Please do not cite without author's permission

Submitted to the Annual Meeting of the Population Association of America 2019

Extended Abstract

Reassessment of fertility transition in India and its future prospects by some modelling approach

Ajit Kumar Yadav[1] and Priyanka Yadav[2]

[1] International Institute for Population Sciences, Mumbai, India, email id: ajitkumaryadav1989@gmail.com

[2]Centre for the Study of Regional Development, School of Social Sciences, Jawaharlal Nehru University, New Delhi, India email id: priyanka.yadav949@gmail.com

Corresponding author – Ajit Kumar Yadav email id: ajitkumaryadav1989@gmail.com

Introduction

In India, in the last four decades fertility rates has declined rapidly. Some states have shown this positive side but there are some states where the observed Total Fertility Rate(TFR) is above replacement level. With decrease in mortality rate of the developing countries since last eighteenth century the rate of fertility has also declined. Because none of the society can afford to live with a TFR of five or six live births for more than a few decades as it will create depressing effect on the wages. Overall, the total fertility rate of the India dropped from 5.8 births per woman in the 1971s to 2.9 in 2011 (RGI, 1971 & 2013). Societies which have high fertility women generally locked with high pressure and have short lives whereas the case is reverse for the low fertility society. The gap of gender equality is narrow in the society of low fertility such as the developing countries Japan, North America, and Europe. Declines have been most rapid in south India and some central part of India, regions where social and economic development has also been relatively rapid but fertility rate still higher in some Northern states of India. The decline in fertility is opening the door of employment and education for young women. All these factors have led to an increase in the women participation in agricultural sector which in turn have narrowed the differential in the wage rate between male and female. Women is emotionally as well as socially more strong and this led to decline in the traditional belief of son preferences, as a girl child is more supportive to its family and parents than a male child.

Sample Registration System and Demographic and Health Survey (DHS) showing that most of the Indian states above replacement level of fertility rate. The National Population Policy tossed in 2000 takes an average term objective to reach the replacement level fertility by 2010. The main objective of this study is to analyze recent new trends in the fertility transitions and its future prospects in India since 1970 to determine whether these transitions are decelerating and how widespread stalling or near-stalling has become around 2020, new level and trend of fertility in India and to fitting Gompertz model for total fertility rate and projection of total fertility rate for India and States 1971-2011.

Data Source

1. SRS 1971-2011.
2. Census of India 1981-2011.

Methodology

This model used for trends analysis of total fertility rate during 1971 to 2012.Under this model, total fertility rate (TFR) will follow this transformation:

$y = TFR-\alpha/q \quad (0<y<1).$ (1)

Where α is the lower limit for TFR, and q is the difference between the upper and lower asymptotes of TFR. India In our case α=1.8 (lowest TFR) and q= 5.2 (assumed Upper - Lower TFR) as per the expert was decided.

The transformed variable y is assumed to fall with time (t) according to the Gompertz curve:

$Y= -\ln [-\ln (TFR-\alpha/q)$

$T*Y = -\ln [-\ln (TFR-\alpha/q)]*T$ (3)

The Gompertz curve has been plotted against the product of (T* y), where Y is change in TFR and t is the time start 1 base year to onwards years.

Results

Arguments

- A key question - to which we do not yet know the answer - is: how far below 2.1 births per woman will levels of fertility fall?

- Most demographic projections agree that fertility levels will fall below 2.1. For example, Natarajan and Jayachandran assume a lower 'floor' for future fertility of 1.6 births; Mari Bhat (Bhat 2002) has tentatively argued for a figure of 1.7; and the one by L Visaria and P Visaria projections employ a figure of 1.8 .
- Fertility in India has fallen under wide range of socio-economic and cultural settings, viz.

a) The rise in level of education
b) Influence of the media
c) Continuing urbanisation
d) Declining infant and child mortality

All have attributed to the overall fertility decline in India.

- Fertility scenario in India has varied significantly while considering state level fertility transitions and no single explanation can be given to justify the dynamics with in the territory.

