel A restricts the sample to the last 7 days and first 7 days around April 2, and it shows that roughly 1,835 births are shifted within a week from April 2 where daily average of births throughout the year is 3,713. In the remaining columns, I progressively widen the window of analysis. As I widen the window, the number of births shifted does not change much, suggesting that most of the shift is concentrated roughly within a week from the cutoff date. Panel B uses natural log of the mean daily birth as an outcome. First column shows that roughly 7.0 percent of births are shifted from a week before April 2 to a week after.

Given the size of the magnitude, some of the birth shifts can be potentially due to the manipulation of reported birthdate. However, since I observe the gradual decline of births roughly from 10 days prior to April 2, it seems unlikely that manipulation of reported birthdate can account for all the shifts.[17] Also in the years when April 2 coincides with weekends, I tend to observe more births on April 3 or later in the first half of the week following April 2, strengthening the claim that there is a real shift (not shown). Further evidence against pure manipulation is shown later when I examine the birth weight of infants, and gestational length of mothers.

[17] The shifts cannot be driven by the home deliveries where manipulation seems easier since only 0.6 percent of births occur at home during 1974–2010. The fraction of births at home shows the declining trend, but even in 1974, the first year of data available, the fraction of home deliveries is only 1.07 percent. It is 0.18 percent in 2010, the last year of data available.

I also explore the patterns of shifts across periods. Appendix Figure A displays the mean daily number of birth around April 2 by different time periods. While the magnitude of the shifts is largest in the earliest period (1974–1980), I also see the discernible delays of births in the most recent decade (2001–2010). To gauge the magnitude of the shifts across years, I run the regression equation (2) separately for each year with 7 days window from the cutoff. Note that since the equation is estimated for each year, I do not include the year fixed effect in the estimation.

Appendix Figure B plots the size of the shifts in each year. There are two things worthwhile to mention. First, across all years, the estimates on the shifts are all positive and statistically significant at the conventional level, indicating that delays of births are not limited to a certain period. For example, the proportion of births shifted is 5.2 percent in 2010, the last year available in the dataset while the corresponding figure for entire 1974–2010 is 7.0 percent.

Second, I observe that magnitude of the delays of births is declining in the recent years. It is not clear *in a prior* whether I expect to observe more or fewer delays in recent years. On one hand, one may expect to observe more delays of births due to the development of medical technology to easily time births as well as more familiarity of the mothers with information on academic advantage of older children.[18] On the other hand, one may expect to observe fewer delays of births if the digitalization of the medical record may make it harder to manipulate the birthdate in the recent years and child care cost increases.[19]

A unique feature of the birth certificates in Japan is that they also report exact hour of birth. Figure 3 plots hourly number of births within 72 hours (3 days) before and after the school entry cutoff date using the pooled 1974–2010 birth data. The graph shows systematic patterns within a day, where more births are observed during the daytime and fewer births on late at night and early in the morning. Interestingly, I observe bunching of reported births on the midnight of April 2, and a slight dip just a few hours before the midnight. Obviously, I do not observe such a pattern around the midnights of other days. While it is more likely to reflect the manipulation of the reported birth hours, since delaying births a few hours is much easier than delaying births a few days, it is also consistent with the real shift of births.

[18] For example, the fraction of weekend births has been increasing from 16 percent in 1974 to 36 percent in 2010, which may reflect that fact that births can be more easily timed through elective C-section and inducement as medical technology advances.

[19] Also as I show later, aging of mothers may potentially account for the fewer delays in recent years since older mothers tend to delay less than younger mothers. To examine how much of the recent decline in the magnitude of the shifts can be explained by aging of mothers, I did a Blinder–Oaxaca decomposition to decompose the magnitude of the shifts into the fraction explained by the compositional change of mothers, and that of remaining. Using 1974 as a baseline year, mother' age can account for roughly 5–20 percent of the change in the magnitude depending on the comparison year (results available upon request).

4.2 Child Outcomes

Since I observe the gradual decline before April 2, it seems unlikely that manipulation of reported birthdate accounts for the entire shift in the timing of births. Here I show further evidence against pure manipulation by examining the birth weight of children, and gestational length of mothers. Birth weight is of particular importance as there is ample evidence that initial health at birth has medium and long-term impacts on children.[20] I am aware of only three previous papers by Gans and Leigh (2009), Tamm (2012), and Maghakian and Schulkind (2013) that analyze the impact of cutoff induced birth timing on infant health.

Figure 4A plots the mean birth weight around April 2.[21] The graph clearly shows that births after the school entry cutoff date are heavier than those before April 2. Figure 4B plots the probability of births over 4,000 grams, and shows similar patterns as mean birth weight. Table 3 presents the results of estimating equation (3) using the individual birth as a unit of observation. Column (1) in Table 3 reports that children born after cutoff date is roughly 2.3 gram heavier than those born before the cutoff date. Since 7.0 percent of births are shifted backward, this would imply that births that are actually delayed are heavier by around 33 grams.[22] This result is also consistent with the fact that boys tend to be heavier than girls at the time of births shown in Section 5.[23] Column (2) reports that births born after school entry cutoff date is 0.05 percentage points more likely to be over 4,000 grams (mean of 2.2 percent). I also find that fraction of births delivered after over 42 weeks of gestation is higher after April 2 in Column (3), which is consistent with the increases in birth weight.

Finally, I analyze infant mortality. One the one hand, if the surge in the number of births right after the school entry cutoff date creates the congestion or overcrowding in hospitals, it could potentially harm the health of infants. On the other hand, it may not affect the infant health since hospitals can anticipate such a surge, and thus they are well prepared. Consistent with the latter view, Figure 4C shows that while the mortality profile is noisy due to the low mortality rate in Japan, there is no clear change in infant mortality. Column (4) in Table 3 confirms that births born right after the cutoff date do not show the excess mortality.[24] Here it is important to note

[20] See e.g. Black et al. (2007), Oreopoulos et al. (2008), Royer (2009), Johnson and Schoeni (2011), Bharadwaj et al. (2012).

[21] The birth weight is collected with 100 grams interval till 1995, and collected with a single gram after 1995. Therefore I stick with this measure and divide the birth weight collected after 1995 by 100.

[22] Appendix Table C presents results from different size of windows around the cutoff date.

[23] If increase in the birth weight is concentrated in recent years, it raises the concern that some of the shifts in the early period are due to the manipulation of reporting instead of real shifts. However, increase in birth weight can be clearly observed in the early periods as well (results available upon request).

[24] Since I am interested in the effect of birth complications due to congestion on infant mortality, I also restricted infant deaths in the sample to those occurred within 28 days from births (neonatal death), and in

that mortality is just one of the health outcomes, and other measures such as readmission rate can be affected. Unfortunately, due to the lack of the data, I cannot examine any other health outcomes.

4.3 C-sections Births Using Insurance Claim Data

The disadvantage of birth data is that they do not report the delivery procedures. To compensate for it, I use the insurance claim data to examine whether C-sections births are timed in response to the school entry cutoff date. Figure 5 shows that elective C-sections, that the day of the operation can be to some extent chosen by mothers, are shifted after the cutoff date, while I do not observe any shifts for emergency C-sections. The spike does not happen exactly on April 2 in the graph because our insurance claim data is limited to two years (2011 and 2012), and thus if April 2 happen to coincide with weekends, the births are shifted to first half of the week after April 2.[25] Table 4 shows the estimates for any C-sections, emergency C-sections, and elective C-sections separately with different windows where the outcome is log of the mean daily number of births. I find that 26.3 percent of elective C-sections are shifted within a week around the cutoff date while the estimates on emergency C-sections are economically small and statistically insignificant. These results are plausible since the C-sections involve some physical risks for both mothers and children, and thus I expect to see the shifts of births only for elective C-sections.

5. Mechanism

So far I show that there were sizeable shifts in births in response to the school entry cutoff date. In this section, I further try to understand the incentives behind parents' behavior.

5.1 Heterogeneous Responses by Mothers' and Child Characteristics

Here, I exploit the characteristics of mother and children to shed a light on the incentives of parents behind the shift of births. Figure 6–8 plot the mean daily number of births by a parity, mother's age, gender of child, and mother's job status using the pooled 1974–2010 birth data. Table 5 summarizes the results from estimating equation (2) where outcome is log of the mean daily number of births separately for each sub-group. Since the shifts of births are concentrated within a week from cutoff date, I estimate the equation within 7 days from the cutoff date.

Figure 6A display that births at higher parity are more likely to be delayed. This pattern is more apparent in Figure 6B which plots the share of high parity birth (2^{nd} and above births)

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which the death is classified as 'conditions originating in the perinatal period' (specifically, ICD-10 category P). The results are similar (results available upon request).

[25] In fact, April 2 is Saturday in 2011, and Monday in 2012.

among all births.[26] The figure shows that share of high parity births discontinuously increases right after April 2. Panel C in Table 5 reports while 8.6 percent of birth at higher parity is delayed, the corresponding estimate for 1st birth is 5.3 percent. The null hypothesis that coefficients on different parity are the same is rejected at 1 percent level. This result implies that mothers may learn from the previous experience of first child that it is probably beneficial for forthcoming children to be born after the cutoff date. Also mothers already gained experience, and thus it may be easier for them to time 2nd births than 1st births. Note that the fraction of 2nd or above births among all births seems to be increasing even after April 2 in the Figure 6B, implying that the timing of conception may be also affected. I will come back to this point in Section 6.

Figure 7A displays that relatively younger mothers less than 30 years old show a larger delay of births, compared to mothers more than 30 years old.[27] Because of this differential pattern by mother's age group, Figure 7B displays a sharp decline in mean mother's age at birth right after the school entry cutoff date. One possible explanation is that for older mothers it is much more important to make sure that they are going to have a kid and thus care less about the timing of births. Also since the delay of births can be potentially harmful to the mother's health, the delays of births for older mothers may be physically difficult, and doctors/hospitals may not admit requests from mothers to delay births.

Next, I examine the mother's differential responses by the gender of births. Figure 9A clearly displays that male births are more likely to be delayed than female births. Figure 9B plots the fraction of male births, and the figure shows that the share of male birth is substantially higher after the school entry cutoff date. Panel C in Table 5 reports while 8.0 percent of male births are delayed, 6.1 percent of female births are delayed.[28] I can reject the null hypothesis that coefficients on male and female births are the same at the conventional level. Appendix Table D presents results of estimation for each gender by parity. Consistent with the finding so far, the table shows that male births at higher parity are most likely to be delayed.

There are a couple of possible explanations for this finding. First, this result may reflect son preference of the parents. If so, it is interesting since Japan is known to reveal little son preference in the prenatal stage, and therefore shows normal sex ratio at births unlike many of Asian countries with elevated sex ratio at births (Sen, 1990, 1992).[29] This result may imply a

[27] Note that mean age of birth is 29.81 years old.

[28] Instead, I can simply regress male birth dummy as an outcome in equation (3). The coefficient on *After* is 0.009 (SE 0.001), and statistically significant at 1 percent level.

[29] Rohlfs et al. (2010) document that boys are more born than girls in Japan in 1966, a year which girls are regarded as less desirable astrologically (Hinoeuma), suggesting that prenatal gender selection were prevailing at least until 1966 in Japan.

different form of son preference at postnatal stage instead of prenatal stage such as sex-selective abortion. Alternatively, the result may reflect the fact that boys are slower in the development in the early childhood and also socially less mature than girls so that parents want to make sure that male births do not suffer from disadvantage of being the youngest within the academic cohort.[30] Also the size of the body may matter more for boys than girls.[31] Unfortunately, I cannot disentangle "son-preference" from such "son-weakness" here.

Next, I examine the differential responses by mothers' working status and mothers' type of jobs among working mothers. Note that mother's working status is only collected every five years ending with last digit of 0 and 5, and thus sample size in this analysis is smaller.

Figure 8A clearly shows that non-working mothers are more likely to delay the timing of births than working mothers. Panel C in Table 5 reports that while non-working mothers shift 11.3 percent of births, the corresponding number is only 3.5 percent for working mothers. The coefficients on working and non-working mothers are statistically different at 1 percent level. The results are plausible since the opportunity cost of delaying births is higher for working mothers than for non-working mothers.

