Journal of Sustainable Development; Vol. 8, No. 9; 2015
ISSN 1913-9063 E-ISSN 1913-9071
Published by Canadian Center of Science and Education

Trailing and Projecting the Real Population of Bangkok to 2030

Chanon Suwanmontri[1] & Hiroyuki Kawashima[1]

[1] Graduate School of Agricultural and Life Sciences, The University of Tokyo, Tokyo, Japan

Correspondence: Chanon Suwanmontri, Graduate School of Agricultural and Life Sciences, The University of Tokyo, Tokyo, 113-0032 Japan. Tel: 81-3-5841-7534. E-mail: chanonsuwan@yahoo.com

Received: August 29, 2015 Accepted: September 8, 2015 Online Published: November 23, 2015

doi:10.5539/jsd.v8n9p121 URL: http://dx.doi.org/10.5539/jsd.v8n9p121

Abstract

Due to imbalanced supplies of medical and healthcare resources between the capital city and other areas, Bangkok attracts its non-residents to access hospitals in the city only for giving births. This causes overestimation of Bangkok's fertility rate and affects results of population projection. Therefore, this paper aims to project real Bangkok population numbers by age group and sex to 2030 by eliminating the influence of Bangkok-born outsiders. It introduces a new fertility rate calculation based on data from National Statistical Office of Thailand. The results show that in 2010 the total fertility rate of Bangkok was merely 0.8. All components being fixed, the projection displays shifts in population age structure, the age group with highest numbers from 25-34 years old in 2010 to 40-44 years old in 2030. Percent aging population expands from 9.6 to 22.6 percent. Furthermore, proportion of population aged 0-14 shrinks from 12.8 percent to 9.6 percent, which means Bangkok in 2030 is expected to face a seriously low number of young populations in opposite to its large number of elderly.

Keywords: Bangkok, population projection, fertility rate

1. Introduction

Demography holds a key to sustainable development. It studies size, composition and distribution of human population looking into causes and consequences of their changes (McFalls, 2007). Since these occurrences are deeply linked with other issues, e.g. economy, sociological perspective, culture, history, environment, and natural resources; population analysis is inevitably essential for any public administration. Developers of any state certainly demand well-conducted population projections for efficient development planning, even though human population dynamic is to some extent hard to be noticed by publics (Cohen, 2005). Human population can be projected in various scales, e.g. global scale, state scale, and local scales. There have been numerous global-level population projections; the official one is The United Nations Population Divisions' World Population Prospects, with numerous scenarios ranging from high to low. Making use of the prospects, Cohen (1995) synthesized how much capacity the earth could carry human population in broad criteria–energy consumption, food demand, natural resource supply, economic welfare, environmental quality, etc. Besides, The United Nations gives population projection by age group and sex of all countries. Nonetheless, local-scale projections are mostly available at statistics offices of each country.

Population projection, like any other simulation-based studies, relies primarily on existing statistics. Different data collection methods or measurements diverge to different projection results. Forecasting future population of Bangkok, known as the center of Thailand's economy, is indispensable for the country's development; though, there are some inconsistences among the province's population data. Being a noticeable primate capital city (Sternstein, 1984), Bangkok became the medical hub of the country. As reported by the Ministry of Public Health (2010), in 2010 the city held 192 medical institutions and 5420 physicians, which made 0.95 physicians per 1000 people. In the same year, the whole country's physician-population ratio was only 0.34 physicians per 1000 people; even provinces surrounding Bangkok had the ratio of 0.51. These better-off health resources attract residents in provinces around Bangkok to access the capital health care and that includes giving births. Bangkok's fertility rates announced by Ministry of Public Health are questioned being overestimated due to included numbers of births by outsider mothers that affect projection results of future Bangkok population.

Therefore, this paper aims to eliminate the influence of Bangkok-born outsiders and project real population in Bangkok by age and sex to 2030. After reviewing population characteristics and dynamics, statistics regarding

fertility in Bangkok were examined. A new calculation method of Bangkok's fertility rates is then introduced with detailed steps of projection. Consequently, projection results are described and compared with an official one conducted by Office of the National Economic and Social Development Board (NESDB), follow by conclusion.

