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Is Taiwan's Lowest-low Fertility Reversible Via Socio-economic Development?+

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Abstract

In this study, we assume that socio-economic development is the underlying mechanism for population changes. In the past 50 years, Taiwan has experienced drastic socio-economic changes and rapid population change. Simultaneous equations are thus used to integrate the effect of Taiwan's socio-economic factors on the projection of its age-specific fertility rate (ASFR). The estimated ASFR is then used to make population projections for Taiwan in the period 2004-2033. The results of our low and medium projections are close to the official (CEPD) medium-high projection for the same time period. The results of the high projection for both studies are rather similar too. Specifically, if Taiwan's socio-economic development grows at a high variant, its fertility would rebound to replacement level by 2033. If it follows the medium variant, fertility would rise to 1.6 births per woman. But if Taiwan's future socio-economic development grows sluggishly as in the assumed low variant case, Taiwan's fertility would remain at a lowest-low level.

Key words: Lowest-low fertility, population projection, socio-economic development

Toward the prevalence of lowest-low fertility among developed and some developing societies, two perspectives have been proposed. One is that period total fertility rate (PTFR) is distorted because of delayed marriage (Bongaarts and Feeney 1998; Bongaarts 2001). The other one states that the lowest-low fertility is a temporary phenomenon caused by a high unemployment rate and economic recession (Knodel *et al*. 1996). Although they attribute current lowest-low fertility to different causes, we consider both causes to reflect the influence of social economic development. If factors of economic development are properly considered in the estimation of PTFR, we will have a more reliable picture about fertility change.

Taiwan has experienced not only drastic social economic changes but also a lowest-low fertility level since 1998. The period total fertility rate in Taiwan fell from 1.77 in 1997 to 1.46 in 1998. It then decreased from 1.56 in 1999 to 1.23 in 2003, with the exception of a slight rebound to 1.68 in 2000 because of the year of the dragon. It has been shown that the the tempo effect caused by delayed marriage is -0.4 births for Taiwan in the period 1985-89 (Bongaarts 2001). In the past 20 years, Taiwan has also experienced a slowdown in economic growth. Its GDP growth rate decreased from 8.5% in 1983 to 3.3% in 2003.

In response to the concerns about lowest-low fertility, the Council of Economic Planning and Development (CEPD, 2006) made a series of population projections based on United Nations' projections for developed societies and Taiwan's own population trend. The projections' TFR assumptions range from a low level of 0.74 to a high level of 2.1. In view of the recent, drastic fertility change, 1.6 is referred to as the medium-level projection, implying that this is the expected or most likely course for Taiwan's population trend. Overall speaking, these projections are based on

the *a priori* experience of other developed countries. They thus may serve as benchmarks for future possible courses of population change. As no mechanism underlying these projections is specified, it is difficult to assess which projection is the most likely course.

In this study, simultaneous equations are used to integrate the effect of social economic factors on age-specific fertility rates ($ASFR_i$). The thus estimated $ASFR_i$ is used to make population projections. Since CEPD's projections are based on the *a priori* experience of other developed countries, they may serve as benchmarks. Comparing our projection with CEPD's, we may obtain an answer to the question "Is Taiwan's lowest-low fertility reversible?" More specifically, we would like to know whether, when factors of social economic development are properly considered in population projections, Taiwan will have a fertility approaching the replacement level. The rest of this paper is arranged as follows: (1) Literature review, (2) Taiwan's demographic and social development trend, (3) The estimation of $ASFR_i$, (4) The results of the projection, and (5) Summary and discussion.

I. Literature Review

In the 1970s, classical demographic transition theorists and United Nations demographers found that fertility decline was associated with socio-economic development. When long-term fertility transition has been completed, socio-economic changes can go no further and then a threshold of replacement fertility will prevail in the long run (United Nations 1973, 1974).

A recent study has cast doubt upon the above conclusion. Bongaarts (2001) found that, on the contrary, "below-replacement fertility is now the

norm in the developed world, but it is also observed in a small but growing number of populations elsewhere, in particular in those Southeast Asia countries where economic development has been extremely rapid in recent decades" (Bongaarts 2001: 262-263). Bongaarts further proposes that two types of factors caused by social economic development are linked to fertility change. The first one is factors enhancing fertility relative to desired family size, and the other, factors reducing fertility. The former includes desired family size, unwanted fertility, replacement of deceased children, and sex preference. In post-transition countries, most of these factors have limited effect. Unwanted fertility is small because of effective birth control. A further reduction in infant and child mortality is limited, as mortality is already very low. Gender preference will presumably decline as societies develop and increasingly treat boys and girls equally. However, the effect of desired family size is debatable. One school of thought proposes that replacement fertility is a theoretical threshold that has little or no meaning for individual couples building their families, and below-replacement fertility is expected to be the norm in post-transitional societies (Demeny 1997). On the contrary, some analysts believe that the current low levels of post-transitional fertility are a temporary phenomenon (Knodel *et al*. 1996). This perspective is supported by data on desired family size, which has remained near or above two children in all societies for which measures are available.

Factors reducing fertility relative to desired family size include rising age of childrearing, involuntary family limitation, and competing preferences. Delay in marriage and the timing of child rearing may distort period total fertility, which is referred to as the tempo effect. There are various ways to adjust TFR for the tempo effect (Bongaarts and Feeny 1998). It has been reported that the tempo effect can be as high as -0.4 births

(Bongaarts 2001). As societies move into the post-transitional phase, better education and high female labor participation rate may delay females' age at marriage and childrearing and even females' marriage preference. In addition, high divorce will increase the period of involuntary fertility, but the decrease of breast feeding has a decreasing effect on fertility. These effects are partly reflected in the proportion of currently married women.

In societies where births out of wedlock are not well accepted, not only later marriage but also less marriage is critical to the level of fertility. After a careful analysis of factors about values, institutions, and behaviors, Retherford *et al*. (2001) conclude that in Japan a key factor has been the near-complete erosion of the institution of arranged marriage, which has not been fully compensated by the emergence of volunteer associations and other social institutions where single men and women with similar interests can readily meet each other. A similar finding was also noted in Taiwan (Chen 2005).

Overall speaking, female labor force participation is related to social economic development and serves as an important factor in fertility. Previous research shows that there is a negative relationship between fertility and the female labor force participation rate. It is striking to note that the relationship is reversed in the findings of some recent empirical research, both longitudinal and cross-sectional (Buts 1979; Macunovich 1995, 1996; Namkee *et al*. 2002; Adsera 2004). This finding lends support to the possible reversal of low fertility back to a replacement or even higher level in the post-transitional phase. In brief, factors related to female labor force participation deserve our serious consideration in fertility estimation. Among them, education and change in industrial composition are the two most important factors.

In brief, there are multiple factors influencing fertility. The

multiplicity itself gives rise to the difficulty of estimating fertility. Their causal interrelationships make fertility estimation even more complicated. In this study, simultaneous equations are used to tackle the problems.

Ⅱ. The Trend of Taiwan's Fertility and Social Development

Taiwan's fertility has started to decline since 1951. Based on demographic characteristics of fertility decline, it can be divided into three stages, i.e. the traditional stage, the modern stage, and the post-transitional stage. In the traditional stage, Taiwan's total fertility rate fell from 7.0 births per woman in 1950 to 4.1 births in 1969. In the modern stage, it further fell to 2.2 births per woman by 1983. In the post-transitional stage, it not only continued to decline but remained at the lowest-low level in the later part of this stage. By 2003, it was a mere 1.2 births per woman (see Table 1).

The drastic fertility decline was accompanied by accelerating socio-economic development. The relationship between fertility decline and social and economic development may provide a solid basis for a systematic investigation into fertility decline. Therefore demographic characteristics and social development of the three fertility stages deserve a brief description.