However, the results for working mothers may mask the heterogeneous responses by the mothers with different types of job. Figure 8B displays the mean daily number of births by mothers' job type among those working. Interestingly, mothers with low-skilled jobs are more likely to shift births *before* the school entry cutoff date while mothers with medium- and high-skilled jobs shift birth *after* the cutoff date. This result implies that while the opportunity cost is smaller for mothers with low-skilled jobs than those with medium- or high-skill jobs, financial burden of an additional year of child care cost forces mothers with low-skilled jobs to time births earlier than school entry cutoff date at the expense of children's academic advantage. Also mothers with low-skilled jobs may face less job security, making it hard for them to take a long absence from work. Panel D in Table 5 reports that while roughly 20 percent of births are shifted *backward* among mothers with medium- or high-skilled jobs, mothers with low-skilled jobs (and hence arguably low income) shift births *forward* by roughly 18 percent of births.

5.2 Availability of Public Day-care Centers

The differential responses by mothers' working status and mothers' type of jobs among working mothers in the preceding sub-sections is consistent with the opportunity cost story. In this sub-section, I further explore whether the easier access to child cares, and hence the lower

[30] Datar (2006) shows that boys benefit significantly more in reading from delaying entry to kindergarten compared to girls.

[31] Allen and Barnsley (1993) show that two and a half times as many boy players in the Hockey League in Canada were born in January as in December where the cutoff date for Canadian hockey is January 1.

cost of raising child, affects the timing of births. The idea behind is that the more available the day-care is at the region, the more I may observe the delays of births, since additional year of child care is less a concern for mothers in these regions. I am certainly aware that this is simply a correlation and not causal estimates since there is no explicitly exogenous regional variation on day-care availability. Nonetheless this is a relevant and interesting correlation and therefore this exercise should be viewed as a complement to the analysis in the preceding section.

As a measure of availability of child care, I exploit the year-to-year prefecture variation of availability of public day-care centers. More specifically, I compute the "capacity" measure at each prefecture for every year by dividing the total slots of public day-care centers by the total number of females between ages 20–39, the child-bearing age.[32] This measure captures the "potential" availability of child care instead of the "actual" availability of child care, where the total slots of the public day-care centers is often divided by the number of children before school entry age instead of the number of females in childbearing age as I do here. This measure is arguably better than actual day-care availability, since the number of children may be the result of mother's fertility decisions, and hence potentially endogenous to the timing of birth shifts (Unayama, 2012). There is considerable prefectural variations in capacity variable – ranging from 0.0355 (Kanagawa in 1974) to 0.293 (Ishikawa in 1979) with mean of 0.144 (SD of 0.053) slot per females. There are 47 prefectures in Japan, and I have information on total slots of public day-care centers at each prefecture for period of 1974–2007.[33]

I estimate the relationship between the availability of public day-care centers and the magnitude of the birth shifts in the following two steps. First, I estimate the following equation (4) for each prefecture p and each birth year y cell separately using 7 days window from the cutoff:

$$\ln(birth_d^{yp}) = \alpha^{yp} + \beta^{yp} After_d^{yp} + \sum_{j=1}^{6} DOW(j)_d^{yp} \gamma_d^{yp} + \sum_{k=1}^{N} Holiday(k)_d^{yp} \delta_d^{yp} + \varepsilon_d^{yp} \quad (4)$$

This equation is simply the analogue of the equation (2), but β^{yp} is estimated at each prefecture/year-of-birth cell instead of using all pooled data at once, thus generating a series of estimates across prefecture/year-of-birth (1,598=47 prefecture/year-of-birth*34 years).[34] Note that since the equation is estimated for each year, I no longer include the year of birth fixed effects.[35]

[32] The number of female population is interpolated through the Census which is collected every five years ending with 0 or 5.
[33] I am grateful to Takashi Unayama for kindly sharing this data.
[34] Note that this is conceptually the same as pooling the data for all years of births, and including all the interaction of independent variables with a full set of prefecture/year-of-birth dummies.
[35] $\hat{\beta}^{yp}$ vary from -0.127 to 0.387 with mean of 0.082 and standard deviation of 0.063.

In the second step, I estimate the following equation (5) where I regress this magnitude of delays at prefecture/year-of-birth cell, $\hat{\beta}^{yp}$, on a capacity measures as I mentioned above.

$$\hat{\beta}^{yp} = \alpha + \beta \ln(capacity_{(y-1)p}) + \gamma_p + \theta_y + \delta X_{yp} + \mu_{yp} \quad (5)$$

Note here that since capacity variable is collected as of October 1 in each year y, I use the capacity variable in y-1, a year prior to March/April when the shifts of births occur in year y. X_{yp} is time-varying prefectural characteristics, and I specifically include the real GDP per capita which is deflated by prefecture GDP deflator to Yen in 2000, and job application-to-opening ratio at October of y-1, which roughly captures prefectural labor market conditions around the time of conception to partially control for selection into fertility. In fact, Dehejia and Lleras-Muney (2004) highlighted the effect of the business cycle on the characteristics of mothers who conceived children in the US. I also include job application-to-opening ratio in March of the year y, to account for the economic condition at the time of births as well.[36] These controls essentially have no impacts on the estimates. The source of variable and years available are summarized in Appendix Table E.

Table 6 summarizes the results from estimating equation (5). Column (1) reports that the 10 percent increase in the capacity of public day-care centers is associated with the increase of delays by 1.4 percent. This result is consistent with the view that better access to public day-care centers reduces the cost of child care, and hence mothers are more willing to delay the births. While I cannot interpret the result as causal, it may imply that increase in the availability of public day-care may potentially exacerbate the shifts of the births.

Adding time-varying controls in Column (2) does not virtually affect the estimate. In Column (3), I run the same equation as (5) but here I use the mean daily number of births at each prefecture/year-of-birth as weights. While the estimates are slightly smaller, it still remains highly statistically significant at the conventional level. Finally, to check whether my results are driven by prefectures with large populations which tend to have low availability of public day-care centers, Column (4) excludes Tokyo and Osaka, two biggest prefectures. The result is essentially the same as Column (3).

In sum, I find that the results are consistent with the hypothesis that cost of the child care may be the one driving force of shifts in the timing of births. However, I need to view this result with a considerable caution since the availability of public day-care is just a crude proxy of the cost of child care.[37] Also again, I stress that I can only provide correlations and not causal

[36] While more standard measure of labor market conditions such as unemployment rate at the prefecture level is only available in the Census years, the monthly job application-to-opening ratio at the prefecture level is available since as early as 1963 in Japan.

[37] While there are private day-care centers, public day-care centers tend to be cheaper than private day-care centers.

interpretation here.

6. Discussion

6.1 Magnitude of the Shifts

Here I examine the magnitude of the shifts by comparing this study to the previous studies that also look at the effect of birth-related cutoff on the timing of births in other contexts. The results are summarized in Table 7. Three things are noteworthy to mention before comparison. First, the school entry cutoff date are known well in advance like tax benefits so that the timing of both conceptions as well as births could be potentially affected by the school entry cutoff date. It is in contrast to the case of bonus payment in July 2004 in Australia which only affect the timing of births because mothers did not know the policy at the time of conceptions (Gans and Leigh, 2009). Second the incentives created by the school entry cutoff date potentially affect the later outcome of children, while other studies examine the immediate financial incentives such as tax incentives. Third, while incentive structure in the other studies goes in one direction in all studies (i.e., either delaying or hastening of births and not both), there is a clear trade-off in parents' incentives in my case. Despite these differences, 7 percent shifts of births found in this study are within the range of other studies.

6.2 Conceptions of Births

So far, I focus on the timing of births instead of timing of conceptions. However, since the school entry cutoff date is well-known, and has not changed since 1947, it is plausible that sensible mothers time conception instead of births. Figure 10A shows that the number of 2^{nd} births peaks early May, and thus fraction of 2^{nd} births among all births in Figure 10B show a peak around April–June. It is possible that parents become more aware of the importance of the timing of births at the second births or simply are more comfortable to give births in spring than summer or winter. While there are many other reasons to time conceptions, in any case this result is consistent with the fact that some types of mothers carefully time the conception in the US (Buckles and Hungerman, 2013).

6.3 Randomness of Births

The findings in this paper have implication for the growing literature that relies on the identification strategy that assumes that births around the school entry cutoff date are random. Most papers use the expected school starting age (defined by the birth month or days in relation to the school entry cutoff date) as an instrument for the actual school starting age to examine the effect of school starting ages on test scores, completed years of schooling, and later labor market outcomes (e.g., Black et al., 2011, Fredriksson and Öckert, 2013). Relatedly, a seminal paper by Angrist and Krueger (1991) use quarter of births as instrument for years of education in the US. Recent papers use more precise information on the exact date of births instead of quarter of birth, and use birthdate in relation to the specified school entry cutoff date to instrument for years of schooling (e.g., McCrary and Royer, 2011).

Most of the papers indeed examine the distribution of births or compare the characteristic of parents around the school entry cutoff date, to make sure that underlying assumptions hold. Therefore my results in Japan may be country specific, but the findings here consistently point to one direction: births around the school entry cutoff date reflect the differences in mother's SES as well as mother's preferences, and thus are not random at least in this setting.[38]

In fact, Bedard and Dhuey (2006) exploit the school entry cutoff date among OECD countries, which include Japan, and show that younger children within the academic cohort do perform worse than older children.[39] Kawaguchi (2010) also finds that those born in March have worse test scores, less completed years of schooling and lower wages than those born in April within the school cohort.[40] Unfortunately, Trends in International Mathematics and Science Study (TIMSS) data for Japan, used by both Bedard and Dhuey (2006) and Kawaguchi (2010), do not collect any of the key SES of mothers such as educational attainment.[41] Therefore I cannot separate the academic disadvantage of March-born children to April-born children into each of "double deficits" effects: younger within the school cohort, and born by mothers with low SES.

7. Conclusion

Parents are known to time birth in response to various incentives. Some papers have already documented that parents do react to incentives if the financial reward is immediate such as tax

[38] See also Buckles and Hungerman (2013), Bound and Jaeger (2000), Dobkin and Ferreira (2010), Cascio and Lewis (2006), Barreca et al. (2011), and Carlsson et al. (2012) on nonrandomness of birthdate. These papers capture the timing of conceptions rather than timing of births.

[39] It is important to note that in addition to estimating each country separately, Bedard and Dhuey (2006) also pooled the data from countries with different school entry cutoff date, and therefore include birth of month fixed effect to control for season of birth effects, and still find that older children perform significantly better than younger children within school-cohort.

[40] Both papers use the month of births instead of day of birth, which could partially mitigate the concerns of sample selection by averaging out the characteristics of children and mothers. However, as shown in the Appendix Figure C, even at the monthly level, mothers who give birth in March are potentially negatively selected compared to those who give birth in April: they tend to be more likely to be working but with low-skilled jobs.

[41] While TIMSS in 1995 and 1999 indeed report the exact date of birth, the sample size of TIMSS at the daily level becomes extremely small (5-10 observation per day), and thus TIMSS is not suitable to examine the outcomes at the daily level. Unfortunately, to my knowledge, I am not aware of any dataset in Japan which contains three key variables: the exact date of birth, the medium and long term outcomes, and the mother's characteristics.

benefits and monetary bonuses but no paper has showed that parents also react to the less immediate incentives such as school entry cutoff date that may potentially affect long term outcomes of children. Examining the universe of births in Japan, I find that mothers in Japan indeed shift the timing of birth in response to the school entry cutoff date. This result shows that mothers can be very forward looking, and thus time the births in response to future outcomes of children.

Also I find that the overall shifts in births, however, mask heterogeneous responses of mothers. In fact, I find that mothers with low-skilled jobs tend to give births *before* the school entry cutoff date while mothers with medium- and high-skilled jobs tend to give births *after* the cutoff date. These findings imply that those children born just before the school entry cutoff date suffer from "double" deficits, which may partially account for the intergenerational immobility.

One remaining question is as to why I find the shifts of births in response to school entry cutoff date in Japan, while other studies in US, Chile and Argentine do not find such behavioral responses of mothers. The strict enforcement of school entry age in Japan, and social promotion education system without delays, and advancement, suggests that the stake of birth timing is much higher in Japan since it determines when the child start schools later in their life. Also having single school entry cutoff date makes it easier for parents to target the relevant date. Whether a similar shift in the timing of births can be observed in other countries for which there is little or no evidence of early/late starting or grade retention, namely, England, Iceland, and Norway, is the avenue for the future research.

