SESSION 12: STOCHASTIC TECHNIQUES FOR DEMOGRAPHIC PROJECTIONS

SESSION 13: STOCHASTIC NATIONAL DEMOGRAPHIC PROJECTIONS

EXPLANATIONS FOR REGIONAL FERTILITY REVERSAL AFTER 2005 IN JAPAN: DEMOGRAPHIC, SOCIO-ECONOMIC AND CULTURAL FACTORS

Miho IWASAWA[1], Ryuichi KANEKO[1]

Abstract

The major goal of this paper is to explore the explanations for the total fertility rate (TFR) upturn in Japan after 2005[2]*. 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. 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 suggest that the TFR upturn is mostly explained by increase in late fertility. 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 lower-order fertility.*

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[3], 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) (see 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

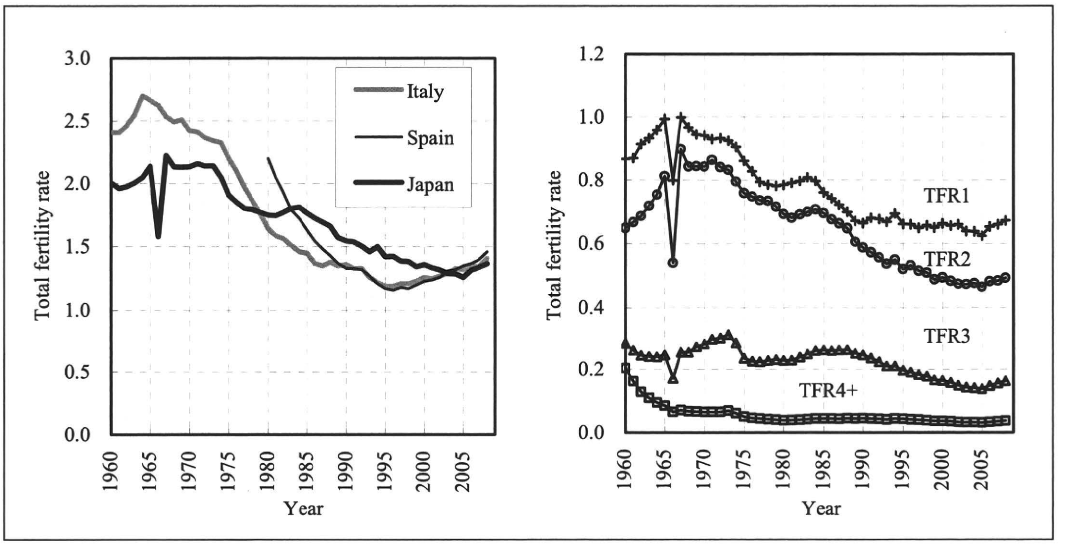
1 National Institute of Population and Social Security Research, Tokyo, Japan

2 This project is contributed by Kenji Kamata, National Institute of Population and Social Security Research (Tokyo, Japan), and James M. Raymo and Kimiko Tanaka, University of Wisconsin at Madison (United States).

3 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 cur-rent TFR below 1.85 will not possibly return to the same level even in 2050 (UN 1996, 1998, 2008).

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. 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.

2. 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) 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 behaviours 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 family culture. The study by Castiglionin and Dalla Zuanna (2008) suggested the association between fertility decline and family culture where traditional gender norms are emphasized. Since Japan shares the similar family 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.

3. 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):

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

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 "neighbourhood" structure that reflects the potential interaction between neighbouring 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.). We used a first-order queen convention to define neighbours for the weight matrix used in estimating spatial regression model.

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

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.

4. Data and Variables

For the dependent variables, the change of all-birth TFR and the change in birth-order-specific TFR by prefecture from 2005 to 2008 are used.