2. Thailand and Bangkok: A brief review

Thailand, located in Southeast Asia, has been a country with a fast-growing Gross Domestic Products (GDP) almost similarly to those of east Asian countries (Intrakumnerd, Chairatana, & Tangchitpiboon, 2002), despite facing a financial crisis during 1997 and 1998 (Chang, Gunnell, Sterne, Lu, & Cheng, 2009). With export-based economic structure (Phiromswad, 2015) the country turned itself into a middle-income country putting more industrialization (Suebsman, Kelly, Yiengprugsawan, Sleigh, & the Thai Cohort Study Team, 2011). However, Thailand has been developed unevenly (Doner, 2009). Bangkok has become greatly urbanized with fast growing population from 4.69 million in 1980 to 8.30 million in 2030, in only 30 years (National Statistical Office: NSO, 1980a; 2010a). The capital city expanded its population proportion of whole country from 10.5 percent to 14.5 percent (NSO, 1980b; 2010b), which can be observed in Figure 1.

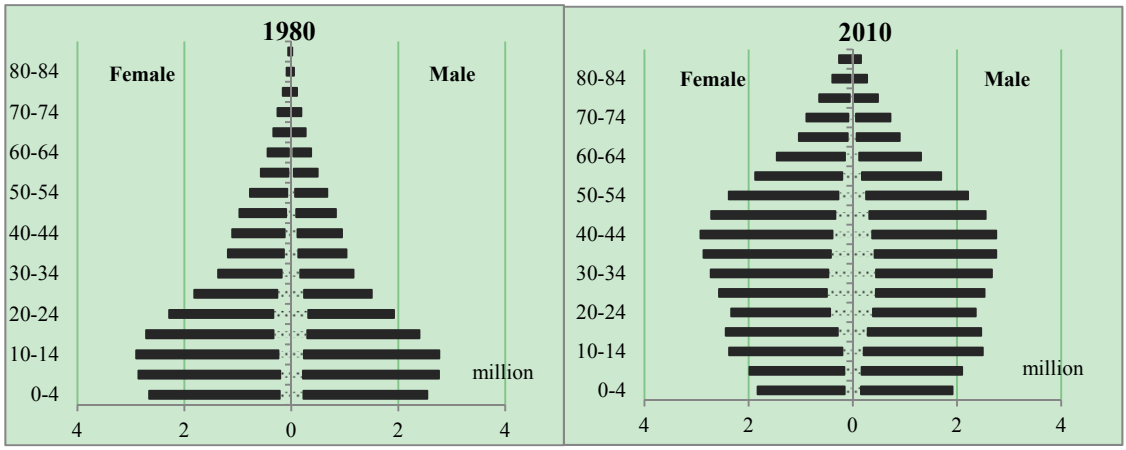

Figure 1. Population pyramids of Bangkok and the whole country in 1980 and 2010

Note. ■ is population of the whole country, ▒ is population of Bangkok

This phenomenal population growth majorly came from two components, namely mortality, and migration. As reported by Ministry of Public Health (2010), life expectancy at birth in Thailand for males and females extended from 63.8 and 68.9 years in 1985, to 70.4 and 77.5 in 2010 respectively. Meanwhile, there have been no significant changes in life expectancy at birth since 2010, so mortality rates in 2010 can be applied in this paper's projection. Bangkok has also been ranked first in both in-migrant numbers and out-migrant numbers over three periods of migration censuses: 1985 to 1990, 1995 to 2000, and 2005 to 2010 (NSO, 1990; 2000; 2010a). Net migration rates (defined as a proportion of net-migration number on total population in a specific area) of Bangkok were 7.75 percent during 1995-1990, and 5.70 percent during 2005-2010. Since number of migrants depend on population in the rest provinces, this paper's projection maintains the migration rates of 2005-2010 period while the migrant number would not be constant due to population sizes in other provinces. Fertility rates are discussed in section 3.

There are a few reports and studies regarding population projection in Thailand. Lexomboon and Punyashingh (2000) applied projection models of World Health Organization –WHO–to predict dentist supplies in Thailand to 2030. Wongboonsin, Guest, and Prachuabmoh (2005) projected Thailand population to 2025 and found that demographic structure in the country gives a demographic dividend increasing economic growth. However, only total population numbers were projected in these two studies. Provincial-level population projection by age and sex are officially provided in Population Projections for Thailand 2010-2040, conducted by NESDB (2013). There were four scenarios of overall fertility for whole country population: increasing, remaining constant, gradually decreasing, and moderately declining. At regional level, the report divided the country into 8 regions: Bangkok (province), vicinity provinces around Bangkok, Northern region, Central region (excluding Bangkok and vicinities), Northeastern region, Western region, Southern region. However, there was only one scenario for

regional projection, expected that fertility would decline approximately 15 percent in all regions, including Bangkok the capital city. Other pieces of research concerning Bangkok population projection by age group and sex are hardly found; this becomes an originality of this paper.