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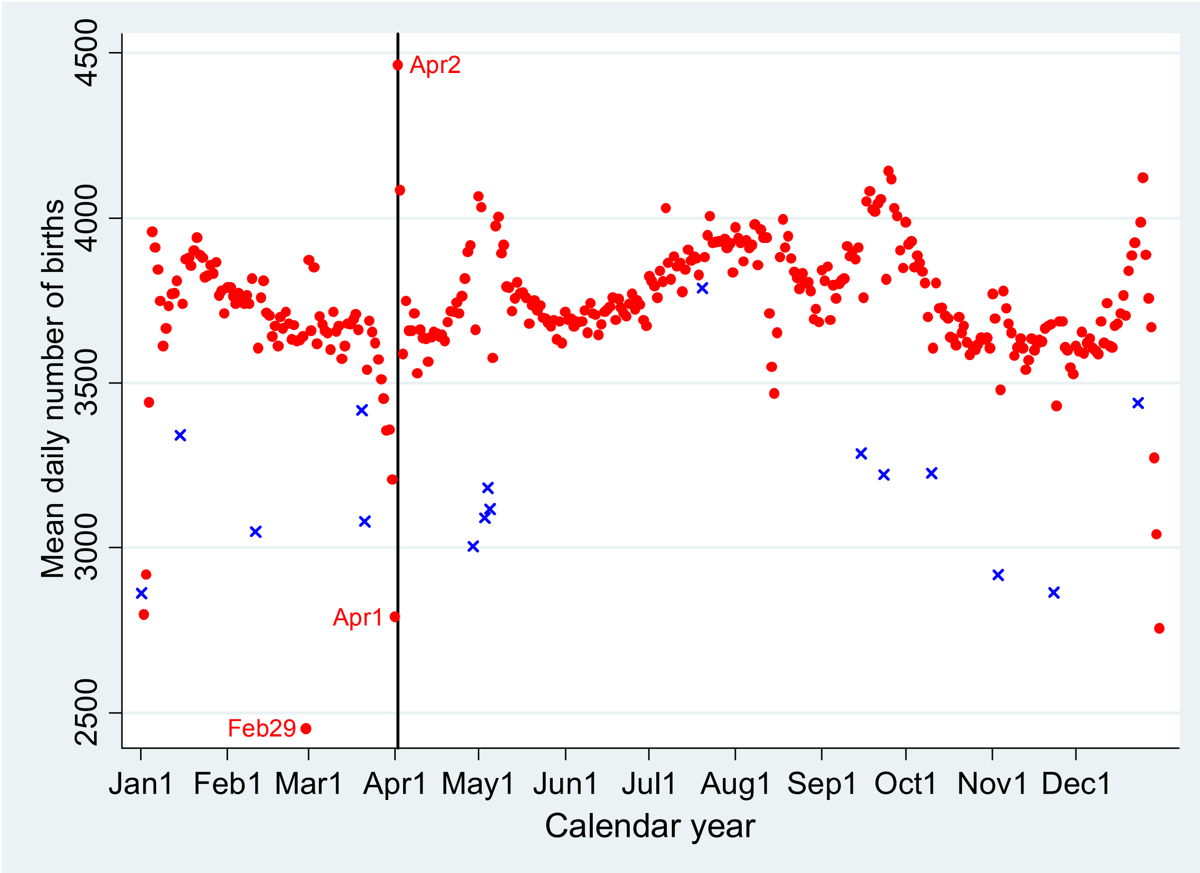
58. **Tamm, Marcus.** (2012) “The Impact of a Large Parental Leave Benefit Reform on the Timing of Birth around the Day of Implementation,” *Oxford Bulletin of Economics and Statistics*, 1–17.
59. **Unayama, Takashi.** (2012) “The Possibility of Pursuing Both Marriage/Childbirth and Employment, and the Development of Nursery Schools,” *Japanese Economy*, 39(1): 48–71.

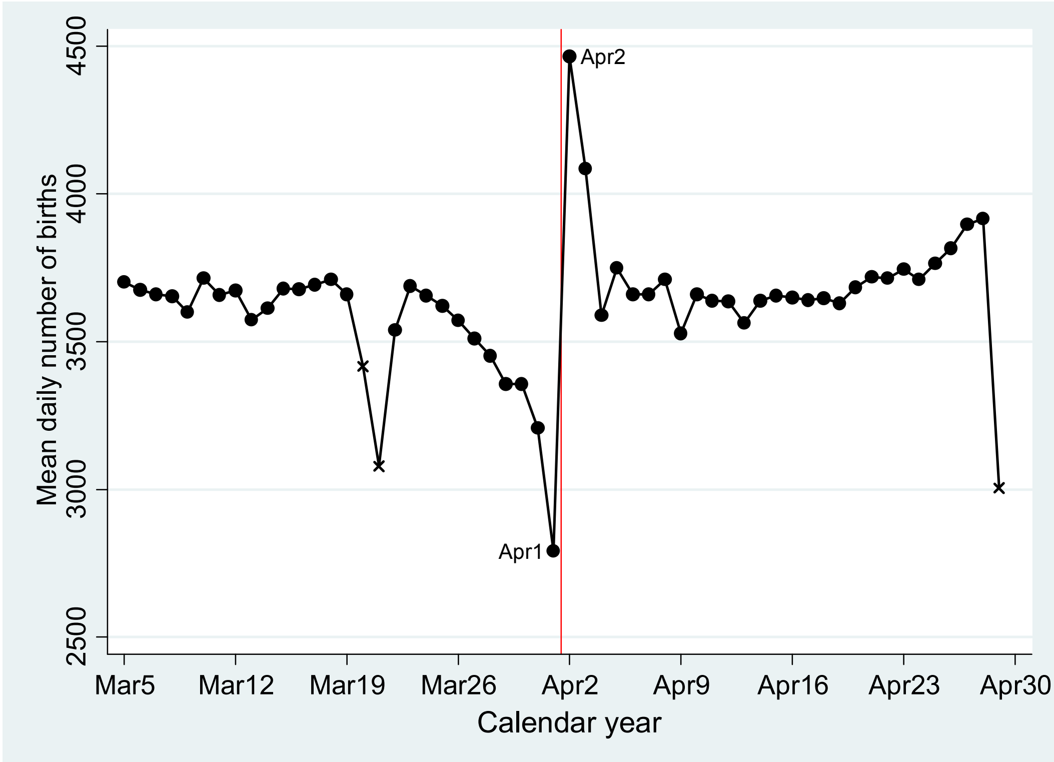
Figure 1: Mean daily number of births through the year



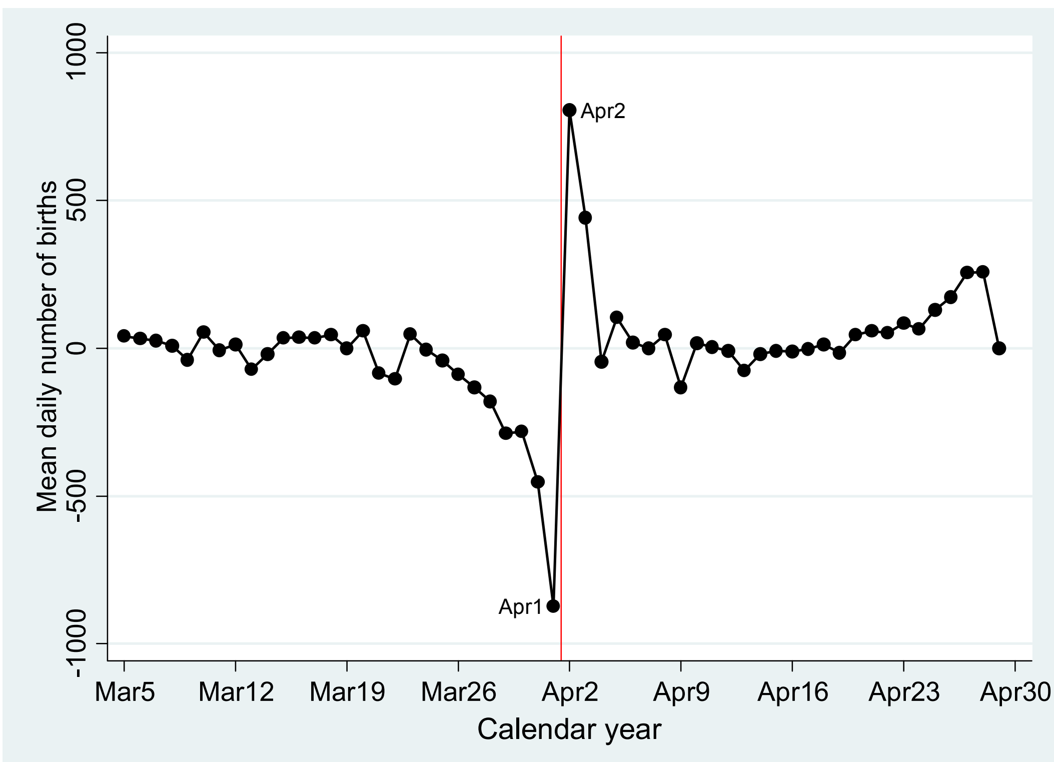
Note: The vertical line corresponds to April 2, which is the school entry cutoff date in Japan. The data come from pooled 1974–2010 birth data. The markers with cross sign are holidays.

Figure 2: Mean daily number of births around April 2

A. Raw data

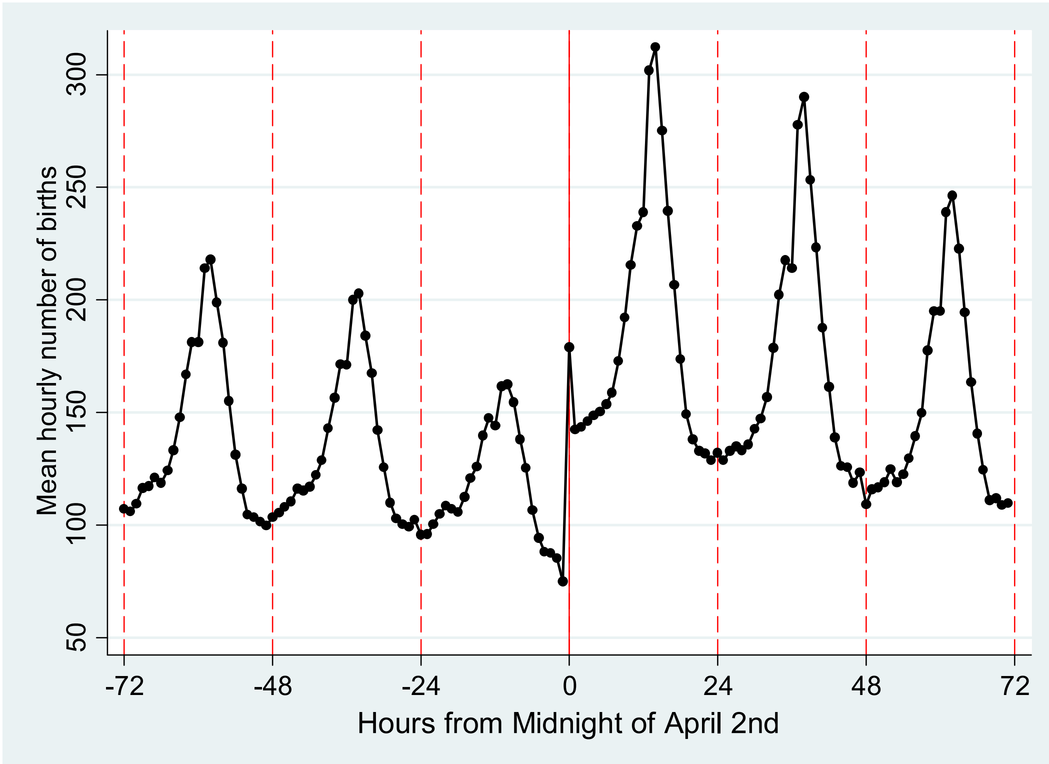


B. Adjusted



Note: The vertical line corresponds to April 2, which is the school entry cutoff date in Japan. The data come from pooled 1974–2010 birth data. Each plot is the mean daily number of birth. The markers with cross sign in Panel A are holidays (either March 20 or March 21 depending on the year, and April 29). Panel B adjusts for holidays, year and day of week fixed effects.