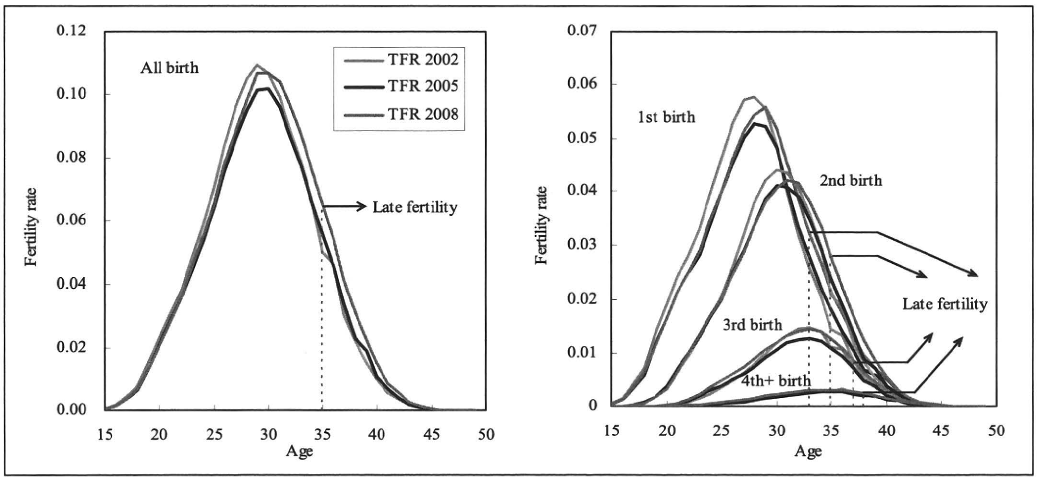
For the explanatory variables, we used four factors Goldstein and his colleagues (2009) focused on to explain fertility upturn in their cross-national study (diminishing tempo effects, increase in foreigners, economic improvement, and policy improvement on work and family reconciliation) and also used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

4.1 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%) (see Figure 2). For the variable, we used the change in fertility rate limited to these ages from 2005 to 2008.

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).

4.2 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 foreign who married to Japanese men[4], 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[5]. 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)[6].

4.3 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 unfavourable economic conditions to influence fertility, we looked at change in employment rate from 2002 to 2007.

4.4 Policies on Work and Family Reconciliation: Change in Labour 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 part of policy initiatives aiming to stimulate higher fertility since 2000 as represented by "New Angel Plan" (Ogawa 2003, Moriizumi 2008)[7]. From 2005 to 2009, the "Children and Childcare Plan" was established, instead of the "New Angel Plan."

---

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

5 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.

6 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.

7 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 labour 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.

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.

4.5 Family culture: Proportion of extended families among households including pre-school 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 family culture across regions as in Italy. According to Kato (2008), pattern of living arrangement reflects the strength of family culture. In eastern regions with strong family culture, historically an older couple (parents) and a younger couple (son and daughter-in-law) co-reside 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.

In our study, we measured strength of family culture by the prevalence of extended family households. 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 family culture and fertility change as in the case of Italy.

4.6 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 family 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 Labour 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 TFR using weighted least squares regression (WLS) and weighted spatial error regression (WSE).

5. Results

5.1 Descriptive statistics

Table 1 shows descriptive statistics of variables we used in the analysis. The values of Moran's I[8] suggest that all of the dependent variables are spatially auto-correlated. 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. 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.

8 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 neighbouring 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 neighbourhood structure, we use queen's case contiguity weight matrix of order one, as well as for the spatial regression analyses.

5.2 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 neighbouring prefectures fit better than the WLS models (see Table 2).

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.

5.3 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 in-crease 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 (see 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 found19% 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. 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	-

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. Discussions

The goal of this study was to explore the explanations for the TFR upturn after 2005 in Japan, one of the "lowest low fertility" countries. We focused on the following factors based on previous studies in Europe: (1) diminishing tempo effect, (2) increase in foreigners, (3) economic improvement, and (4) policies initiative on work and family reconciliation, and (5) family 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 house-holds).

