



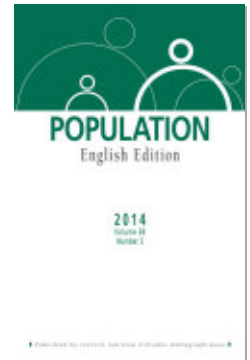
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Fertility Levels and Trends in North Korea

Thomas Spoorenberg

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Thomas SPOORENBERG*

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Knowledge of the population dynamics of the Democratic People's Republic of Korea (DPR Korea or North Korea) is very limited. Due to the closure of the country to the international community and the secretive nature of the political regime, little demographic and social information has ever filtered out of the country. Demographers have had to rely on limited data and show imagination and skill to derive demographic estimates from the limited data available (Eberstadt and Banister, 1992; Robinson et al., 1999; Goodkind and West, 2001; Goodkind et al., 2011; Spoorenberg and Schwekendiek, 2012).

Despite widespread mistrust regarding the quality of the official demographic statistics made available to the international community, existing demographic studies have shown that the estimates derived from these data are fairly consistent. As we shall see, direct and indirect information on births can be used with some confidence for studying the changes at work in North Korea.

This short paper sheds new light on demographic changes in North Korea by presenting additional evidence on fertility levels and trends over the last three decades. Its objective is twofold: first, to assess the consistency of available information on total fertility by comparing as many estimates of total fertility as possible derived from various data sources (censuses, sample surveys and vital registration system) and from the application of diverse estimation methods (direct, indirect); and second, to provide a more detailed picture of intercensal changes in fertility levels and trends in the country. Existing studies on fertility changes in North Korea relied on the 1993 and 2008 population and housing censuses that collected information on the number of births in the household during the 12 months preceding the census. While widely valuable, these data only indicate the total fertility in the country at two points in time separated by an interval of 15 years, leaving what was happening during the intercensal period unknown. This intercensal period spans the period between the mid-1990s and the early 2000s – known as the “Arduous March” – that coincides with the country's loss of Soviet support in the early 1990s and a series of

* Associate Statistician, Demographic Statistics Section, United Nations.

Correspondence: Thomas Spoorenberg, Demographic Statistics Section, Statistics Division, United Nations, 2 United Nations Plaza, Room DC2-1566, New York, NY10017, United States, Tel.: +1 212 963 3214, email: spoorenberg@un.org

natural disasters in 1995 that severely affected the country and caused widespread famine. Until now, in the absence of empirical data, scholars had to resort to assumptions to describe the changes in total fertility during that period.

The first section of this paper introduces the data and methods used to study the changes in fertility levels and trends in North Korea. The main results are then presented in the form of a triangulation exercise that compares total fertility estimates obtained from various sources and estimation methods. The comparison of the levels and trends of various total fertility estimates computed from distinct data sources and estimation methods is used here as a validation procedure. As the main focus is on the estimation of changes in total fertility levels and trends, the analytical perspective is purposively concise, data-driven and technical.

I. Data and methods

The main data sources used to study the fertility levels and trends in North Korea are the last two population and housing censuses conducted in 1993 and 2008. The first census took place in late 1993-early 1994, with a reference date of 31 December 1993 (DPRK Central Bureau of Statistics, 1995), and the second in the first two weeks of October 2008, with a reference date of 1 October 2008 (DPRK Central Bureau of Statistics, 2009). Technical assistance was received for both censuses. The 2008 operation was conducted in accordance with international principles and recommendations (United Nations Statistics Division, 2008) and is considered of good quality (Engracia, 2010).

Both direct and indirect estimation methods were applied to the two censuses. A first series of direct estimates of total fertility were computed from the number of (live) births in the household during the 12 months preceding the census distributed by the age of the mother and the female population aged 15-49. Second, the reverse survival method of fertility estimation was applied using the population of each census by single years of age and sex. Total fertility was estimated by reverse-surviving the population to estimate a number of past births and women. The Excel template “FE_reverse.xlsx (version 04/01/2013)” provided with Timæus and Moultrie (2013) was used to estimate total fertility. The fertility estimation was performed using the Coale-Demeny Model West, using estimates of mortality levels ($5q_0$ and $45q_{15}$) taken from the *World Population Prospects: The 2012 Revision* (UNPD, 2013). The age-specific fertility rates needed to distribute the number of births by women's age group were taken from the 1993 and 2008 censuses of North Korea.