3. Examining Fertility Rates of Bangkok

There are two ways to analyze fertility rates: period fertility, and cohort fertility (Newell, 1988). Although cohort analysis, considering one group of people experiencing the same time (Caselli, Vallin, & Wunsch, 2006), is less common; it is provided in population censuses of each provinces in Thailand decennially. Period fertility focuses on every age group of people in the same specific year (Halli & Rao, 1992); it can be presented in several ways which are used in this paper, e.g. crude birth rate, age-specific fertility rate, and total fertility rate. Crude birth rate refers to number of births per thousand people (Preston, Heuveline, & Guillot, 2001). General fertility rate (GFR), age-specific fertility rate (ASBR), and total fertility rate (TFR) are calculated as follows (Smith, Tayman, & Swansan, 2001): In a specific year,

$$GFR = \frac{B}{F_{15\text{-}49}} \times 1000 \quad (1)$$

; B is total number of live birth

$F_{15\text{-}49}$ is number of females in child-bearing ages, 15-49

$$ASBR_u = \frac{B_u}{F_u} \times 1000 \quad (2)$$

; $ASBR_u$ is age-specific fertility rate of females in age group u

B_u is the number of birth given by females in age group u

F_u is the number of females in age group u

$$TFR = \Sigma ASBR \quad (3)$$

Thailand began a fertility transaction period, which was partly influenced by contraceptive use, in the early 1960s dropping total fertility rate from over six to only 1.98 in 1944-1995 (Guest, 1999). Phaktoop (2000) asserted that migration in Thailand slowed timing of first marriage, which might be associated with fertility. However, the country's fertility rate has levelled off to approximately 1.6 since 2000 (Zhang, Chamratrithirong, Shah, & Jampaklay, 2008).

However, Bangkok's fertility rate differs from other parts of the country due to it being a primate city (Fong, 2012). Manpower health resources between Bangkok and rural area were still unevenly distributed (Nishiura et al, 2004). According to the Ministry of Public Health (2010), crude birth rates in 2010 varied by region: 9.4 in Northern region, 10.1 in North-eastern region, 12.9 in Central region excluding Bangkok, 15.3 in Southern region, and17.7 in Bangkok (country's average in 2010 was 12.1). Despite the province with highest population number and highest density, Bangkok's birth rate was questionably far higher than any other area. There is a common idea, as asserted in the study of Montgomery (2008), that fertility rate tends to be lower in urban areas; the fast-growing Bangkok should have been included as well. For this reason, fertility in Bangkok and surrounding provinces is necessary to be examined. Seeing that age-specific fertility data are not provided in provincial level (except Bangkok), general fertility rate of the provinces are examined.

Data from Population and Housing Census are used for calculating the general fertility rates. Based on the calculation, in 2010 Bangkok had general fertility rate of 34.6, while its neighbor provinces–Pathum Thani, Samut Prakarn, and Nonthaburi–had 24.1, 17.9, 25.9 respectively. Although Bangkok is more developed and urbanized, statistics derived from the Ministry of Public Health (2010) insured that Bangkok had significantly higher general fertility rate than the surrounding ones. In addition, mortality rate of infants under one year old was 0.13 percent, while there was a five-percent gap between numbers of live birth (725 110) during 2010 and actual under-age-one population (761 689) in the capital city, which took over almost 50 times to the mortality rate. According to National Statistical Office (NSO, 2010a), an annual average out-migrant number aged under five from Bangkok was only 6423, or 0.8 percent of the population aged under one; that is to say, 4.07 percent of the group were missing. Since population dynamic only comes from death, birth, and migration, the only possibility for having a gap should be that Bangkok's fertility rate by the Ministry of Public Health does not represent the real fertility. In other words, the gap should be the proportion of infants whose mothers reside in the other provinces, probably nearby, but decided to give birth in Bangkok and bring their infants back to their provinces of residence. So as to project Bangkok's real population number and structure in 2030, the actual data on population number aged below one should be used instead of the official age-specific fertility rates published by the Ministry of Public Health.