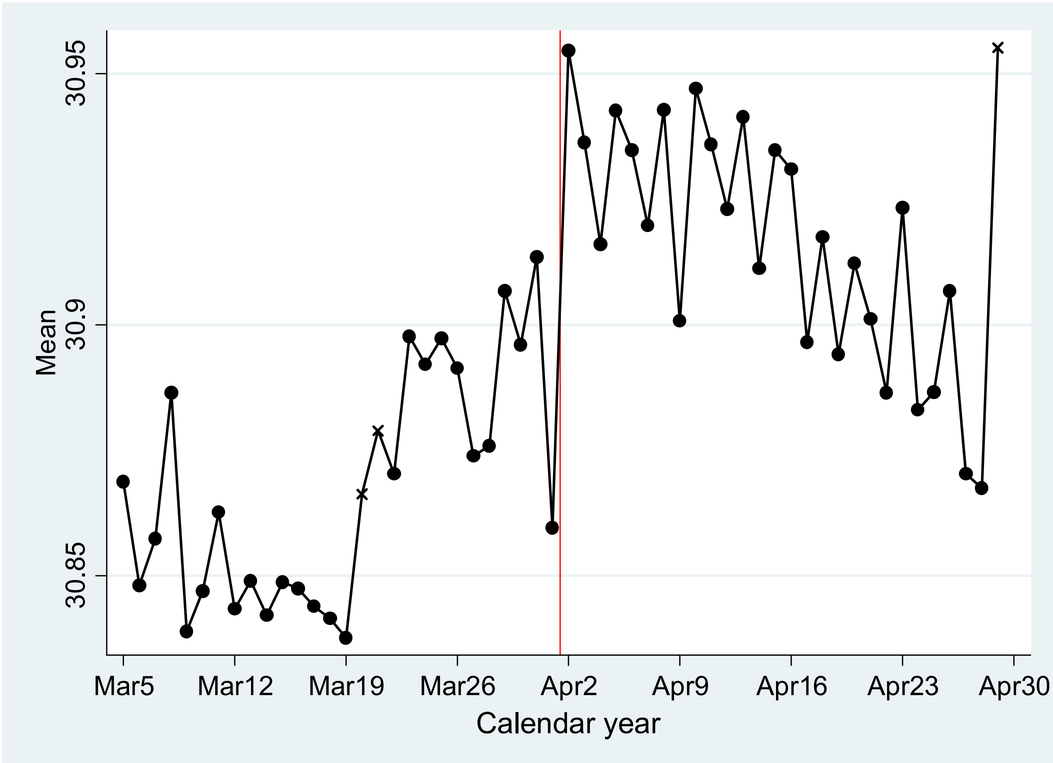
Figure 3: Reported birth hours within 72 hours from April 2



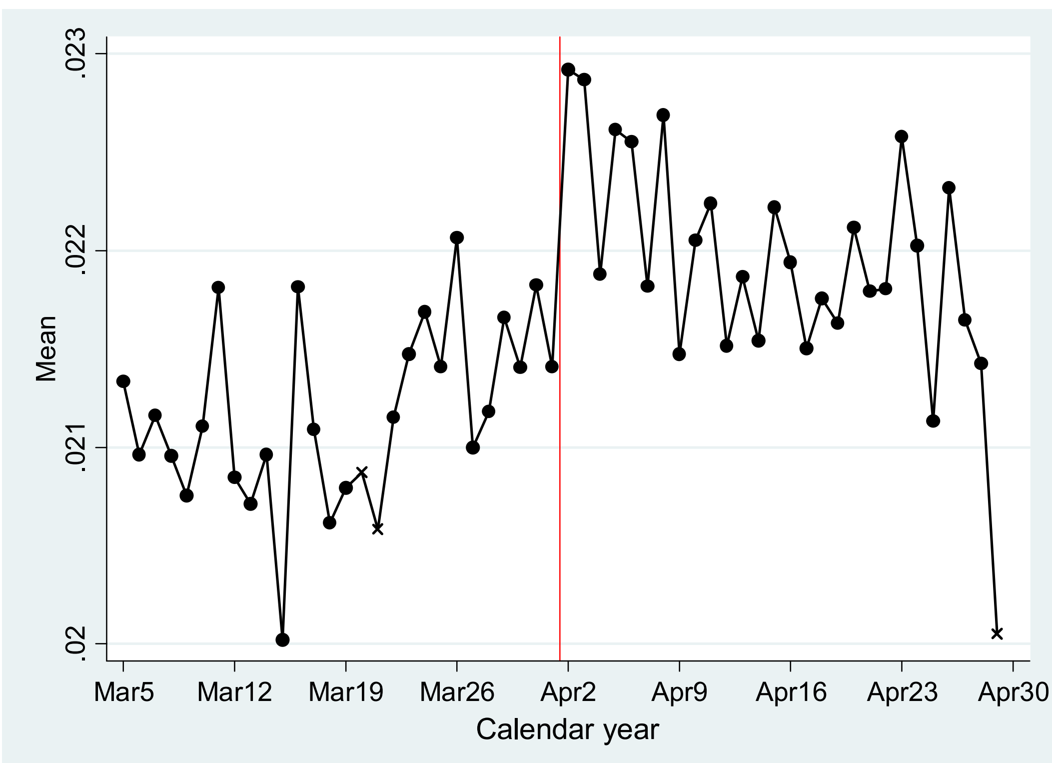
Note: The data come from 1974–2010 pooled birth data. The sold vertical line corresponds the midnight of Aprils 2, which is the exact school entry cutoff time in Japan. Every vertical dashed line corresponds to the midnight of other days. Each plot is the mean hourly number of births.

Figure 4: Child Outcomes

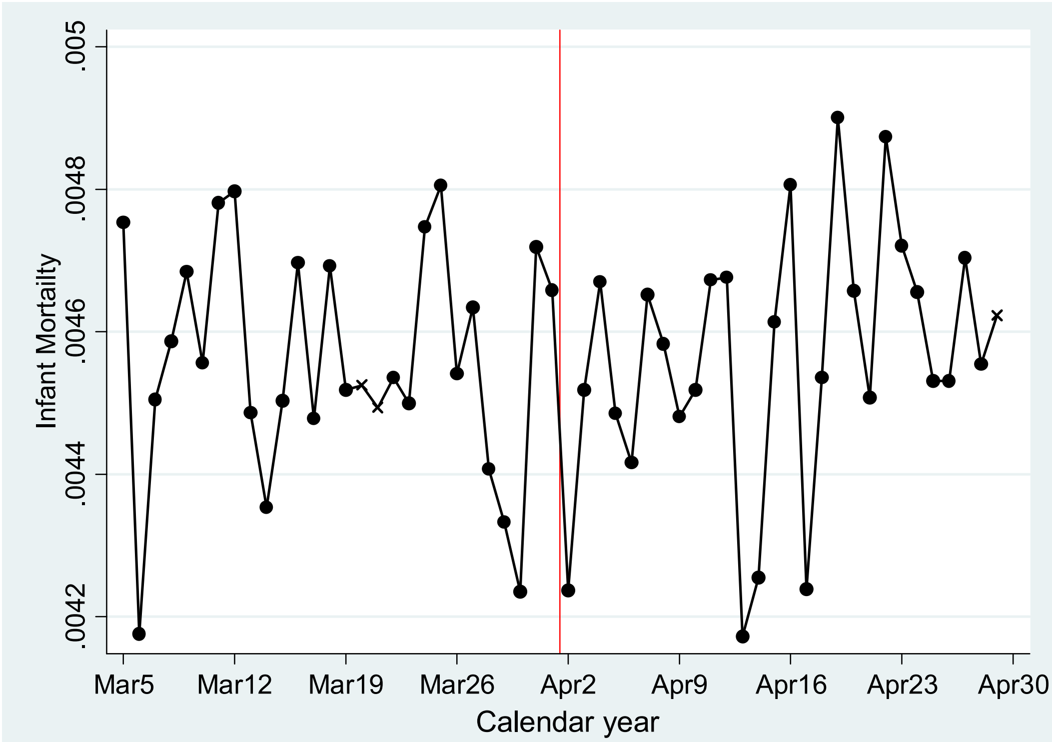
A. Mean Birth weight (100 grams)



B. Fraction of births over 4,000 grams

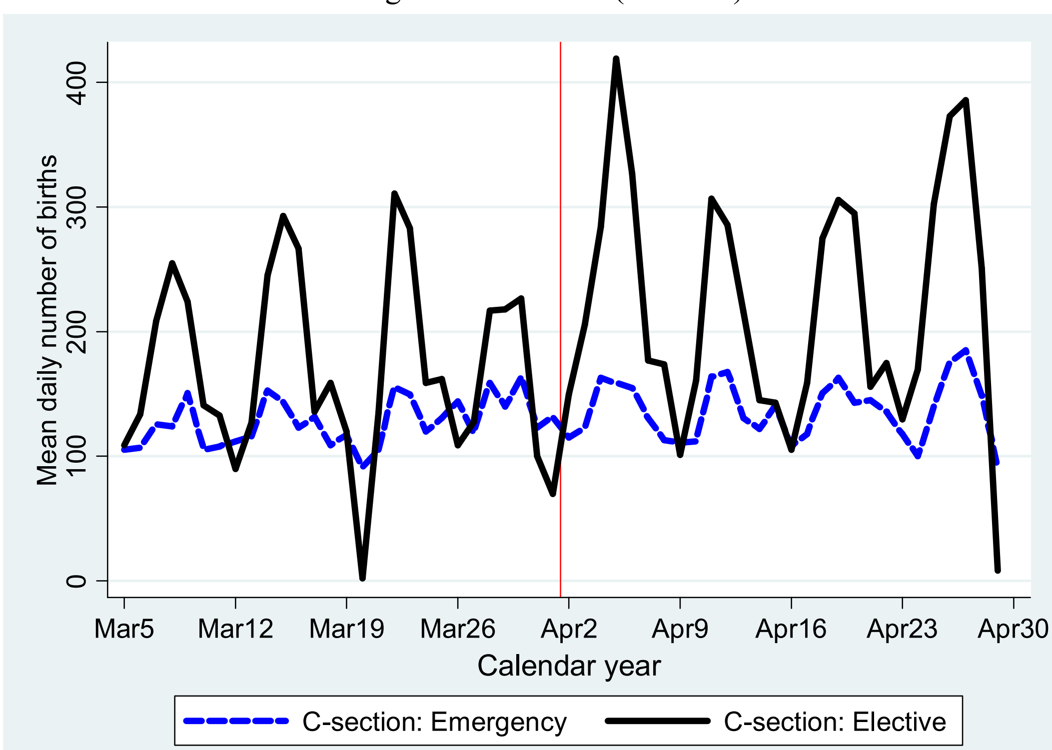


C. Infant mortality



Note: The vertical line corresponds to April 2, which is the school entry cutoff date in Japan. The data come from pooled 1974–2010 birth data. Each plot is the mean of outcome in each day. The markers with cross sign are holidays.

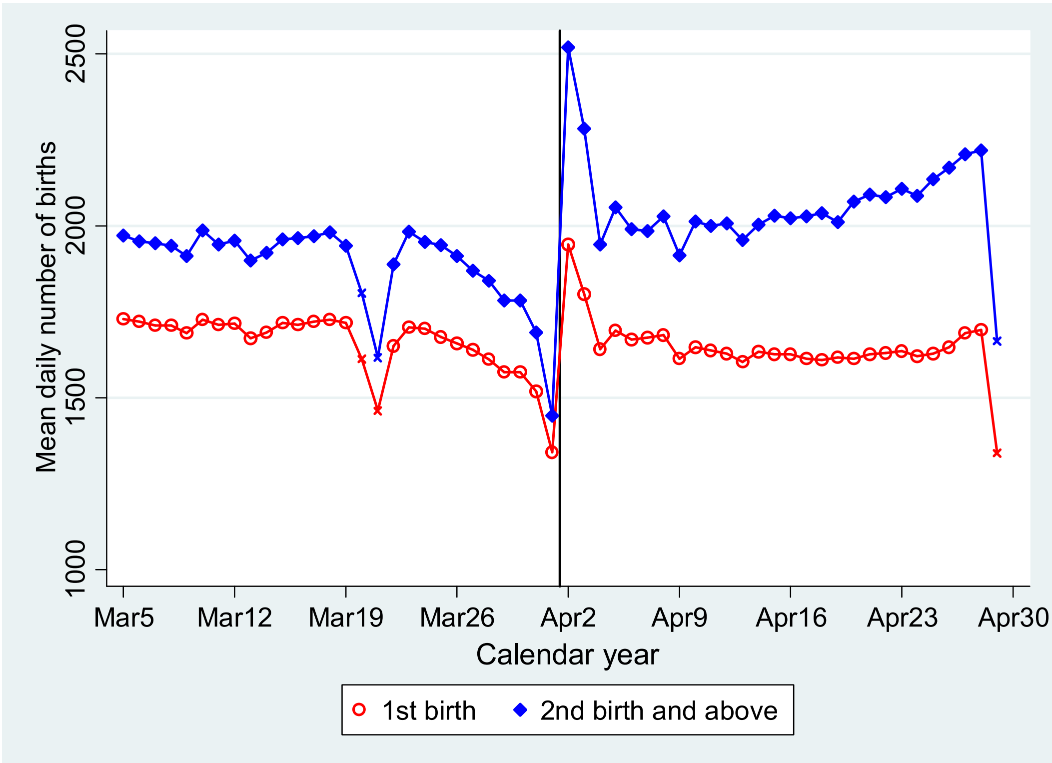
Figure 5: C-section (raw data)