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 in-creased 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 centres 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 centres among all preschool children has significantly 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 labour market because there were no vacancies at day-care centres. 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 in-crease 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 de-signs and methods that enable us to grasp the impact of family policies on individual behaviour 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 estimated 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 the 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 family 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 family attitude remain strong.

Conversely, our results suggest that parenting has become easier even in urban areas where family culture is relatively weak. In these areas, conditions favourable to family formation other than family support may be established. Since proportion of extended families shows positive impact in third and higher-order birth models, economic or physical support from co-residing grandparents may play important roles 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. 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 behaviour 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 centres 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.

References

Anselin, L. (1988). Spatial econometrics: Methods and models. Dordrecht, the Netherlands: Kluwer Academic Pub.

Billari, F.C. (2008). Lowest-low fertility in Europe: Exploring the causes and finding some surprises. The Japanese Journal of Population 6(1):2-18.

Billari, F.C.and Kohler, H.P.(2004). Patterns of low and lowest-low fertility in Europe. Population Studies 58(2):161-176.

Bongaarts, J. and Feeney, G. (1998). On the quantum and tempo of fertility. Population and Development Review 24(2):271-291.

Bongaarts, J. (2001). Fertility and reproductive preferences in post-transitional societies. Population and Develop-ment Review 27 Supplement: Global Fertility Transition: 260-281.

Bongaarts, J. (2002). The end of the fertility transition in the developed world. Population and Development Review 28(3):419-443.

Blossfeld, H.-P., Klijzing, E., Mills, M., and Kurz, K. (2005). Globalisation, uncertainty, and youth in society. Lon-don: Routledge.

Chi, G.and J. Zhu. 2008. "Spatial regression models for demographic analysis." Population Research and Policy Re-view 27(1):17-42.

Castiglioni, M. and Dalla Zuanna, G. (2008). Marital and reproductive behavior in Italy after 1995: Bridging the gap with Western Europe? European Journal of Population 25:1-26.

Caltabiano, M., Castiglioni, M., and Rosina, A. (2009). Lowest-low fertility: Signs of a recovery in Italy? Demo-graphic Research 21(23):681-718.

Cliff, A.D. and Ord,J.K. (1981). Spatial processes: Models and applications. London, England: Pion Ltd.

Goldstein,J.R., Sobotka,T., and Jasilioniene, A. (2009). The end of 'Lowest-Low' fertility? Paper presented at the an-nual meeting of Population Association of America, Detroit, USA, April 30 – May 2 2009.

ISTAT (2008). Indicatori demografici anno 2008 [electronic resource]. Rome: ISTAT. http://www.demo.istat.it/altridati/indicatori/index_e.html

Katō, A. (2008). Kazoku kozo to jinko gensyo no chiikisei. Paper presented at the annual meeting of Population Asso-ciation of Japan. Tokyo, Japan, June 7-8 2008. (in Japanese)

Kohler, H.-P., Billari, F.C., and Ortega, J.A. (2002). The Emergence of lowest-low fertility in Europe during the 1990s. Population and Development Review 28(4): 641-680.

Ministry of Health, Labour and Welfare. (2006). Hesei 18 nenban Rodo keizai no bunseki. (in Japanese)

Ministry of Health, Labour and Welfare. (2009). Hesei 21 nen Jinkodotai tokei no nenkan suikei (Estimates for Vital Statistics of Japan, 2009). (in Japanese)

Moran, P.A.P.(1950). Notes on continuous stochastic phenomena. Biometrika 37:17-23.

Moriizumi, R. (2008). Shorai jinko suikei no kokusai hikaku: Nihon to Syuyosenshinkoku no jinko no yukue. Jinko Mondai Kenkyu 64(3):45-69. (in Japanese)

Moriizumi, R. (2008). Jisedai ikusei shien taisaku. In: Kanekiyo, H. and Anzo, S. (eds.) Jinkogensyojidai no syakai-hosyo. Tokyo: Harasyobo: 119-151. (in Japanese)

National Institute of Population and Social Security Research (2007a). Nihon no Syorai Suikei Jinko (Population Projection for Japan: 2006-2055), Tokyo: Kosei Tokei Kyokai.

