（1 年後）の状態分布 ${}_5K_x^{1981}$（状態=未婚、既婚×{無子、1 子、2 子、3 子、4 子以上}、x=16-20 歳、21-25 歳、…、41-45 歳、46-49 歳）を推定する。

3. ${}_5K_x^{1981}$ の年齢を 15-19 歳、20-24 歳、…、45-49 歳に組み替え、1981 年の状態分布推定値 ${}_5L_x^{p,1981}$ を得る。

4. ${}_5L_x^{p,1981}$ と年齢別女子人口、初婚件数、出生順位別出生届出数を用い、1981 年の初婚・出生ハザード ${}_1M_x^{1981}$ を計算し、生命表を作成する。

5. 以上の繰り返しにより、1980 年を起点に 2010 年まで状態分布の推定値が得られるが、推定された状態分布は 1990 年、2000 年、2005 年、2010 年のセンサスから得られる状態分布からの誤差を含む。状態分布推定値がセンサスの状態分布に合致するよう年齢別、期間別（1980～1990 年、1991～2000 年、2001～2005 年、2006～2010 年）に補正する（詳細は状態分布の補正方法を参照）。

6. 補正した状態分布推定値 ${}_5L_x^{\alpha,1980}$ による初婚・出生ハザードを用いて生命表を作成する。

各年次の生命表の作成方法

既往出生数を状態とする多相生命表の作成は Palloni(2001)による標準的な手法を用いた。

${}_1d_x^{ij}$ を $(x,x+1)$ 歳区間における状態 i から状態 j への異動（初婚・出生）数、${}^il_{x+1}^j$ を x 歳時の状態が i であった人のうち x+1 歳時の状態が j である人の数、${}_1L_x^{ij}$ を x 歳時の状態が i で x+1 歳時の状態が j である人年、${}_1M_x^{ij}$ を $(x,x+1)$ 歳区間における状態 i から状態 j への観察された異動（初婚・出生）率とし、次のように行列を定義する。

$$\mathbf{l_{x+1}} = \begin{pmatrix} {}^1l_{x+1}^1 & {}^1l_{x+1}^2 & \cdots & {}^1l_{x+1}^k \\ {}^2l_{x+1}^1 & {}^2l_{x+1}^2 & \cdots & {}^2l_{x+1}^k \\ \vdots & \vdots & \ddots & \vdots \\ {}^kl_{x+1}^1 & {}^kl_{x+1}^2 & \cdots & {}^kl_{x+1}^k \end{pmatrix}$$

$$\mathbf{l_x} = \begin{pmatrix} {}^1l_x^1 & 0 & \cdots & 0 \\ 0 & {}^2l_x^2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & {}^kl_x^k \end{pmatrix}$$

$$\mathbf{D_x}=\begin{pmatrix}\sum_{j\ 1}d_x^{1j} & -_1d_x^{12} & \cdots & -_1d_x^{1k}\\ -_1d_x^{21} & \sum_{j\ 1}d_x^{2j} & \cdots & -_1d_x^{2k}\\ \vdots & \vdots & \ddots & \vdots\\ -_1d_x^{k1} & -_1d_x^{k2} & \cdots & \sum_{j\ 1}d_x^{kj}\end{pmatrix}$$

$\mathbf{L_x}$は$\mathbf{l_{x+1}}$と同様、$\mathbf{M_x}$は$\mathbf{D_x}$と同様である。これらの関数には次の(3)～(5)式の関係が成立する。

$$\mathbf{l_{x+1}}=\mathbf{l_x}-\mathbf{D_x} \qquad \cdots(3)$$

$$\mathbf{D_x}=\mathbf{L_xM_x} \qquad \cdots(4)$$

$$\mathbf{L_x}=\tfrac{1}{2}\left(\mathbf{l_x}+\mathbf{l_{x+1}}\right) \qquad \cdots(5)$$

$\mathbf{l_x}$は$(x,x+1)$歳区間の期首の状態分布を表し、(3)式の左辺の$\mathbf{l_{x+1}}=\mathbf{l_x}-\mathbf{D_x}$にある$\mathbf{l_{x+1}}$の列方向の合計(各行の列別合計；期末の状態分布)を対角に配置したものである。そのため、(3)式の左辺の$\mathbf{l_{x+1}}$と右辺の$\mathbf{l_x}$は要素が異なる。観察されたx歳における状態iからjへの異動数$_1D_x^{ij}$と、x歳における状態iの年央人口$_1N_x^i$から、$_1M_x^{ij}=\ _1D_x^{ij}\ /\ _1N_x^i$を求め、これを所与とすると、(3)式から(5)式を用いて(6)式のようにl_{x+1}（x=20,…,49）を求めることができる[1]。

$$\mathbf{l_{x+1}}=\mathbf{l_x}\left[\mathbf{I}-\tfrac{1}{2}\mathbf{M_x}\right]\left[\mathbf{I}+\tfrac{1}{2}\mathbf{M_x}\right]^{-1} \qquad \cdots(6)$$

ここで、Iは単位行列を表す。同様に、(3)式から(5)式を用いると、(7)式の関係が得られる[2]。

$$\mathbf{D_x}=\mathbf{l_x}\left[\mathbf{I}+\tfrac{1}{2}\mathbf{M_x}\right]^{-1} \qquad \cdots(7)$$

そのため、生命表の初婚・出生率は$\mathbf{Q_x}=\left[\mathbf{I}+\tfrac{1}{2}\mathbf{M_x}\right]^{-1}$となる。