Assumed that the birth rate pattern among age group of mother can represent the real situation, this paper estimates a new age-specific fertility rate of Bangkok for the population projection as follows:

• Bangkok' age-specific fertility rate graph shape, derived from the Ministry of Public Health (2010), is converted into ratios as shown in Table 1.

• Bangkok's child-bearing female (15 to 49 years old) population number by age group in 2010 from the population census (NSO, 2010a) are multiplied by the original age-specific fertility rate to gain a total birth number.

• The original total birth number is replaced by the number of population under age one from the census (NSO, 2010a). Then, the new age-specific birth numbers are calculated using the ratios acquired from the first step.

• Lastly, the new age-specific birth numbers and the child-bearing female population are used to find the new age-specific fertility rate and a new total fertility rate of Bangkok in 2010.

Table 1 presents calculation results of each step as well as the new fertility rates which are to be dealt with Bangkok population projection to 2030. As can be seen from the table, the new total fertility rate proposed in this paper is 0.85 which amount to merely one-third of the official one, 2.24. This level of total fertility rate is not found unusual for a primate urbanized economic city with high population density like Bangkok. In 2008, Beijing and Shanghai had total fertility rates of only 0.7; likewise, which of Busan in South Korea was only 0.98 (Jones, 2009). These have proved that this paper's fertility rates are practical for the projection.

Table 1. Calculation of the new age-specific fertility rates and total fertility rate of Bangkok in 2010

Age group of mothers	Official fertiltiy rates	Official numbers of births	Ratios of age-specific births	The new proportionated births	Official numbers of females	The new fertility rates
15-19	49.6	14 194	0.071	5398	286 186	18.8
20-24	95.7	41 555	0.210	15803	434 227	36.3
25-29	121.3	60 167	0.304	22881	496 020	46.1
30-34	113.2	53 150	0.269	20212	469 525	43.0
35-39	55.9	23 513	0.119	8941	420 627	21.2
40-45	11.8	4603	0.023	1750	390 087	4.4
45-49	0.7	234	0.001	89	334 441	0.2
Total	2.24	197 417	1.000	75076	2 831 113	0.85

Note. The official fertility rates are derived from the Ministry of Public Health. The official numbers of females are derived from the National Statistical Office.

4. Bangkok Population Projection to 2030

This study applies 'cohort component method', which is the most standardized method being used internationally, to forecast Bangkok's population by age group and sex to 2030. This method is also implemented in NESDB's Population Projections for Thailand 2010-2040 (NESDB, 2013). The cohort components are comprised of mortality, fertility, and migration. For each sex and age group except the youngest group aged 0-4 in projected year, a five-year interval projection (2015, 2020, 2025, and 2030) is done by the following formula:

$$P_{t+5,u+1} = (P_{t,u} \times S_u) + INMIG_u - OUTMIG_u \quad (4)$$

; $P_{t,u}$ is population number of age group u in year t

S_u is survival rate of age group u

$INMIG_u$ is five-year-interval in-migrants of age group u to Bangkok

$OUTMIG_u$ is five-year-interval of out-migrants of age group u from Bangkok

For the youngest age group (uo), 0 to 4 years old in projected year, fertility is also considered as below:

$$P_{t+5,u0} = 5 \times (R \times B \times S_{u0}) \quad (5)$$

; R is male-female ratio of births

B is number of projected births

S_{u0} is survival rate of population aged 0-4

Survival rates and male-female birth ratios in 2010 were applied, which were derived from the Ministry of Public Health. In-migration rates and out-migration rates during 2005 and 2010 were used, which were derived from the National Statistical Office. The new age-specific fertility rates calculated in this paper were used to estimate the birth numbers.

The projection results are shown in Table 2. It was found that there are remarkable changes in Bangkok population number and age structure over 20 years of projection. Total population of Bangkok continues to expend from 8.3 million to 9.1 million. Females still outnumbers males, yet the female proportion expands from 51.4 percent in 2010 to 52.6 percent in 2030. Age groups with highest numbers for both sexes shift from 25-34 years old in 2010 to 40-44 years old. A shrinking proportion was found in young population under 15 years old from 12.8 percent to 9.6 percent; on the contrary, the elder one with 60 years old and over dramatically increases from 9.6 percent in 2010 to 22.6 percent in 2030. As a result, a dependency ratio–the ratio of those aged 0-14 and over 60 to total population–would remarkably prolong to 35.3 percent. This implies that Bangkok is expected to be a complete aging capital city in 2030. A population is to be illustrated in discussion section. Even though the very low fertility in Bangkok brings down future young population numbers overall population size is influenced by migration inflow.