National Institute of Population and Social Security Research (2007b). The 13th National Fertility Survey (Kekkon to Syussan ni Kansuru Zenkoku Chosa) Dai I Hokokusyo, Waga-kuni Fufu no Kekkon-Katei to Syussyoryoku, Chosa Kenkyu Hokoku Shiryo, No.23, Tokyo: Kosei Tokei Kyokai.

National Institute of Population and Social Security Research (2007c). The 13th National Fertility Survey (Kekkon to Syussan ni Kansuru Zenkoku Chosa) Dai II Hokokusyo, Waga-kuni Dokushin-so no Kekkon-Kan to Ka-zoku-Kan, Chosa Kenkyu Hokoku Shiryo, No.24, Tokyo: Kosei Tokei Kyokai.

Neyer, G. and Andersson, G. (2008). Consequences of family policies on childbearing behavior: effects or artifacts. Population and Development Review 34(4):699-724.

Ogawa, N. (2003). Japan's changing fertility mechanisms and its policy responses. Journal of Population Research 20(1):89-106.

Ohbayashi, T. (1996). Syakaisoshiki no chiikiruikei. In: Kreiner, Y. (ed.) Chiikisei kara mita Nihon: Tagenteki rikai no tameni. Tokyo: Shinyosya: 13-37. (in Japanese)

United Nation. (1996). World Population Prospects: The 2008 Revision.

United Nation. (1998). World Population Prospects: The 2008 Revision.

United Nation. (2008). World Population Prospects: The 2008 Revision.

Ward, M.D. and Gleditsch, K.S. (2008). Spatial regression models. Los Angeles: Sage Publications.

APPLYING A FERTILITY PROJECTION SYSTEM TO PERIOD EFFECT ANALYSIS: AN EXAMINATION OF THE RECENT FERTILITY UPTURN IN JAPAN[1]

Ryuichi KANEKO[2]

Abstract

Models of population projection play a significant role in analyzing current demographic processes as well as in forecasting their future course. In this study, I utilize a fertility projection based on the official population projection for period effect analysis of current fertility trends in Japan. The objective of the paper is threefold; first, I demonstrate the usefulness of population projection models in analyzing demographic processes in the past and present as well as in the future, secondly I classify and clarify the period effects in terms of the cohort fertility schedule so that causes and mechanisms of fertility changes can be identified, and thirdly I apply the framework to the recent peculiar fertility development in Japan, especially the upturn since 2006. Unlike previous upturns seen among countries in Europe and North America, the pure period effects that are separated from the tempo effect played a major role in the recent decline and subsequent rise in Japanese fertility, although the recuperation mechanism is also induced in an irregular manner by the effects.

1. Introduction

The role of population projections is to provide information on various future changes in demographic structure (e.g., population size and age composition by sex) based on assumptions on the future course of vital events such as fertility, mortality and migration. However, since they offer a comprehensive demographic model, they can be broadly applied to analyzing population processes. In this paper, I describe the use of a fertility projection employed in the official population projection for analysis of the period effects in past and current fertility trends in Japan.

It is crucial to understand the relationships between the period and cohort observations of fertility in order to identify the essential trends and prospects. As adjustments and adaptation behavior in an individual's reproductive process take place along his/her life course, most of the large-scale regularities in fertility rates tend to emerge in cohort experiences. Demographic measures, however, usually trace fertility development annually, and try to provide a description of it with the "lifecycle" measures by means of the hypothetical cohort of the period. Hence two lifecycle measures with different values, i.e. those for true and hypothetical cohorts, describe the very same phenomena. There has been much effort to connect these measures, most notably by Bongaarts and Feeney (1998).

In addition to these formal issues, problems often arise in attempts to understand fertility changes in terms of period and cohort effects, which affect fertility trends via different mechanisms. In most cases, these efforts are unsuccessful due to the mixture of those effects in practice.