Conclusion:

- TFR in India reach in 1.5 in 2034.
- But in rural TFR reach in 1.5 in 2029.
- But in urban TFR reach in 1.5 in 2056.

Figure1.Level, trend and Pattern of TFR for India by Rural, Urban and Total Population

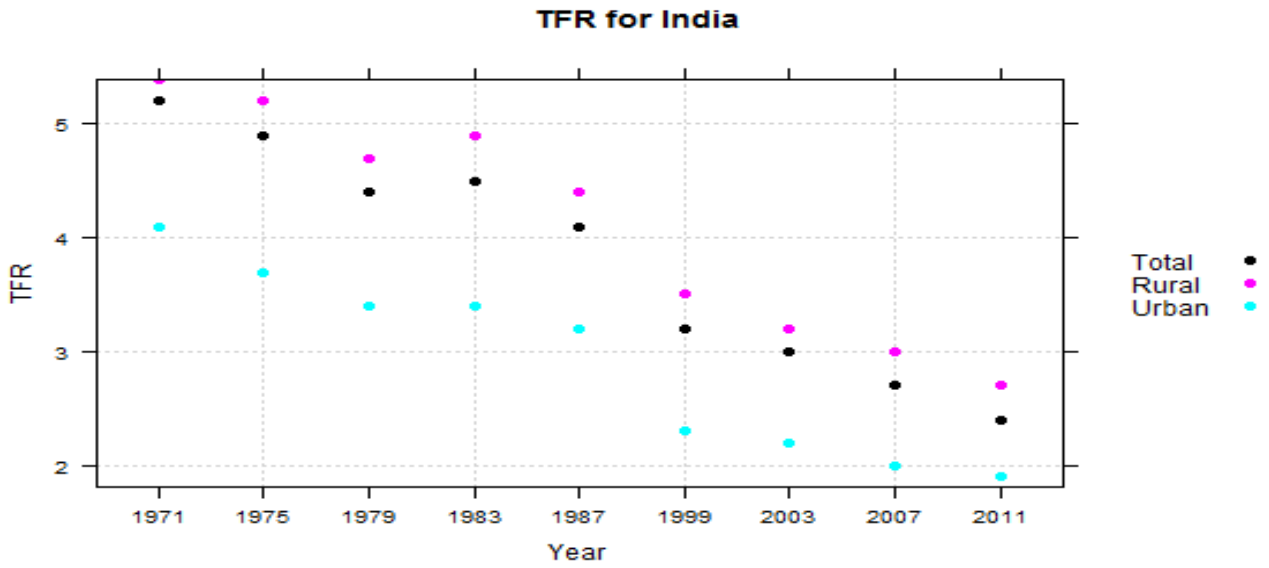


Figure2.Level, trend and Pattern of TFR of India States by Rural, Urban and Total

