Explanations for the Fertility Reversal after 2005 in Japan

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Abstract

The major goal of this paper is to explore the explanations for the total fertility rate (TFR) upturn in Japan after 2005. Following the view on the retreat from lowest-low fertility in European countries (Castiglioni and Dalla Zuanna 2008, Goldstein, Sobotka and Jasilioniene 2009), we focus on possible factors such as elimination of tempo effects, increase of foreign mothers, improvement of the economic condition, and policy improvement on work-family reconciliation. We also examine the influence of familistic culture. Using weighted least squares models or weighted spatial error models, we estimate the influence of these factors on prefecture (state)-level TFR change from 2005 to 2008 by birth order. Our results show that the TFR upturn is mostly explained by increase in late fertility suggesting that catching up in their 30s reduces some tempo effects. While increase in foreign mothers and decline in unemployment rates also pushed TFR upward, change in maternal labor force participation was negatively associated with the TFR change. Cultural factor also explains the TFR variations. The higher proportion of extended family households contributes to fertility increase in third and higher birth order, but this relationship was not observed for first and second birth fertility.

Key words: lowest-low fertility, fertility reversal in Japan, prefecture-level total fertility rate, spatial error model

1. Introduction

Rapid population change due to extremely low birth rate has a significant impact on future societies, thus great attention has been paid to understand current fertility trend for plausible population projections. In the past, most population projections hold the assumption that the post-transitional fertility would eventually stay close to the replacement level (Bongaarts 2002). Today, many of the official population projections including the United Nation's projection[1], however, consider such assumption unrealistic. These projections assume that very low fertility will continue for a while, especially for countries with extremely low fertility rates (total fertility rate (TFR) less than 1.3) (UN 2008, Moriizumi 2008). Kohler and his colleagues (2002) suggest the possibility of these nations, what they call the nations with "the lowest low fertility," remaining the same for several decades. Despite such pessimistic view, since the latter half of the 1990s, the fertility rates showed some recovery in Italy and Spain, two of the title holders of the lowest low fertility. Other lowest-low fertility nations in Central Europe, Eastern Europe, and East Asia also showed such recovery in fertility since 2000. In Japan, the TFR appears to recover after it reached the record low of 1.26 in 2005. In 2008, the TFR was 1.37 and expected to remain the same level in 2009 (MHLW 2009) (Figure 1).

Currently, various scholars introduced new perspectives to understand nations with the lowest-low fertility (Castiglioni and Dalla Zuanna 2008, Billari 2008, Goldstein, Sobotka and Jasilioniene 2009, Caltabiano, Castiglioni and Rosina 2009). These scholars focused on the fertility upturn in Europe, thus whether the explanation of fertility upturn is applicable to other regions is questionable. Our paper aims to explore factors influencing the recent fertility upturn in Japan. Specifically, we asked whether factors explaining the fertility upturn in Europe (Castiglioni and Dalla Zuanna 2008, Goldstein, Sobotka and Jasilioniene 2009) are applicable to explain the fertility upturn in Japan. To answer this question, we estimated ecological regression models explaining variation of prefecture (state)-level TFR change since 2005.

[Figure 1]

2. Explanations for Lowest-low Fertility

In order to discuss factors of fertility reversal in the lowest-low fertility countries, it is necessary to understand how the lowest-low fertility itself came about. In other words, recent fertility upturn may reflect the change in the factors which led to the lowest-low fertility.

Reviewing literatures that examined causes of lowest-low fertility, there are factors such as postponement of childbearing, absence of high-fertility sub-population, low-growth economy, increasing opportunity cost, and a familistic welfare regime.

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1 The medium-variant fertility assumption used for the United Nation biannual population projection in 1996 states that nations experiencing below the replacement fertility rates will recover to the replacement level of 2.1 in 2050. In the projections in 1998, however, the assumption was changed stating that fertility would only recover to 1.8 by 2050. In 2008, it is assumed that nations with current TFR below 1.85 will not possibly return to the same level even in 2050 (UN 1996, 1998, 2008).

In the following discussion, we explain how these factors contributed to the lowest-low fertility in Japan.

2.1. Postponement of Childbearing

A dramatic rise in the age of childbirth is observed in places where they experienced the lowest-low fertility (Billari and Kohler 2004, Jones 2007). Thus a part of the lowest-low fertility can be explained by a demographical mechanism that the postponement of births to older ages reduces the number of births in a given period even if the number of children per women born over their lifetime remains unchanged. Period measures are influenced by the changes in the timing of childbearing, and such effect is called tempo effects or tempo distortion (Ryder 1964, Bongaarts and Feeney 1998). If the lowest-low fertility can be explained solely by such tempo effects since increasing women postponed the timing of childbearing, the postponement will be caught up later and TFR will eventually recover to a level higher than lowest-low fertility.

There are two patterns of postponement: a pattern where the first child is postponed through delayed marriage yielding a high proportion of childlessness observed in Southern European countries, Singapore, and another pattern where the second and/or third child is postponed observed several Central and Eastern European countries, and Korea (Billari and Kohler 2004, Jones 2007). Japan is the first pattern where postponement of the first child associated with postponement of marriage (Iwasawa 2005, Retherford and Ogawa 2006). At the same time, the completed number of children (cohort total fertility rate) tends to be smaller for cohorts with higher average age at birth than cohorts with lower average age at birth (NIPSSR 2007a), suggesting the possibility that the postponement-quantum interactions as pointed out by Kohler and his colleagues (Kohler, Billari, and Ortega 2002) have already been happening. According to Bongaarts and Feeney’s tempo-adjusted measures (Bongaarts and Feeney 1998) for Japan, the tempo-adjusted TFR were always higher than 1.3 but it also declined (Kaneko 2009). Not all, but a part of the lowest-low fertility in Japan should be explained by the tempo effect.

2.2. Absence of High-fertility Sub-population

Developed countries maintaining relatively high fertility rates commonly have sub-groups among their populations that exhibit high fertility rates. In countries receiving many immigrants from high fertility countries in particular, there is a tendency that such immigrants maintain fertility rates higher than the rest of the population of the host country (Coleman 2006). In the USA, which has a particularly high fertility among industrialized nations, the percentage of religious population is relatively high, and high fertility of such groups positively contributes to the overall fertility (Frejka and Westoff 2008).

In Japan, the percentage of foreign nationals is extremely low, at only 1.4%, and their fertility rates are lower than Japanese women (NIPSSR 2007a). Moreover, the effect of religious population raising the fertility level is low in Japan (Kojima 2008). Thus, the absence of high fertility and religious sub-population contributes to the very low fertility in Japan relative to other advanced nations.

2.3. Low-growth Economy

Since marriage and childbirth require long-term commitment, young people seek economic stability prior to making such decisions. During the period of economic growth, young people were able to obtain stable jobs from the early stages of their lives, but today, it became difficult for young people to obtain stable jobs in many advanced nations due to low-growth economy (Blossfeld et al. 1995). In Eastern European countries, generous social-welfare systems and secured jobs in the socialism period collapsed alongside the shift to free market economies, which have become a factor in suppressing reproductive behaviors (Perelli-Harris 2005). Furthermore, the economies of young people tend to become more unstable in social systems that are relatively advantageous to the elders, such as the system of promotion by seniority (*nenko joretsu*) practiced in Japan and Italy (Miyamoto 2002).