(1) The traditional stage (1951-1968)

Consistent with the experience of other developed societies, Taiwan's mortality decline preceded fertility decline. The available data show that Taiwan's mortality started to decline in 1905. In this phase, mortality decline was largely concentrated among young age groups. The survival rate to age 20 years had increased from 0.583 in 1920 to 0.843 in 1951. This

Table 1. Fertility rates and percent of currently married for transition turning point and projection years, 1951-2033, Taiwan

Rate	1951	1969	1983	2003	Projections					
					High		Medium		Low	
					2018	2033	2018	2033	2018	2033
Total fertility rate	7,040	4,120	2,155	1,235	1,815	2,130	1,630	1,696	1,435	1,368
Age- specific fertility rate for married women by age										
15-19	68	40	26	11	10	10	10	10	10	10
20-24	287	245	154	52	68	56	71	63	75	69
25-29	350	298	174	92	153	188	138	154	121	121
30-34	311	151	62	69	110	144	95	106	78	70
35-39	226	63	13	20	22	28	13	6	3	3
40-44	132	23	2	3	0	0	0	0	0	0
45-49	34	4	0	0	0	0	0	0	0	0
Marital total fertility rate	9,249	7,845	6,745	8,935	9,141	9,806	9,012	9,477	8,872	9,197
Age- specific fertility rate for married women by age										
15-19	340	497	623	960	979	931	900	946	911	961
20-24	399	473	412	459	457	478	486	512	502	546
25-29	368	338	225	230	222	368	292	336	276	304
30-34	321	162	71	104	100	221	147	174	127	129
35-39	240	68	15	26	26	40	21	17	12	3
40-44	143	26	3	3	3	0	0	0	0	0
45-49	38	5	0	0	0	0	0	0	0	0
Percent of women currently married										
15-19	15.10	8.24	4.12	1.94	0.43	0.01	0.08	0.08	0.23	0.23
20-24	73.43	51.92	34.58	14.84	13.30	12.22	11.08	7.21		
25-29	94.42	86.35	75.33	46.11	42.80	39.11	39.49	32.14	37.08	26.93
30-34	93.77	92.23	88.07	71.21	69.54	67.60	66.99	62.24	65.10	58.17
35-39	90.22	92.25	90.59	78.04	77.07	75.86	74.77	71.03	72.96	67.19
40-44	83.76	90.38	90.80	79.16	78.61	77.85	75.93	72.25	73.74	67.59
45-49	74.85	86.44	89.41	78.94	78.82	78.53	76.15	72.95	73.97	68.33

Sources:

(1) Statistics for 1951-2003 was adopted from the Ministry of the Interior, R. O. C., *2003 Taiwan-Fukien Demographic Fact Book*.

(2) Statistics for 2013-2003 projected by the authors.

implies that the number of surviving children at 20 years old decreased from 6.9 children to 4.9 children. If we assume that in this period the desired family size was four, which is similar to the result of a 1965 fertility survey (Freedman *et al*. 1994), then the number of surviving children substantially exceeded the desired family size in most of this phase. In response to the pressure of an increasing number of unwanted children, married women of higher socio-economic status started to limit their family size in the late 1950s. Soon the government launched a nationwide family planning program in 1964, with an emphasis on older women who had already reached their desired family size. As a result, there was a drastic decrease in fertility for women aged 30 and above (see Table 1).

Concurrently, the government had promoted labor-intensive industry to siphon the agricultural surplus working force of unmarried young men and women from rural to urban areas. In the period 1951-69, the female workforce employed in non-agricultural sectors increased from 26% to 61% (see Table 1). The successful transition is attributable to many factors, but the government policies promoting development of education and human resources were the most instrumental ones. More specifically, in this period the government on one hand expanded universal six-year primary education to nine years in 1968, and on the other hand emphasized on vocational education and skill training in order to provide an adequate workforce for the primary stage of industrialization (Liu 1992). Under the influences of social development, both PTFR and desired number of children (DSC) started to decline, and the gap between excess fertility and the desired family size of four had been narrowed down.

(2) The Modern Stage (1969-1983).

As the agricultural surplus labor was becoming exhausted in the late

1960s, married women who had completed childbearing started to re-enter the labor market and brought more and more women to non-agricultural sectors. In general, women were at first mostly relegated to static jobs with scant earnings in labor-intensive industries. When the government upgraded the industries to become capital-intensive in the early 1980s, women employed in white collar jobs increased from 14% in 1969 to 26% in 1983. At the same time the proportion of higher education for the population aged 15 and over had also increased from 5% to 11% (Table 1). In the process, Taiwan was transformed from a developing society into an industrialized urban society. By 1983 women employed in non-agriculture increased to 84% of total employed women and the population living in urban areas increased to 70%. The per capita annual income increased eightfold, from NT$ 12,800 to 103,100 (equivalent to US$ 320-2,570).

In response to this rapid progression, the average age at first marriage for women steadily increased to 25 years, and the desired family size fell to 2.8 children by 1983 (see Table 1). On the other hand, the total fertility rate declined rapidly and met the prevailing desired family size for a brief period around the early 1970s. In this period fertility decline was mainly the contribution of women aged 20-30. Although fertility of the youngest cohort, aged 15-19, increased substantially, its proportion of being married was negligible and had a limited effect on PTFR (see Table 2).

(3) The post-transitional stage (1984-2003)

During the period 1984-2003, there was a drastic change in per capita annual income and fertility. At first, income continued to increase from NT $ 103,100 in 1984 to NT$ 399,000 in 2000. It then dipped to NT$ 387,000 in 2001 and slowly recovered to NT$ 402,000 in 2003. After the completion of the fertility transition in 1983, the total fertility rate virtually

Table 2. Indicators of Social and Economic Development at Fertility Transition Turning Point and Projected Years : Taiwan, 1951-2033

Variables		Observed				2033 Projections [9]		
		1951	1969	1983	2003	High	Medium	Low
Per Capita Income NT$ (1000)	Y	1.41	12.80	103.09	403.06	797.32	740.89	688.33
Economic (GDP) Growth rate, at 2001Constant NT$ [1]	EGR	12.0	9.0	8.5	3.3	2.3	2.1	1.8
Percent of labor force employed in nonagricultural sector [2]	PNEA	25.7	60.7	84.0	92.7	96.0	97.0	98.0
Percentage of White Collar [2]	PWC	8.7	14.4	25.9	48.7	52.0	51.0	50.0
Urbanization Rate [3]	URB	25.9	53.9	69.5	78.3	82.0	81.0	80.0
Percent of Higher Education [4]	HEDU	1.9	5.4	10.5	29.5	33.0	34.0	35.0
Enrollment age 15-19 [4]	ENR15	2.3	21.3	43.5	89.2	92.0	91.0	90.0
Enrollment age 20-24 [4]	ENR20	0.1	3.7	4.3	27.3	40.0	39.0	38.0
Bride Average Age at First Marriage [5]	FMA	19.8	22.1	24.6	27.2	29.0	29.5	30.0
Desired number of children of women [6]	IDC	4.1	3.5	2.8	2.2	2.0	1.8	1.5
Family Planning Current User Rate [7]	FPL	1.4	40.5	73.7	71.0	78.0	76.5	75.0
Childcare by self [6]	CCARE	98.1	88.2	79.6	68.8	50.0	47.5	45.0
Infant Mortality Rate [5]	IMR	40.4	19.5	8.3	5.3	3.7	3.4	3.2
Life expectancy at birth, male [8]	em	53.1	65.1	69.9	73.4	76.4	78.7	80.2
Life expectancy at birth, female [8]	ef	57.3	70.8	75.1	79.3	83.0	85.5	87.2

Sources: Statistics for 1951-2003 were adapted from:

(1) Directorate-General of Budget, Accounting and Statistics, R. O. C., *National Income of the Republic of China, Taiwan Area, 2004*.