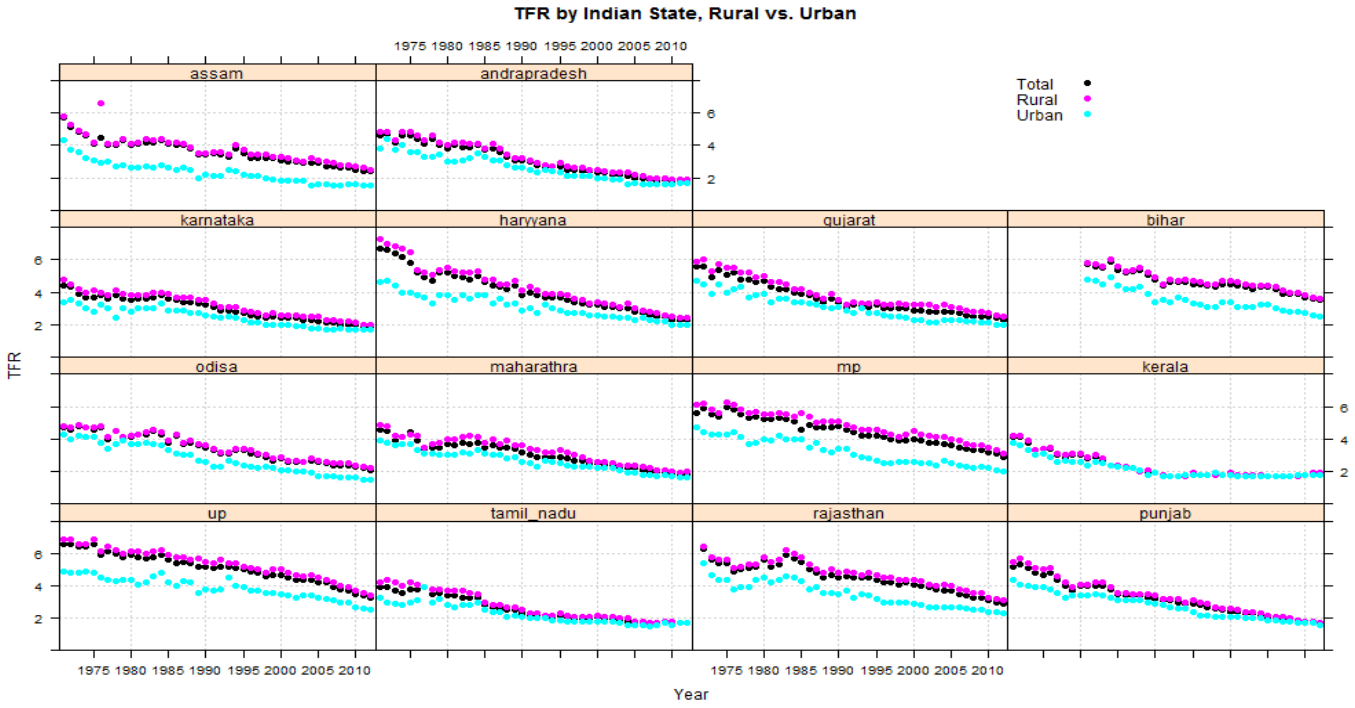


Figure3. Age Pattern of fertility of India

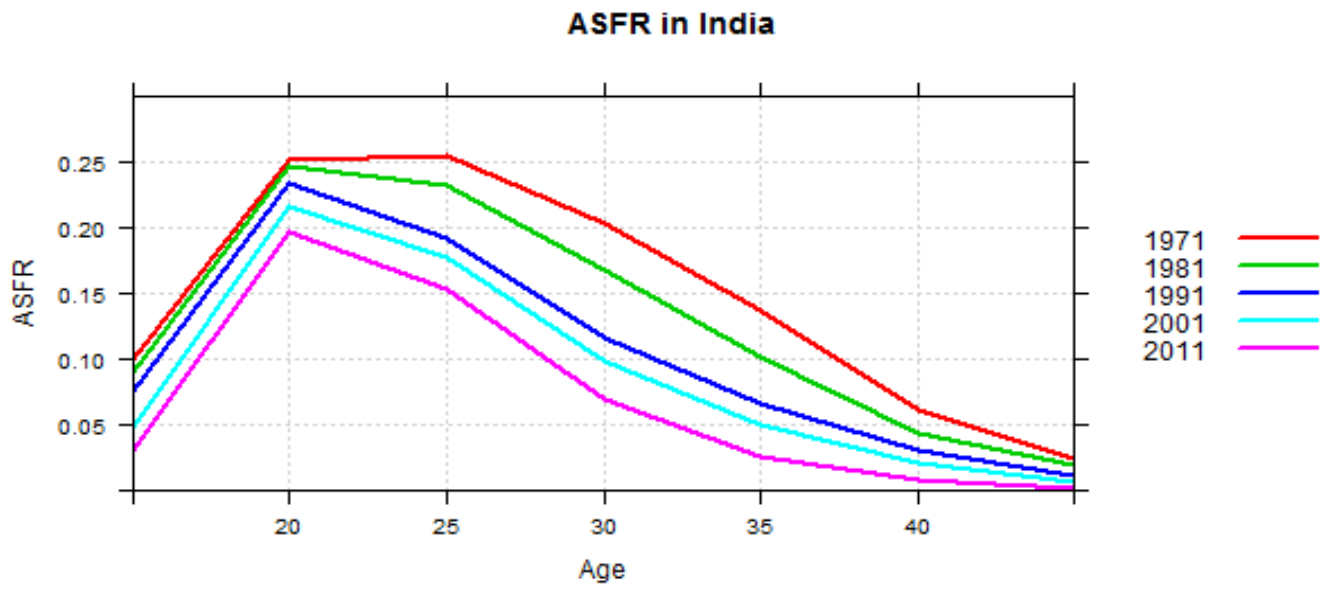
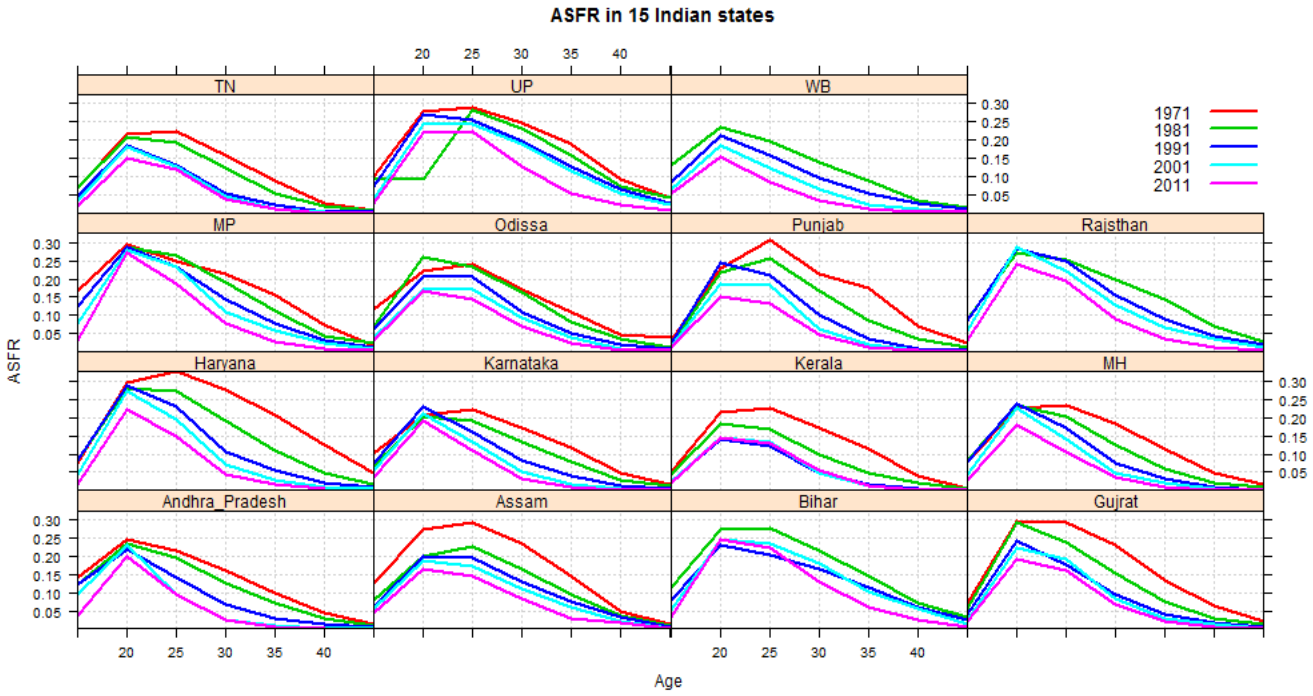


Figure4. Age Pattern of fertility Indian states



Reference:

Brass, W. (1979, October). Evaluation of birth and death registration using age distributions and child survivorship data. In Asian and Pacific census forum(Vol. 5, No. 3, pp. 9-11).

RGI (1971) Sample Registration System Statistical Report 1970 office of RGI & Census Commission of India MOHA Delhi.