Japan experienced recession three times (1991 to 1993, 1997 to 1999, and 2001 to 2002) resulted in higher unemployment rate of young people than other age groups, and increased percentage of the non-regular employees (MHLW 2006). Kojima (2005) used individual data merged with area data and showed the negative relationship between the unemployment rate and childbearing.

2.4. Increasing Opportunity Cost

In societies where more women complete college degrees and their potential wage are increasing, the opportunity costs of having a child for women become high. Under conditions where it is difficult to raise children and continue working, remaining childless becomes a realistic option. Although many industrialized nations have promoted policies to improve conditions for working mothers, the employment rate of women who have children, particularly preschool children, vary greatly among the countries (OECD 2007). The fertility tends to be lower in areas where parental leave and childcare services are not fully implemented.

In Japan, various policies are implemented to improve the conditions for working mothers. However, the percentage of women who continue working after childbirth was at only 20% as of 2005 and this level remained unchanged since the 1980s (NIPSSR 2007b, Kaneko et al. 2008). Therefore, increasing opportunity cost for women with insufficient policy significantly contributes to the lowest-low fertility in Japan.

2.5. Cultural Conditions: Familistic Welfare Regime

Lowest-low fertility countries are characterized by “strong” family ties, familistic attitudes and welfare, as observed in several Southern European countries (Zuanna and Micheli 2004, Reher 2007). In this context the welfare lacks attention towards young adults and their children, and has a lower attention towards the compatibility of parenthood with other choices (i.e., education, work). The general idea that welfare should not crowd out family relationships that is embedded in familistic welfare thinking is once advantageous but currently working against fertility (Billari 2008). This familistic culture is also visible in Japanese society (Atoh 2005, Suzuki 2006).

Such welfare regime that heavily relied upon families (familialism) is strongly connected with attitudes on gender division of labor as well. While the differences between men and women have gradually disappeared in education and employment, the concept of gender-based division of domestic work remains strong in Japanese society. This leads to heavier load on women as well as disinclination to rely on public services for childrearing (McDonald 2006), contributing to the lowest-low fertility in current Japanese society.

3. Total Fertility Rate Upturn in Lowest-low Fertility Countries

Since the latter half of the 1990s, surprisingly some European and Asian nations with lowest low fertility (TFR below 1.3) including Japan experienced fertility upturn. Various scholars offered explanations to understand the fertility upturn, mainly in southern European nations.

Castiglioni and Dalla Zuanna (2008) analyzed the TFR reversal observed in Italy in the latter half of the 1990s. They claimed that the fertility upturn is observed in northern Italy and other economically developed areas where new family formation behaviors discussed in the Second Demographic Transition (SDT) such as legal separations and extramarital childbirth are prominent. Such a significant fertility upturn was not observed in southern Italy where strong traditional family norms contributed to high fertility rates in the past (Castiglioni and Dalla Zuanna 2008). Billari (2008) pointed out that the rapid increase of foreign population in Italy and Spain also contributed to recent increase in fertility rates.

Goldstein and his colleague (2009) showed that some recovery from lowest-low fertility was also observed in Central Europe, Eastern Europe, and East Asia. Their analyses suggested that a decline in the tempo effect—driven by the slowdown of postponement visible in women's mean age at birth, and dramatic increase in immigrants explain certain increase of the TFR in some areas (e.g. Spain). Based on the temporal correlation between unemployment rates and total fertility rates, they also suggested that economic recovery may have contributed to the fertility recovery. Although further studies are necessary, they concluded that expansion of work and family reconciliation policies is likely to lead to recovery of fertility rates (Goldstein, Sobotka and Jasilioniene 2009).

In our study, we focus on the factors Goldstein and his colleagues used to explain fertility upturn in their cross-national study. They are: (1) diminishing tempo effects, (2) increase in foreigners, (3) economic improvement, and (4) policy improvement on work and family reconciliation. In addition, we also looked at the influence of familistic culture. The study by Castiglioni and Dalla Zuanna (2008) suggested the association between fertility decline and familistic culture where traditional gender norms are emphasized. Since Japan share the similar familistic culture with Italy where families play a central role in caring for their family members rather than relying on public services, we find it important to include it as an additional factor to explain variation in fertility change in Japan.

Besides the fact that most studies have focused on studying fertility upturn in Western European nations, there are several advantages in studying fertility upturn in Japan in terms of the data quality. First, official register-based statistics maintained in time-series are available from prefectural-level data sources. Second, since immigration controls in Japan are relatively reliable, highly accurate data set is available on international migration. Moreover, racial diversification is relatively small compared with other industrialized nations. In fact, foreign national including immigrants count for 1.4 percent of the total population in 2008, which allows for simple models that does not take into account racial heterogeneity.

4. Method

We estimate weighted least squares models (WLS) and weighted spatial error models (WSE), and select the more appropriate model for explaining prefecture-level variation in TFR change.

The unit of our analysis is geographically associated aggregated data. Geographically referenced data often show spatial autocorrelation. Spatial autocorrelation refers to a situation in which values on a variable of interest are systematically related to geographic location. Thus, if an ordinary least-square regression model that assumes the error terms to be independently, identically, and normally distributed is used without taking the existence of spatial autocorrelation among residuals, the standard errors of the regression coefficient estimates can be underestimated or overestimated (Chi and Zhu 2008).

For this reason, our study not only estimates an ordinary least squared model but also estimates a spatial error model which explicitly models spatial autocorrelation of such error terms, and select the more appropriate model in terms of model fitness and significance of the spatial autoregressive coefficients of the models. A spatial error model is specified as follows (Anselin 1988, Ward and Gleditsch 2008):

$$y = X\beta + u,$$
$$u = \lambda W u + \varepsilon,$$
$$\varepsilon \sim N\left(0, \sigma^2 I\right)$$

where y is a (n x 1) vector representing the dependent variables, X is a (n x k) matrix representing the k-1 independent variables, β is a (k x 1) vector of regression parameters to be estimated, u is a (n x 1) vector of error terms presumed to have a covariance structure as given in the second equation, λ is a spatial autoregressive coefficient to be estimated, W is a (n x n) weight matrix defining the "neighborhood" structure that reflects the potential interaction between neighboring locations and zeros out pairs of locations for which spatial correlation is ruled out a priori, and ε is a (n x 1) vector of independently distributed (spatially uncorrelated) errors (i.i.d.). Under this specification, spatial autocorrelation in the dependent variable y results from exogenous influences. Portions of the spatial autocorrelation may be explained by the independent variables included in the model (themselves spatially autocorrelated) and the remainder is specified to derive from the spatial autocorrelation among the residual terms. We used a first-order queen convention to define neighbors for the weight matrix used in estimating spatial regression model[2].