(2) Directorate-General of Budget, Accounting and Statistics, R. O. C., *Yearbook of Manpower Survey Statistics, 2004.*

(3) Council for Economic Planning and Development, R. O. C., *Urban and Regional Development Statistics*, *2004.*

(4) Ministry of Education R. O. C., *Educational Statistics of the Republic, 2004*.

(5) The Ministry of the Interior, R. O. C., *Taiwan-Fukien Demographic Fact Book*.

(6) Directorate-General of Budget, Accounting and Statistics, R. O. C., *2004 Report on Women's Marriage, Fertility and Employment, Taiwan Area*, for various survey years; for non survey years data were interpolated.

(7) The Institute of Family Planning KAP surveys for various survey years; for non survey years data were interpolated.

(8) The Ministry of the Interior, R. O. C., *Abridged Life Tables of Taiwan-Fuchien Area, 2004*.

(9) *Projected by the authors*.

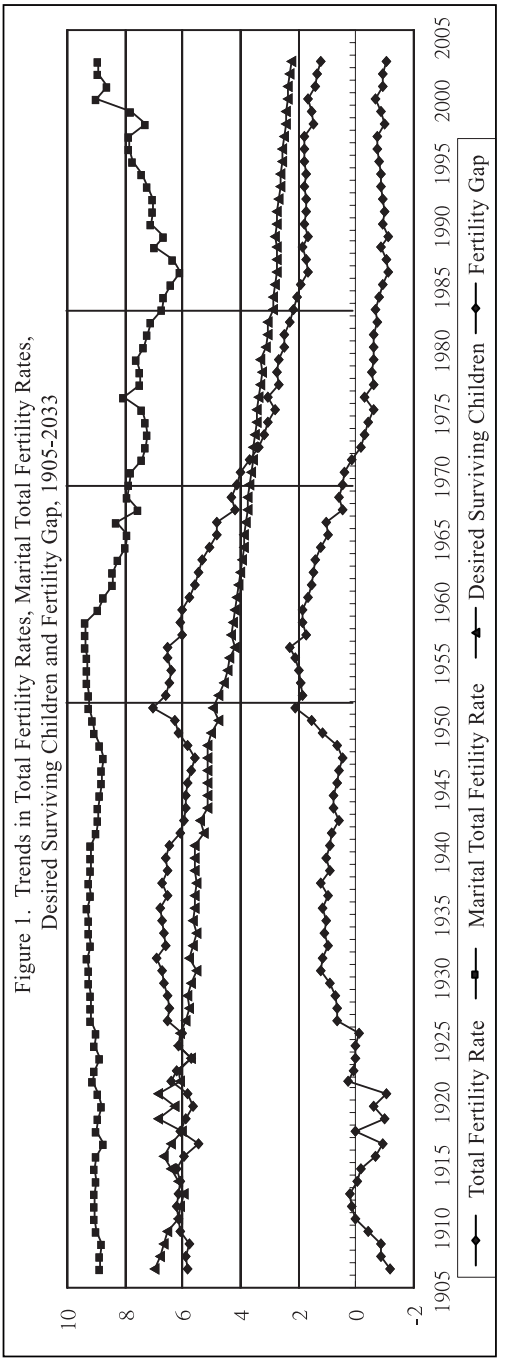
stabilized at about 1.8 births in the period 1983-1997 (see Figure 1). Thereafter it fell with fluctuations to the lowest-low fertility of around 1.3 births during the period 1998-2003. Meanwhile the desired surviving family size decreased steadily from 2.85 in 1983 to 2.26 in 2003. Therefore, the fertility deficit gap tended to close up gradually. Taiwan's below-replacement fertility, like all nations that completed fertility transition, was largely attributable to ongoing shifts in the timing of childbearing. The rise in timing of childbearing mainly resulted from the rise in average age at first marriage of women from 24.6 years old in 1983 to 27.2 in 2003 (see Table 1).

The above brief review of the fertility transition and its socio-economic background suggests that mortality decline is the prerequisite factor behind the onset of fertility decline. Industrialization, urbanization, female education, and non-agricultural employment are the factors which played a crucial role in subsequent stages of fertility transition in Taiwan. The developments of these factors are closely interwoven and have profound impacts on the demographic choices. Urbanization leads to a radical change in lifestyle. Extension of education years involves changes in age at first marriage, childbearing timing, and number of births. Female employment induces prolonged single-hood, needs for childcare services, and changes in family arrangement and management.

Ⅲ. The Estimation of $ASFR_i$

The above discussion shows that fertility change is related to social development factors. The relationship is specified in the following equations.

Figure 1. Trends in Total Fertility Rates, Marital Total Fertility Rates, Desired Surviving Children and Fertility Gap, 1905-2033



$$ASFR_i = \alpha_0 + \alpha_1 MAR_i + \alpha_2 ASMFR_i + \alpha_3 D1PNEA + \alpha_4 D2PNEA + \varepsilon \quad \text{---- (1)}$$

$$MAR_i = \beta_0 + \beta_1 HEDU + \beta_2 FMA + \beta_3 WLPR + \varepsilon \quad \text{---- (2)}$$

$$ASMFR_i = \gamma_0 + \gamma_1 IDC + \gamma_2 FPL + \gamma_3 CCARE + \gamma_4 WLPR_i + \gamma_5 IMR + \gamma_6 Y + \varepsilon \quad \text{----(3)}$$

$$WLPR_i = \delta_0 + \delta_1 ENR_j + \delta_2 EGR + \delta_3 PWC + \delta_4 URB + \varepsilon \quad \text{----(4)}$$

$_i$ = 15-19, 20-24…45-49; $_j$=15-19, 20-24.

Here we assume that $ASFR_i$ is affected by the proportion of currently married women (MAR_i), age-specific marital fertility (ASMFR), and percent of labor force employed in non-agricultural sectors (PNEA). PNEA is further broken down into two dummy variables. D1PNEA indicates a dummy variable for the period 1951-1970; and D2PNEA, for the period 1971-1985. The reference period is 1986-2033.

The second equation shows that percent married (MAR) is explainable by percent of higher (college and above) education (HEDU), bride's average at first marriage (FMA) and women's labor force participation rate (WLPR). In the third equation, seven instrumental variables are used, including desired number of children for women aged 15 and above (IDC), percent of current family planning users (FPL), children cared for by self (CCARE), women's labor participation rate for the age group 15-19 ($WLPR_{15}$) and the age group 20-24 ($WLPR_{20}$), infant mortality rate (IMR), and per capita annual income in NT$ (Y). Finally, we use six instrumental variables to explain women's labor participation, including enrollment percent for the age group 15-19 (ENR_{15}) and age group 20-24 (ENR_{20}), economic growth rate (EGR), percent of white collar (PWC), and urbanization rate (URB). In total, there are 13 instrumental variables used to estimate $ASFR_i$. Among them, only CCARE is dichotomized. Code 1 is assigned to women who care for their children by themselves; otherwise, code 0. The remaining 13 variables are integers.

As our study period was from 1951 to 2003, 52 annual observations

were used for the estimation of $ASFR_i$ with a system which consisted of four stochastic equations. The system was estimated by the 3 stage least squares (3SLS) method with a second-order autocorrelation corrections model. The estimated regression coefficients are presented in Table 3.

