Population Association of America 2014 – Long Abstract

Evaluating Fluctuations in National Sex Ratios in Selected Countries: 1960s − 2012

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The sex ratio at birth is an important analytical measure across several disciplines such as biology, genetics, sociology and demography. As a demographic measure it can provide valuable information regarding other demographic trends. For example, as the sex ratio in an area increases over time, it can lead to a marriage squeeze and slow the overall natural increase in a population. Data on sex ratio at birth has also been used to understand trends in low birth weight and infant mortality since male babies have higher infant mortality rates (Mathews and Hamilton, 2005).

The sex ratio at birth can also be indicative of other societal trends. An extremely imbalanced sex ratio at birth has been associated with a son preference in some Asian countries (Anderson and Silver, 1995; Belanger et al., 2003; Goodkind, 2004). In Nordic countries, there is some evidence of a relationship between birth order and gender preference (Andersson et al., 2006).

Traditionally, national sex ratios at birth in developed countries tended to fluctuate very little. However, fluctuation can be observed when examining the age of mother and parity in national level data. A reliable evaluation measure of the sex ratio at birth could prove to be very helpful in further understanding sex ratio at birth as fertility trends change in many low fertility countries. This paper expands earlier work examining fluctuations in sex ratios at birth in sub-national geographies for selected countries and compares trends in sex ratios at birth across countries by age of mother and parity.

Using a theoretical model to calculate probability ranges of sex ratios at birth, this research examines how well actual birth data from several countries over a series of years matched the model's probability ranges, given the randomness of the outcome of a male birth compared to a female birth for any given number of births. The model assumes a binomial distribution of male births, using the expected outcome of 105 male births for every 100 female births. Then, setting bounds for the probability ranges, the actual birth data are matched against the probability ranges to examine how the birth data compare to the theoretical model. For example, if the probability range is set at 90%, there is a 90% chance that the observed number of male births falls within the expected range. Or equivalently, there is a 10% chance the observed number of male births falls outside of the expected range. Assuming the number of male births are independent from year to year with a probability level of 90%, ten percent of the years examined in the data would have sex ratios at birth that would fall outside the expected range for the time series by chance. However, since this research assumes the sex outcome at birth is a random event, there should be no pattern as to which years fall beyond the bounds set by the model.

The model is tested with vital statistics and/or census data from the United States, Denmark, Sweden, the Netherlands, and South Korea. Longitudinal time series data on total number of births, age of mother, and parity will be tested when data are available in a given country. The time periods vary beginning in the late 1960s through the mid 1990s up to 2012, depending on the country and data available.

Initial findings indicate the model provides insight into how sex ratios at birth behave as fertility declines and births are becoming more infrequent events in any given year, particularly at higher parities than in the past. The age distribution of women giving birth is also changing as women are waiting longer to have children.

The sex ratios at birth associated with a very high number of births are found to have a much narrower range of acceptable fluctuation than previously understood. For example, the model indicates it takes almost 58,000 births to achieve an expected sex ratio range of 104 – 106, at the 90 percent threshold in the model. The acceptable range for sex ratios widens considerably at lower numbers of birth. For example, a sex ratio at the 90 percent threshold for 500 births, the model predicts a sex ratio at birth between 91 and 121 would be acceptable. All the countries in the study, except Denmark, regularly have more than that 58,000 births each year, providing enough births to examine sex ratios at birth broken down by parity and/or age of mother.

The number of male births compared to the total number of births can also be adjusted in the model to reflect a different expected national sex ratio at birth and provide results on what is the expected or "normal" fluctuation in sex ratios at birth at those chosen parameters.

A model such as this can be a valuable evaluation and research tool. It would allow researchers to focus on any consistent outliers in a time series of data rather than those due to the expected random chance in any single year of births.

Preliminary Results

The following figures illustrate the level of agreement between observed sex ratios at birth and expected sex ratios, based on our assumed binomial model for the number of male births. Figures 1 and 2 show the observed sex ratio at birth by parity and the expected lower and upper bounds in South Korea for the years 1981 to 2009. For Swedish birth data, Figures 3, 4, and 5 display the observed sex ratio at birth by age of mother and the expected lower and upper bounds for the years 1968 to 2012. Out of all study years and for each group, we would expect 10 percent of the observed sex ratios to fall outside of the expected bounds by random chance.