RGI (2013) Sample Registration System Statistical Report 2012 office of RGI & Census Commission of India MOHA Delhi.

Guilmoto, C. Z. (2012). Skewed sex ratios at birth and future marriage squeeze in China and India, 2005–2100. Demography, 49(1), 77-100.

Bhat, P. N. M., &Zavier, A. F. (2003). Fertility decline and gender bias. Demography, 40(4), 637-657.

Bhat, P. N. M. (1995). On the quality of birth history data collected in National Family Health Survey 1992-93. Demography India, 24(2), 245-58.

Bongaarts, J. and Guilmoto, C. Z. (2015), How Many More Missing Women? Excess Female Mortality and Prenatal Sex Selection, 1970–2050. Population and Development Review, 41: 241–269

Sekher, T. V. (2012). Ladlis and Lakshmis: financial incentive schemes for the girl child in India,. Economic & Political Weekly, 13, 58-65.

Sekher, T. V. and N. Hatti (2009). Unwanted Daughters: Gender Discrimination in Modern India, Rawat Publications, Jaipur.

Shekhar, Chander & Ram, F. (2003).Declining Juvenile Sex Ratio in India: Theoretical Investigations. Journal of Population Studies, 25, 97-109.

Table 1: Projection of TFR in India for Total Population in India

Time	TIME (T)	T * NEG LOG NEG LOGY	t	y=a+b*t	EXP(y)	EXP[EXP(y)]	1/EXP[EXP(y)]	Projected	t
1971	1	0.883497588	43	1.07	2.907796475	18.31639344	0.054595901	2.0566	2014
1972	2	1.766995175	44	1.14	3.122694074	22.70747292	0.044038366	2.0070	2015
1973	3	2.328024894	45	1.21	3.353473451	28.60190863	0.034962702	1.9643	2016
1974	4	3.104033193	46	1.28	3.601308332	36.64614841	0.027287997	1.9283	2017
1975	5	3.880041491	47	1.35	3.867459185	47.82072797	0.020911434	1.8983	2018
1976	6	4.275608115	48	1.42	4.153279634	63.64238209	0.0157128	1.8739	2019
1977	7	4.577601103	49	1.50	4.460223338	86.50682717	0.011559781	1.8543	2020
1978	8	5.231544118	50	1.57	4.789851389	120.2834919	0.008313693	1.8391	2021
1979	9	5.634329821	51	1.64	5.14384025	171.37262	0.005835238	1.8274	2022
1980	10	6.260366467	52	1.71	5.523990281	250.6331411	0.003989895	1.8188	2023
1981	11	7.193373162	53	1.78	5.932234894	376.9961194	0.002652547	1.8125	2024
1982	12	7.847316177	54	1.85	6.37065039	584.4378181	0.001711046	1.8080	2025
1983	13	8.501259191	55	1.92	6.841466517	935.8605841	0.001068535	1.8050	2026