For both methods (direct and indirect), the adjustment procedure detailed in Spoorenberg and Schwekendiek (2012) was applied to the female population in order to include the females living in institutional quarters (i.e. institutions

such as dormitories, nurseries, boarding houses, homes for the elderly, military camps, penal colonies, etc.) in the population by age and sex enumerated during the 1993 census.

The total fertility figures directly and indirectly estimated from census data are sensitive to data accuracy. Due to different factors (poor performance of fieldworkers, respondents' uncertainty about exact date of birth, or reluctance to report a deceased child), direct fertility estimates based on recent census data are usually under-estimated (United Nations Statistics Division, 2004). Data quality issues also affect the estimates of total fertility based on the reverse survival method. While the method is fairly insensitive to assumptions about child mortality, adult female mortality or age-specific fertility rates, the estimates of total fertility given from the reverse survival method depend heavily on the accuracy of the age distribution (Timæus and Moultrie, 2013; Spoorenberg, 2014). As infants and young children are frequently under-enumerated in most censuses in less developed countries, the estimates of total fertility are too low for the (two) most recent years. Furthermore, specific age digit preferences could influence the accuracy of total fertility estimates. However, given the high quality of age distribution data in North Korea and the negligible impact of international migration, the reverse survival method of fertility estimation should return consistent fertility estimates (UNPD, 1983, p. 178; Timæus and Moultrie, 2013).

The census-based fertility estimates were augmented with a series of estimates based on the results of several sample surveys conducted in North Korea. Multiple Indicator Cluster Surveys (MICS) were conducted in 1998, 2000 and later in 2009; and Reproductive Health Surveys (RHS) in 1997, 2002, 2004, and 2006, but the use and value of most of these surveys is limited because in many cases: 1) no publication has filtered out; 2) the selected sample is not representative of the entire national population as only a few provinces or areas were included; 3) birth history information (i.e. full birth history or summary birth history) were not collected; and 4) such information, if collected, is not published in the final report. Furthermore, only the published figures can be used, as micro-data are not available. Despite these limitations, the present study includes all information on total fertility that could be extracted from the published sources.⁽¹⁾ They are summarized in Table 1.

From the body of available demographic data sources for North Korea, eight different fertility series could be derived from six data sources (Table 1). The direct estimates are based on the number of births in the household during the twelve months preceding the census data collection. The indirect estimates are obtained using three different methods. As explained above, the reverse

(1) The author had access to the following reports: 1997 RHS (Population Center, 1998), 2000 MICS (DPRK Central Bureau of Statistics, 2000), 2002 RHS (DPRK Central Bureau of Statistics, n.d.), 2004 RHS (DPRK Central Bureau of Statistics, 2004), truncated report of 2006 RHS (DPRK Central Bureau of Statistics, 2007), 2009 MICS (DPRK Central Bureau of Statistics and UNICEF, 2010).

survival method uses the population by single age and sex to estimate fertility for the 15 years preceding the data collection operation. The second indirect method uses the children ever born (CEB) data by age of the mother to derive an estimate of completed total fertility for different periods preceding the data collection operation. CEB data for women aged 40-44 and 45-49 were used to approximate completed total fertility. An estimated mean age at childbearing of 28 years (based on the 1993 and 2008 censuses) was used to approximate the reference date of these estimates.⁽²⁾ The final indirect method uses information on the percentage distribution of women by parity at the time of the 1997 RHS to derive an estimate of total fertility by summing the product of the proportion of women having reached a given parity at the time of the survey by the number of children they had (parity). It is important to keep in mind that these fertility estimates are drawn from the published sources to which we had direct access. For example, the 2002 RHS collected full birth histories for women aged 15-49, but the report does not include any data on fertility based on this information. Full birth histories for women age 15-49 were also collected in the 2006 RHS, but due to the difficulty of accessing North Korean sources, only a truncated version of the report could be consulted.

Table 1. Data sources and types of derived total fertility estimates, North Korea

	Direct estimate	Indirect estimate		
		Reverse survival	Completed fertility	Parity-based
1993 Census	X	X		
1997 RHS				X
2000 MICS				
2002 RHS			X	
2004 RHS			X	
2006 RHS				
2008 Census	X	X		
2009 MICS		X		

The fertility estimates that could be derived from the available sources do not have the same coverage. While the census includes the entire national population, the surveys differ in their sample coverage as detailed in the reports.