本稿で扱う既往出生の状態は、[未婚、既婚×{無子、第1子あり、第2子あり、第3子

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[1] (5)式を(4)式に代入、結果を(3)式に代入して、$\mathbf{l_{x+1}}=\mathbf{l_x}-\tfrac{1}{2}\left(\mathbf{l_x}+\mathbf{l_{x+1}}\right)\mathbf{M_x}$を得る。項を整理すると、$\mathbf{l_{x+1}}\left(\mathbf{I}+\tfrac{1}{2}\mathbf{M_x}\right)=\mathbf{l_x}\left(\mathbf{I}-\tfrac{1}{2}\mathbf{M_x}\right)$、Iは単位行列、$0<{}_1M_x^{ij}<1$なので$\left(\mathbf{I}+\tfrac{1}{2}\mathbf{M_x}\right)$は正則（逆行列が存在）である。

[2] (4)式に(5)式を代入し、$\mathbf{l_{x+1}}$に(3)式を代入すると$\mathbf{D_x}=\mathbf{l_x}-\tfrac{1}{2}\mathbf{D_xM_x}$、$\mathbf{D_x}$について解いたものが(7)である。

あり、第4子以上あり}] であり、便宜的に状態1～状態6と呼ぶことにする[3]。$(x, x+1)$歳の区間で初婚と第1子を出産することと複数回の出生が行われることはないと仮定し、既往出生の状態別異動率（初婚・出生ハザード）を(8)式のように設定し、基数となる$\mathbf{l}_{20}$は(9)式のように設定することで(3)式から(5)式を解いた。

$$\mathbf{M}_{\mathbf{x}} = \begin{pmatrix} {}_1M_x^{12} & -{}_1M_x^{12} & 0 & 0 & 0 & 0 \\ 0 & {}_1M_x^{23} & -{}_1M_x^{23} & 0 & 0 & 0 \\ 0 & 0 & {}_1M_x^{34} & -{}_1M_x^{34} & 0 & 0 \\ 0 & 0 & 0 & {}_1M_x^{45} & -{}_1M_x^{45} & 0 \\ 0 & 0 & 0 & 0 & {}_1M_x^{56} & -{}_1M_x^{56} \\ 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix} \cdots(8)$$

$$\mathbf{l}_{20} = \begin{pmatrix} 1000 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix} \cdots(9)$$

初婚・出生ハザードは年齢5歳階級（の人口が1年間に経験する率）でしか得られないが、多相生命表の作成では1歳（1年）毎の状態間遷移確率が必要である。ここでは、5歳階級の率を用いて、20-24歳の平均的な率で20歳、…、24歳の間は状態間を異動するというように作成した。この場合、21歳から24歳の間の期首状態分布$\mathbf{l}_{\mathbf{x}}$は各歳の状態間遷移確率を用いた場合から乖離が生ずるが、25歳時点ではそれほど深刻ではない。

状態分布の補正方法

状態分布の補正はある期間について、期首センサスの状態分布を基に期末センサス時の状態分布を推定し、推定値と期末センサスによる観察値の誤差二乗和を最小化するという方法を用いる。ここでは1980年から1990年を例に説明する。その他の期間（1990～2000年、2000～2005年、2005～2010年）についても同様である。

以下の記号を用いる。

${}_5L_x^{obs,1980}$、…、${}_5L_x^{obs,2010}$：各年のセンサスによる15-19歳、20-24歳、…、45-49歳の状

[3] 6番目の状態が第4子以上ありなので、第3子ありから第4子以上ありの状態への異動率は、${}_1M_x^{56} = {}_1D_x^{56} / \left({}_1N_x^5 + {}_1N_x^6 \right)$によって求める。ここで、${}_1D_x^{56}$は第4子以上の出生数をあらわす。また、第4子以上ありからほかの状態へは異動しないので（${}_1d_x^{6j} = 0$）、第4子以上ありから第4子以上ありへの異動率は0である（$\sum_j {}_1d_x^{6j} = 0$）。

態分布

${}_1D_x^{ij,1980}$、…、${}_1D_x^{ij,2010}$：各年の 15-19 歳、20-24 歳、…、45-49 歳での初婚件数（i=1, j=2）と出生順位別出生数（i≧2、j≧3）

${}_5N_x^{1980}$、…、${}_5N_x^{2010}$：各年 6 月末現在 15-19 歳、20-24 歳、…、45-49 歳の女子人口

${}_5K_x^{1981}$、…、${}_5K_x^{2010}$：前年の状態分布から推定された 16-20 歳、21-25 歳、…、41-45 歳、46-49 歳の状態分布

${}_5L_x^{p,1981}$、…、${}_5L_x^{p,2010}$：各年について推定された 15-19 歳、20-24 歳、…、45-49 歳の状態分布

まず、単年度の生命表を作成したときに利用した(3)式に対応する(10)式で${}_5K_x^{1981}$を推定する[4]。

$$\mathbf{{}_5K_x^{j,1981}} = (1,\cdots,1)\left(\mathbf{{}_5L_x^{obs,i,1980}} - \mathbf{{}_5L_x^{obs,i,1980}}\ \mathbf{{}_1M_x^{1980}}\right) \qquad (10)$$

ここで状態間遷移確率行列$\mathbf{{}_1M_x^{1980}}$は${}_1D_x^{ij,1980}/\left({}_5L_x^{obs,i,1980}\ {}_5N_x^{1980}\right)$を行列配置したものである。$\alpha_x^{i,1980-90}=0$を初期値として、20-24 歳については(11)式、25-29 歳については(12)式を用いて、${}_5K_x^{1981}$の年齢を組み替えることで${}_5L_x^{p,1981}$を得る。30-34 歳以上についても(12)式と同様である。

$${}_5L_{20-24}^{p,i,1981} = \alpha_{20-24}^{i,1980-90} + \left({}^{i}l_{20}^{i} + 4\ {}_5K_{21-25}^{i,1981}\right)/5 \qquad (11)$$

$${}_5L_{25-29}^{p,i,1981} = \alpha_{25-29}^{i,1980-90} + \left({}_5K_{21-25}^{i,1981} + 4\ {}_5K_{26-30}^{i,1981}\right)/5 \qquad (12)$$