In Japan, population size varies significantly among prefectures. For example, the population of Tokyo is 12 million, by contrast Tottori prefecture has only 600, 000 citizens, approximately a twentieth of the

2 In this convention, the neighbors for any given prefecture "A" are other prefectures that share a common boundary with "A" in any direction. Although Hokkaido and Okinawa don't share any borders with any other prefecture, we defined Hokkaido as having Aomori and Okinawa as having Kagoshima as their respective neighbors. Because Hokkaido and Aomori are connected with an undersea tunnel, Seikan tunnel, and Okinawa and Kagoshima have historically shown frequent interchanges with each other, it is natural to assume proximity between them.

population in Tokyo. Since the variables we use, which will be mentioned in the next section, are mostly related to behaviors among women of reproductive ages, we used female population in reproductive ages (15 – 49 years of age) in each prefecture for weights.

Accordingly, we estimate a weighted least squares model (WLS) and a weighted spatial error model (WSE). We used "spdep" package in the open source programming language R for model estimations. The selected model is used to examine the association between explanatory variables and fertility upturn by predicting the national values in fertility change after 2005 and showing the contribution of each factor to fertility increase.

5. Data and Variables

For the dependent variables, the change of all-birth TFR and the change in birth-order-specific TFR by prefecture are used. We focus on the change from 2005, when the national-level TFR started to upturn, to 2008, latest available year.

For the explanatory variables, we used four factors Goldstein and his colleagues (2009) focused on to explain fertility upturn in their cross-national study (diminishing tempo effects, increase in foreigners, economic improvement, and policy improvement on work and family reconciliation) and also used a contextual factor reflecting familistic culture.

5.1. Diminishing Tempo Effect: Change in Late Fertility

Tempo effects are caused by postponement of childbearing. If the postponement trend visible in women's mean age at birth stops, the tempo effects observed in the past are expected to diminish. Under this circumstance, women who postponed childbearing in their 20s start to catch up in their 30s or later. Thus we expect that diminishing tempo effects would be accompanied by fertility increase in the 30s.

In our study, diminishing tempo effect was measured as increase in "late fertility." For simplicity, we assume that late fertility accounts for approximately 20% of the total. Late fertility is thus defined as fertility at 35 years old or over for all births (which accounts for 18.1% of the total fertility rate as of 2008), 33 years old or over for the first births (20.6%), 35 years of age or over for the second births (20.2%), 36 years old or over for the third births (22.6%), and 38 years old or over for the fourth and higher-order births (22.4%) (Figure 2). For the variable, we used the change in fertility rate limited to these ages from 2005 to 2008.

[Figure 2]

5.2. Increase in Foreigners: Change in Fertility Rate by Foreign Mothers

The period TFR provided officially by the Ministry of Health, Labour and Welfare are calculated for new born children with Japanese nationality. The calculation does not include children born to foreign couples living in Japan but includes children whose mothers are foreigners married to Japanese men[3], because these children have Japanese nationality. Nonetheless, the female population used as the denominator is limited to Japanese women, and their foreign mothers are not included[4]. This invites an increase of the total fertility rate through a structural factor of an increasing number of foreign women giving birth to Japanese children, even if the actual fertility of Japanese women remains unchanged.

In Japan, the percentage of international marriages has been increasing from the late 1990s. The percentage of marriages where wives are foreign accounts for 2.8% of total number of marriages in 1990, which increased to 4.6% in 2005. Since the female population used as the denominator is limited to Japanese women, an increasing number of foreign women giving birth to Japanese children may be causing recent fertility upturn. In other words, we expect prefectures where increase in foreign mothers is observed to be positively associated with fertility change.

In our study, the influence of increase in foreign mothers is measured as change in TFR "inflated" by foreign mothers. Specifically, we use change from 2005 to 2008 in TFR contributed by foreign mothers (TFR x percentage of births born to foreign mothers)[5].

5.3. Economic Improvement: Change in Employment Rate

In Japan, the unemployment rate has been falling since around 2004. Since it was followed by upturn in TFR, improvement in economic condition is likely to play a role in the recovery of the fertility rate. In other words, the association between prefectures with economic improvement and fertility change is expected to be positive.

In our study, using the Labour Force Survey, economic improvement was measured by change in employment rate (complementary number of the unemployment rate) by prefecture. Since there expected to be a time lag for the recovery from unfavorable economic conditions to influence fertility, we looked at change in employment rate from 2002 to 2007.

5.4. Policies on Work and Family Reconciliation: Change in Labor Force Participation Rate among Mothers having Preschool Children Living in Nuclear Family

Family policies variation across space can help us study the effect of such policies on fertility (Neyer and Anderson 2008). Japanese government has been promoting the work and family reconciliation programs as

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3 In Japan, nationality is difficult to receive even foreign mothers married to Japanese men.

4 Definition of total fertility rate in the Vital Statistics is as follows:
Total fertility rate = Sum for ages (15-49) [(Number of births born to Japanese mothers)+ (Number of children with Japanese nationality born to foreign mothers*)]/ (Population of Japanese females)
* This refers to a child whose father has Japanese nationality.

5 Since the number of births by mother's nationality is not available by birth order, we used the percentage of births born to foreign mothers out of the total number for the birth-order specific TFR as well.

part of policy initiatives aiming to stimulate higher fertility since 2000 as represented by "New Angel Plan" (Ogawa 2003, Moriizumi 2008)[6]. From 2005 to 2009, the "Children and Childcare Plan" was established, instead of the "New Angel Plan." There are improvements in the benefits of child-care leave and implementation of the After-school Childcare plan (securing places of activity for children after school in all elementary school zones). In 2007, the "Action Agenda for Promoting Work-life Balance" was resolved as a priority task of the "Strategies for Japan to Support Children and Families." More importantly, after 2005, each municipality is obliged to take its own measures according to its action plans based on the Law for Measures to Support the Development of the Next Generation. This might have caused differences in the progress of policies of reconciliation of work and family life depending on the region. In other words, we expect to see a positive effect on prefectures with better family policies on fertility upturn since more women will give a birth in areas where they have more supportive policies for women to balance between work and family.

There are no established measurement for the effectiveness of policies on family and work. In our study, we measured the effectiveness of policies on family and work by the change in the employment rate of mothers. Improvement in public services and corporations regarding reconciliation of work and family life are considered to bring about larger effects among mothers of nuclear families who cannot easily receive support from relatives such as grandmothers/fathers. Thus we focus on mothers of nuclear families with children under 6 years of age. We use the change in their employment rate between 2002 and 2007, obtained from the Employment Status Surveys for each prefecture conducted in 2002 and 2007.

5.5. Familistic culture: Proportion of extended families among households including preschool children

As in Italy, there are regional differences in family systems in Japan. Ohbayashi (1996) classified the regionality of social organizations, and claimed that paternalistic family organizations played important decision-making roles in northern part of Japan (Tohoku Region) (Ohbayashi 1996). On the other hand, in western Kyushu, coastal Shikoku, Hokuriku, and coastal Tokai, the village organizations had more important decision-making roles than family organizations (Ohbayashi 1996). Therefore, there are variations in familistic culture across regions as in Italy. According to Kato (2008), pattern of living arrangement reflects the existence of familistic culture. In eastern regions with strong family culture, historically an older couple (parents) and a younger couple (son and daughter-in-law) coreside in a single household. In contract, in western Japan, a parent couple lives in an independent household from children's family, usually on the same lot.