(2) Using Ryder's correspondence between period and cohort measures (Ryder 1964, 1983), the mean number of children ever born (CEB) to a cohort is used to approximate the period total fertility rate at the time this cohort was at its mean age at childbearing. See Feeney (1995, 1996) for further details about time translation of mean CEB for women aged 40 and over.

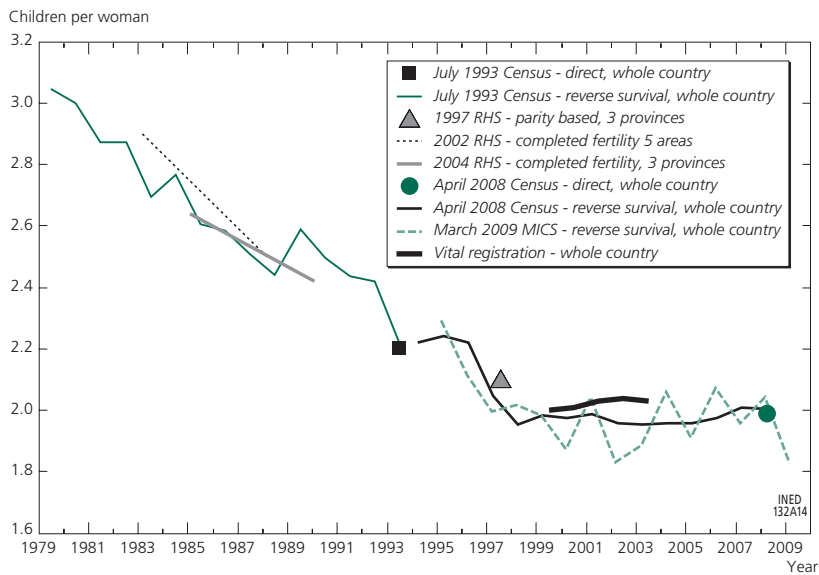
The 1997 and 2004 RHS were conducted in three provinces; the 2002 RHS in five areas;⁽³⁾ and the 2006 RHS in six provinces.

Finally, the introductory sections of some survey reports cite fertility estimates derived from the vital registration system in North Korea. These estimates were also included in this study in order to assess their consistency.

II. Fertility levels and trends

The total fertility estimates that could be derived from the available data sources allow us to study changes in fertility levels and trends over three decades, from 1979 to 2009 (Figure 1). The consistency of the fertility information available for North Korea can then be assessed by comparing the levels and trends of various total fertility estimates computed from distinct data sources and using different estimation methods.

Figure 1. Estimates of total fertility in North Korea, various sources and estimation methods, 1979-2009



Indeed, what Figure 1 shows is the remarkable consistency of total fertility estimates based on different data sources and resulting from the application of different estimation methods. According to these estimates, total fertility

(3) Munhung-ri, Kangdong County, Pyongyang Municipality; Chongjong-ri, Chongdan County, South Hwanghae Province; Saenal-ri, Sinchon County, South Hwanghae Province; Yomju-up (county town), North Phyongan Province; Kujang-up (county town), North Phyongan Province.

was around 3 children per woman in 1980 and declined almost linearly until the early 1990s, before stabilizing at around 2 children per woman.

During the 1980s, the census-based fertility estimates are highly consistent with the RHS-based completed fertility estimates obtained from the children-ever-born data. Despite the fact that the indirect survey estimates are based on data for five areas (for the 2002 RHS) and three provinces (2004 RHS), the trends suggested by these figures confirm the fertility changes derived from the census data.

Despite the remarkable consistency between the different fertility series, the accuracy of some estimates should be interpreted critically. For example, the two series based on the 1993 census seem to be affected by under-enumeration. The sudden drop in the most recent reverse survival estimate reflects a likely under-enumeration of infants during the 1993 census. The fact that the direct estimate based on the number of recent births in the household is below the most recent reverse survival estimate for the same year points to an under-enumeration of the number of recent births in the household during the census. In comparison, such under-enumeration patterns are not apparent in the direct and indirect fertility estimates based on the 2008 census.

The close correspondence between fertility estimates resulting from the application of the reverse survival method to the 2008 census and the 2009 MICS data during the 1990s and 2000s is of particular interest. Furthermore, the total fertility estimate based on the parity distribution data from the 1997 RHS, as well as the figures from vital registration, confirm the fertility levels and trends given by the reverse survival method.