(11)～(12)式の${}_5L_x^{p,1981}$と、1981 年の初婚件数・出生順位別出生数及び女子人口を用いると(13)式の関係から${}_5K_x^{1982}$を計算することができ、同様の繰り返しによって${}_5L_x^{p,1990}$が得られる。

$$\mathbf{{}_5K_x^{j,1982}} = (1,\cdots,1)\left(\mathbf{{}_5L_x^{obs,i,1981}} - \mathbf{{}_5L_x^{obs,i,1981}}\ \mathbf{{}_1M_x^{1981}}\right) \qquad (13)$$

なお、$\mathbf{{}_1M_x^{1981}}$は${}_1D_x^{ij,1981}/\left({}_5L_x^{p,i,1981}\ {}_5N_x^{1981}\right)$を行列配置したものである。このようにして推

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[4] 既婚×3 子以上→既婚×4 子以上については、
${}_5K_x^{6,1981} = {}_1D_x^{ij,1980}/\left({}_5L_x^{ibs,5,1980} + {}_5L_x^{ibs,6,1980}\right){}_5N_x^{1980}$ を用いる。

定された ${}_5L_x^{p,1990}$ が ${}_5L_x^{obs,1990}$ に合致するように $\alpha_x^{i,1980-90}$ を設定する。具体的には(14)式を満たす $\alpha_x^{i,1980-90}$ （x=20-24 歳、･･･、45-49 歳、i=2、･･･、6）を数値解析的に推定した[5]。

$$\log\left({}_5L_x^{p,i,1990}/\left(1-{}_5L_x^{p,i,1990}\right)\right)-\log\left({}_5L_x^{obs,i,1990}/\left(1-{}_5L_x^{obs,i,1990}\right)\right)=0 \ for\ i\geq 2$$
$$\log\left(\left(1-\sum_{i=2}^{6}{}_5L_x^{p,i,1990}\right)/\left(\sum_{i=2}^{6}{}_5L_x^{p,i,1990}\right)\right)-\log\left({}_5L_x^{obs,i,1990}/\left(1-{}_5L_x^{obs,i,1990}\right)\right)=0 \ for\ i=1$$
(14)

すなわち、${}_5L_x^{p,1990}$ は分布関数であるため、[1] ${}_5L_x^{p,1990}\in[0,1]$、[2] $\sum_{i=1}^{6}{}_5L_x^{p,i,1990}=1$ という 2 つの制約を満たさなければならないが、ここでは[1]のために対数オッズ変換を行い、[2]については状態 1 の分布について制約を課した。$\alpha_x^{i,1980-90}$ の推定値が得られると(11)～(12)式から ${}_5L_x^{p,1981}$、･･･、${}_5L_x^{p,1990}$ が得られ、初婚・出生ハザードを ${}_1D_x^{ij,1981}/\left({}_5L_x^{p,i,1981}\,{}_5N_x^{1981}\right)$ 等に設定すれば 1980～1990 年の毎年の生命表が構築される。

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[5] 6 年齢階級×5 状態の解 $\alpha_x^{i,1980-90}$ についての方程式体系は、$\alpha_{20-24}^{i,1980-90}$ が ${}_5L_x^{p}$ の 1981 年から 1990 年までのすべての年齢階級に登場し高次非線形となる。推定は(14)式の 2 乗和を最小化する非線形最小二乗法の枠組みにより、最適化には修正ニュートン法を用いた。なお、${}_5L_x^{obs}$ が 0 の時、対数オッズが定義できないため、ここでは 0 の ${}_5L_x^{obs}$ は $2.2e^{-4}$ で置き換えた。また、修正ニュートン法は非正（ここでは $x\leq 2.2e^{-8}$）の範囲でも求解するが、その場合の対数オッズを
$\log\left(x/(1-x)\right)=\log\left(eps/(1-eps)\right)+\frac{1-eps}{eps}(x-eps)-\frac{1}{2eps^2}(x-eps)^2, eps=2.2e^{-8}$ で置き換える拡張法（extension method）を援用した。

Ⅲ　研究成果の刊行に関する一覧表

研究成果の刊行に関する一覧表

書籍

（なし）

論文

発表者指名	論文タイトル名	発表誌名	巻号	ページ	出版年
鈴木透	日韓の世帯形成パターン	人口問題研究	67(3)	1-12	2011
SUZUKI, Toru	Low Fertility and Governmental Intervention in Japan and Korea	paper presented at international seminar on "Comparative Study on Family Demographic Changes and Family Policies in Eastern Asia"		Kuwansei Gakuin University, Waseda University	1&3 August, 2011
鈴木透	東アジアの低出産・高齢化問題－日本・韓国・台湾の比較	中日韓三国における人口問題と社会発展国際シンポジウム提出論文		中国社会科学院日本研究所	2011 年 9 月 24 日
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Yu-Hua Chen	Trends in Low Fertility and Policy Responses in Taiwan	paper presented at international seminar on "Comparative Study on Family Demographic Changes and Family Policies in Eastern Asia"		Kuwansei Gakuin University, Waseda University	1&3 August, 2011
Gavin Jones	Late marriage and low fertility in Singapore: the limits of policy	paper presented at international seminar on "Comparative Study on Family Demographic Changes and Family Policies in Eastern Asia"		Kuwansei Gakuin University, Waseda University	1&3 August, 2011

Ⅳ　研究成果の刊行物・別刷

Low Fertility and Governmental Intervention in Japan and Korea[1]

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Introduction

When below replacement fertility appeared in Northern/Western Europe in the 1980s, the second demographic transition theory (van de Kaa, 1987) interpreted the trend as an expression of value changes from familism to individualism, together with such changes as increase in cohabitation, extramarital births, divorce, female labor force participation and living alone. In the 1990s, however, the TFR (Total Fertility Rate) dropped to "lowest-low" level of 1.3 or less in Southern/Eastern European countries (Kohler et al., 2002). The emergence of lowest-low fertility drastically changed the correlation between fertility level and family variables. Today, countries with robust marriage institution, traditional gender role and strong familism tend to show lower fertility.