6 In addition to the "New Angel Plan" in 2000 to 2004 (reinforcement of child-rearing services, improvement of employment environment for reconciliation of work and family life, correction of corporate climate whereby gender division of labor and priority on workplace are taken for granted), the Zero Children on Waiting List Strategy was started in 2001 for the purpose of building up sufficient child-care centers. In 2003, the Law for Measures to Support the Development of the Next Generation (promotion of concentrated and systematic measures of 10 years by municipalities and corporations) was formulated.

In our study, we measured familistic culture by the prevalence of extended families. Based on the 2005 census, we calculated the proportion of the extended family among households including children of less than six years of age in each prefecture. As such a characteristic does not change in the short term, we include it in our model as a fixed effect. We expect to see negative relationship between prefectures with strong familistic culture and fertility change as in the case of Italy.

5.6. Model

The model used to examine each effect of elimination of tempo effects, inflation by foreign mothers, economic improvement, policies on work and family reconciliation, and familistic culture can be expressed as follows. Δ represents difference.

ΔTFR (2005-2008) = Constant
+ Δ Late fertility (2005-2008)
+ ΔTFR inflated by foreign mothers (2005-2008)
+ Δ Employment rate (2002-2007)
+ Δ Labor force participation rate among mothers having preschool children living in a nuclear family (2002-2007)
+ Proportion of extended families among households including preschool children (fixed effect) (2005)

We fit this model to the data for all-birth TFR and birth-order specific TFRs using weighted least squares regression (WLS) and weighted spatial error regression (WSE).

6. Results

6.1. Descriptive statistics

Table 1 shows descriptive statistics of variables we used in the analysis. The values of Moran's I[7] suggest that all of the dependent variables are spatially autocorrelated. For explanatory variables, the following factors showed significant spatial autocorrelation: change of late fertility for all-birth fertility, first birth fertility and fourth and higher-order fertility, change of fertility inflated by foreign mothers for all-birth and all birth-order-specific births, change of employment rate, and proportion of extended family.

[Table 1]

[7] Moran's I statistic measures the degree of linear association between an attribute (y) at a given location and the weighted average of the attitude at its neighboring locations (Wy), and can be interpreted as the slope of the regression of (Wy) on (y) (Cliff and Ord 1973, Moran 1950). As for the spatial weight matrix to specify a neighborhood structure, we use queen's case contiguity weight matrix of order one, as well as for the spatial regression analyses.

The change in the TFR for all birth is higher in the pacific coastal areas of Kanto and Tokai, and the northern coastal areas of Setonaikai and western Kyushu (Figure 3, Appendix). Looking at TFR by birth order, the change in the first-order TFR is consistently higher in the pacific coastal areas of Kanto and Tokai and the coastal areas of Setonaikai; and it is lower in Hokkaido and the Tohoku Region except for Miyagi. The change in the third-order TFR is higher in Saitama, Chiba, Aichi, Hyogo, Shimane, Hiroshima, and northern Kyushu.

In addition, we observed the increase in fertility inflated by foreign mothers in the coastal Tokai and northern Setonaikai coastal areas (e.g. Okayama and Hiroshima). The increase in employment rate was remarkable in Kansai, northern Kyushu, and Tokyo metropolitan areas. The increase in the employment rate of mothers of preschool children in nuclear families was evidently higher in Toyama, Nagasaki, Fukui, and Gunma, and was lower in Hiroshima, Ehime, and Fukushima. As expected, the proportion of extended family households was higher in the Tohoku Region (e.g. Yamagata, Akita, and Niigata), while it was lower in metropolitan areas (e.g. Tokyo, Osaka, and Kanagawa) and western part of Japan.

[Figure 3]

6.2. Model estimations

Weighted least squares (WLS) models and weighted spatial error (WSE) models are estimated for all-birth and birth-order specific TFR (first, second, third, and fourth and higher-order births). Model coefficients and diagnosis for spatial autocorrelation among model residuals are shown in Table 2 (first, second, and third birth model only).

For change in the first-order TFR, the following four variables were significant in both WLS and WSE models: changes in late fertility (+), fertility inflated by foreign mothers (+), employment rate (+), and mothers' employment rate (+).The directions of the effect of late fertility rate, fertility rate inflated by foreign mothers, and employment rate were expected. However, the change of mothers' employment rate had unexpected negative effect. The constant is negative, but insignificant suggesting that there was no common effect.

For change in the second-order TFR, the late fertility rate (+), change of fertility rate inflated by foreign mothers (+), and proportion of extended families (-) are statistically significant in both WLS and WSE models. The direction of each coefficient is as we expected. The constant is positive, but insignificant.

For change in the third-order TFR, the effects of change in late fertility rate (+) and proportion of extended families (+) are statistically significant in both WLS and WSE models. Unlike second-order TFR, the effect of the proportion of extended families is positive, which implies that prefectures with higher proportion of extended families have higher increase in third birth fertility. The constant is positive and significant, suggesting overall common positive effect regardless of explanatory variables.

As for the fourth and higher-order birth model, the effects of changes of late fertility (+), fertility inflated by foreign mothers (+), and mothers' employment rate (-) are statistically significant factors. As in the case of third birth, the proportion of extended families are positive and statistically significant. The constant is also positive and significant.

For change in the TFR for all births, the effects of changes in late fertility (+), fertility inflated by foreign mothers (+), and mothers' employment rate (-), and the proportion of extended families (-) are statistically significant. Although the constant is positive, it is not significant.

According to the Lagrange Multiplier test for spatial autocorrelation, as for the first and third birth models, the WLS models fit better than the WSE models; for all-birth, second birth, and fourth and higher-order birth models, the WSE models specifying autocorrelation among residual of neighboring prefectures fit better than the WLS models (Table 2).

[Table 2]

6.3. Contribution of each factor to national TFR increase

Based on the regression coefficients estimated by the well-fit model, the contribution of each explanatory variable is summarized in Table 3. The increase of the national TFR from 2005 to 2008 can be decomposed into each contribution of factors using the model estimated. Estimating the increase using the national figure of each variable, the change of late fertility accounted for 98% of the increase in first-order TFR, and the increase of fertility inflated by foreign mothers accounted for 11%. The increase of employment rate explained 24%. Contrary to our expectation, the increase of employment rate of mothers with preschool children accounted for decrease in the TFR by 18%. It also shows 15% decrease as a common effect regardless of the change of each factor (Table 3).

As for second-order TFR, in addition to the 20% common effect, the increase of late fertility accounted for 64% and increase in fertility inflated by foreign mothers accounted for 14%. Contribution of employment rate and mothers' employment rate were 7% and -4%, respectively.

As for third-order TFR, the contribution of the common effect that cannot be explained by factors examined here is as high as 62%. The increase of late fertility explains 45% and fertility inflated by foreign mothers explains 5% of the increase in third-order TFR. Employment rate and mothers' employment rate were -2% and -10%, respectively.

As for fourth and higher-order birth TFR, the common effect is as high as 98%, indicating that there are important factors not examined here. The increase of late fertility accounts for 16% and fertility inflation contributed by foreign mothers accounts for 23% of the increase in fourth and higher-order TFR. Employment rate and mothers' employment rate accounts for -22% and -15%, respectively.