---

[1] This is a draft paper presented to the Joint Eurostat-UNECE Work Session on Demographic Projections (Lisbon, Portugal, 28-30 April, 2010), and to be revised. Do not cite any material in the preset paper.

[2] National Institute of Population and Social Security Research, Japan. e-mail: r-kaneko@ipss.go.jp

In the present paper, therefore, the period effects are first sorted out according to their means of effect on the cohort fertility schedule. Then applying the cohort-based fertility projection model, we separate the period effect from fertility fluctuations observed in recent Japan in order to identify the driving forces of changes.

Accordingly, this paper has three objectives; (1) to demonstrate the utility of population projection models in analyzing demographic processes in the past and present as well as in the future, (2) to measure and understand the period effects in terms of modifiers of the cohort fertility schedule, and applying those new procedures (3) to identify factors and mechanisms of the recent peculiar fertility development in Japan, paying particular attention to the question of whether the small upturn in Japan is induced by the similar mechanisms as those behind the fertility upturns recently observed among most of the countries in Europe and North America.

2. Background

2.1 Historic population trends and the lowest low fertility in Japan

The year 2005 is a dividing line for population trends in Japan in several senses; first, the population of Japan was announced to have decreased from the previous year for the first time after about hundred and fifty years of steady rise since the closing period of the Tokugawa era except the turmoil during the Second World War, and second, the proportion of the population aged 65 and above exceeded one fifth (20.2 percent), attaining the highest in the world.

Though the combination of a low fertility rate and high longevity is the cause these striking changes in the population of Japan, the principal driver is the prolonged continuation of low fertility rates far below replacement level fertility, which Japan has been experiencing since the mid-1970s

In spite of a series of government measures and escalating public awareness, fertility continued to decline until it fell into the so called "lowest low" level for the first time in 2003, and finally reached the lowest ever TFR of 1.26 in 2005. The number of live births, which exceeded 2.09 million in 1973, had decreased by nearly half, to 1.06 million, in 2005 – again the lowest number recorded since the Second World War.

Because of the population momentum, the broad course of these historic population changes is already inevitable at this point. However, the upcoming levels and pace of changes depend on the future fertility rates. As such, the impact on society of rise or further fall of the fertility rates could be of great significance.

As a matter of fact, fertility made an upturn immediately after achieving the lowest ever TFR. In 2006, the TFR rose by 0.06 to 1.32, which is the largest increase since the 1970s. Fertility kept rising to 1.34 in 2007, and 1.37 in 2008. The last three year period of rising TFR was during the period 1982-1984. Although the extent of the increase is relatively minor and the overall level still far below replacement, this recent upturn of fertility is a significant turnaround: such a rise is a unique development both in terms of magnitude and deviation from the downward trend. We now proceed to engage in a detailed examination of this phenomenon.

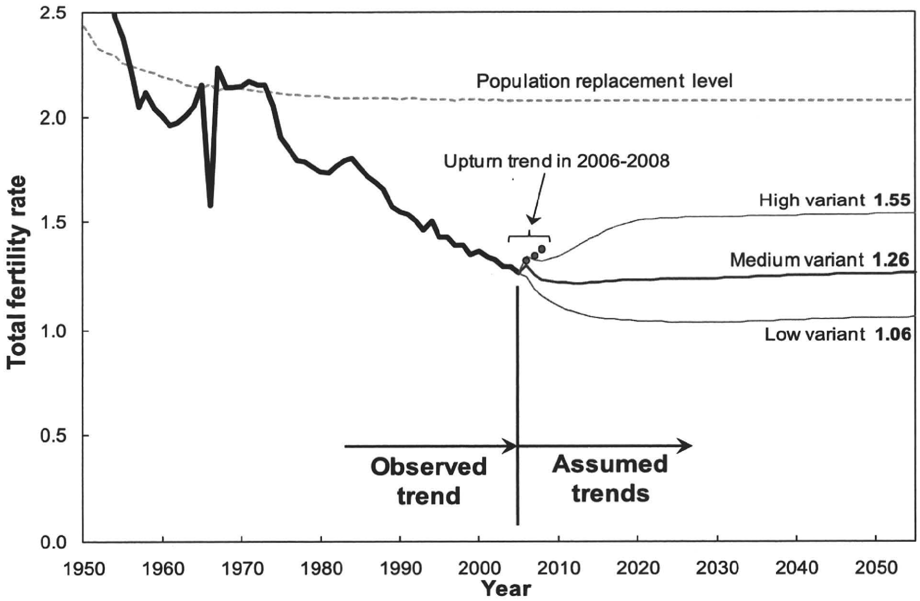
2.2 The upturn of the period fertility rate in 2006 and onward