Even when Southern/Eastern European countries experienced historically low fertility level of less than 1.3 in the 1990s, demographers could not imagine that Eastern Asian advanced countries would be the top runners of fertility decline with extremely low fertility of less than 1.2 after the year 2000. While it is regrettable that no demographic theory could predict it, we still need to seek interpretation and explanation of such emergent change.

This paper examines fertility decline and governmental reaction in Japan and the Republic of Korea (simply "Korea" henceforth). Demographic analysis will examine the effects of delayed childbirth, nuptiality decline and other proximate determinants. Effects of desired family size, direct cost of children, economic recession and female labor force participation are also considered. The cultural divide of fertility suggests the effectiveness of cultural deterministic view of fertility. A comparative approach on the family pattern in Northern/Western Europe, Southern/Eastern Europe, Japan and Confucian countries will be attempted.

Low fertility is a very serious problem both in Japan and Korea because it causes

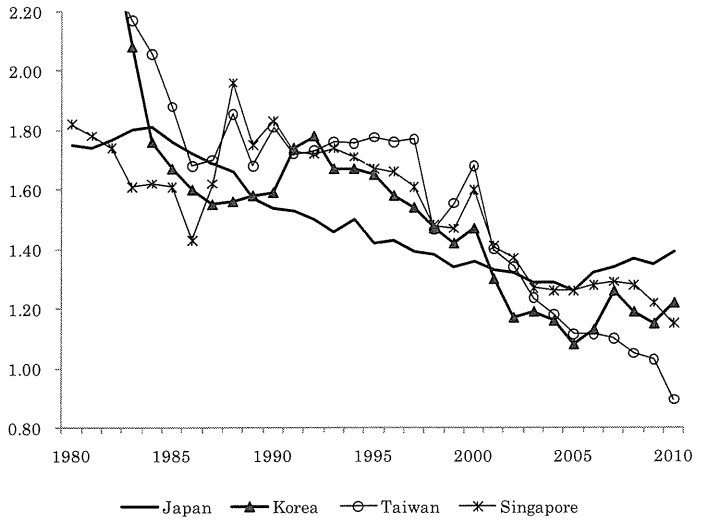
[1] This work was supported by the Scientific Grant of Ministry of Health, Labour and Welfare of Japan.
[2] The views expressed in this paper are those of the author and not those of the National Institute of Population and Social Security Research.

unbearably rapid population aging. The governmental reaction to fertility decline and the development of pronatal policy measures in both countries will be described. Because of the cultural difference and smaller governmental budget than European welfare countries, it will take a long time for Japan and Korea catch up European forerunners in fertility recovery. The problem is more serious in Korea with more distant cultural pattern from Northern/Western Europe and with difficulty to cope with compressed socioeconomic changes as a late comer.

1. Unexpected Fertility Decline in Eastern Asia

Demographers have been failing to anticipate emergent changes in fertility. The prediction of classic demographic transition theory that fertility will fluctuate around the replacement level was rejected by the postwar baby boom and subsequent spread of below replacement fertility. Cyclical change that asserted by Easterlin (1978) was denied when it became apparent that most developed countries cannot regain the replacement level for decades. When Scandinavian countries and German speaking countries led fertility decline into the below replacement level, the second demographic transition theory (van de Kaa, 1987) asserted that the trend is the result of value change toward individualism and secularization. The theory predicted that fertility decline will proceed together with post-modern family changes such as increase in cohabitations, extramarital births and divorces. The prediction failed due to the emergence of lowest-low fertility defined as the TFR of 1.3 or less (Kohler et al., 2002). A paradoxical situation has appeared that fertility is lower in countries with more robust marriage institution, more effective gender segregation and stronger familism.

Figure 1. TFR in Eastern Asia



In the 2000s, lowest-low fertility started spreading in Eastern Asian advanced countries. Figure 1 shows the development of fertility decline in Japan, Korea, Taiwan and Singapore since 1980. Although Korea, Taiwan and Singapore showed lower TFRs than Japan in the late 1980s, these three countries sustained higher level than Japan throughout the 1990s. However, sudden acceleration of fertility decline in three countries after the small millennium baby boom resulted in the lower TFRs than Japan. Korea arrived at the line of 1.3 in 2001, followed by other countries including Japan in 2003. While Japan, as many European countries, escaped from lowest-low fertility after 2005, the TFR of other country stayed at the lowest-low level. The TFR of Singapore, 1.22 in 2009, was considerably higher than Tokyo (1.12) or Seoul (0.96). Low fertility problem in Korea and Taiwan is much more serious because they are at the lowest level in the world if metropolitan area and very small countries are excluded.