1984	14	9.155202206	56	1.99	7.347077807	1551.655659	0.000644473	1.8030	2027
1985	15	8.983854363	57	2.07	7.890055761	2670.592831	0.000374449	1.8018	2028
1986	16	9.160060219	58	2.14	8.473161921	4784.620169	0.000209003	1.8010	2029
1987	17	9.293675143	59	2.21	9.099361921	8949.580342	0.000111737	1.8005	2030
1988	18	9.385024098	60	2.28	9.771840564	17533.00817	5.70353E-05	1.8003	2031
1989	19	9.434219487	61	2.35	10.49401802	36098.9127	2.77017E-05	1.8001	2032
1990	20	9.441162541	62	2.42	11.26956724	78399.06191	1.27553E-05	1.8001	2033
1991*	21	8.902864342	63	2.49	12.10243259	180309.9503	5.54601E-06	**1.8000**	**2034**
1992*	22	9.326810263	64	2.56	12.99684998	441021.9715	2.26746E-06	1.8000	2035
1993*	23	9.204195083	65	2.64	13.95736832	1152412.718	8.67745E-07	1.8000	2036
1994*	24	9.604377478	66	2.71	14.98887275	3232843.816	3.09325E-07	1.8000	2037
1995*	25	10.00455987	67	2.78	16.09660941	9787429.43	1.02172E-07	1.8000	2038
1996*	26	9.789701965	68	2.85	17.28621217	32159297.86	3.10952E-08	1.8000	2039
1997*	27	9.681425103	69	2.92	18.56373125	115378807.7	8.6671E-09	1.8000	2040
1998	28	9.537070658	70	2.99	19.93566402	454934505.9	2.19812E-09	1.8000	2041
1999	29	9.464666235	71	3.06	21.40898802	1985205004	5.03726E-10	1.8000	2042
2000	30	9.794891993	72	3.14	22.99119646	9659391209	1.03526E-10	1.8000	2043
2001	31	9.471318598	73	3.21	24.69033633	52829539333	1.89288E-11	1.8000	2044
2002	32	9.116962945	74	3.28	26.51504932	3.27597E+11	3.05253E-12	1.8000	2045
2003	33	8.967416179	75	3.35	28.47461577	2.32471E+12	4.30161E-13	1.8000	2046
2004	34	8.751565836	76	3.42	30.5790019	1.90674E+13	5.24455E-14	1.8000	2047
2005	35	9.008964831	77	3.49	32.83891044	1.82708E+14	5.47321E-15	1.8000	2048
2006	36	8.251578486	78	3.56	35.26583511	2.06899E+15	4.83329E-16	1.8000	2049
2007	37	7.528800929	79	3.63	37.87211906	2.80319E+16	3.56737E-17	1.8000	2050
2008	38	6.918020638	80	3.71	40.67101765	4.60467E+17	2.17171E-18	1.8000	2051
2009	39	7.100073812	81	3.78	43.67676586	9.30204E+18	1.07503E-19	1.8000	2052
2010	40	6.221658448	82	3.85	46.90465068	2.34656E+20	4.26156E-21	1.8000	2053
2011	41	5.248107091	83	3.92	50.37108889	7.51426E+21	1.3308E-22	1.8000	2054
2012	42	5.376109703	84	3.99	54.09371052	3.10885E+23	3.21662E-24	1.8000	2055