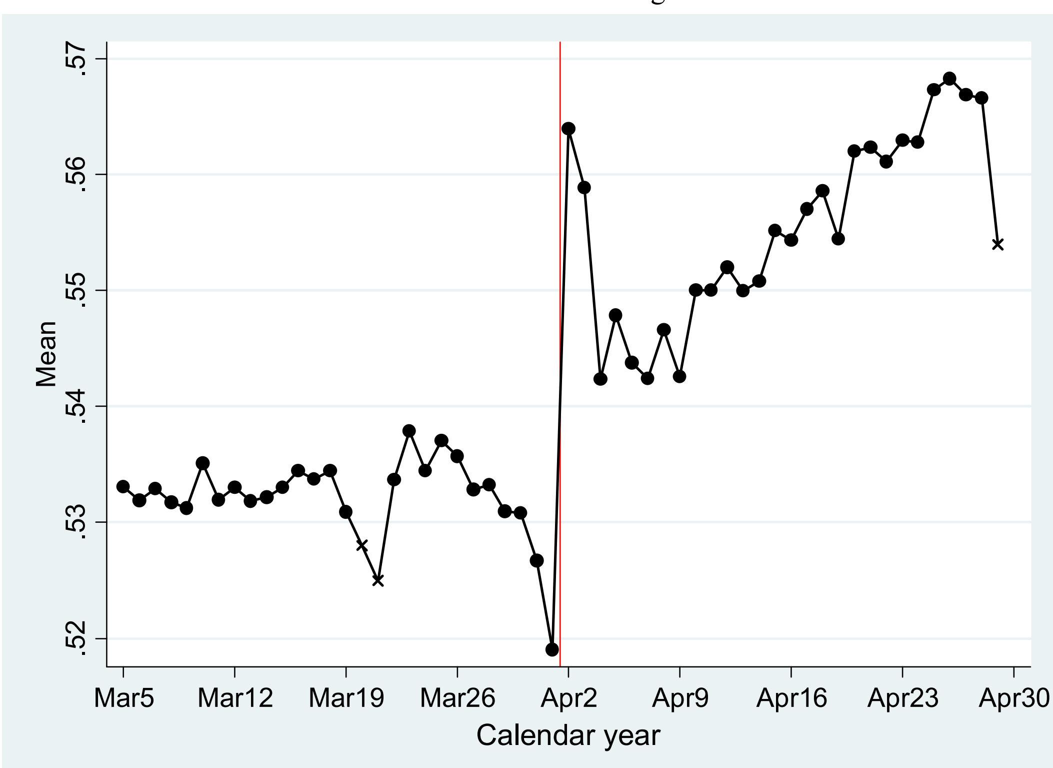
Note: The vertical line corresponds to April 2, which is the school entry cutoff date in Japan. The data come from pooled 2011–2012 DPC data. The graph plots the mean daily number of birth.

Figure 6: Heterogeneous responses, by parity

A. Number of births by parity



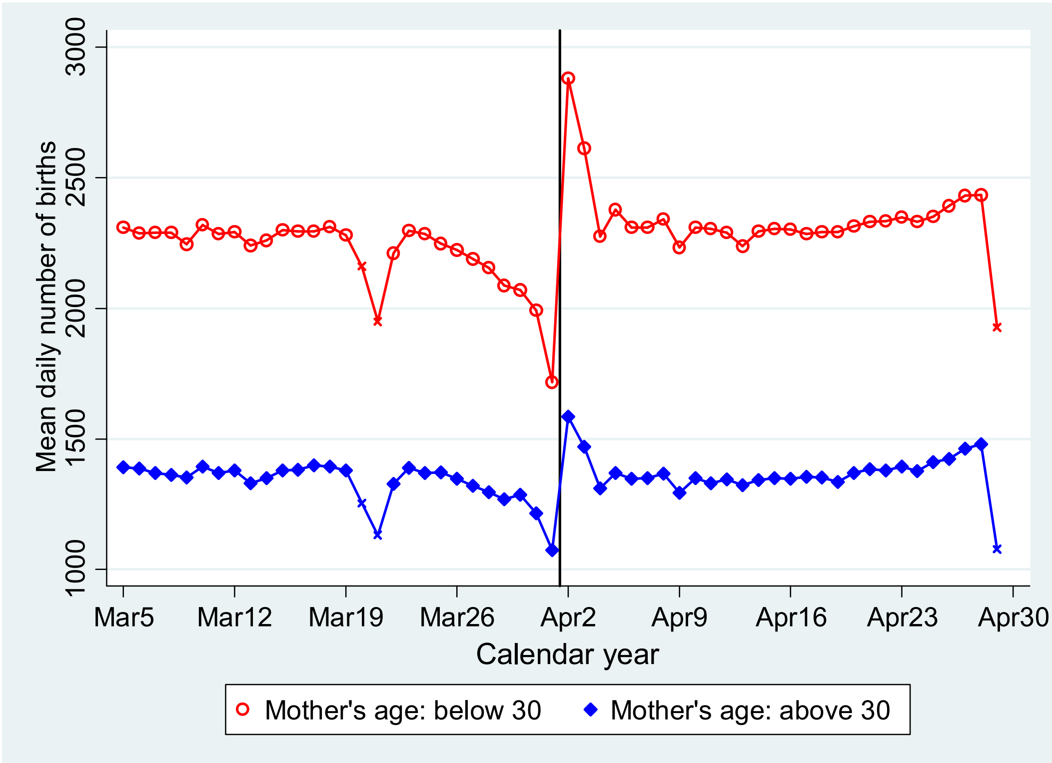
B. Fraction of 2nd+ births among all births



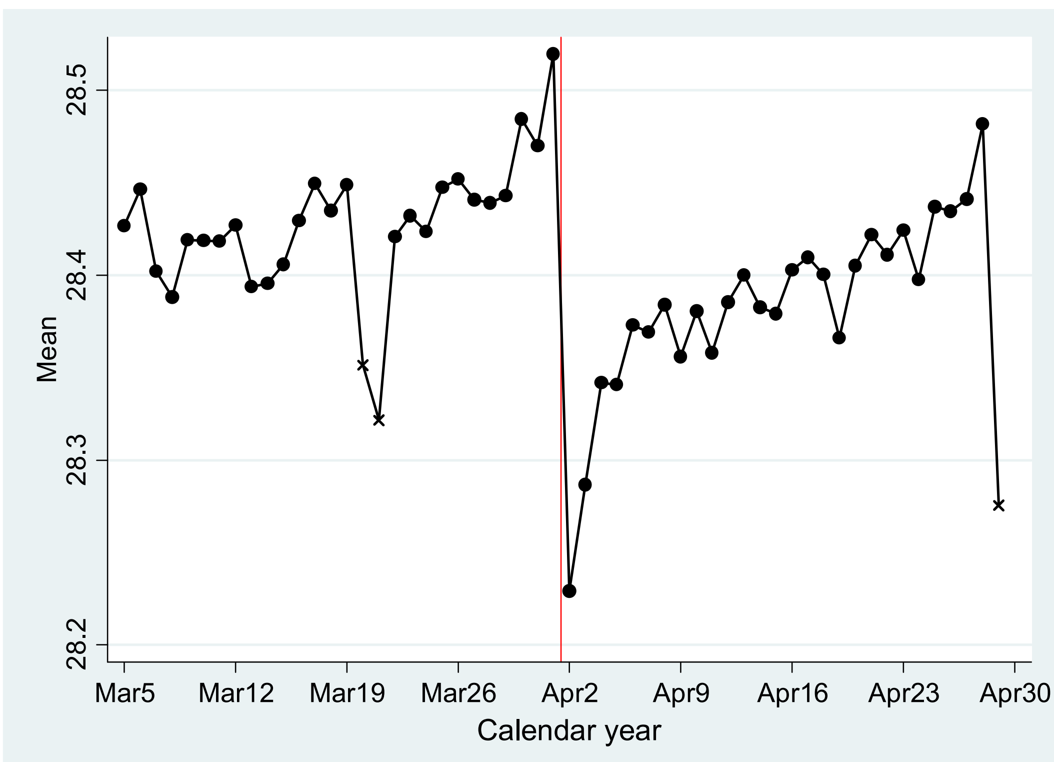
Note: The vertical line corresponds to April 2, which is the school entry cutoff date in Japan. The data come from pooled 1974–2010 birth data. Each plot in Panel A is the number of births in each day. Each plot in Panel B is the mean of outcome in each day. The markers with cross sign in Panel A and B are holidays.

Figure 7: Heterogeneous responses, by mother's age

A. Number of births by mother's age



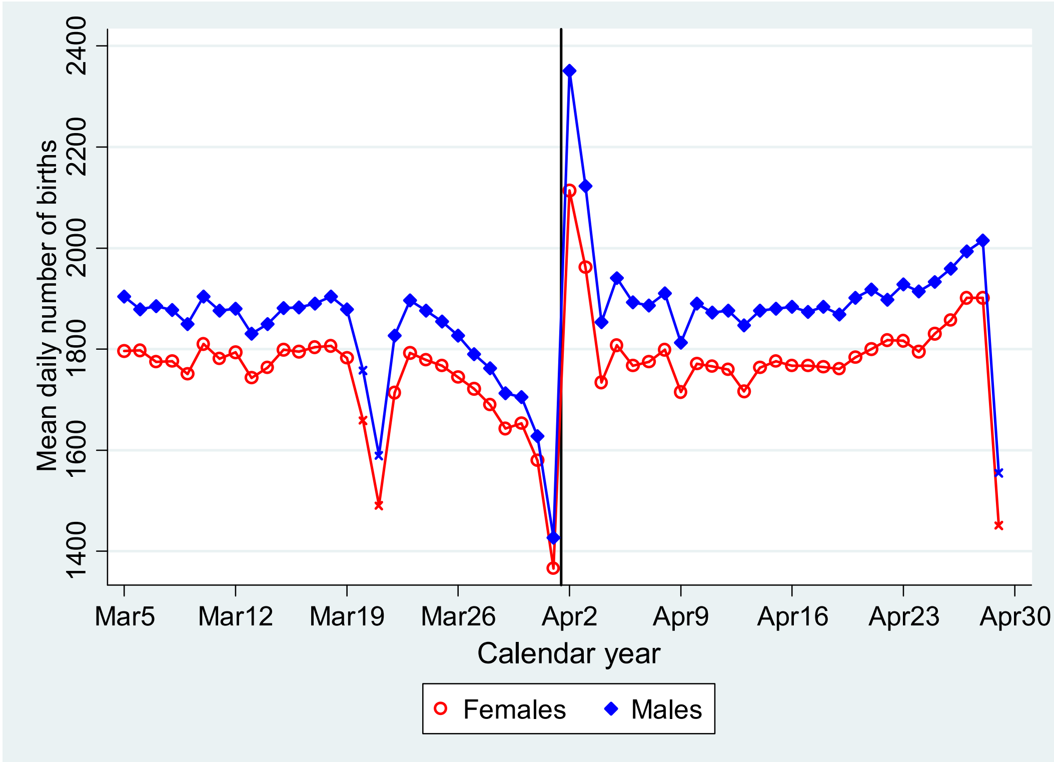
B. Mother's age



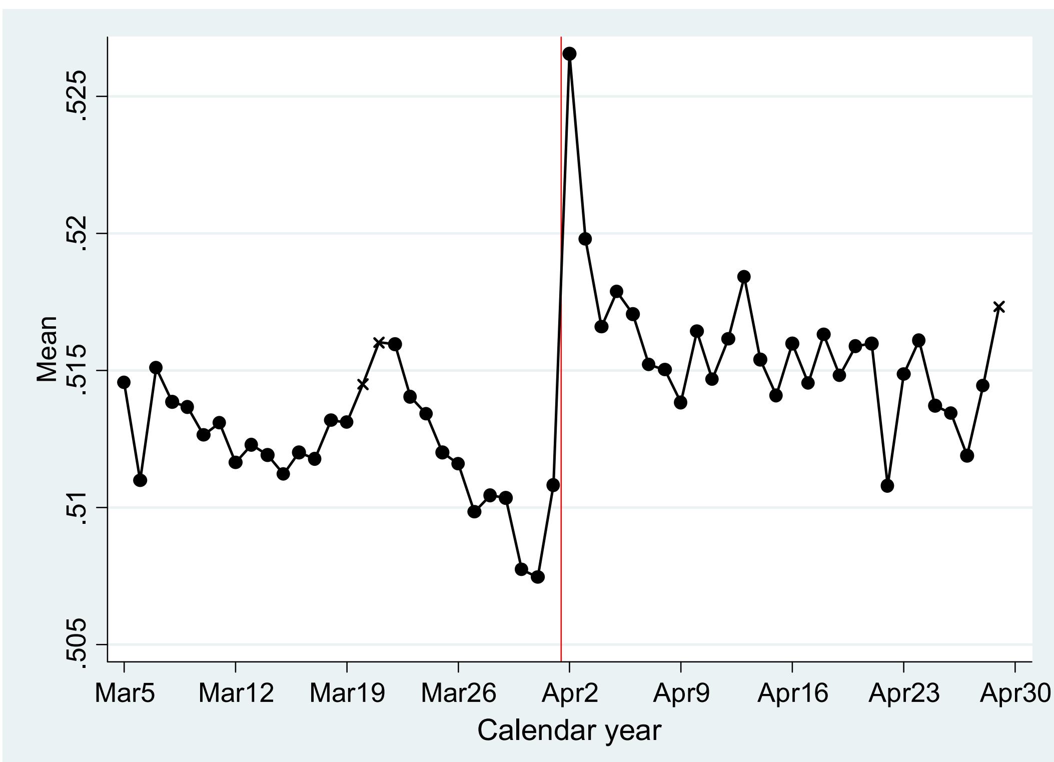
Note: The vertical line corresponds to April 2, which is the school entry cutoff date in Japan. The data come from pooled 1974–2010 birth data. Each plot in Panel A is the number of births in each day. Each plot in Panel B is the mean of outcome in each day. The markers with cross sign in Panel A and B are holidays.