Table 3 shows that the estimated coefficients of the four behavioral equations are satisfactory, with the exception of women aged 15-20 and 45-49. In particular, the unexpected positive signs for the coefficients of percent of labor force employed in non-agricultural sector for all age groups under 30 needs further intensive studies. Most of the estimated standard errors are small enough to give a value of t statistically significant at the 0.01 level. Some of the Durbin Watson coefficients are typically low, implying that there is no auto-correlation problem. With the exceptions mentioned above, most of the signs of the individual regression coefficients are consistent with *a priori* expectations.

Table 3 also shows that among the 13 instrumental variables, desired number of children is the most important one. The coefficient is much greater than the coefficients of other variables. It is also noted that the three age groups, 15-19, 20-24, and 40-44, have a negative coefficient, implying that there is a drastic decrease in ideal family size among younger cohorts and a smaller degree of decrease among the cohort aged 40-44. In addition, we also note that the proportion of being married (MAR_i) is the most important variable for the estimation of $ASFR_i$. Six out of seven MAR_i coefficients are positive and significant at the 0.01 level. The results indicate that a decline in marriages may be a critical issue in the future.

With the regression coefficients shown in Table 3 and the expected target set for 13 instrumental variables by the year 2033 (see Table 1), we are able to compute the projected $ASFR_i$ for the period 2004-2033. The medium projection for all 13 instrumental variables in the period 2004-2033

Table 3. Regression Coefficients Estimates for Simultaneous System of Fertility Behavior: Taiwan, 1951-2003

Variable	15-19	20-24	25-29	30-34	35-39	40-44	45-49
ASFR							
Constant	4.140	-130.043 ***	-199.133 ***	-107.824 ***	-49.597 ***	-3.724	-3.861
MAR	3.198 ***	3.743 ***	2.347 ***	1.429 ***	0.571 ***	0.047	0.045
MASF	0.006	0.333 ***	0.845 ***	0.736 ***	0.933 ***	0.856 ***	0.841 ***
D1PNEA	0.051	0.244 ***	0.141 ***	-0.029	-0.069 **	-0.006	-0.004
D2PNEA	0.087 ***	0.175 ***	0.019	-0.114 **	-0.061 ***	-0.006	-0.003
Adj. R^2	0.947	0.988	0.997	0.956	0.998	0.997	0.992
D.W.	0.859	0.498	1.233	0.453	1.178	1.615	1.305
A. C.	0.570	0.751	0.383	0.774	0.411	0.193	0.347
MAR							
Constant	52.851 ***	93.835 ***	124.704 ***	109.016 ***	107.887 ***	110.413 ***	97.856 ***
HEDU	-0.617 ***	-1.377 ***	-1.761 ***	-1.292 ***	-0.998 ***	-0.966 ***	-0.960 ***
FMA	-1.210 ***	-0.349	-1.424 ***	-0.791 ***	-0.962 ***	-1.435 ***	-1.217 ***
WLPR	-0.325 ***	-0.607 ***	0.089	0.271 ***	0.353 ***	0.542 ***	0.735 ***
Adj. R^2	0.912	0.981	0.989	0.953	0.854	0.773	0.829
D.W.	0.337	0.120	0.401	0.233	0.142	0.195	0.180
A. C.	0.831	0.940	0.800	0.884	0.929	0.903	0.910
MASF							
Constant	762.575 ***	1190.781 ***	363.458 ***	-229.472 **	-268.997 ***	-239.919 ***	-104.876 ***
IDC	-109.609	-81.729	188.529 ***	97.725 ***	12.267	-29.927 *	6.872
FPL	3.991 ***	3.519 ***	-0.943 ***	-1.131 ***	-0.680 ***	-0.491 ***	-0.037
CCAR			-7.620 ***	0.189	2.941 **	4.175 ***	1.015 ***
WLPR	-3.739 *	-12.222 ***					
IMR	5.077 *	-3.918 *	0.125	4.817 ***	4.126 ***	1.877 ***	0.090
Y	0.100	-0.230 **	0.103 **	0.396 ***	0.220 ***	0.109 ***	0.046
Adj. R^2	0.865	0.377	0.905	0.940	0.963	0.921	0.839
D.W.	0.236	0.741	0.745	0.403	0.277	0.133	0.098
A. C.	0.882	0.630	0.628	0.799	0.861	0.933	0.951
WLPR							
Constant	17.827 ***	-8.979 ***	-8.873 ***	-10.886 ***	-16.307 ***	-19.748 ***	-19.896 ***
ENR	-0.855 ***	-0.584 ***					
EGR	0.187 ***	0.060	0.256 ***	0.148	0.228 **	0.162	0.057
PWC			1.055 ***	0.752 ***	0.487 ***	0.311 ***	0.160 ***
URB	0.808 ***	1.017 ***	0.373 ***	0.499 ***	0.711 ***	0.834 ***	0.838 ***
Adj. R^2	0.966	0.942	0.981	0.969	0.966	0.963	0.963
D.W.	0.268	0.131	0.263	0.205	0.217	0.154	0.157
A. C.	0.866	0.935	0.868	0.898	0.892	0.923	0.921

Note:
* Significant at 10 percent level.
* * Significant at 5 percent level.
*** Significant at 1 percent level.
D1PNEA=D1 * PNEA where D1=1 (0 otherwise) if percent of labor force employment in non-agricultural sector in period 1951-69.
D2PNEA=D2 * PNEA where D2=1 (0 otherwise) if percent of labor force employment in non-agricultural sector in period 1970-83.
Knowledge-intensive period 1983-2003 for reference.

was projected on the basis of the extension of time trend for respective variables over the period 1951-2003. The high projection assumes that the government has made appropriate policy efforts to promote higher economic growth and to achieve the targets of other variables set for high projection. The low projection assumes that the government fails to make sufficient policy efforts as usual. It is worth noting that among the projected instrumental variables, economic growth rate plays a crucial role in determining the reversion of current Taiwan's lowest-low fertility in the future. Our projections for the economic growth rates up to 2033 slowly decline from 3.3% in 2003 to 1.8% in 2033, consistent with the range of growth rates in the majority of developed countries in the 2000s.

Figure 2 shows the distribution of high, medium, and low projections of $ASFR_i$. The three levels of projection share a mostly similar pattern for the seven age groups ranging from 15-19 to 45-49. The age groups 40-44 and 45-49 have zero fertility. The three groups 20-24, 25-29, and 30-34 have the highest fertility, and the remaining two age groups, 15-19 and 35-39, are in between.

The three $ASFR_i$ projections, however, vary in fertility level and pattern of change. According to the high projection, the two high fertility groups (25-29 and 30-34) share a consistently increasing trend. The former will increase from 113.5 in 2004 to 256.1 in 2033, and thereafter from 77.4 in 2004 to 207.1 in 2033 (see Figure 2). The medium projection has a trend similar to that of the high projection for the two age groups, but at a moderate pace. The fertility for the age group 25-29 will increase from 111.5 in 2004 to 187.6 in 2033; and that for the age group 30-34, from 75.9 in 2004 to 142.7 in 2033. The low projection, however, has a different pattern of change. The fertility of the age group 25-29 will increase from 109.2 in 2004 to 126.9 in 2033. It then consistently declines to 120.8 in