Table 2: Projection of TFR in India for Rural Population in India

TIME (T)	TIME (T)	T * NEG LOG NEG LOGY	t	y=a+b*t	EXP(y)	EXP[EXP(y)]	1/EXP[EXP(y)]	Projected	t
1971	1	0.966956832	43	1.26	3.512771055	33.54108333	0.029814183	1.6491	2014
1972	2	1.933913664	44	1.34	3.820309068	45.6183053	0.021921025	**1.6096**	**2015**
1973	3	2.650492763	45	1.42	4.154771588	63.73740447	0.015689374	1.5784	**2016**
1974	4	3.53399035	46	1.51	4.518515816	91.69939814	0.010905197	1.5545	2017
1975	5	4.417487938	47	1.59	4.914105324	136.1974027	0.007342284	1.5367	2018
1976	6	4.859658522	48	1.68	5.34432812	209.4171341	0.004775158	1.5239	2019
1977	7	5.205399628	49	1.76	5.812216298	334.3593449	0.002990794	1.5150	**2020**
1978	8	5.949028147	50	1.84	6.321067407	556.1663315	0.001798023	1.5090	2021
1979	9	6.413412172	51	1.93	6.874467693	967.2603492	0.001033848	1.5052	2022
1980	10	7.126013525	52	2.01	7.476317372	1765.726275	0.000566339	1.5028	2023
1981	11	8.179913702	53	2.10	8.130858118	3397.713953	0.000294316	1.5015	2024
1982	12	9.312099578	54	2.18	8.842702956	6923.681781	0.000144432	1.5007	**2025**
1983	13	10.08810788	55	2.26	9.616868779	15015.95796	6.65958E-05	1.5003	2026
1984	14	10.41079926	56	2.35	10.4588117	34850.11431	2.86943E-05	1.5001	2027
1985	15	10.24132899	57	2.43	11.3744655	87069.8105	1.1485E-05	1.5001	2028
1986	16	10.46308824	58	2.52	12.37028346	235692.5445	4.24282E-06	**1.5000**	**2029**
1987	17	10.64262299	59	2.60	13.45328384	696124.5242	1.43652E-06	1.5000	**2030**
1988	18	10.78062524	60	2.68	14.63109933	2260506.205	4.42379E-07	**1.5000**	**2031**
1989	19	10.87757151	61	2.77	15.91203086	8137803.511	1.22883E-07	1.5000	2032
1990	20	10.93373546	62	2.85	17.30510609	32772689.62	3.05132E-08	1.5000	2033
1991*	21	10.42729522	63	2.93	18.82014304	149102275.3	6.70681E-09	1.5000	2034
1992*	22	10.92383309	64	3.02	20.46781927	774570526.5	1.29104E-09	1.5000	**2035**
1993*	23	10.85733692	65	3.10	22.25974717	4648205994	2.15137E-10	1.5000	2036
1994*	24	11.32939505	66	3.19	24.20855576	32631886601	3.06449E-11	1.5000	2037
1995*	25	12.41344669	67	3.27	26.32797972	2.71704E+11	3.68047E-12	1.5000	2038
1996*	26	11.6449533	68	3.35	28.63295617	2.72355E+12	3.67168E-13	1.5000	2039
1997*	27	11.67920481	69	3.44	31.13972997	3.34051E+13	2.99355E-14	1.5000	2040
1998	28	11.33983635	70	3.52	33.86596817	5.10274E+14	1.95973E-15	1.5000	2041
1999	29	11.63234974	71	3.61	36.83088458	9.89578E+15	1.01053E-16	1.5000	2042
2000	30	12.09449893	72	3.69	40.05537512	2.48787E+17	4.0195E-18	1.5000	2043
2001	31	11.67233696	73	3.77	43.56216514	8.29484E+18	1.20557E-19	1.5000	2044
2002	32	11.35950349	74	3.86	47.37596953	3.75943E+20	2.65998E-21	1.5000	2045
2003	33	11.15027603	75	3.94	51.52366697	2.37927E+22	4.20296E-23	1.5000	2046
2004	34	11.99904265	76	4.03	56.03448931	2.16506E+24	4.61881E-25	1.5000	2047
2005	35	11.52448015	77	4.11	60.9402276	2.92418E+26	3.41976E-27	1.5000	2048
2006	36	10.91850079	78	4.19	66.27545617	6.06827E+28	1.64792E-29	1.5000	2049
2007	37	10.12322022	79	4.28	72.07777626	2.009E+31	4.97759E-32	1.5000	2050
2008	38	9.781161817	80	4.36	78.38808106	1.10538E+34	9.04667E-35	1.5000	2051
2009	39	10.03856081	81	4.45	85.2508439	1.05675E+37	9.463E-38	1.5000	2052
2010	40	9.312973933	82	4.53	92.71443167	1.84232E+40	5.42793E-41	1.5000	2053
2011	41	8.518008515	83	4.61	100.8314457	6.17363E+43	1.61979E-44	1.5000	2054
2012	42	7.646233336	84	4.70	109.6590926	4.21055E+47	2.37499E-48	1.5000	2055