Figure 8: Heterogeneous responses, by gender

A. Number of births by gender



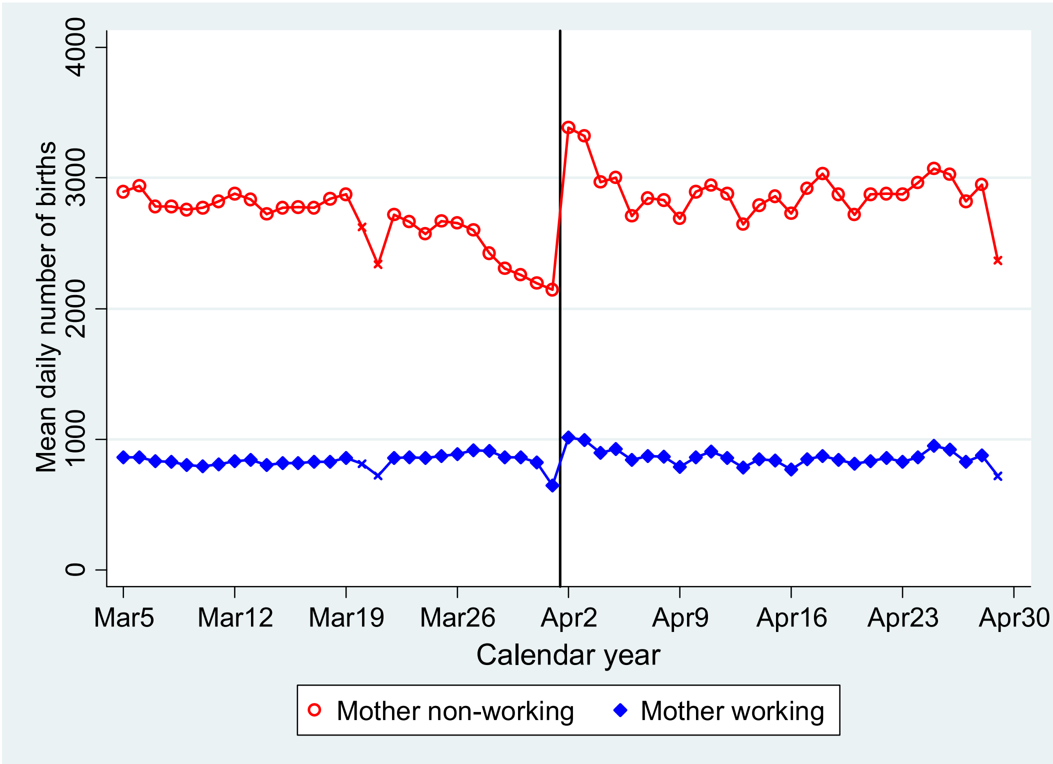
B. Fraction of male births



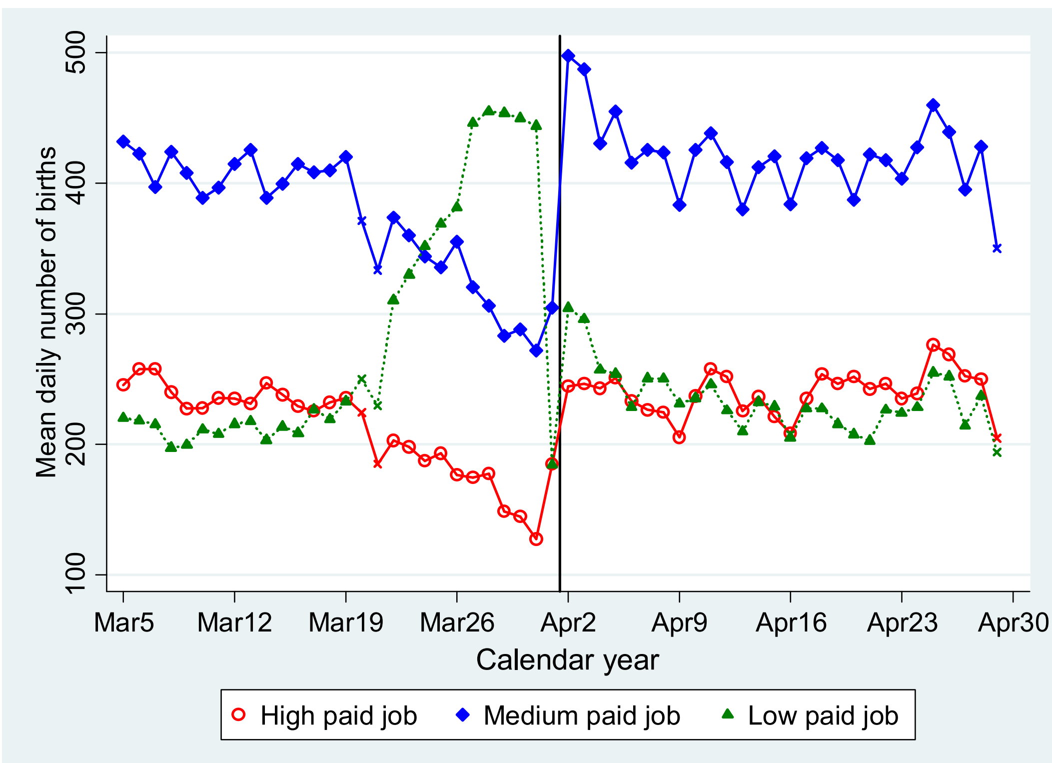
Note: The vertical line corresponds to April 2, which is the school entry cutoff date in Japan. The data come from pooled 1974–2010 birth data. Each plot in Panel A is the number of births in each day. Each plot in Panel B is the mean of outcome in each day. The markers with cross sign in Panel A and B are holidays.

Figure 9: Heterogeneous responses, by mother's working status

A. Working vs. non-working mothers



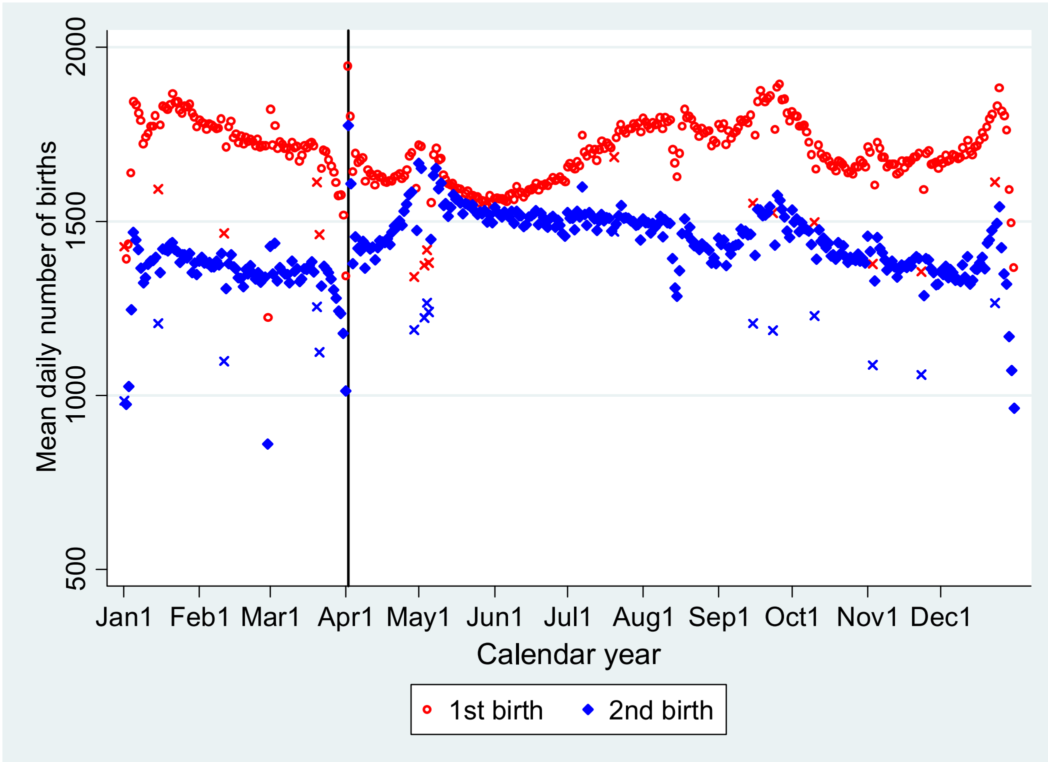
B. Among working mothers: Type of jobs



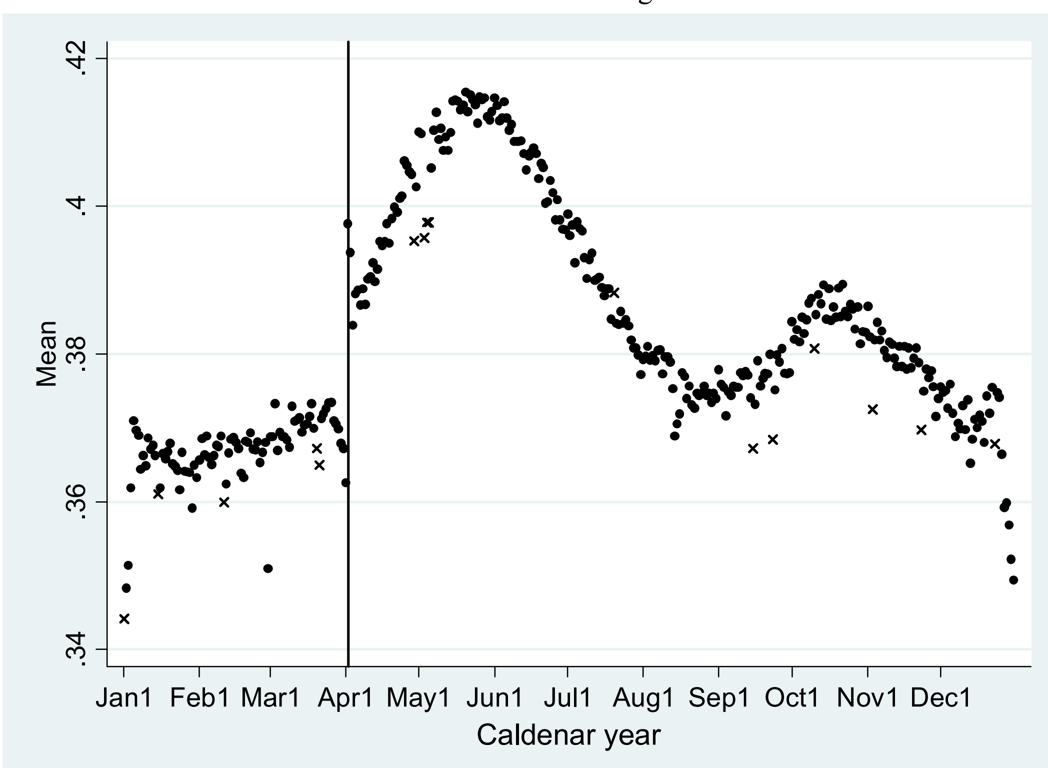
Note: The vertical line corresponds to April 2, which is the school entry cutoff date in Japan. The data come from 1975, 1980, 1985, 1990, 1995, 2000, and 2005 pooled birth data. Each plot in Panel A is the number of births in each day. Each plot in Panel B is the mean of outcome in each day. The markers with cross sign in Panel A and B are holidays.