Based on these, we found 19% of increase in all birth TFR is accounted by the common effect, 72% by the change in later fertility, 11% by the change in fertility contributed by foreign mothers, 11% by the change in employment rate, and -12% by the change of mothers' employment rate.

[Table 3] [Figure 4]

Based on the regression coefficients and the correlation coefficients between explanatory variables and the dependent variable, we obtain the variance explained by the explanatory variables. For the all-birth TFR, late fertility rate explains approximately 33% of total variance on fertility change, 28 % by fertility inflated by foreign mothers, 5% by employment rate, 3% by mothers' employment rate, and 10 % by proportion of extended families (all explanatory variables explain 79% of total variance). The result suggest that demographic factors such as late fertility rate and fertility inflated by foreign mothers account for approximately 60% of the variation in change, the fixed effect of the proportion of extended families explains 10%, and economic improvement and policies on work and family reconciliation explain 5% and 3% of the variation, respectively. The remaining 20% of the variation is explained by other factors not included in our study.

6.4. Spatial autocorrelation regardless of explanatory variables

In the all-birth model, second birth model, and fourth and higher-ordered birth model, we found a spatial autocorrelation structure which cannot be explained by explanatory variables. We illustrated the estimated spatial component of error term correlated with one another for nearby observations on the map for all-birth model and second birth model (Figure 5). In the equation, it corresponds to λWu, which we can obtain as a remaining part of observed data (y) after subtracting the part explained by explanatory variables ($X\beta$) and a spatially uncorrelated model residual (ε).

In the all-birth model, so-called “hot spot” (surrounded by neighbors with high TFR increase) clusters of TFR increase are observed in Kyushu, Hokuriku and Gifu, northern Tohoku, and Hokkaido. In the second birth model, in addition to Kyushu, Hokuriku, northern Tohoku, and Hokkaido, hot spot clusters exist in western Chugoku as well. These high values imply that surrounding areas showed positive effects independent of changes in the factors we focused upon in this study. Although further studies are necessary, there are possibilities that advantageous conditions for fertility behaviors common to these clusters or that conditions occurring in an area had spread to surrounding areas in a short period. As in the case of the first demographic transition, local TV or newspapers could be a vehicle for some ideas (Hornik and McAnany 2001). Alternatively, through social competition or social emulation mechanism suggested by Casterline (2001), neighboring prefecture may immediately follow the effective countermeasure by a certain local government. Gathering further information through qualitative research on the programs taken or attitudinal changes in these areas will be necessary.

[Figure 5]

7. Discussions

The goal of this study was to explore the explanations for the TFR upturn after 2005 in Japan. We focused on the following factors based on previous studies for European lowest-low fertility: (1) diminishing tempo effect, (2) increase in foreign mothers, (3) economic improvement, and (4) policies initiative on work and family reconciliation, and (5) familistic culture. We estimated models to explain the prefecture-level variation of change in TFR from the variation of the relevant variables (change in late fertility, change in fertility contributed by foreign mothers, change in employment rate, change in maternal employment rate, and the proportion of extended family households).

The factors such as change in late fertility, change in fertility contributed by foreign mothers, and change in employment rate are positively associated with TFR change as we expected. The improving in employment rate of mothers with preschool children living in nuclear families, however, shows a negative relationship to the change in TFR. This suggests that the level of TFR has increased much in the area where the change in mothers' employment rate is smaller than other areas. The result suggests continuing difficulty for a working mother with children to have another child. Conversely, we may need to take into consideration the recent state of day-care centers in urban areas. The areas where TFR has increased since 2005 include prefectures including large metropolitan areas such as Tokyo, Kanagawa, and Miyagi. In these prefectures, the proportion of children on the waiting lists of day-care centers among all preschool children has increased dramatically since 2006. It is speculated that there was an increase in the number of mothers who decided to have children hoping to raise children while working, but dropped out of the labor market because there were no vacancies at day-care centers. Therefore, if the shortage of day-care services in these areas can be resolved, it will not only reduce the number of children on waiting lists but also increase the employment rate of mothers from the present level so that potential jobseekers can be employed.

Whatever the case, as Neyer.and Andersson (2008) suggested that, macro-analytical investigations based on aggregate indicators are considered to be insufficient to examine the impact of family policies on fertility, since macro indicators do not take fertility-relevant structuring effects of family policies into account and cannot reveal group-specific effects. Thus we need to have research designs and methods that enable us to grasp the impact of family policies on individual behavior for a clearer assessment.

Other than short-term variable factors such as tempo effect, immigrant mother effect, economic effect, and policy effect above, 19% increase in TFR between 2005 and 2008 is explained by the constant term of the model. However, these factors are not statistically significant in the all-birth model, although significantly in third birth and fourth and higher-order birth models. This is thought to be a common nationwide positive effect regardless of prefecture specific factors. It is possible that the idea that childbearing should be supported by society has been widely accepted and it encouraged the younger generations to have many children. If nationwide economic recovery is included in this common effect, the impact of a economic recession after 2008 could be larger than 0.01 reflecting only economic variation between prefectures.

Lastly, the proportion of extended families used as an indicator of familistic culture showed a negative impact in the all-birth and second birth models as in the case of Italy. Namely, the recent recovery of the fertility rate is weaker in areas such as the Tohoku region where strong familistic attitude remain strong. Conversely, our results suggest that parenting has become easier even in urban areas where familistic culture is relatively weak. In these areas, conditions favorable to family formation other than family support may be established. Since the proportion of extended families shows positive impact in third and higher-order birth models, economic or physical support from coresiding grandparents may play important roles for large families even today.

In Japan, part of the TFR upturn since 2005 can be explained by short-term conditional change such as an increase in international marriages and economic recovery. Therefore, it is possible that the TFR will decline again in the near future because of decline in the number of international marriages and worsening economic situation since 2008. On the other hand, an increase in late fertility accounts for as much as 70% of the change in our analysis, suggesting there may be a moderate increase in TFR due to the elimination of the tempo effect for some time. However, whether such a catch-up behavior is followed by subsequent generations depends on whether women in their 30s who finally had children can continue to work as they expected. Problems such as a recent increase of children on the waiting lists of day-care centers in metropolitan areas and "*ikugyu-giri* (firing due to taking parental leave)", which came to the surface in the economic recession since 2008, may negatively influence the TFR through increasing pessimistic views on working conditions for mothers. While urgent countermeasures are called for, it is necessary to carefully monitor the uptake of policies on work and family reconciliation when we foresee future trends of fertility.