Table 2. Projection results of Bangkok population by age group and sex to 2030

Year	2010		2015		2020		2025		2030	
Age	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
0-4	159.51	154.88	188.10	184.50	181.77	178.29	162.67	159.55	139.64	136.97
5-9	173.04	160.96	144.06	140.59	169.50	166.99	163.63	161.19	146.60	144.43
10-14	212.64	199.06	155.87	152.46	136.84	133.25	160.71	157.91	155.01	152.30
15-19	290.79	286.19	191.52	192.09	150.21	147.31	132.00	128.83	154.72	152.33
20-24	391.89	434.23	289.41	304.57	210.51	218.27	166.95	170.11	148.31	150.09
25-29	447.74	496.02	426.24	504.13	366.74	402.22	296.12	327.22	239.45	261.45
30-34	450.33	469.53	451.53	521.95	453.36	520.15	399.24	434.58	334.85	366.35
35-39	421.50	420.63	436.75	475.29	455.48	518.73	454.82	513.15	404.90	436.66
40-44	374.91	390.09	410.99	425.89	437.82	472.70	451.61	509.08	449.24	500.75
45-49	321.12	334.44	350.81	388.00	403.08	421.22	426.46	464.28	438.13	497.42
50-54	259.90	276.67	302.92	331.66	343.35	383.26	391.12	413.85	411.11	452.98
55-59	179.08	200.05	236.73	269.97	289.55	323.21	327.62	372.93	372.18	401.92
60-64	128.42	147.89	164.87	192.71	221.98	259.40	270.90	310.09	305.91	357.14
65-69	76.53	96.07	115.59	140.60	151.36	183.10	203.57	246.18	248.25	294.10
70-74	66.58	83.88	69.46	88.42	101.02	129.14	132.11	168.03	177.42	225.57
75-79	38.65	56.25	59.82	69.80	54.53	73.61	79.17	107.35	103.45	139.64
80-84	25.05	38.65	34.98	43.72	43.37	54.18	39.61	57.17	57.35	83.22
85+	14.90	27.15	22.25	41.14	23.38	31.18	28.98	38.64	26.47	40.77

Note. Unit: thousand

5. Discussion and conclusion

Despite the same projection method, different component data gives divergent results. Table 3 compares methods and elements used in this paper and the NESDB's projection. According to the table, both of them use cohort component method and start projection from 2010. However, this paper calculates its own age-specific fertility rates, 0.85 in total, and fixes the rates along the projection, while which of NESDB assumes that total fertility

rate in Bangkok is 1.36 and steadily drops down to 1.14. Another difference is that this paper views Bangkok unchanged in mortality rates, whereas the projection of NESDB presumes that Bangkok people get their health enhanced and trend to live longer; the life expectancy at birth is to expand maximally by 6 percent. Both projections also take migration rates of Bangkok constant from 2010.

Table 3. The comparison of methods and elements used in projection between this paper and NESDB's

Items	This paper's	NESDB's
Method	Cohort component method	Cohort component method
Launch year	2010	2010
Interval	5-year	1-year
Fertility rate	0.85, fixed	falls to 1.14
Mortality rate	fixed by 2010	decreases by 6 percent
Migration rate	fixed by 2010	fixed by 2010

Projection results of this paper and NESDB's one differ in the way they should be. Bangkok population pyramids in 2030 of the two projections are presented in Figure 2. It is seen that there are significant differences of population aged 0-19 between the two projections. This is because fertility rates' influence starts from 0 to 4 years old population in 2015 and lasts to 20-24 years old in 2030. Males and females aged 15-19 of 0.15 million each are observed in this paper while over 0.21 million of each sex are found in NESDB's paper. The fertility rates being constant, a contracting pyramid with smoothly reduced base is viewed in this article's projection, while NESDB's one is with compact waves in the base. In addition, numbers of females over 85 years old are diverse, 40.7 thousand in this projection but 50.7 thousand in NESDB's.