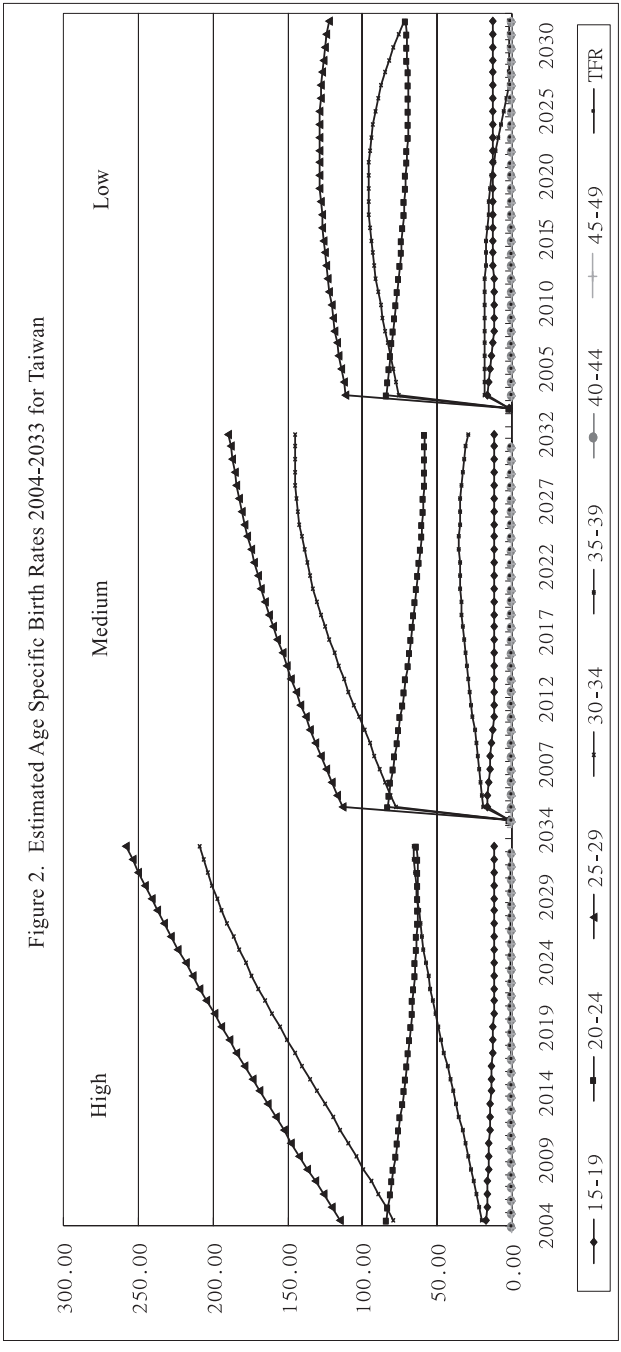


Figure 2. Estimated Age Specific Birth Rates 2004-2033 for Taiwan

2033. Similarly, the fertility of the age group 30-34 will increase from 74.1 in 2004 to 94.3 in 2020 and then decline to 70.2 in 2033.

The fertility pattern for the age group 35-39 varies for the three projection levels. The high projection shows that there will be a steady increase from 18.3 in 2004 to 63.9 in 2033. The medium and low projections will have a slightly different pattern of change. The medium projection shows an increase in fertility from 17.4 in 2004 to 33.4 in 2024 and then a steady decrease to 27.5 in 2033. The low projection will experience a consistent decrease from 16.4 in 2004 to 0.0 beginning in 2028.

The pattern of fertility change for the age group 15-19 is similar for the three projections, but varies in pace. The high projection will have a decline in fertility from 15.3 in 2004 to 9.7 in 2022 and then a steady but small rebound to 9.8 in 2033. The age group's fertility for the medium projection will decline from 14.8 in 2004 to 9.8 in 2012 with a consistent rebound to 10.2 in 2033. The low projection will experience a decline from 14.5 in 2004 to 1.4 in 2009 and then also a consistent minor rebound to 10.9 in 2003.

When we sum up $ASFR_i$, we find that our projected TFR are rather different from CEPD's TFR assumptions. Our low projection will have an increase of TFR from 1.48 in 2006 to 1.56 in 2021 and then a decline to 1.36 in 2033 (see Table 4). On the other hand, our medium and high projections will have a steady increase in TFR. TFR for our medium projections will increase from 1.51 in 2004 to 2.12 in 2033, while our high projection will have an increase of TFR from 1.53 in 2004 to 2.99 in 2033.

Table 4. ASFR Assumptions Made by CEPD

Year	ASFR							TFR
	15-19	20-24	25-29	30-34	35-39	40-44	40-49	
CEPD Replacement Projection (TFR = 2.1 in 2021)								
2004	0.012	0.058	0.117	0.057	0.011	0.001	0	1.257
2011	0.013	0.062	0.157	0.077	0.013	0.002	0	1.591
2021	0.014	0.057	0.223	0.109	0.017	0	0	2.1
2051	0.014	0.057	0.223	0.109	0.017	0	0	2.1
CEPD High-Projection (TFR = 1.8 in 2021)								
2004	0.012	0.057	0.116	0.056	0.011	0.001	0	1.242
2011	0.012	0.057	0.144	0.07	0.012	0.002	0	1.459
2021	0.012	0.049	0.191	0.093	0.015	0	0	1.8
2051	0.012	0.049	0.191	0.093	0.015	0	0	1.8
CEPD Mid-High Projection (TFR = 1.6 in 2021)								
2004	0.012	57	0.115	0.056	0.011	0.001	0	1.231
2011	0.012	0.053	0.135	0.066	0.012	0.001	0	1.371
2021	0.011	0.044	0.17	0.083	0.013	0	0	1.6
2051	0.011	0.044	0.17	0.083	0.013	0	0	1.6
CEPD Mid Projection (TFR = 1.215 in 2021)								
2004	0.011	0.052	0.092	0.069	0.02	0.003	0	1.215
2011	0.011	0.052	0.092	0.069	0.02	0.003	0	1.215
2021	0.011	0.052	0.092	0.069	0.02	0.003	0	1.215
2051	0.011	0.052	0.092	0.069	0.02	0.003	0	1.215
CEPD Mid-Low Projection (TFR = 1.1 in 2021)								
2004	0.011	0.055	0.112	0.054	0.01	0.001	0	1.203
2011	0.01	0.045	0.114	0.056	0.01	0.001	0	1.153
2021	0.007	0.03	0.117	0.057	0.009	0	0	1.1
2051	0.007	0.03	0.117	0.057	0.009	0	0	1.1
CEPD Low Projection (TFR = 0.9 in 2021)								
2004	0.011	0.055	0.111	0.054	0.01	0.001	0	1.192
2011	0.009	0.041	0.105	0.051	0.009	0.001	0	1.065
2021	0.006	0.024	0.096	0.047	0.007	0	0	0.9
2051	0.006	0.024	0.096	0.047	0.007	0	0	0.9
CEPD Trend Projection (TFR = 0.74 in 2021)								
2004	0.011	0.054	0.109	0.053	0.01	0.001	0	1.171
2011	0.008	0.037	0.094	0.046	0.008	0.001	0	0.954
2021	0.005	0.02	0.078	0.038	0.006	0	0	0.74
2051	0.005	0.02	0.078	0.038	0.006	0	0	0.74
Author								
2004 (High)	0.015	0.082	0.113	0.077	0.018	0	0	1.530
2011	0.013	0.074	0.151	0.113	0.031	0	0	1.910
2021	0.010	0.064	0.202	0.163	0.051	0	0	2.450
2033	0.010	0.062	0.256	0.207	0.064	0	0	2.990
2004 (Mid)	0.015	0.082	0.111	0.076	0.017	0	0	1.510
2011	0.010	0.073	0.136	0.100	0.024	0	0	1.720
2021	0.010	0.062	0.166	0.131	0.033	0	0	2.000
2033	0.010	0.056	0.188	0.143	0.027	0	0	2.120
2004 (Low)	0.015	0.082	0.109	0.074	0.016	0	0	1.480
2011	0.010	0.076	0.119	0.086	0.016	0	0	1.540
2021	0.011	0.069	0.127	0.094	0.011	0	0	1.560
2033	0.011	0.069	0.121	0.070	0.000	0	0	1.360

IV. Population Projection

In this study, the registered population by sex and single age at mid-year 2003 is used as the base population. We also assume that there will be no immigration, emigration, war or natural disasters in the future. Numbers of children to be borne are estimated based on the three sets of estimated age-specific fertility rates described in the last section. The number of persons of each age for both sexes surviving to the next higher age a year later is estimated separately by applying survival ratios calculated from the three sets of assumed mortality rates. The corresponding male life expectancies are 76.4, 78.7, and 80.2 for high, medium, and low projections (see Table 1). The counterpart life expectancies for females are 83.0, 85.5, and 87.2.