Figure 10: Mean daily number of births through the year, by parity

A. 1st and 2nd or above



B. Fraction of 2nd birth among all births



Note: The vertical line corresponds to April 2, which is the school entry cutoff date in Japan. The data come from pooled 1974–2010 birth data. The markers with cross sign are holidays.

Table 1: Top 5 and bottom 5 of mean daily birth within a year

	Date	Mean daily births	Ratio to average daily birth
Top 5			
	April 2	**4,465**	**1.20**
	Sep 25	4,143	1.12
	Dec 25	4,122	1.11
	Sep 26	4,119	1.11
	April 3	**4,085**	**1.10**
Bottom 5			
	Feb 29	2,452	0.66
	Dec 31	2,757	0.74
	April 1	**2,791**	**0.75**
	Jan 2	2,798	0.75
	Jan 1	2,862	0.77

Notes: The ratio to the average is daily births divided by the mean daily births. Therefore a value of 1.1 represents a 10 percent increase in the daily births compared to the average in the year. Mean daily births during 1974–2010 are 3,713. Solid ones are within a week from April 2.

Table 2: Shift of births

	(1)	(2)	(3)	(4)
Windows	±7 days	±14 days	±21 days	±28 days
Panel A: Number of births				
After	524.2***	268.6***	178.9***	166.2***
	(55.1)	(30.0)	(20.4)	(16.5)
Number of births moved	*1,835*	*1,880*	*1,879*	*2,327*
N	518	1,036	1,554	2,072
R2	0.83	0.86	0.89	0.90
Panel B:ln(number of births)				
After	0.136***	0.070***	0.047***	0.043***
	(0.009)	(0.005)	(0.004)	(0.003)
Share of births moved	*7.0%*	*3.6%*	*2.4%*	*2.2%*
N	518	1,036	1,554	2,072
R2	0.86	0.88	0.90	0.91

Notes: Coefficient on *After* is reported. *After* is a dummy that takes one if the birthday is after April 2 in each year and zero otherwise. Standard errors in parenthesis. * p<0.10, ** p<0.05, *** p<0.01. Sample is daily births within the relevant window from 1974–2010. All specifications include public holiday, and year*day of week fixed effects. Window denotes the number of days before and after April 2. For example, the ±7 day window covers the seven days prior to April 2, and the first seven days after April 2. Number of births moved is $W\beta/2$, where W is the number of days in the window. Share of births moved is $\exp(\beta/2)-1$.

Table 3: Child's characteristics

	Birth weight (100 g)	Birth weight>4000 g	Gestation>42 wks	Mortality (per 1000 births)
	(1)	(2)	(3)	(4)
After	0.023***	0.0005***	0.0007***	-0.090
	(0.005)	(0.0002)	(0.0002)	(0.090)
N	1,847,984	1,847,984	1,846,441	518
R2	0.014	0.004	0.011	0.883
Mean	30.90	0.022	0.023	4.155

Notes: Coefficient on *After* is reported. *After* is a dummy that takes one if the birthday is after April 2 in each year and zero otherwise. Standard errors in parenthesis. * p<0.10, ** p<0.05, *** p<0.01 significant at 1%. Sample is individual birth from pooled 1974–2010 birth data. All specifications include public holiday, and year*day of week fixed effects. The window is restricted to the seven days prior to April 2, and the first seven days after April 2.

Table 4: Shift of C-section births from insurance claim data
(Outcome: *ln(number of births)*)

			(1)	(2)	(3)	(4)
		Mean	±7 days	±14 days	±21days	±28 days
Any	After	170	0.198*	0.083	0.092**	0.136***
			(0.102)	(0.068)	(0.044)	(0.046)
	R2		0.978	0.963	0.967	0.947
	Share of births moved		*10.4%*	*4.2%*	*4.7%*	*7.0%*
Emergency	After	69	-0.040	-0.021	0.015	0.057
			(0.106)	(0.065)	(0.067)	(0.082)
	R2		0.942	0.860	0.859	0.800
	Share of births moved		*-2.0%*	*-1.0%*	*0.8%*	*2.9%*
Elective	After	100	0.467***	0.239***	0.202***	0.223***
			(0.062)	(0.034)	(0.025)	(0.002)
	R2		0.995	0.982	0.980	0.944
	Share of births moved		*26.3%*	*12.7%*	*10.7%*	*11.8%*
	N		28	56	84	112

Notes: Outcome is log number of births. Coefficient on *After* is reported. *After* is a dummy that takes one if the birthday is after April 2 in each year and zero otherwise. Standard errors in parenthesis. * p<0.10, ** p<0.05, *** p<0.01 significant at 1%. Sample is individual birth from pooled 2011–2012 insurance claim data. All specifications include public holiday, and year*day of week fixed effects. The window is restricted to the seven days prior to April 2, and the first seven days after April 2.

Table 5: Heterogeneous response, by mother's and children's characteristics
(Outcome: *ln(number of births)*)

	A. Parity		B. Mother's age		C. Gender	
	1st	2nd or above	Less than 30	More than 30	Female	Male
	(1)	(2)	(3)	(4)	(10)	(11)
After	0.101***	0.164***	0.151***	0.109***	0.118***	0.153***
	(0.024)	(0.033)	(0.029)	(0.028)	(0.029)	(0.029)
Share of births moved	*5.2%*	*8.6%*	*7.9%*	*5.6%*	*6.1%*	8.0%
N	518	518	518	518	518	518
R2	0.952	0.951	0.982	0.945	0.948	0.952
Mean of daily births	1,645	1,938	2,253	1,330	1,740	1,843
	D. Working status		E. Type of job			
	Not working	Working	High-skilled	Medium-skilled	Low-skilled	
	(5)	(6)	(7)	(8)	(9)	
After	0.215***	0.070*	0.378***	0.374***	-0.384***	
	(0.022)	(0.038)	(0.044)	(0.035)	(0.104)	
Share of births moved	*11.3%*	*3.5%*	*20.8%*	*20.6%*	*-17.5%*	
N	98	98	98	98	98	
R2	0.950	0.731	0.864	0.938	0.637	
Mean of daily births	2,689	880	200	376	333	

Notes: Coefficient on *After* is reported. *After* is a dummy that takes one if the birthday is after April 2 in each year and zero otherwise. Standard errors in parenthesis. * p<0.10, ** p<0.05, *** p<0.01. Sample for Panel A, B and C is daily births from 1974–2010. Sample for Panel D and E is daily births from 1975, 1980, 1985, 1990, 1995, 2000, and 2005 pooled birth data. The window is restricted to the seven days prior to April 2, and the first seven days after April 2. All specifications include public holiday, and year*day of week fixed effects. Share of births moved is $\exp(\beta/2)-1$.

Table 6: Magnitude of Shifts and Capacity of Child Care Centers

	(1)	(2)	(3)	(4)
	Without controls	With controls	Weight	Exclude Tokyo and Osaka
Capacity	0.140***	0.146***	0.112***	0.111***
	(0.032)	(0.035)	(0.020)	(0.032)
N	1,598	1,597	1,597	1,529
R2	0.447	0.448	0.538	0.523
Year fixed effects	X	X	X	X
Prefecture fixed effects	X	X	X	X
Controls		X	X	X
Weight			X	X
Without Tokyo and Osaka				X

Notes: Coefficient on *capacity* is reported. *Capacity* is defined as the total slots of the day-care centers (i.e. total capacity of day-care centers) divided by the total number of females between ages 20–39, the child-bearing age. Other controls include the real GDP per capita which is deflated by prefecture GDP deflator to Yen in 2000, job application-to-opening ratio at October of year *y-1 (*a year prior to March/April when the shifts of births occur in year *y)*, application-to-opening ratio in March of the year *y*. Weight uses the mean daily number of births at each prefecture/year cell. Tokyo and Osaka are two largest prefectures in Japan. Standard errors in parenthesis. * p<0.10, ** p<0.05, *** p<0.01.

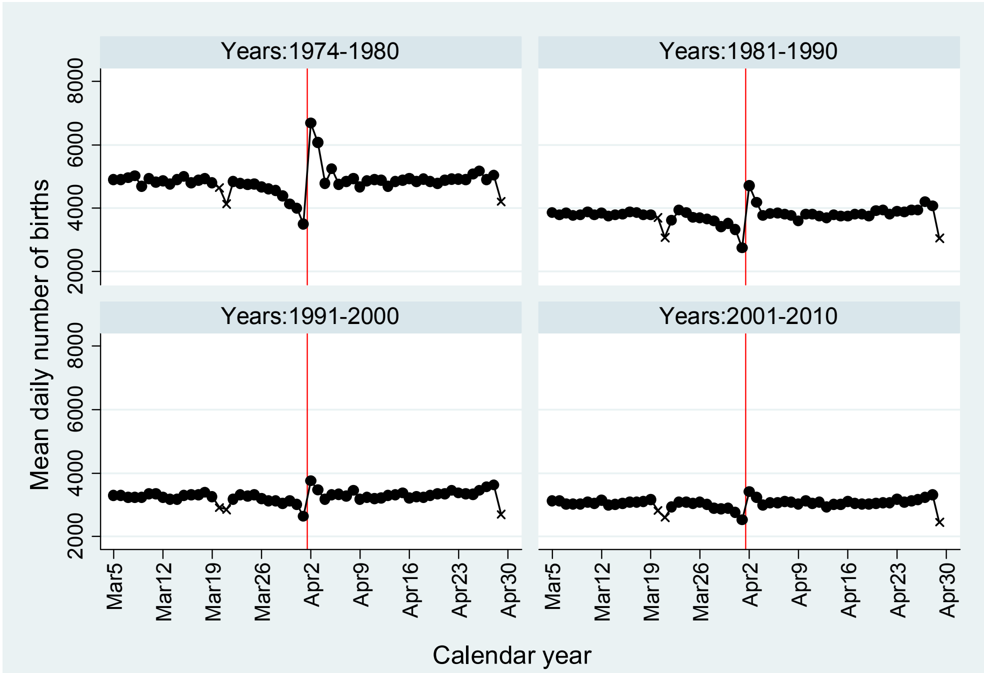
Table 7: Magnitude of the timing of shifts from other studies

Authors	Policy	Country	Incentives	Could policy also affect conceptions?	Share of births moved
Dickert-Conlin and Chandra (1999)	Tax changes from 1979-1993	US	Hasten	Yes	13.6%
Gans and Leigh (2009)	Baby Bonus introduction in 2004	Australia	Delay	No	16.2%
Gans and Leigh (2009)	Baby Bonus increase in 2006	Australia	Delay	Yes	9.2%
Tamm (2012)	Parental leave benefit reform in 2006/2007	Germany	Delay	Yes	7.8%
Neugart and Ohlsson (2013)	Parental leave benefit reform in 2006/2007	Germany	Delay	Yes	5.4%
Shigeoka (2013)	School entrance cutoff dates from 1974-2010	Japan	*Both*	Yes	7.0%

Note: The share of birth moved in the last column is based on the estimates from a 7-days window from the cutoff dates.