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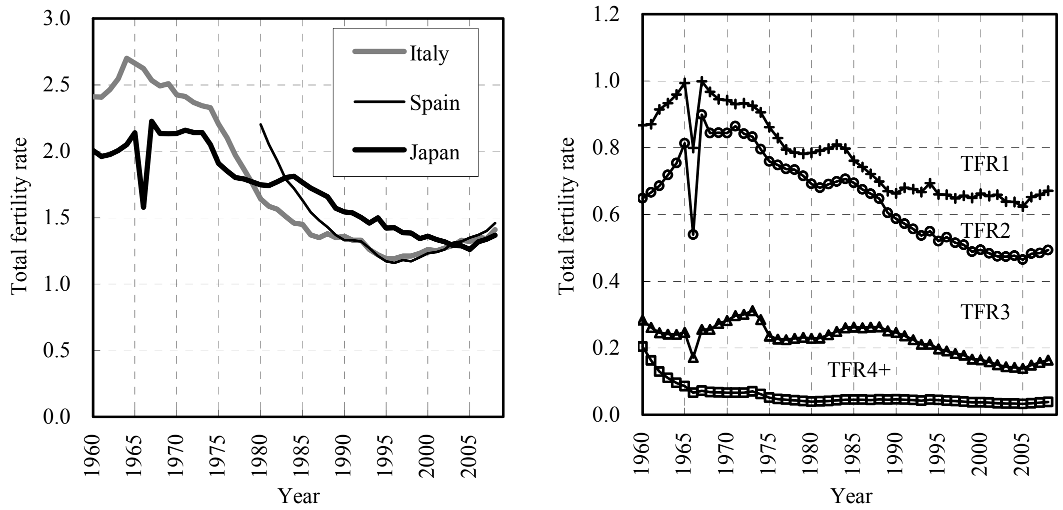
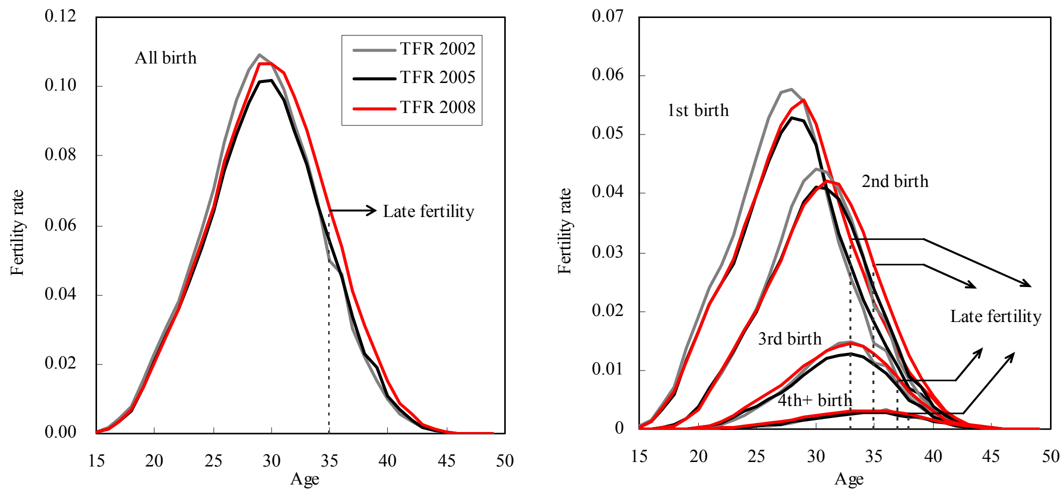
Figure 1: Total fertility rate in Japan, Italy and Spain (left) and birth-order-specific total fertility rates in Japan (right): 1960 ~ 2008



Source: Japan: Vital Statistics (Statistics and Information Department, Minister's Secretariat, Ministry of Health, Labour and Welfare). Italy: UN, Demographic year book, Eurostat database, ISTAT (2008). Spain: UN, Demographic year book, Eurostat database.

Figure 2: All birth and birth order-specific age-specific birth rates: 2002, 2005, 2008



Source: Vital Statistics (Statistics and Information Department, Minister's Secretariat, Ministry of Health, Labour and Welfare).

Figure 3: Geographic patterns for dependent variables: Change in total fertility rates from 2005 to 2008: All birth and birth-order specific birth

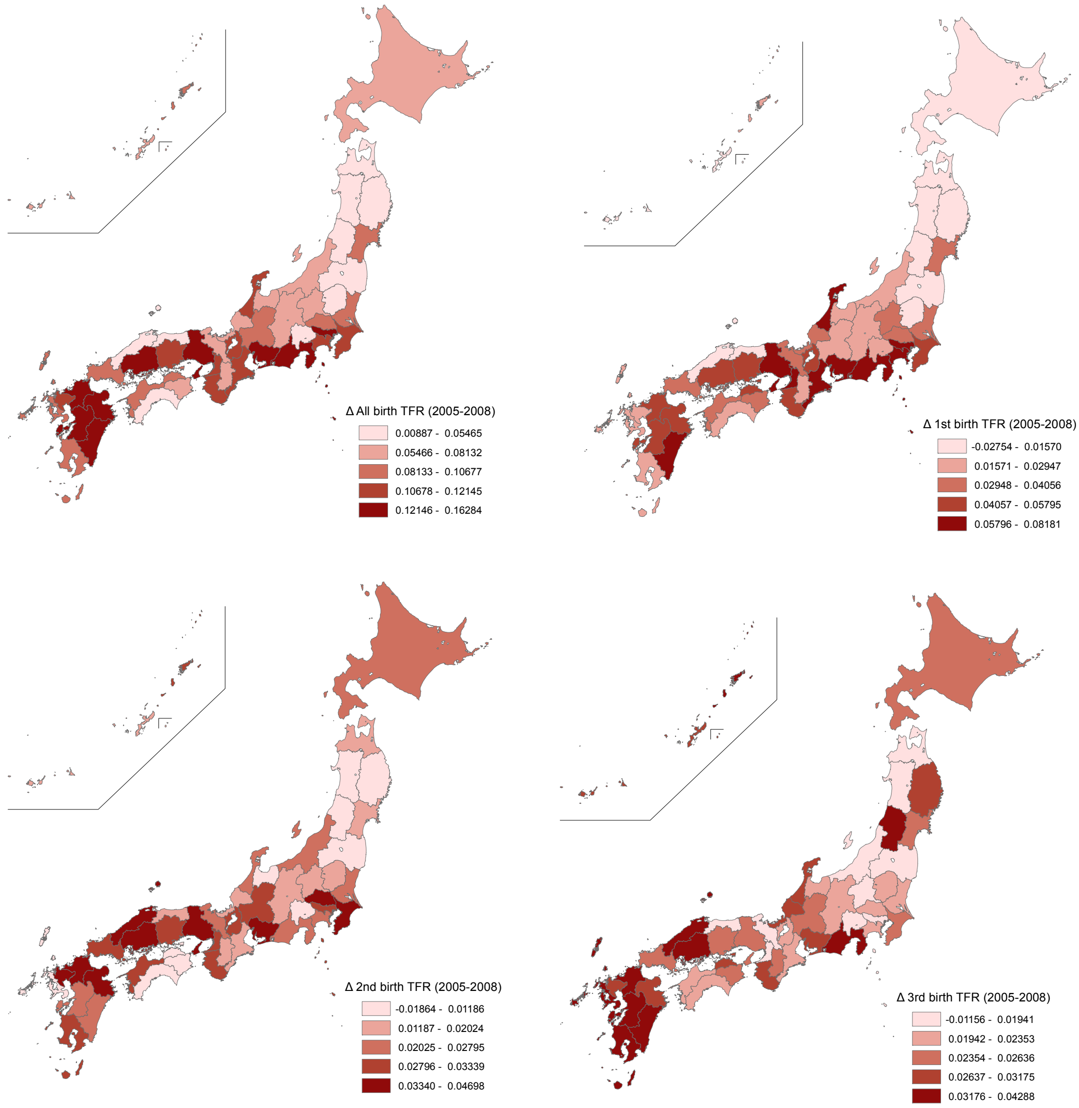
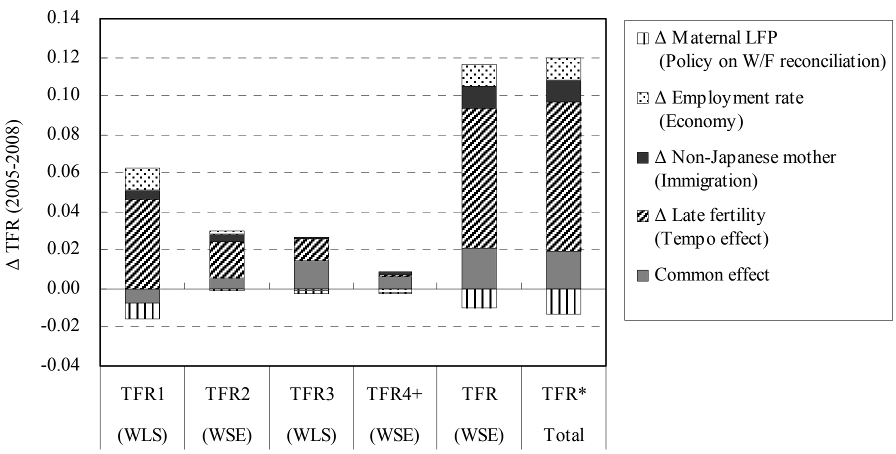