The results of our projected population are presented in Appendices 1.1, 1.2, and 1.3. Trends of total population, number of birth, and dependency ratio are discussed in reference to CEPD's projection results as follows.

(1) The trend of total population

Our three projections have a rather different result of total population. Our low projection shows that Taiwan's population will reach its peak in 2023 at about 24.0 million (see Table 5). It will gradually decline, thereafter. This result is in between CEPD's medium and medium-high projections. On the other hand, our medium projection has a slightly different result. It will have a peak total population around 24.5 million in 2028 and will decrease slightly by year 2033. This result is slightly greater than CEPD's medium-high projection. Finally, our high projection shares a

Table 5. Total Population for Taiwan, 2003 to 2033, Projected by CEPD and the Authors

Units: 1000 Persons

	2003	2008	2013	2018	2023	2028	2033
Author							
Low- Projection	22535	23179	23635	23900	23987	23871	23540
Medium- Projection	22535	23214	23757	24154	24407	24479	24364
High- Projection	22535	23245	23867	24389	24813	25103	25273
CEPD							
Lowest Low (0.74)	22535	23015	23111	23002	22690	22186	21443
Low (0.9)	22535	23061	23253	23252	23056	22663	22020
Medium Low (1.1)	22535	23092	23363	23474	23424	23169	22652
Medium (1.295)	22535	23111	23441	23650	23688	23508	23076
Medium high (1.6)	22535	23172	23639	24040	24349	24443	24253
High (1.8)	22535	23204	23750	24266	24723	24959	24907
Replacement	22535	23248	23909	24595	25268	25716	25874

Source:

Council for Economic Planning and Development (CEPD), 2006. *Projections of Population of the Taiwan Area, Republic of China,* 2006-2051. Taipei: CEPD, Executive Yuan.

trend of steady increase in total population with CEPD's replacement projection in the period 2003 to 2033. By the year 2033, total population projected by our high assumptions is 25.3 million, which is 0.6 million less than CEPD's replacement estimate.

(2) Number of Births

Changes in numbers of birth are a concern for the government and demographers because they have a profound effect on population composition and labor supply. According to CEPD's lowest-low projection, Taiwan's number of births will experience a drastic steady decline from 226 thousand in 2003 to 79 thousand in the year 2033 (see Table 6). Its low to medium projection shares a steady decline trend, but at a more moderate

Table 6. Number of Taiwan Births 2003-2033, Projected by CEPD and Authors

Units: 1000 Persons

	2003	2008	2013	2018	2023	2028	2033
Author							
Low- Projection	217	251	231	212	196	175	160
Medium- Projection	217	263	253	244	233	217	209
High- Projection	217	274	273	273	272	266	273
CEPD							
Lowest Low (0.74)	226	194	154	125	109	96	79
Low (0.9)	226	210	175	147	133	117	99
Medium Low (1.1)	226	219	194	172	163	144	123
Medium (1.215)	226	226	210	193	178	160	141
Medium high (1.6)	226	245	241	236	237	212	190
High (1.8)	226	257	260	263	267	239	219
Replacement (2.1)	226	272	287	302	311	281	263

Source:

Council for Economic Planning and Development (CEPD), 2006. *Projections of Population of the Taiwan Area, Republic of China,* 2006-2051. Taipei: CEPD, Executive Yuan.

pace. The medium-high projection shows a rebound to 245 thousand in 2008 and thereafter a steady decline to 190 thousand in 2033. Its high and replacement projections show an increase of births until the year 2023.

Our low and medium projections show a trend of steady decline in number of births in the projection period. Our low projection includes 160 thousand births in the year 2033, which is slightly smaller than CEPD's medium-high projection. Meanwhile, the projected number of births for our medium projection is 209 thousand in the year 2033, which is between CEPD's medium-high and high projections. On the other hand, our high projection shows an increase of births from 217 thousand in the year 2003 to 288 thousand in 2008. It fluctuates slightly thereafter. By the year 2033, it will have 273 thousand births, which is 10 thousand greater than CEPD's

replacement projection.

(3) Dependency Ratio

Finally, dependency ratio is used to summarize the differences between the two types of projections in age composition. Table 7 shows that our low and medium projections share a similar pattern of change in dependency ratios with CEPD's projections, with the exception of replacement projection. Young dependency ratio will consistently decline, but old dependency will increase continuously. They, however, differ slightly in size. Young dependency ratios for our low and medium projections will be 18.4 and 22.0 in the year 2033 respectively. Both of them are slightly greater than CEPD's medium-high projection. On the other hand, old dependency ratios for our low and medium projections are 39.3 and 38.5 in the year 2033 respectively. They are slightly less than CEPD's replacement (37.8) projection, and much less than CEPD's high projection (38.6) and medium-high projection (39.2). Obviously, differential dependency ratios reflect different fertility and mortality assumptions.

The change of young dependency ratio for our high projection and CEPD's replacement projection is somewhat different from other projections. They show a decline in young dependency ratio until the year 2013 and a rebound beginning in the year 2018. By 2033, our high projection will have a young dependency ratio of 26.2, which is slightly smaller than CEPD's replacement projection (27.8).

The above discussion on projections of total population, numbers of births, and dependency ratio points out that our low and medium projections are close to CEPD's medium-high projection, but our high projection is close to their replacement projection. As our projections are based on an

Table 7. Dependency Ratios of Taiwan 2003-2033 Projected by the Authors and the Council for Economic Planning and Development (CEPD)

	2003	2008	2013	2018	2023	2028	2033
Author							
Low Projection							
Young	28.0	25.1	22.7	22.5	21.9	21.0	20.0
Old	13.0	14.2	15.1	19.3	25.0	31.4	37.3
Total	41.0	39.3	37.8	41.8	46.8	52.4	57.3
Medium Projection							
Young	28.0	25.2	23.2	23.5	23.6	23.3	22.9
Old	13.0	14.2	15.1	19.3	24.9	31.1	36.8
Total	41.0	39.4	38.3	42.8	48.5	54.5	59.7
Hi Projection							
Young	28.0	25.4	23.8	24.9	25.8	26.2	26.6
Old	13.0	14.2	15.1	19.3	24.8	30.9	36.1
Total	41.0	39.5	38.9	44.2	50.6	57.1	62.7
CEPD							
Trend Projection (0.74)							
Young	27.1	23.3	18.5	15.0	12.8	11.4	10.7
Old	13.2	14.1	15.1	19.7	26.1	34.0	42.0
Total	40.2	37.4	33.6	34.7	38.9	45.4	52.7
Low Projection (0.9)							
Young	27.1	23.6	19.3	16.5	14.7	13.5	12.8
Old	13.2	14.1	15.1	19.7	26.1	33.7	41.3
Total	40.2	37.7	34.5	36.2	40.7	47.2	54.1
Mid-low Projection (1.1)							
Young	27.1	23.8	20.0	17.8	16.7	16.0	15.4
Old	13.2	14.1	15.1	19.7	26.0	33.4	40.7
Total	40.3	37.9	35.1	37.5	42.7	49.4	56.1
Medium Projection (1.215)							
Young	27.1	23.9	20.4	18.8	18.2	17.6	16.9
Old	13.2	14.1	15.1	19.7	26.0	33.3	40.2
Total	40.3	38.0	35.5	38.5	44.2	50.8	57.1
Medium-High Projection (1.6)							
Young	27.1	24.3	21.6	21.1	21.8	22.0	21.7
Old	13.2	14.1	15.1	19.7	25.9	32.8	39.2
Total	40.3	38.4	36.7	40.8	47.6	54.8	60.9
High Projection (1.8)							
Young	27.1	24.5	22.2	22.4	23.8	24.4	24.2
Old	13.2	14.1	15.1	19.7	25.8	32.6	38.6
Total	40.3	38.6	37.3	42.1	49.6	57.0	62.8
Replacement Projection (2.1)							
Young	27.2	24.7	23.1	24.3	26.7	27.9	27.8
Old	13.2	14.1	15.1	19.7	25.8	32.3	37.8
Total	40.4	38.8	38.2	44.0	52.5	60.2	65.6

Source:

Council for Economic Planning and Development (CEPD), 2006. *Projections of Population of the Taiwan Area, Republic of China,* 2006-2051. Taipei: CEPD, Executive Yuan.