Despite larger variations due to the smaller sample size of the 2009 MICS, the two series of reverse survival fertility estimates offer original empirical evidence of fertility trends during the tumultuous period from the mid-1990s to the early 2000s in North Korea. During this period, data sources agree and indicate that total fertility declined swiftly. On average, the total fertility declined by more than 12% (or 0.28 children per woman) from about 1996 to about 1998. In subsequent years (1999-2008), it remained fairly constant at around two children per woman.

Finally, the sudden drop in the last reverse survival fertility estimate from the 2009 MICS population data should not be interpreted as a sign of the onset of further fertility decline, but rather as the indication of a likely under-enumeration or omission of children under age one.

Conclusion

Our knowledge of the demography of North Korea is very limited. Using a range of data from population censuses, sample surveys and the country's vital registration system, this short paper documents the fertility changes over

the last three decades in the country. One of the most interesting results is the impressive consistency of total fertility estimates based on different data sources and resulting from the application of different estimation methods. This finding corroborates the conclusion made elsewhere about the high quality of the available official demographic data from North Korea (Eberstadt and Banister, 1992; Spoorenberg and Schwekendiek, 2012).

For the first time, the triangulation exercise performed in this paper provides empirical evidence about what happened to fertility during the “Arduous March” period of the mid-1990s to early 2000s in North Korea. Until now, no empirical data was available to support the assumptions made by scholars about changes in total fertility during this period. According to the estimates presented here, total fertility declined by almost 0.3 children per woman during that period.

Given the abundant literature on sizeable fertility swings during complex emergencies, the fertility decline from 1996 to 1998 in North Korea documented here might appear modest. One could indeed question the accuracy of this estimate as it results from the application of an indirect method that might not accurately reproduce the actual decline of total fertility at that time. For a number of reasons, the fertility decline that is estimated in this note appears to be robust, however. First, given the good quality of the population distribution by single years of age and sex from the 2008 census and 2009 MICS, the reverse survival method should return consistent results. Second, the mortality statistics used to reverse survive the population closely reproduce the 2008 census when applied to the population by age and sex of the 1993 census (UNPD 2013). Third, the estimated fertility decline is very close to the assumption of a decline of 0.34 children per woman made in an intercensal prospective population reconstruction that closely matches the 2008 census (Spoorenberg and Schwekendiek, 2012). Lastly, the consistency of the fertility decline given by the reverse survival estimates based on the 2008 census and 2009 MICS – two independent sources – gives further confirmation of the accuracy of that estimate.

Beyond corroborating the consistency of demographic information from North Korea, our study highlights the interest of relying on indirect estimation methods to depict intercensal demographic changes. Indeed, application of the reverse survival method of fertility estimation to the census data could open up promising avenues for the study of intercensal fertility changes at different levels in the country (residence, province, education...). Such an endeavour is limited, however, by the fact that the population living in institutional quarters is not included in available data tabulations at these levels. Such exclusion yields a slight over-estimation of total fertility (as women are missing in the denominator). This point is not too critical, however, as the 2008 census counted only 40,000 females among the population of institutional living quarters (DPRK Central Bureau of Statistics, 2009). A second limitation

resides in the fact that population data by residence, province, and education are only published by five-year age group and sex, while population data by single year and sex are needed for the reverse survival method of fertility estimation applied in this paper. This problem can be circumvented by applying oscillation methods (e.g. Sprague, Beers, etc. (Judson and Popoff, 2004)) that disaggregate five-year age group data into single-age population data.

Once more, such pitfalls call for demographers to demonstrate even more imagination in the study of demographic changes in North Korea.

The views expressed in this paper are those of the author and do not necessarily reflect the views of the United Nations.



STATISTICAL APPENDIX

Table A1. Estimates of total fertility, various sources and estimation methods, North Korea

1993 Census, whole country			2008 Census, whole country			2009 MICS, whole country	
Reference date	Direct	Reverse survival	Reference date	Direct	Reverse survival	Reference date	Direct
July 1993	2.16	2.22	April 2008	2.00	2.00	March 2009	1.83
July 1992		2.42	April 2007		2.01	March 2008	2.04
July 1991		2.44	April 2006		1.98	March 2007	1.96
July 1990		2.50	April 2005		1.96	March 2006	2.07
July 1989		2.59	April 2004		1.96	March 2005	1.91
July 1988		2.44	April 2003		1.95	March 2004	2.06
July 1987		2.51	April 2002		1.96	March 2003	1.89
July 1986		2.59	April 2001		1.99	March 2002	1.83
July 1985		2.61	April 2000		1.98	March 2001	2.04
July 1984		2.77	April 1999		1.98	March 2000	1.87
July 1983		2.70	April 1998		1.95	March 1999	1.98
July 1982		2.87	April 1997		2.05	March 1998	2.02
July 1981		2.87	April 1996		2.22	March 1997	2.00
July 1980		3.00	April 1995		2.24	March 1996	2.11
July 1979		3.04	April 1994		2.22	March 1995	2.29