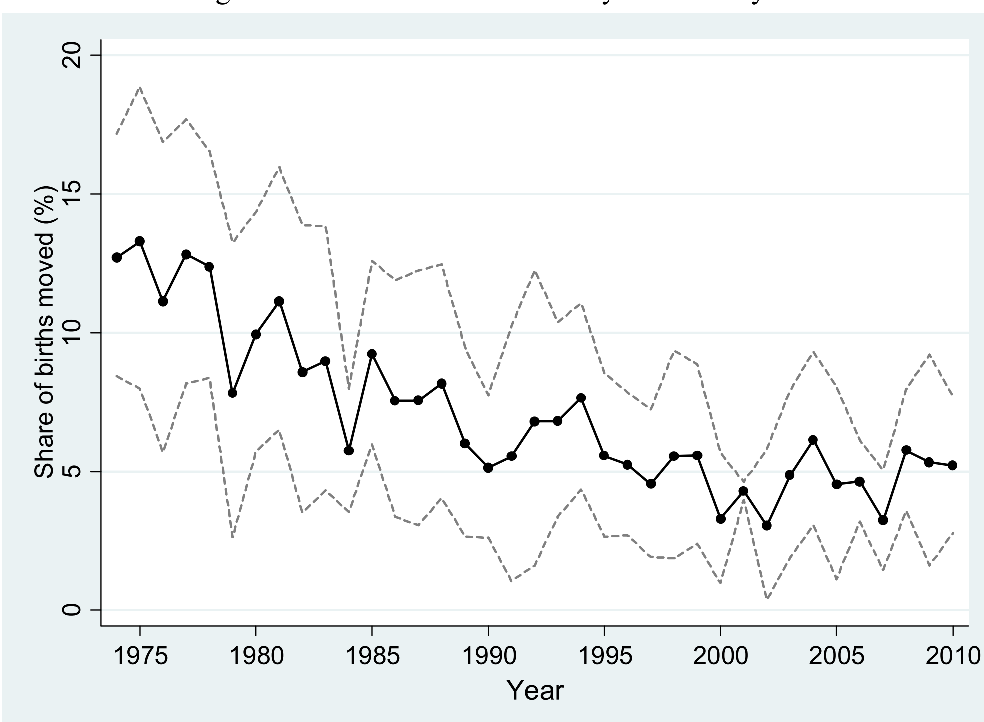
Appendix Figures and Tables

Figure A: Mean daily number of births around April 2, by period



Note: The vertical line corresponds to April 2, which is the school entry cutoff date in Japan. The data come from pooled 1974–2010 birth data. The markers with cross sign are holidays. Each plot is the number of births in each day.

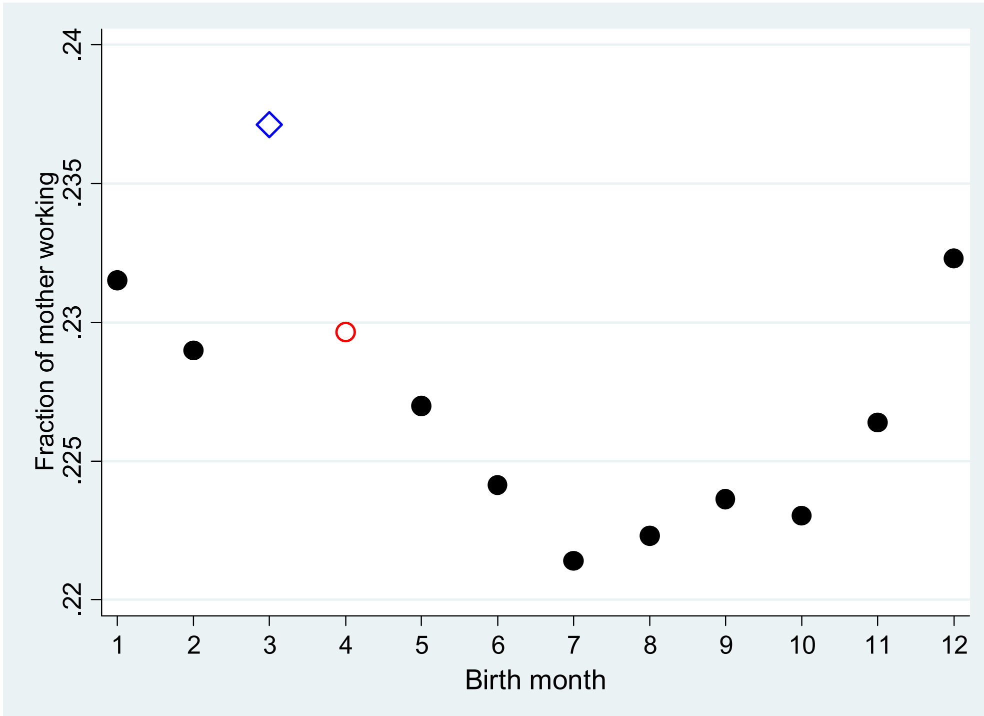
Figure B: Share of births moved by each birth year



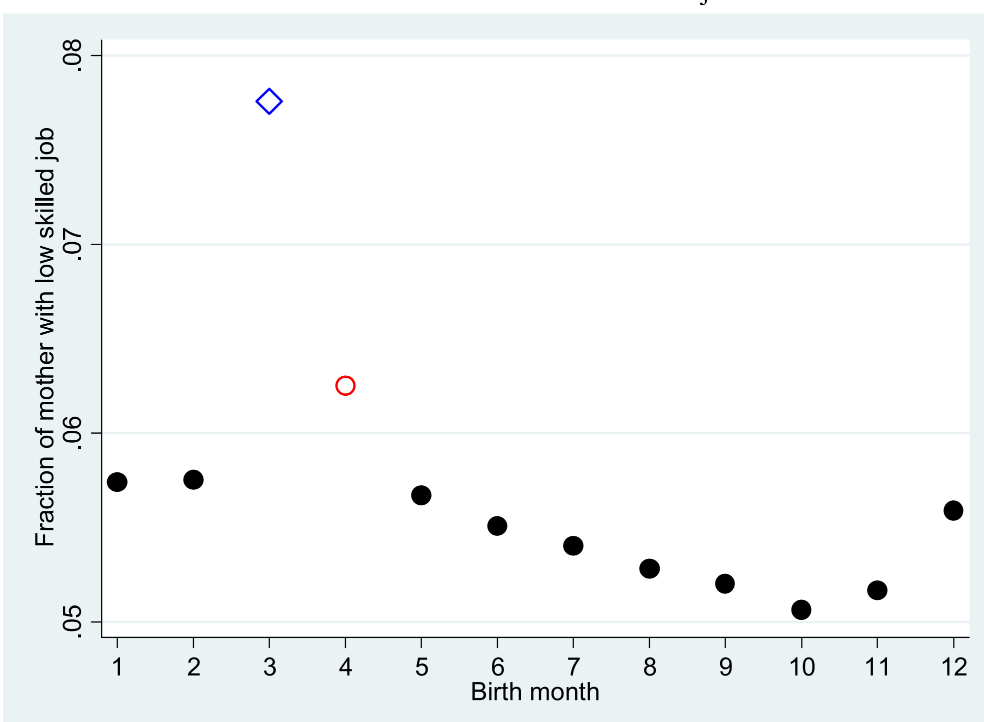
Note: The data come from 1974–2010 birth data. The dotted line represents 95 % confidence interval.

Figure C: Monthly plot of mother's observable characteristics

A. Fraction of mothers working



B. Fraction of mothers with low skilled job



Note: The data come from 1975, 1980, 1985, 1990, 1995, 2000, and 2005 pooled birth data. Each plot is the mean of outcome in each month. The markers in square are March, and those in circle are April.

Table A: Type of mother's job

Skill level	Description
High-skilled	Managers Professionals
Medium-skilled	Clerical support workers Service and sales workers
Low-skilled	Skilled agricultural, forestry and fishery workers Craft and related trades workers Plant and machine operators, and assemblers Elementary occupations

Table B: Summary statistics

	7 days before cutoff date	7 days after cutoff date	Dif (2)-(1)	Entire year
	(1)	(2)	(3)	(4)
A. Mother characteristics				
Age (in years)	29.84	29.75	-0.091***	29.81
Working	0.26	0.23	-0.030***	0.23
High-Skilled job	0.04	0.05	0.009***	0.06
Medium-Skilled job	0.10	0.11	0.019***	0.11
Low-skilled job	0.13	0.07	-0.058***	0.06
B. Child characteristics				
1st birth	0.47	0.45	-0.020***	0.46
2nd birth	0.37	0.39	0.021***	0.38
Birth weight (in 1000 grams)	30.89	30.94	0.047***	30.89
Birth weight (>3500 grams)	0.1783	0.1819	0.0037***	0.1785
Birth weight (>4000 grams)	0.0215	0.0225	0.0010***	0.0216
Birth weight (>4500 grams)	0.0017	0.0018	0.0001*	0.0017
Gestational length (weeks)	39.21	39.23	0.017*	39.20
Delivered at hospital	0.54	0.52	-0.021***	0.53
Delivered at clinic	0.43	0.45	0.016***	0.44
Delivered at home	0.003	0.004	0.0005**	0.003
Infant mortality	0.0042	0.0041	-0.0001	0.0042
Mean daily number of births	3,321	3,845	524***	3,713

Note: * p<0.10, ** p<0.05, *** p<0.01 significant at 1%. The data come from pooled 1974-2010 birth data except for working, high skilled job, medium skilled job, low skilled job, which come from 1975, 1980, 1985, 1990, 1995, 2000, and 2005 pooled birth data. Colum (1) is mean from the sample in seven days prior to April 2, and Column (2) is mean from sample in the first seven days after April 2, and Colum (3) is difference between (2) and (1). Column (4) is the mean from data that cover entire year.

Table C: Child's characteristics

		(1)	(2)	(3)	(4)
Windows	Mean	±7 days	±14 days	±21 days	±28 days
A: Birth weight (100 g)					
After	30.90	0.023***	0.038***	0.047***	0.045***
		(0.005)	(0.007)	(0.007)	(0.007)
N		1,847,984	3,689,329	5,579,356	7,477,055
R2		0.014	0.014	0.014	0.014
B: Birth weight>4000 g					
After	0.022	0.0005***	0.0006***	0.0007***	0.0007***
		(0.0002)	(0.0001)	(0.0001)	(0.0001)
N		1,847,984	3,689,329	5,579,356	7,477,055
R2		0.004	0.004	0.004	0.004
C: Gestation>42 wks					
After	0.023	0.0007***	0.0001	0.0003**	0.0005***
		(0.0002)	(0.0002)	(0.0002)	(0.0001)
N		1,846,441	3,686,276	5,574,761	7,470,764
R2		0.011	0.010	0.010	0.009
D: Mortality per 1000 births					
After	4.155	-0.090	-0.100	-0.030	-0.010
		(0.090)	(0.060)	(0.050)	(0.050)
N		518	1,036	1,554	2,072
R2		0.883	0.844	0.826	0.817

Notes: Standard errors in parenthesis. * p<0.10, ** p<0.05, *** p<0.01 significant at 1%. Sample is individual birth within the relevant window from pooled 1974–2010 birth data. All specifications include public holiday, and year*day of week fixed effects. Window denotes the number of days before and after the April 2. For example, the ±7 day window covers the seven days prior to April 2, and the first seven days after April 2.

Table D: Heterogeneous response, by gender/parity of child

	A: Female births			B: Male births		
	All births	1st Child	2nd or above child	All births	1st Child	2nd or above child
	(1)	(2)	(3)	(4)	(5)	(6)
After	0.118***	0.084***	0.145***	0.153***	0.117***	0.183***
	(0.029)	(0.024)	(0.033)	(0.029)	(0.024)	(0.034)
Share of births moved	*6.1%*	*4.3%*	*7.5%*	*8.0%*	*6.0%*	*9.6%*
N	518	518	518	518	518	518
R2	0.948	0.944	0.946	0.952	0.944	0.950
Mean	1,740	799	940	1,843	846	998

Note: Standard errors in parenthesis. * p<0.10, ** p<0.05, *** p<0.01. Sample is daily births within the relevant window from 1974–2010 pooled birth data. All specifications include public holiday, and year*day of week fixed effects. Window denotes the number of days before and after April 2. For example, the ±7 day window covers the seven days prior to April 2, and the first seven days after April 2. Share of births moved is exp(β/2)−1.

Table E: Source of variables

Variable name	Years available	Mean	SD	Source
Total slots of day-care centers	1974–2007: yearly level	42,199	30,829	Survey of Social Welfare Institutions
Number of female population between ages 20-39	1970–2010: every five years	371,624	378,970	Census
GDP per capita	1974–2009: yearly level	2,269	730	Prefecture SNA, available at http://www.esri.cao.go.jp/jp/sna/data/data_list/kenmin/files/files_kenmin.html (last accessed March 11, 2013)
Prefecture specific deflator	1974–2009: yearly level	91	12	Prefecture SNA, available at http://www.esri.cao.go.jp/jp/sna/data/data_list/kenmin/files/files_kenmin.html (last accessed March 11, 2013)
Job application-to-opening ratio (Oct)	1974–2009: monthly level	0.863	0.561	Job/employment placement services statistics, available at http://www.e-stat.go.jp/SG1/estat/List.do?lid=000001108017 (last accessed March 11, 2013)
Job application-to-opening ratio (March)	1974–2009: monthly level	0.839	0.475	Job/employment placement services statistics, available at http://www.e-stat.go.jp/SG1/estat/List.do?lid=000001108017 (last accessed March 11, 2013)