Note:

1. Young - Persons under 15 per 100 persons to persons 15-64 years of age.
2. Old - Persons 65 and over per 100 persons to persons 15-65 years of age.
3. Total - Persons under 15 and 65 and over per 100 persons to persons 15-66 years of age.

estimation of ASFR adjusted by social development, we thus come to the following suggestions. If Taiwan's social development is maintained at a high level in the next 30 years, our lowest-low fertility will probably be reversed to a level approaching replacement. Even if our social development remains at a low or medium level, our fertility will probably rebound to 1.6 births per woman.

V. Summary and Discussion

Classic population theory suggests that social economic changes plays a major role in bringing fertility down to the replacement level and assumes that population growth in the long run will be near zero, implying that fertility will on average be close to the replacement level of about 2.1 (Demeny 1997; Caldwell 1982). As the fertility of many societies has dropped below the replacement level, we thus are inclined to believe that social economic factors will continue to have an effect on fertility changes in the post-replacement era. Simultaneous equations are thus used to integrate the effect of social economic factors on ASFR. The thus estimated ASFR is then used to make population projections. The results of our low and medium projections are close to CEPD's medium-high projection, but our high projection is approaching CEPD's replacement level. In other words, if we assume that social development is the underlying mechanism for population changes, different levels of social development bring about differential population changes. If Taiwan's socio-economic development grows at a high rate, its fertility would rebound to the replacement level by 2033. If it follows the medium rate, fertility would rise to 1.6 births per woman. Only if Taiwan's future socio-economic development grows as sluggishly as in the assumed low case would its fertility remain at the

lowest-low level.

In the past, higher family benefits are recommended as a useful approach to raise lowest-low fertility. France and Germany are widely cited as evidence of the impact of policy on fertility. Higher family benefits provided in France have resulted in a fertility level higher than Belgium by about 0.2 children per woman (Gauthier 2001). It has also been argued that the higher fertility observed in East Germany was a series of family policy measures introduced in 1976-77, including an extended maternity leave and a paid childcare leave (Buttner and Lutz 1990).

Yet providing incentives to have children in wedlock is costly and is not affordable for most developing countries. In this study, we find that maintaining current social economic development is also able to reverse lowest-low fertility to near replacement level. This implies that maintaining social economic development is another way for developing societies to solve the lowest-low fertility issue.

Appendex Table 1.1 Population Projections by Sex and Age for Taiwan, 2003-2033

High- Projection Units: 1000 Persons

	2003	2008	2013	2018	2023	2028	2033
				Both Sexes			
0～4	1,326	1,485	1,670	1,790	1,879	1,953	2,058
5～9	1,587	1,324	1,483	1,668	1,789	1,877	1,952
10～14	1,614	1,585	1,322	1,481	1,666	1,787	1,875
15～19	1,658	1,610	1,580	1,318	1,477	1,662	1,783
20～24	1,985	1,651	1,603	1,574	1,313	1,472	1,657
25～29	1,873	1,975	1,643	1,596	1,567	1,308	1,467
30～34	1,829	1,862	1,965	1,635	1,588	1,560	1,302
35～39	1,898	1,815	1,849	1,951	1,624	1,578	1,551
40～44	1,903	1,877	1,796	1,830	1,932	1,609	1,564
45～49	1,720	1,873	1,848	1,769	1,803	1,906	1,589
50～54	1,406	1,680	1,831	1,808	1,733	1,769	1,872
55～59	841	1,358	1,625	1,773	1,753	1,684	1,723
60～64	802	798	1,291	1,548	1,692	1,680	1,619
65～69	668	739	738	1,197	1,440	1,584	1,580
70～74	589	583	648	650	1,060	1,290	1,429
75～79	430	464	464	520	525	873	1,074
80～84	231	283	309	313	354	371	627
85+	132	233	305	359	396	216	243
Total	22,494	23,197	23,971	24,780	25,590	26,179	26,965

Appendex Table 1.1 Population Projections by Sex and Age for Taiwan, 2003-2033

High- Projection Units: 1000 Persons

	2003	2008	2013	2018	2023	2028	2033
				Male			
0～4	692	761	855	917	962	998	1,045
5～9	826	691	759	854	916	961	998
10～14	843	824	690	758	853	915	960
15～19	856	840	821	687	756	850	912
20～24	1,016	850	835	816	684	752	846
25～29	952	1,009	845	829	812	680	748
30～34	926	945	1,001	838	823	806	675
35～39	963	916	935	991	830	816	799
40～44	963	948	902	921	977	819	806
45～49	866	942	928	884	903	959	805
50～54	704	839	913	901	859	879	936
55～59	417	674	803	876	866	828	850
60～64	390	391	632	756	828	821	789
65～69	321	353	355	578	695	765	765
70～74	314	274	303	308	505	613	684
75～79	237	241	213	238	245	409	506
80～84	118	151	156	140	161	170	294
85+	60	108	146	160	152	185	209
Total	11,464	11,755	12,093	12,453	12,825	13,227	13,627

Appendex Table 1.1 Population Projections by Sex and Age for Taiwan, 2003-2033

High- Projection Units: 1000 Persons

	2003	2008	2013	2018	2023	2028	2033
				Female			
0～4	634	725	815	874	917	955	1,013
5～9	762	633	724	814	873	916	954
10～14	772	761	632	723	813	872	915
15～19	803	770	759	631	722	812	871
20～24	969	801	768	758	630	720	810
25～29	921	966	799	767	756	628	719
30～34	903	918	963	796	764	754	627
35～39	935	899	914	960	793	762	752
40～44	940	929	894	909	954	789	758
45～49	854	931	920	886	901	947	784
50～54	702	842	917	908	873	890	936
55～59	424	685	822	897	888	856	873
60～64	413	407	659	792	864	859	830
65～69	347	387	382	619	745	819	815
70～74	276	309	345	342	556	677	745
75～79	193	223	251	282	280	465	567
80～84	113	132	153	172	194	200	334
85+	72	126	159	199	244	31	35
Total	11,030	11,442	11,878	12,327	12,766	12,953	13,337