Table 3: Projection of TFR in India for Urban Population in India

TIME	TIME (T)	T * NEG LOG NEG LOGY	t	y=a+b*t	EXP(y)	EXP[EXP(y)]	1/EXP[EXP(y)]	Projected	t
1971	1	0.546686773	43	0.52	1.673977596	5.333339533	0.187499782	2.4375	2014
1972	2	1.197847248	44	0.55	1.732590015	5.655282224	0.176825835	2.3841	2015
1973	3	1.343648458	45	0.58	1.793254682	6.008977985	0.166417651	2.3321	2016
1974	4	1.791531277	46	0.62	1.856043452	6.398371163	0.156289777	2.2814	2017
1975	5	2.239414097	47	0.65	1.9210307	6.827992456	0.146455932	2.2323	2018
1976	6	2.543675526	48	0.69	1.988293402	7.303059737	0.136928909	2.1846	2019
1977	7	2.635688991	49	0.72	2.057911232	7.829598501	0.12772047	2.1386	2020
1978	8	3.012215989	50	0.76	2.12996665	8.41458618	0.118841257	2.0942	2021
1979	9	3.388742988	51	0.79	2.204545007	9.066125603	0.1103007	2.0515	2022
1980	10	3.765269987	52	0.82	2.28173464	9.793654144	0.102106934	2.0105	2023
1981	11	3.88204321	53	0.86	2.36162698	10.60819674	0.094266728	1.9713	2024
1982	12	4.518323984	54	0.89	2.444316659	11.52267299	0.086785419	1.9339	2025
1983	13	4.894850983	55	0.93	2.529901623	12.55227122	0.079666857	1.8983	2026
1984	14	5.602553529	56	0.96	2.618483248	13.71490569	0.072913371	1.8646	2027
1985	15	5.293695286	57	1.00	2.710166457	15.03177745	0.066525732	1.8326	2028
1986	16	4.888422502	58	1.03	2.805059849	16.52806506	0.06050315	1.8025	2029
1987	17	5.597604646	59	1.07	2.903275825	18.23377831	0.054843269	1.7742	2030
1988	18	5.499475315	60	1.10	3.004930722	20.18481769	0.049542186	1.7477	2031
1989	19	4.423662618	61	1.13	3.110144949	22.42429455	0.044594491	1.7230	2032
1990	20	4.656486967	62	1.17	3.219043133	25.00418305	0.039993308	1.7000	2033
1991*	21	4.36288241	63	1.20	3.331754263	27.98739591	0.03573037	1.6787	2034
1992*	22	4.005169843	64	1.24	3.448411844	31.45040448	0.031796093	1.6590	2035
1993*	23	5.354960012	65	1.27	3.569154058	35.48656087	0.028179682	1.6409	2036
1994*	24	4.986151326	66	1.31	3.694123923	40.21032979	0.024869231	1.6243	2037
1995*	25	4.551329367	67	1.34	3.823469465	45.76270532	0.021851855	1.6093	2038
1996*	26	3.328067911	68	1.38	3.957343894	52.31817863	0.019113815	1.5956	2039
1997*	27	3.283068975	69	1.41	4.095905784	60.09374649	0.016640667	1.5832	2040
1998	28	3.504552685	70	1.44	4.239319261	69.36061929	0.014417403	1.5721	2041
1999	29	3.245846193	71	1.48	4.387754197	80.45951972	0.01242861	1.5621	2042
2000	30	3.211226771	72	1.51	4.541386414	93.82078444	0.010658619	1.5533	2043
2001	31	3.073724377	73	1.55	4.700397888	109.9909278	0.009091659	1.5455	2044
2002	32	2.180773516	74	1.58	4.864976967	129.6679519	0.007712006	1.5386	2045
2003	33	2.022403297	75	1.62	5.035318595	153.7485684	0.006504126	1.5325	2046
2004	34	1.218078702	76	1.65	5.211624542	183.3917439	0.005452808	1.5273	2047
2005	35	1.253904546	77	1.69	5.39410364	220.1047656	0.004543291	1.5227	2048
2006	36	0.640789779	78	1.72	5.582972037	265.8605802	0.00376137	1.5188	2049
2007	37	-0.115565144	79	1.75	5.778453445	323.258866	0.003093496	1.5155	2050
2008	38	0	80	1.79	5.980779412	395.7486993	0.002526856	1.5126	2051
2009	39	0	81	1.82	6.190189592	487.9386069	0.002049438	1.5102	2052
2010	40	-1.606840036	82	1.86	6.406932032	606.0315405	0.001650079	1.5083	2053
2011	41	-1.647011037	83	1.89	6.631263461	758.4398245	0.001318496	1.5066	2054
2012	42	-3.654732847	84	1.93	6.863449599	956.6614809	0.001045302	1.5052	2055
								1.5000	2056