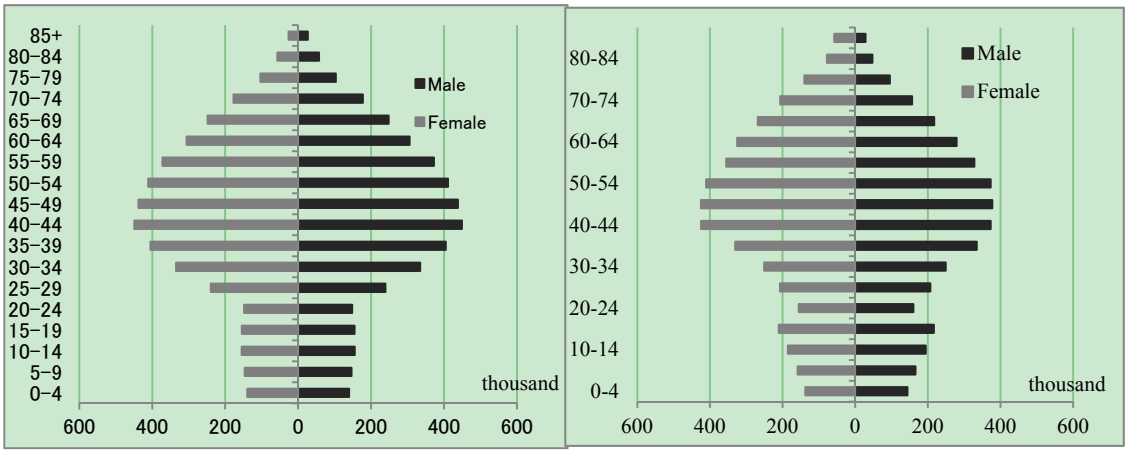

Figure 2. Projected Bangkok population in 2030 of this paper (left) and NESDB's (right)

Structures of projected population are also analyzed and compared in Table 4. As can be seen from the table, the two projections share the same male and female proportions. In spite of resembling aging percentage (people with 60 years old and over), the under-age-15 population percentages differ by 2.3 percent. The dissimilarity in youth percentages apparently comes from different age-specific fertility rates. This makes dependency ratio different between the two projections as well. Nonetheless, one limitation of this projection is that it assumes negligible international migration that could not effect overall population number.

Table 4. The comparison of projected population structures between this paper's and NESDB's

Items	This paper's	NESDB's
Percentage of males	47.3	47.6
Percentage of female	52.6	52.3
Percentage of Population under aged 15	9.6	11.9
Percentage of Percentage of Population aged 60 and over	22.6	22.9
Dependency ratio	32.2	34.8

In conclusion, based on the actual child-bearing female data and the population under age one in Bangkok, there observes a smooth contracting population pyramid of Bangkok. With the fixed total fertility rate of 0.85, young population percentage under age 15 falls by 3.1 percent and raises dependency ratio up by the same proportion. Comparing population structure with the official projection (NESDB, 2013) convinces that this paper gives practical projection results, while it can also represent a real number of Bangkok residents after eliminating proportions of Bangkok-born outsides. The results in this paper can be applied for future urban planning research that could help solve difficulties emerged by the primate urbanization, towards economic and social sustainable development.

References

Caselli, G., Vallin, J., & Wunsch, G. (2006). *Demography analysis and synthesis: A treatise in population*. Burlington, MA: Elsevier.

Chang, S., Gunnell, D., Sterne, J. A. C., Lu, T., & Cheng, A.T.A. (2009). Was the economic crisis 1997–1998 responsible for rising suicide rates in East/Southeast Asia? A time–trend analysis for Japan, Hong Kong, South Korea, Taiwan, Singapore and Thailand. *Social Science & Medicine*, *68*, 1322–1331. http://dx.doi.org/10.1016/j.socscimed.2009.01.010

Cohen, J. E. (1995). Population growth and earth's human carrying capacity. *Science, 269*, 341-346.

Cohen, J. E. (2005). *Human population grows up*. Scientific American [PDF document]. Retrieved from http://www.rockefeller.edu/labheads/cohenje/PDFs/324CohenHumanPpnGrowsUpSciAm2005.pdf

Donner, R. F. (2009). *The politics of uneven development: Thailand's economic growth in comparative perspective*. New York, NY: Cambridge University Press.

Fong, J. (2012). Political vulnerabilities of a primate city: the May 2010 red shirts uprising in Bangkok, Thailand. *Journal of Asian and African Studies*, *48*(3), 332-347. http://dx.doi.org/10.1177/0021909612453981

Guest, P. (1999). Fertility preferences in Thailand. *Journal of Population and social studies*, *8*(1), 1-19.

Halli, S. S., & Rao, K. V. (1992). *Advanced techniques of population analysis*. New York, NY: Plenum Publishers.