Appendex Table 1.2 Population Projections by Sex and Age for Taiwan, 2003-2033

Medium- Projection Units: 1000 Persons

	2003	2008	2013	2018	2023	2028	2033
				Both Sexes			
0～4	1,326	1,421	1,501	1,529	1,526	1,500	1,465
5～9	1,587	1,324	1,419	1,499	1,527	1,525	1,499
10～14	1,614	1,585	1,322	1,417	1,497	1,525	1,523
15～19	1,658	1,610	1,580	1,318	1,413	1,493	1,522
20～24	1,985	1,651	1,603	1,574	1,313	1,408	1,488
25～29	1,873	1,975	1,643	1,596	1,567	1,308	1,403
30～34	1,829	1,862	1,965	1,635	1,588	1,560	1,302
35～39	1,898	1,815	1,849	1,951	1,624	1,578	1,551
40～44	1,903	1,877	1,796	1,830	1,932	1,609	1,564
45～49	1,720	1,873	1,848	1,769	1,803	1,906	1,589
50～54	1,406	1,680	1,831	1,808	1,733	1,769	1,872
55～59	841	1,358	1,625	1,773	1,753	1,684	1,723
60～64	802	798	1,291	1,548	1,692	1,680	1,619
65～69	668	739	738	1,197	1,440	1,584	1,580
70～74	589	583	648	650	1,060	1,290	1,429
75～79	430	464	464	520	525	873	1,074
80～84	231	283	309	313	354	371	627
85+	132	233	305	359	396	216	243
Total	22,494	23,132	23,736	24,284	24,743	24,880	25,074

Appendex Table 1.2 Population Projections by Sex and Age for Taiwan, 2003-2033

Medium- Projection Units: 1000 Persons

	2003	2008	2013	2018	2023	2028	2033
				Male			
0～4	692	727	768	783	781	766	744
5～9	826	691	726	767	782	781	766
10～14	843	824	690	725	766	781	780
15～19	856	840	821	687	723	764	779
20～24	1,016	850	835	816	684	719	760
25～29	952	1,009	845	829	812	680	715
30～34	926	945	1,001	838	823	806	675
35～39	963	916	935	991	830	816	799
40～44	963	948	902	921	977	819	806
45～49	866	942	928	884	903	959	805
50～54	704	839	913	901	859	879	936
55～59	417	674	803	876	866	828	850
60～64	390	391	632	756	828	821	789
65～69	321	353	355	578	695	765	765
70～74	314	274	303	308	505	613	684
75～79	237	241	213	238	245	409	506
80～84	118	151	156	140	161	170	294
85+	60	108	146	160	152	185	209
Total	11,464	11,722	11,973	12,199	12,391	12,561	12,662

Appendex Table 1.2 Population Projections by Sex and Age for Taiwan, 2003-2033

Medium- Projection Units: 1000 Persons

	2003	2008	2013	2018	2023	2028	2033
				Female			
0～4	634	693	732	746	745	734	722
5～9	762	633	692	732	745	744	733
10～14	772	761	632	692	731	745	744
15～19	803	770	759	631	690	730	743
20～24	969	801	768	758	630	689	728
25～29	921	966	799	767	756	628	688
30～34	903	918	963	796	764	754	627
35～39	935	899	914	960	793	762	752
40～44	940	929	894	909	954	789	758
45～49	854	931	920	886	901	947	784
50～54	702	842	917	908	873	890	936
55～59	424	685	822	897	888	856	873
60～64	413	407	659	792	864	859	830
65～69	347	387	382	619	745	819	815
70～74	276	309	345	342	556	677	745
75～79	193	223	251	282	280	465	567
80～84	113	132	153	172	194	200	334
85+	72	126	159	199	244	31	35
Total	11,030	11,410	11,763	12,085	12,352	12,318	12,412

Appendex Table 1.3 Population Projections by Sex and Age for Taiwan, 2003-2033

Low- Projection Units: 1000 Persons

	2003	2008	2013	2018	2023	2028	2033
				Both Sexes			
0～4	1,326	1,422	1,506	1,536	1,533	1,510	1,504
5～9	1,587	1,324	1,420	1,504	1,534	1,531	1,509
10～14	1,614	1,585	1,322	1,418	1,503	1,532	1,530
15～19	1,658	1,610	1,580	1,318	1,414	1,499	1,529
20～24	1,985	1,651	1,603	1,574	1,313	1,409	1,494
25～29	1,873	1,975	1,643	1,596	1,567	1,308	1,404
30～34	1,829	1,862	1,965	1,635	1,588	1,560	1,302
35～39	1,898	1,815	1,849	1,951	1,624	1,578	1,551
40～44	1,903	1,877	1,796	1,830	1,932	1,609	1,564
45～49	1,720	1,873	1,848	1,769	1,803	1,906	1,589
50～54	1,406	1,680	1,831	1,808	1,733	1,769	1,872
55～59	841	1,358	1,625	1,773	1,753	1,684	1,723
60～64	802	798	1,291	1,548	1,692	1,680	1,619
65～69	668	739	738	1,197	1,440	1,584	1,580
70～74	589	583	648	650	1,060	1,290	1,429
75～79	430	464	464	520	525	873	1,074
80～84	231	283	309	313	354	371	627
85+	132	233	305	359	396	216	243
Total	22,494	23,133	23,743	24,298	24,763	24,909	25,141

Appendex Table 1.3 Population Projections by Sex and Age for Taiwan, 2003-2033

Low- Projection Units: 1000 Persons

	2003	2008	2013	2018	2023	2028	2033
				Male			
0～4	692	761	855	917	962	998	1,045
5～9	826	691	759	854	916	961	998
10～14	843	824	690	758	853	915	960
15～19	856	840	821	687	756	850	912
20～24	1,016	850	835	816	684	752	846
25～29	952	1,009	845	829	812	680	748
30～34	926	945	1,001	838	823	806	675
35～39	963	916	935	991	830	816	799
40～44	963	948	902	921	977	819	806
45～49	866	942	928	884	903	959	805
50～54	704	839	913	901	859	879	936
55～59	417	674	803	876	866	828	850
60～64	390	391	632	756	828	821	789
65～69	321	353	355	578	695	765	765
70～74	314	274	303	308	505	613	684
75～79	237	241	213	238	245	409	506
80～84	118	151	156	140	161	170	294
85+	60	108	146	160	152	185	209
Total	11,464	11,755	12,093	12,453	12,825	13,227	13,627

Appendex Table 1.3: Population Projections by Sex and Age for Taiwan, 2003-2033

Low- Projection Units: 1000 Persons

	2003	2008	2013	2018	2023	2028	2033
				Female			
0～4	634	661	651	619	571	512	458
5～9	762	633	660	650	618	570	511
10～14	772	761	632	660	650	618	570
15～19	803	770	759	631	658	649	617
20～24	969	801	768	758	630	657	647
25～29	921	966	799	767	756	628	656
30～34	903	918	963	796	764	754	627
35～39	935	899	914	960	793	762	752
40～44	940	929	894	909	954	789	758
45～49	854	931	920	886	901	947	784
50～54	702	842	917	908	873	890	936
55～59	424	685	822	897	888	856	873
60～64	413	407	659	792	864	859	830
65～69	347	387	382	619	745	819	815
70～74	276	309	345	342	556	677	745
75～79	193	223	251	282	280	465	567
80～84	113	132	153	172	194	200	334
85+	72	126	159	199	244	31	35
Total	11,030	11,378	11,650	11,845	11,938	11,683	11,514

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台灣的超低生育率可以透過經濟發展逆轉提升嗎？

陳肇男* 劉克智**

中文摘要

本研究假設社經發展是人口數量改變的潛在機轉。在過去 50 年，台灣經歷了急劇的社經變化和快速的人口變遷。同步方程式因此被引用來整合社經因素探討對年齡別生育率之影響。估計所得的年齡別生育率再用來推計台灣 2004-2033 的人口。本研究的低與中推計結果接近行政院經建會同期間的中高推計，而兩者之高推計結果也接近。質言之，假如台灣社經發展呈快速成長總生育率有可能在 2033 年反彈到替代水準；假如社經發展呈中度成長，總生育率有可能回升到 1.6；假如社經發展持續下挫，總生育率有可能維持在超低水準。

關鍵詞：超低生育率、人口推計、社經發展

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