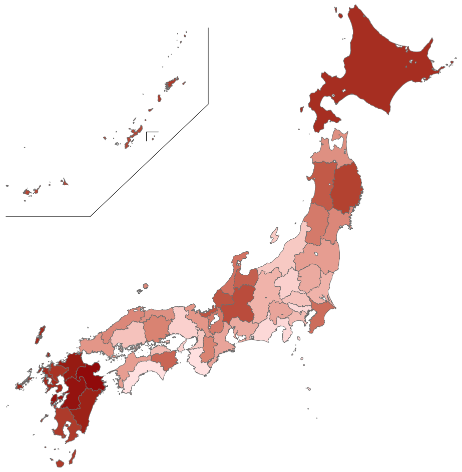
Figure 4: Decomposition of change in total fertility rate in Japan from 2005 to 2008



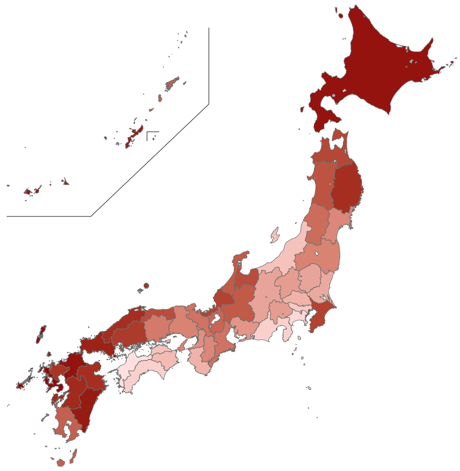
Note: Decomposition for TFR* is obtained by summing up the results for birth order specific TFR.

Figure 5: Geographic patterns of increase in total fertility rates explained by spatial autocorrelated error term in spatial error model

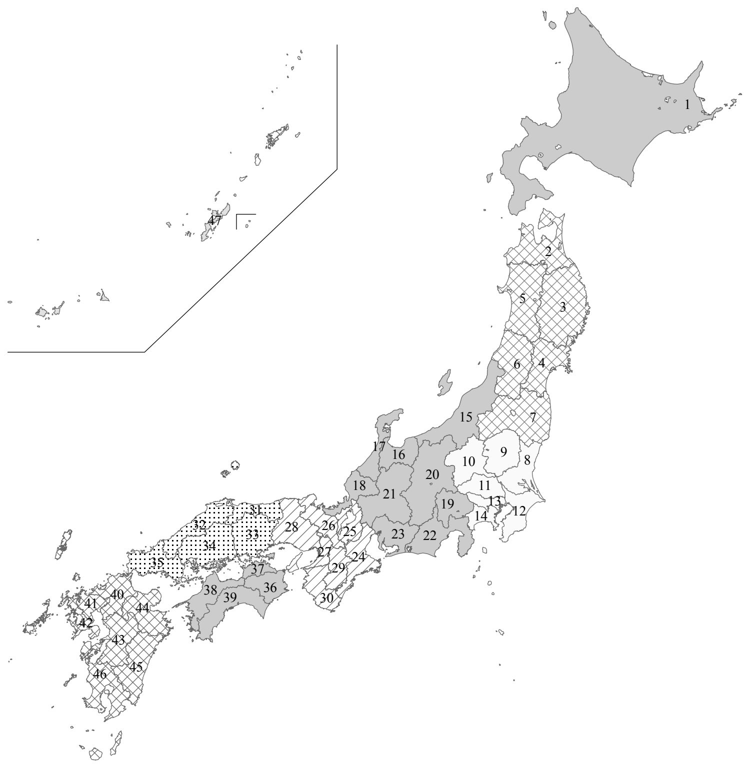
Result for all-birth TFR



Result for second birth TFR



Appendix: Prefectures in Japan



Region		Prefecture
Hokkaido	1	Hokkaido
Tohoku	2	Aomori
	3	Iwate
	4	Miyagi
	5	Akita
	6	Yamagata
	7	Fukushima
Kanto	8	Ibaraki
	9	Tochigi
	10	Gumma
	11	Saitama
	12	Chiba
	13	Tokyo
	14	Kanagawa
Chubu	15	Niigata
	16	Toyama
	17	Ishikawa
	18	Fukui
	19	Yamanashi
	20	Nagano
	21	Gifu
	22	Shizuoka
	23	Aichi
Kinki	24	Mie
	25	Shiga
	26	Kyoto
	27	Osaka
	28	Hyogo
	29	Nara
	30	Wakayama
Chugoku	31	Tottori
	32	Shimane
	33	Okayama
	34	Hiroshima
	35	Yamaguchi
Shikoku	36	Tokushima
	37	Kagawa
	38	Ehime
	39	Kochi
Kyusyu	40	Fukuoka
	41	Saga
	42	Nagasaki
	43	Kumamoto
	44	Oita
	45	Miyazaki
	46	Kagoshima
Okinawa	47	Okinawa