As already explained, the total fertility rate (TFR) in Japan reached its lowest value ever in 2005. In the following year, however, it showed a surprisingly strong recovery and has been increasing thereafter, at least until 2008. Figure 1 shows the TFR trend together with the development of the population replacement level and different assumptions used for the Population Projections for Japan. In this graph, the values recorded in the three years from 2006 to 2008 are shown as dots. This reversal gives the impression that the constant decline throughout the years leading up to 2005 has suddenly turned around. In fact, the TFR values in 2007 and 2008 are higher than any of the fertility assumptions of the latest official population projections based on the values until 2005, even the high variant assumption.

In the past, such sudden upturns were also observed in the three-year period from 1982 to 1984 as well as in 1994. In the case of the upturn in 1982 to 1984, the TFR of 1.74 in 1981 had increased by 0.07 by 1984. In 1994, an increase of 0.04 was recorded in a single year.

The increase observed from 2006 to 2008 amounts to 0.11, which is clearly a significant increase compared to these past upturns. Moreover, the increase of 0.06 in 2006 is the greatest increase observed in a single year since the 1970s.

Figure 1. Trends of Total Fertility Rate: Observed and Assumed.



Source: The Vital Statistics, NIPSSR(2007).

Looking at the TFR in the years immediately following the periods of past increase, both 1985 and 1995 witnessed relatively sharp reductions of -0.05 and -0.08, respectively. It is not known if this most recent increase will follow the same profile as in the past, or if it might last for a relatively long period of time. However, looking at the monthly development shown below, some deceleration and signs of stagnation can already be observed in 2009.

Whether this recent upturn is temporary or caused by actual, substantive changes in the basic course is of significant importance when investigating the future fertility trend. The assumptions on fertility rate in the latest population projection, in particular, are based on the actual values measured until 2005, and in the medium-variant scenario the long-term TFR value is projected to end up at the very low level of 1.26. Since this assumption was established by projecting cohort fertility rates, a deviation of actual values in recent years does not directly imply that these assumptions are inappropriate. Nonetheless, if the deviation occurs as a result of more basic changes in reproductive behaviors, the assumption must be reviewed for the future projections. Thus, this upturn is examined in more detail in the following discussion.

From the mid-1990s to the beginning of the second millennium, one by one the so-called lowest low fertility countries in Europe experienced reversals of their fertility rate trends. Indeed, as of the time of this writing, the majority of these countries have broken away from the lowest low fertility status (Goldstein et al. 2009). In fact, while the occurrence of reversal of fertility rate trend is not limited to low fertility countries, and the period and degree vary, it can be said that the US and most of the countries in Europe are currently experiencing a steady upturn in fertility rates.

To begin with, with few exceptions, the decline of fertility rates in these countries was generally caused by a general delay of childbearing known as "postponement transition" (Kohler et al. 2002, Sobotka 2004, Billari 2008); Goldstein et al. explain that the fertility rate upturns in recent years were caused by the weakened tempo effects on the period fertility rate due to this transitional trend diminishing or dying out. They call this process "tempo transition" (Goldstein et al. 2009).