Table 1. TFR of Advanced Industrial Countries

Country	TFR	Country	TFR
Israel	2.96	Czech Republic	1.49
Iceland	2.14	Bulgaria	1.48
New Zealand	2.14	Croatia	1.47
Turkey	2.12	Lithuania	1.47
Mexico	2.08	Cyprus (3,4)	1.46
Ireland	2.07	Latvia	1.44
United States	2.04	Malta	1.43
Norway	1.98	Slovak Republic	1.41
France	1.98	Italy	1.41
Chile	1.97	Spain	1.40
Australia	1.97	Poland	1.40
Sweden	1.94	Austria	1.39
United Kingdom	1.94	Germany	1.38
Finland	1.86	Japan	1.37
Denmark	1.84	Romania	1.35
Belgium	1.83	Hungary	1.33
Netherlands	1.79	Portugal	1.32
Canada	1.66	Singapore	1.22
Estonia	1.63	Korea	1.15
Luxembourg	1.59	Taiwan	1.03
Slovenia	1.53		
Greece	1.51		
Switzerland	1.50		

OECD Family Database, downloaded on 4, April, 2011
(http://www.oecd.org/document/4/0,3746,en_2649_34819_37836996_1_1_1_1,00.html)
中華民国行政院主計處 (http://www.dgbas.gov.tw/mp.asp?mp=1)
Statistics Singapore (http://www.singstat.gov.sg)

When McDonald (2005) chose the line of 1.5, the cultural divide of TFR was evident. All Scandinavian countries, French speaking countries and English speaking countries have rarely experienced the TFR lower than 1.5. On the other hand, all German speaking countries, Southern Europe, Eastern Europe, the former Soviet Union and Eastern Asian advanced countries failed to sustain the line of 1.5. Most Southern/Eastern European

countries that suffered from lowest-low fertility of 1.3 or less in the 1990s have escaped from that level. In 2008, Moldova was the only European country still showing the lowest-low level (Goldstein et al., 2009). As shown in Table 1, such countries as Estonia, Slovenia and Greece have already retained the level higher than 1.5 to make the cultural divide ambiguous. To the contrary, Eastern Asian advanced countries other than Japan still remains at the lowest-low level. In the regional level, the former East Germany and Northern Italy have experienced the TFR less than 1.0. However, according to Goldstein et al. (2009), no European country other than Ukraine has experienced the TFR as low as 1.08 in Korea in 2005. The latest TFR of Taiwan (0.895 in 2010) is as low as that was recorded in the former East Germany (0.83 in 1992).

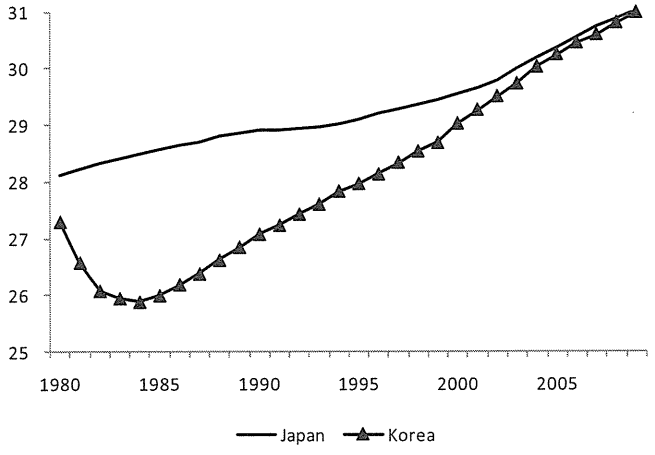
Lesthaeghe (2010) asserted that heterogeneity and historical path dependency do not imply the failure of the second demographic transition theory. However, no demographer including the founder of the theory could expect a drastic fertility decline in advance to other transitions ,such as cohabitation, extramarital births, divorce and living alone. The connection between low fertility and strong familism caused a big problem for demographers (Dalla Zuanna, 2001; Micheli, 2000). The relationship between fertility and the family pattern will be revisited later.

2. Demography of Fertility Decline

2-1. Delay in Childbearing

Most of the advanced industrial countries show the delay in childbearing. As shown in Figure 2, Japan and Korea are not an exception. Korea finished the first fertility transition in the early 1980s and the mean age at childbirth started rising. In Japan, the delay was accelerated after 2000. The delay in Korea was even faster and Korean women have almost caught up Japanese women.

Figure 2. Mean Age of Mother at Childbearing



It is known that the delay in childbirth exaggerates fertility decline shown in the TFR.

Bongaarts and Feeney (1998) formalized how to adjust this "tempo distortion." Their ATFR (Adjusted Total Fertility Rate) is defined by birth order.

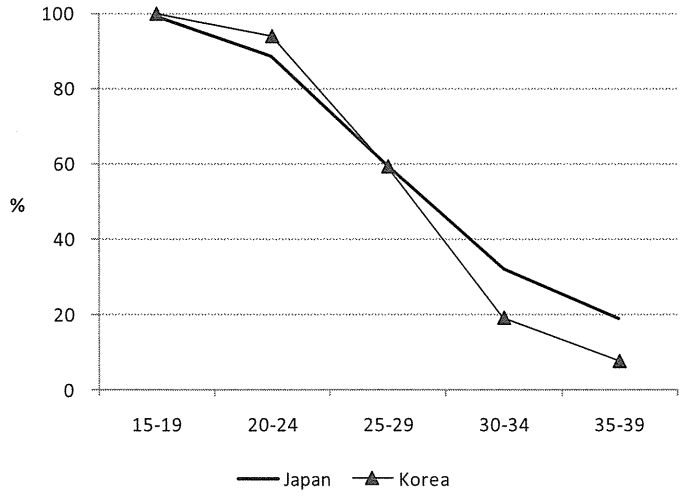
$$ATFR_i = \frac{TFR_i}{1 - r_i}.$$

Here, r_i is the rate of change in the mean age at childbirth by birth order. In Japan, the mean age at all births increased by annual average of 0.16 years in the period of 2000-09. This implies that the TFR of Japan would be higher by 1 / (1 – 0.16) = 19% if there were no delay in childbirths. In Korea, the annual increase was 0.22 years, which implies that the TFR would be 28% higher if the delay stopped immediately. More accurate magnitude of tempo distortion can be obtained from birth order specific calculation. However, it is enough here to point out that there is considerable exaggeration of fertility decline, especially in Korea.