Table 1: Descriptive statistics for variables used in the analyses

	Variable			Period of change	Source	National-level value	Prefecture-level data (N=47) Weighted Mean[5]	Min	Max	Spatial autocorrelation Moran's I[5]
Dependent variables	Change in TFR		All birth	2005-08	Vital Statistics [3]	0.1069	0.1051	0.0089	0.1628	0.343 ***
			1st birth	2005-08	Vital Statistics [3]	0.0472	0.0470	-0.0275	0.0818	0.304 **
			2nd birth	2005-08	Vital Statistics [3]	0.0291	0.0281	-0.0186	0.0470	0.252 **
			3rd birth	2005-08	Vital Statistics [3]	0.0242	0.0237	-0.0116	0.0429	0.136 #
			4th + birth	2005-08	Vital Statistics [3]	0.0064	0.0063	0.0003	0.0182	0.494 ***
Explanatory variables	Change in late fertility	age 35+	All birth	2005-08	Vital Statistics [3]	0.0459	0.0435	0.0108	0.0575	0.189 *
		age 33+	1st birth	2005-08	Vital Statistics [3]	0.0248	0.0234	0.0087	0.0350	0.427 ***
		age 35+	2nd birth	2005-08	Vital Statistics [3]	0.0190	0.0180	0.0054	0.0269	0.006
		age 36+	3rd birth	2005-08	Vital Statistics [3]	0.0056	0.0069	-0.0006	0.0126	0.003
		age 38+	4th + birth	2005-08	Vital Statistics [3]	0.0011	0.0011	-0.0036	0.0037	0.222 *
	Change in TFR inflated by non-Japanese mothers		All birth	2005-08	Vital Statistics [3]	0.0020	0.0019	-0.0047	0.0085	0.406 ***
			1st birth	2005-08	Vital Statistics [3]	0.0009	0.0009	-0.0024	0.0042	0.422 ***
			2nd birth	2005-08	Vital Statistics [3]	0.0006	0.0006	-0.0020	0.0029	0.383 ***
			3rd birth	2005-08	Vital Statistics [3]	0.0004	0.0003	-0.0005	0.0011	0.329 ***
			4th + birth	2005-08	Vital Statistics [3]	0.0001	0.0001	-0.0001	0.0003	0.368 ***
	Change in employment rate			2002-07	Labour Force Surveys [4]	0.0150	0.0155	-0.0010	0.0270	0.284 **
	Change in labor force participation rate among mothers having preschool children [1]			2002-07	Employment Status Surveys [4]	0.0554	0.0556	-0.0066	0.1636	-0.051
	Proportion of extended families [2]			2005	Census [4]	0.1878	0.1839	0.0789	0.5011	0.379 ***

*** p<.001 ** p<.01 * p<.05 # p<.1

1) For mothers of in nuclear families

2) For households including preschool children

3) Statistics and Information Department, Minister's Secretariat, Ministry of Health, Labour and Welfare

4) Statistics Bureau, Ministry of Internal Affairs and Communications

5) Reproductive age female population (15-49) in 2005 is used as a weight.

Table 3: Decomposition of change in total fertility rate in Japan from 2005 to 2008

	1st birth TFR (1)	2nd birth TFR (2)	3rd birth TFR (3)	4th+ birth TFR (4)	All birth TFR	All birth TFR (1)+(2)+(3)+(4)
TFR in 2005	0.62404	0.46433	0.13935	0.03238	1.26010	1.26010
TFR in 2008	0.67124	0.49340	0.16354	0.03879	1.36697	1.36697
Change from 2005 to 2008	0.04720	0.02907	0.02420	0.00641	0.10687	0.10687
Decomposition						
Common effect	-0.00710	0.00566	0.01489	0.00629	0.02068	0.01975
Change in late fertility (Declining tempo effect)	0.04644	0.01866	0.01092	0.00101	0.07274	0.07703
Change in TFR inflated by non-Japanese mothers (Contribution of immigration)	0.00494	0.00403	0.00127	0.00147	0.01128	0.01170
Change in employment rate (Ecomonic improvement)	0.01125	0.00193	-0.00056	-0.00140	0.01174	0.01121
Change in maternal LFP (Policy improvement on work/family reconciliation)	-0.00832	-0.00120	-0.00233	-0.00096	-0.00957	-0.01282
Contribution (%)						
Common effect	-15.0	19.5	61.5	98.2	19.4	18.5
Change in late fertility	98.4	64.2	45.1	15.8	68.1	72.1
Change in TFR inflated by non-Japanese mothers	10.5	13.9	5.2	22.9	10.6	11.0
Change in employment rate	23.8	6.6	-2.3	-21.9	11.0	10.5
Change in maternal LFP	-17.6	-4.1	-9.6	-15.0	-9.0	-12.0
Model used for predictions	Weighted LS	Weighted spatial error model	Weighted LS	Weighted spatial error model	Weighted spatial error model	-

Table 2: Coefficients of regression models of change in total fertility rates: first, second and third birth

Variable	Change in 1st birth TFR						Change in 2nd birth TFR						Change in 3rd birth TFR					
	Weighted least squares			Weighted spatial error model			Weighted least squares			Weighted spatial error model			Weighted least squares			Weighted spatial error model		
	β	β'	Std. error	β	β'	Std. error	β	β'	Std. error	β	β'	Std. error	β	β'	Std. error	β	β'	Std. error
Constant	-0.01		0.01	-0.01		0.01	0.01		0.01	0.01		0.01	0.01		0.01 *	0.01		0.00 **
Change in late fertility 1)	1.95	0.52	0.35 ***	2.03	0.54	0.34 ***	0.90	0.31	0.36 *	1.02	0.35	0.28 ***	1.75	0.52	0.47 ***	1.42	0.42	0.43 **
Change in TFR inflated by non-Japanese mothers	5.61	0.29	1.76 **	5.70	0.29	1.69 ***	5.74	0.39	1.41 ***	6.86	0.46	1.27 ***	3.00	0.10	3.59	5.67	0.19	3.57
Change in employment rate	0.78	0.18	0.35 *	0.81	0.18	0.34 *	0.18	0.07	0.22	0.13	0.05	0.20	-0.03	-0.02	0.20	-0.01	-0.01	0.20
Change in labor force participation rate among mothers having preschool children	-0.16	-0.22	0.07 *	-0.16	-0.22	0.06 **	-0.01	-0.02	0.04	-0.02	-0.06	0.03	-0.04	-0.15	0.04	-0.02	-0.06	0.03
Proportion of extended families 2)	-0.02	-0.07	0.02	-0.02	-0.07	0.02	-0.03	-0.25	0.01 *	-0.03	-0.25	0.01 **	0.02	0.26	0.01 #	0.02	0.23	0.01 #
Lambda (spatial autoregressive coefficient)				*0.15*						*0.43*						*0.25*		
Likelihood Ratio Test (H0: *Lambda* =0)				0.62						11.30 ***						1.02		
R-squared	0.80						0.68						0.34					
Adjusted R-squared	0.78						0.64						0.26					
AIC	-259.2			-257.8			-304.6			-313.9			-311.0			-310.0		
N	47			47			47			47			47			47		
Diagnostics for spatial autocorrelation																		
Moran's I (residuals)	0.10 #			0.05			0.36 ***			-0.03			0.10 #			-0.05		
Lagrange multiplier diagnostics for spatial autocorrelation																		
LM (error)	1.08						8.02 **						0.31					
LM (lag)	0.00						0.28						1.08					
Robust LM (error)	1.24						7.81 **						0.08					
Robust LM (lag)	0.16						0.08						0.86					
LM (SARMA)	1.25						8.10 *						1.17					

*** p<.001 ** p<.01 * p<.05 # p<.1

β represents a coefficient and β' represents a standardized coefficient.

1) For 1st birth model, late fertility rate represents fertility rates over age 33, for 2nd birth model, fertility rates over age 35, and for 3rd birth model, fertility rates over age 36.

2) Centered values are used.