Sources: 1993 Census: Author's calculations based on DPRK Central Bureau of Statistics (1995); 2008 Census: Author's calculations based on DPRK Central Bureau of Statistics (2009); 2009 MICS: Author's calculations based on DPRK Central Bureau of Statistics and UNICEF (2010).

Table A2. Estimates of total fertility, various sources and estimation methods, North Korea

1997 RHS, 3 provinces		2002 RHS, 5 areas		2004 RHS, 3 provinces		Vital registration	
Reference date	Parity based	Reference date	Completed fertility	Reference date	Completed fertility	Reference date	Direct
July 1997	2.085	March 1988	2.5	January 1990	2.42	July 1999	2.00
		March 1983	2.9	January 1985	2.64	July 2000	2.01
						July 2001	2.03
						July 2002	2.04
						July 2003	2.03

Sources: 1997 RHS: DPRK Population Center (1998); 2002 RHS: Author's calculations based on DPRK Central Bureau of Statistics (n.d.); 2004 RHS: Author's calculations based on DPRK Central Bureau of Statistics (2004); Vital Registration: DPRK Central Bureau of Statistics and UNICEF (n.d. and 2004).



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Thomas SPOORENBERG • FERTILITY LEVELS AND TRENDS IN NORTH KOREA

This short paper contributes additional evidence to the existing body of knowledge on demographic changes in North Korea by studying fertility levels and trends over the last three decades. Using as many estimates of total fertility as possible derived from various data sources (censuses, sample surveys and vital registration system) and computed using diverse estimation methods, we show that the demographic data from North Korea are remarkably consistent for the study of fertility. Total fertility in North Korea declined from about 3.0 children per woman in 1980 to about 2.0 in 1998 and remained around that level until 2008. This paper also provides original empirical evidence about what happened to fertility during the tumultuous period between the mid-1990s and the early 2000s in North Korea.

Thomas SPOORENBERG • NIVEAUX ET TENDANCES DE LA FÉCONDITÉ EN CORÉE DU NORD

Cette note de recherche est une contribution à la connaissance des évolutions démographiques en Corée du Nord. Elle porte sur les niveaux et tendances de la fécondité au cours des trois dernières décennies. Différentes estimations de l'indice synthétique de fécondité tirées de sources variées (recensements, enquêtes par sondage, statistiques d'état civil) et obtenues par diverses méthodes d'estimation permettent de montrer que les données démographiques nord-coréennes sont remarquablement cohérentes concernant l'étude de la fécondité. L'indice synthétique est passé d'environ 3,0 enfants par femme en 1980 à environ 2,0 en 1998, avant de se fixer autour de ce niveau jusqu'en 2008. L'étude propose aussi des données originales sur l'évolution de la fécondité au cours de la période tumultueuse entre le milieu des années 1990 et le début des années 2000 en Corée du Nord.

Thomas SPOORENBERG • NIVELES Y TENDENCIAS DE LA FECUNDIDAD EN COREA DEL NORTE

Esta nota de investigación es una contribución al conocimiento de las evoluciones demográficas en Corea del Norte y más precisamente de los niveles y las tendencias de la fecundidad en las tres últimas décadas. Utilizando diferentes estimaciones del índice sintético de fecundidad obtenidas a partir de fuentes diversas (censos, encuestas, estadísticas de estado civil) y con diferentes métodos de estimación, mostramos que los datos norcoreanos son muy coherentes concerniendo el estudio de la fecundidad. De 1980 a 1998, el índice sintético de fecundidad pasó de 3,0 hijos por mujer a 2 aproximadamente y se mantuvo a este nivel hasta 2008. Este papel contiene también datos originales sobre la fecundidad durante el tumultuoso periodo que va desde la mitad de los años 1990 hasta principios de los años 2000.

Keywords: Fertility, estimation, reverse survival method, data quality, North Korea.