Intarakumnerd, P., Chairatana, P., & Tangchitpiboon., T. (2002). National innovation system in less successful developing countries: the case of Thailand. *Research Policy*, *31*, 1445–1457. http://dx.doi.org/10.1016/S0048-7333(02)00074-4

Jones, G. W. (2009). Recent fertility trends, policy responses and fertility prospects in low fertility countries of East and Southeast Asia. In *United Nations Expert Group Meeting on Recent and Future Trends in Fertility* (pp. 1-20). New York, NY: United Nations Department of Social and Economic Affairs.

Lexomboon, D., & Punyashingh, K. (2000). Supply projections for dentists, Thailand (2000-2030). *Human Resource for Health Development Journal*, *4*(2), 94-105.

McFalls, J. A. (2007). Population: A lively introduction. *Population Bulletin*, *62*(1), 1-31.

Ministry of Public Health. (2010). *Public Health Statistics.* Bangkok, Thailand: Ministry of Public Health.

Montgomery, M. R. (2008). The urban transformation of the developing world. *Science*, *319*, 761-764. http://dx.doi.org/10.1126/science.1153012

National Statistic Office. (1980a). *The 2010 population and housing census: Bangkok*. Bangkok, Thailand: National Statistical Office of Thailand.

National Statistic Office. (1980b). *The 2010 population and housing census: whole kingdom*. Bangkok, Thailand: National Statistical Office of Thailand.

National Statistic Office. (1990). *The 2010 population and housing census: Bangkok*. Bangkok, Thailand: National Statistical Office of Thailand.

National Statistic Office. (2000). *The 2010 population and housing census: Bangkok*. Bangkok, Thailand: National Statistical Office of Thailand.

National Statistic Office. (2010a). *The 2010 population and housing census: Bangkok*. Bangkok, Thailand: National Statistical Office of Thailand.

National Statistic Office. (2010b). *The 2010 population and housing census: whole kingdom*. Bangkok, Thailand: National Statistical Office of Thailand.

Newell, C. (1988). *Methods and models in demography*. New York, NY: The Guildford Press.

Nishiura, H., Barua, S., Lawpoolsri, S., Kittitrakul, C., Leman, M. M., Maha, M. S., & Muangnoicharoen, S. (2004). Health inequalities in Thailand: Geographic distribution of medical supplies in the provinces. *Southeast The Asian Journal of Tropical Medicine Public Health*, *35*(3), 735-740.

Office of the National Economic and Social Development Board. (2013). *Population projection for Thailand 2010-2040*. Bangkok, Thailand: Office of the National Economic and Social Development Board.

Phaktoop, M. (2000). Impact of migration on age at first marriage of Thai. *Journal of Population and social studies*, *8*(2), 35-65.

Phiromswad, P. (2015). Measuring monetary policy with empirically grounded restrictions: An application to Thailand. *Journal of Asian Economics*, *38*, 104-113. http://dx.doi.org/10.1016/j.asieco.2015.04.005

Preston, S. H., Heuveline, P., & Guillot, M. (2001). Demography: *Measuring and modeling population processes*. Oxford, UK: Blackwell Publishing.

Seubsman, S., Kelly, M. J., Yiengprugsawan, V., Sleigh, A. C., & the Thai Cohort Study Team. (2011). Gender, socioeconomic status, and self-rated health in a transitional middle-income setting: evidence from Thailand. *Asia-Pacific Journal of Public Health*, *23*(5), 754-765. http://dx.doi.org/10.1177/1010539509356807

Smith, S. K., Tayman, J., & Swanson, D. A. (2001). *State and local population analysis: Methodology and Analysis*. New York, NY: Kluwer Academic/Plenum Publishers.

Sternstein, L. (1984). The growth of the population of the world's pre-eminent “primate city”: Bangkok at its bicentenary. *Journal of Southeast Asian Studies, 15*(1), 43-68.

Wongboonsin, K., Guest, P., & Prachuabmoh, V. (2005). Demographic change and the demographic dividend in Thailand. *Asian Population Studies*, *1*(2), 245-256. http://dx.doi.org/10.1080/17441730500317493

Zhang, H., Chamratrithirong, A., Shah, I., & Jampaklay, A. (2008). The place of fertility intentions: analysis of subsequent childbearing behavior among married Thai women. *Journal of Population and social studies*, *16*(2), 52-72.