2-2. Marriage

Figure 3 shows the proportion of single women in the 2005 census. While Korean women show lower proportion of single than Japanese women at age 30 and over, they show higher proportion in younger ages especially early 20s. As in the case of fertility before the turn of century, nuptiality in Korea used to be higher than in Japan. However, nuptiality decline in Korea has been so rapid recently that the proportion of single started exceeding Japan in young ages. It is expected that the higher proportion than Japan will extend to older ages as time goes by.

Figure 3. Proportion of Single Women (2005)



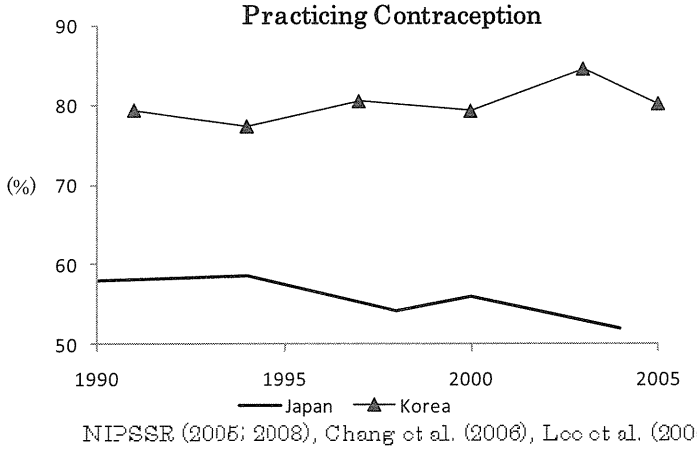
The proportion of extramarital births in 2008 was 2.1% in Japan and 1.8% in Korea. In such countries with practically no extramarital births, a large part of fertility decline can be attributed to nuptiality decline. Although some Japanese and Korean demographers

asserted that nuptiality decline explains whole part of fertility decline using AMFRs (Age-specific Marital Fertility Rates), the method is erroneous (Hirosima, 2001; Kaneko, 2004; Suzuki, 2009a). More sophisticated demographic analyses have shown that between 35% and 75% of fertility decline in Japan can be explained by nuptiality decline (Hirosima, 1999; 2000; Iwasawa, 2002; Ogawa, 2003; Kaneko, 2004; Suzuki, 2005). For Korea, Suzuki (2008) showed that while 31.5% of fertility decline between 2000 and 2005 was explained by nuptiality decline, 68.5% was attributed to the decline in marital fertility.

2-3. Proximate Determinants

Since marriage does not explain fertility decline in its entirety, there should be proximate determinants (Bongaarts, 1978) that caused a significant fall in marital fertility. However, neither contraception nor induced abortion is responsible for it in Japan. As shown in Figure 4, the proportion of currently married women practicing contraception was 52% in 2004 and was lower than in the early 1990s. In Korea, the contraception rate was as high as 79.3% in 2000 and there was a further increase to 84.5% in 2003. While this explains a part of the TFR decline from 1.47 to 1.19 in this period, the decline from 1.19 (2003) to 1.08 (2005) does not match with the trend in contraception.

Figure 4. Proportion of Married Women Practicing Contraception



NIPSSR (2005; 2008), Chang et al. (2006), Lee et al. (2005)

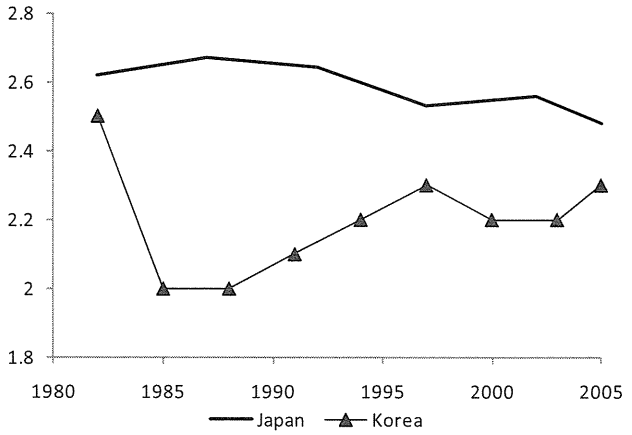
While the trend of induced abortion in Korea is unknown, the ratio of abortions to births in Japan dropped in the early 1990s and sustained a low level under 30%. As expected, the frequency of miscarriages has also been declining. There were 27,005 still births in 2006 in Japan and the ratio to live births was 2.5%. It was significantly lower than the 4.4% of 1990. It is said that many mothers in Japan stop breastfeeding by 1.5 years after giving birth. Thus, neither intrauterine mortality nor postpartum amenorrhea seems to have contributed to the recent fertility decline.

The remaining proximate determinants are frequency of intercourse and sterility.

There is no time series data on coital frequency or infecundity of married couples in Japan. It might be possible to assert that sexless couples are increasing due to the long working hours or strengthened mother-child ties. It might also be possible to hypothesize an increase in infecundity due to the rising age at marriage, environmental hormones, and sexually transmitted diseases (Semba, 2002). However, it is difficult to quantitatively evaluate such hypotheses, due to the lack of necessary data.