One very important point in this perspective is the interpretation that the actual cohort fertility rates have not reached the level of 1.3, called the lowest low, in any of the countries but rather that this level in the period TFR is a transient phenomenon due to the aforementioned tempo effect.

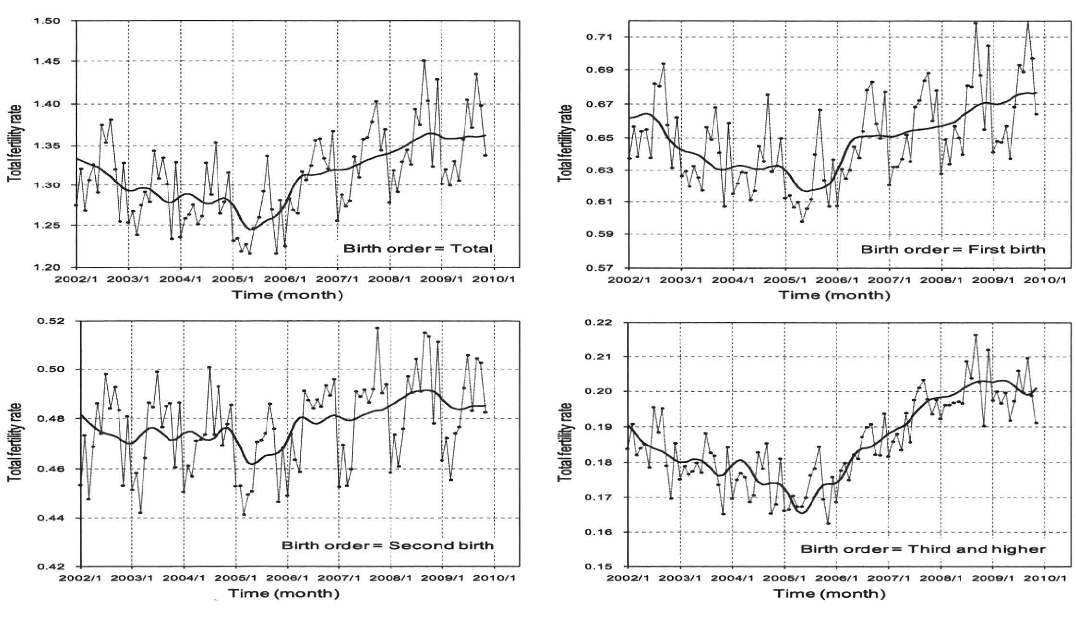
If this interpretation is correct and the fertility rate upturn in Japan observed since 2006 is caused by a mechanism similar to that of the trend observed in the US and countries in Europe, there is a possibility that the recovery may continue for a relatively long period of time. In this case it is unlikely that the future cohort fertility rate will drop below the lowest low level, as projected by the medium (and low) variant assumptions in the Population Projections in Japan.

3. Demographic analysis of the upturn

3.1 A close look at the upturn – Examination of monthly data

In order to analyze changes in the various fertility rates in Japan in recent years more closely, the observed data is first plotted on a monthly basis. Figure 2 shows monthly fertility rates and their trends after making seasonal adjustments by birth order in the period from January 2002 to June 2009 (the latest values obtained as of November 2009). In the figure, fertility rates are indicated as annual values (corresponding to 365 days), obtained by adjusting the age-specific number of births in individual months to have the same number of days and dividing the values by the projected population by age in the middle of the given month. Moreover, seasonal adjustment is performed according to the U.S. Census Bureau's X-11 method. Please note that the annually published values of fertility rates in Japan use the population as of October 1, rather than the middle of the period, as the denominator. Thus the fertility rate values become slightly higher than is the case here, where the population in the middle of a month is used.

Figure 2. Monthly Progress of Fertility Rates by Birth Order: 2002-2009.



Note: Dots with thin lines denote monthly time series of annualized TFR by birth order, and lines represent seasonally adjusted trends with the U.S. Census Bureau's X-11 method.