2-4. Demands for Children

Figure 5. Ideal Number of Children



National Fertility Surveys in Japan and Korea

An important question on the recent fertility decline is whether it is a result of voluntary choice. The Low Fertility Trap Hypothesis (Lutz et al., 2006) suggested a possibility of positive feedback between attitude and behavior. The mechanism has already started working in German speaking countries where the ideal number of children is extremely low. However, very low fertility in Japan and Korea is not the result of very low demand for children. Figure 5 shows the change in the ideal number of children in two countries. The demand for children in Japan has been declining slowly but still as high as 2.48 in 2005. In Korea, the ideal family size was small in the early 1980s but gradually recovered to 2.3 in 2005. Thus, the recent fertility decline in both countries should be explained not by demand itself but by obstacles to fulfilling the demand.

2-5. Direct Cost of Children

In the world of post-industrialization, globalization and rapid technological development, there is a growing demand for human capital investment. Thus, parents are more interested in quality for their children and educational costs have become higher (Becker, 1991; Willis, 1994). The rising cost of children, including public and private educational costs, is thought to be the main reason of the recent low fertility rate in Eastern

Asia.

Table 2. Expenditure on Education as Percentage of GDP

OECD countries	Public	Private	Total
Iceland	7.0	0.8	7.8
United States	5.0	2.6	7.6
Denmark	6.6	0.5	7.1
Korea	4.2	2.8	7.0
Chile	3.7	2.7	6.4
Sweden	6.1	0.2	6.3
Belgium	5.9	0.2	6.1
Canada	4.6	1.5	6.1
France	5.5	0.4	6.0
New Zealand	4.8	1.2	5.9
United Kingdom	5.2	0.6	5.8
Mexico	4.7	1.1	5.7
Finland	5.5	0.1	5.6
Portugal	5.1	0.5	5.6
Netherlands	4.7	0.8	5.6
Austria	5.1	0.2	5.4
Poland	4.8	0.5	5.3
Australia	3.8	1.4	5.2
Japan	3.3	1.6	4.9
Spain	4.2	0.6	4.8
Germany	4.0	0.7	4.7
Ireland	4.4	0.2	4.7
Czech Republic	4.1	0.5	4.6
Italy	4.1	0.4	4.5
Slovak Republic	3.4	0.5	4.0

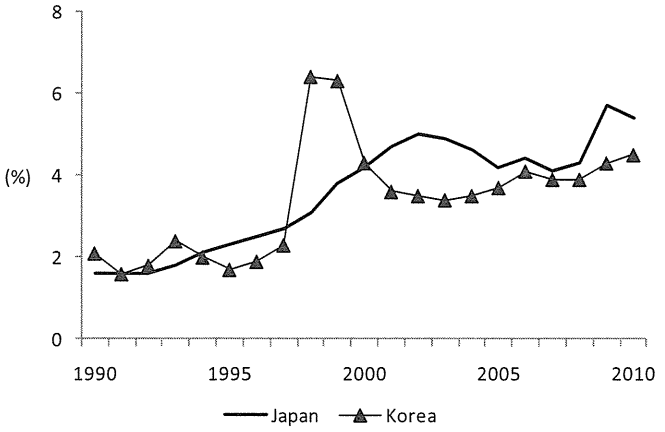
OECD, Education at a Glance 2010.

Table 2 shows the educational expenditure as the percent of GDP by country. While Korea spends the fourth highest amount as the total, it spends highest educational cost from private sources. This implies that Korean parents are forced to spend money so that their child can survive in severe competition in Korean society. While the educational fever in Japan is not as harsh as in Korea, Japanese parents also spend considerable amount of educational cost, only after Korea, Chile and the United States.

2-6. Economic Recession and Labor Market Condition

Young people who grow up in periods of rapid economic growth tend to have high aspirations for their future lives. When the economy slows down, however, labor market conditions for young workers become tight. Those who conceive difficulty in achieving their expected standard of living will hesitate when it comes to marriage and childbearing (Easterlin, 1978). It is known that the relative income of Japanese young men is especially low due to the seniority based employment system (Lutz et al., 2006).

Figure 6. Unemployment Rate of Men aged 30-34

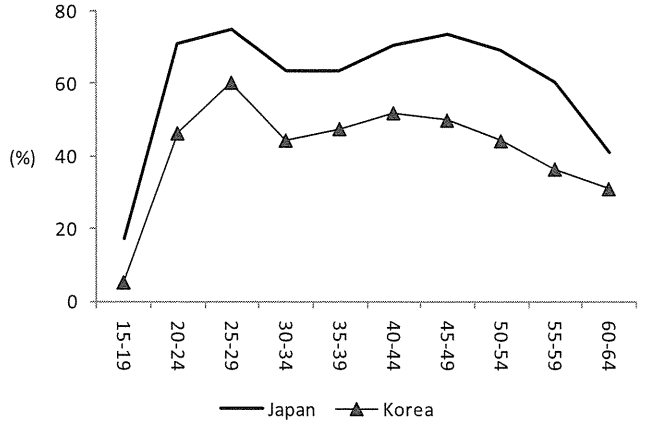


Labor Force Surveys in Japan and Korea

Figure 6 shows the increase in unemployment for Japanese and Korean men aged 30-34. The unemployment rate in Japan rose from 1.6% in 1990 to 5.0% in 2002 due to the bad economic condition. The impact of the financial crisis in Korea in 1998 was disastrous. In both countries, the labor market condition became tighter than the period of rapid economic growth or bubble economy. Such a change induces young people's pessimistic attitude toward the future and lowers nuptiality and fertility.

2-7. Female Labor Force Participation and Gender Roles

Figure 7. Female Labor Force Rate (2005)



2005 Census in Japan and Korea

According to Becker (1991, pp. 350–354), the main cause of family changes since the latter half of the 20th century has been the rising economic power of women. The expanding occupational opportunities for women increased the time spent on market activities and raised the opportunity cost of children. The declining return from the gender-based division of labor reduced the merit of marriage and promoted the rise in the divorce rate. These changes resulted in the increase in female-headed households, cohabitation, and

extramarital births.

Both Japan and Korea have the so-called M-shaped curve of female labor force participation rates as shown in Figure 7. The pattern suggests that women in 30s are difficult to stay at workplace due to the low compatibility between work and the family life. In a society with low compatibility, the increase in female labor force participation depresses fertility through the opportunity cost of childbearing and childrearing.

3. Cultural Deterministic View of Fertility

3-1. Moderately Low Fertility and Western European Family Pattern

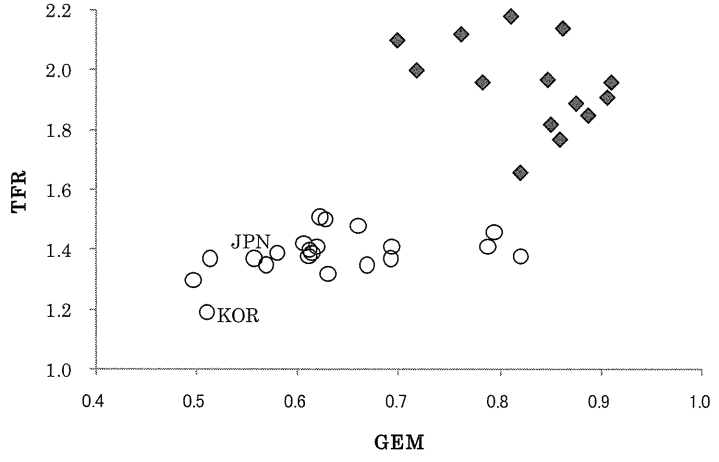
When lowest-low fertility was a phenomenon occurring only in Europe in the 1990s, it was natural to look for features common in lowest-low fertility countries. However, once lowest-low fertility spread out from Europe, the appropriateness of this attempt became questionable. Rather, the phenomenon seems to be a natural response to socioeconomic changes in the postmaterial era. In this respect, those countries that have avoided lowest-low fertility should be seen as exceptional and as requiring explanation. Such countries include Nordic countries, Western European countries except for German speaking countries, and English speaking countries. Since English speaking countries are assumed to have the Anglo-Saxon family pattern as modal model, these countries are called "Northern/Western European countries." Such Northern/Western European family pattern is contrasted to that in "low fertility countries." As McDonald (2005) pointed out, the latter includes German speaking Western European countries, Southern European countries, Eastern European countries, the former Soviet Union members, and Eastern Asian advanced countries.

Reher (1998) asserted that the contrast between weak family ties in Western and Northern Europe and strong family ties in Southern Europe has deep historical roots. In contrast to the Oriental family system that affected Southern Europe, the Occidental structure was based on the conjugal pair, and women had a higher position in the northern part of the continent. The Reformation changed the meaning of marriage from a sacrament to a civil contract, enhanced women's position further, reduced parental authority, and promoted individualism (Reher, 1998, pp. 213–214).

Figure 8 shows the correlation between the Gender Empowerment Measures (GEM) in the UNDP Human Development Report 2007/2008 and the TFR in 2008. The correlation is high (0.726) and the discrimination is very impressive. McDonald (2000, p. 437) stated that fertility falls to very low levels when gender equity rises in individual-oriented institutions but remains low in family-oriented institutions. However, it seems that gender equity in formal sector (GEM) itself is a powerful predictor of fertility. The strong correlation suggests that Northern/Western gender pattern with the deep historical root plays an important role

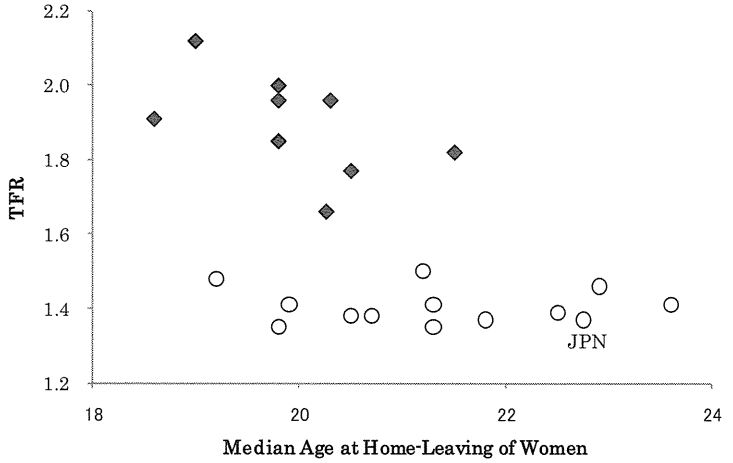
to sustain moderately low fertility in these countries.

Figure 8. Gende Empowerment and Fertility



◆ Northern-Western Europe ○ Low Fertility Countries
UNDP HDI 2007/2007, OECD Family Database

Figure 9. Home-Leaving and Fertility



◆ Northern-Western Europe ○ Low Fertility Countries
Ravanera et al.(1995), Goldscheider and GoldScheider (1994), Billari et al.(2001), Suzuki (2003)

Another prominent feature of Northern/Western Europe and their descendents is early home-leaving. In these countries in the pre-industrial era, young men and women left the parental home before marriage to work as servants (Reher, 1998, p. 204; Wall, 1989, p. 370). The tradition of the majority of men and women leaving home before marriage still remains today (Billari et al., 2001, pp. 18–19). Premarital home-leaving is thought to promote union formation through both consensual union and formal marriage, while Southern European adolescents are suffering from postponement syndrome, which discourages autonomy and weakens their ability to make decisions in their own lives (Livi-Bacci, 2001, p. 148; Dalla Zuanna, 2001, pp. 148-149). Figure 9 shows the correlation between the median