Figure 1. South Korean Sex Ratio at Birth by Parity 1 & 2: 90 Percent Probability Level

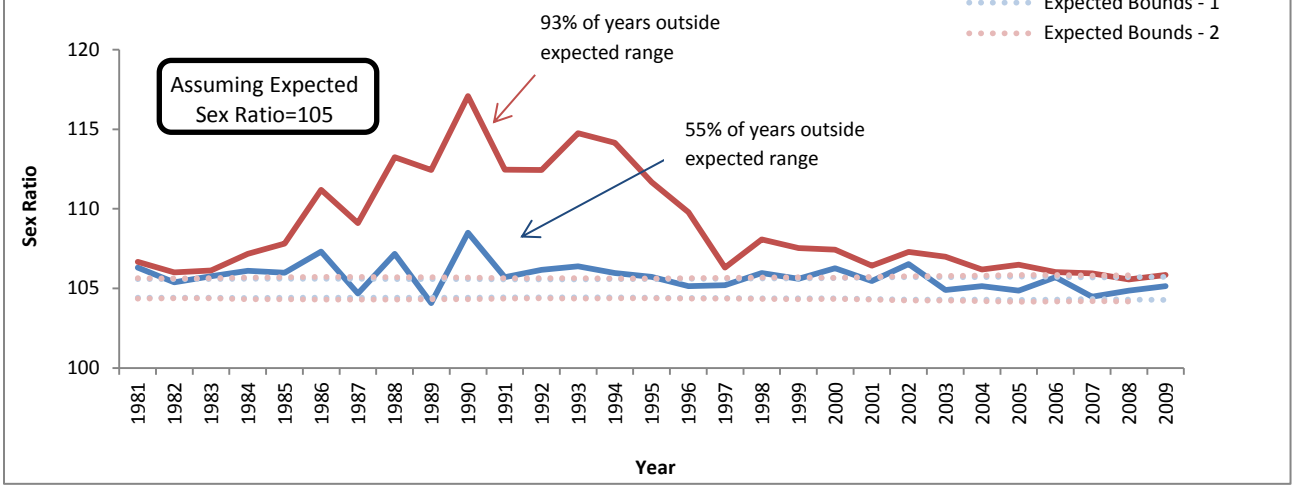


Figure 2. South Korean Sex Ratio at Birth by Parity 3, 4, & 5: 90 Percent Probability Level

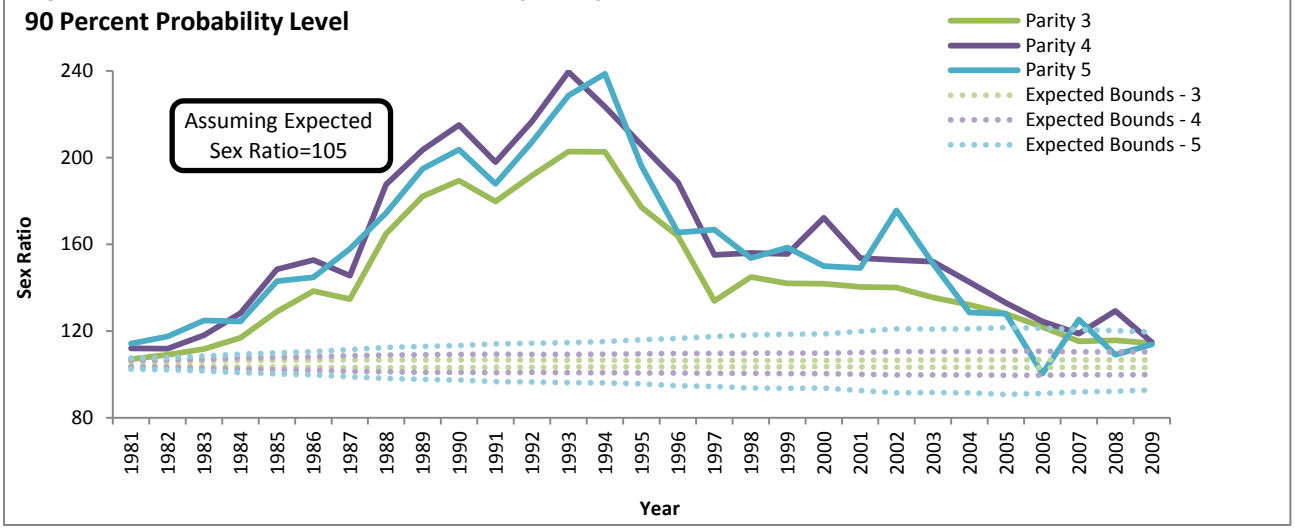


Figure 3. Swedish Sex Ratio at Birth by Age of Mother (15-24 Years Old): 90 Percent Probability Level

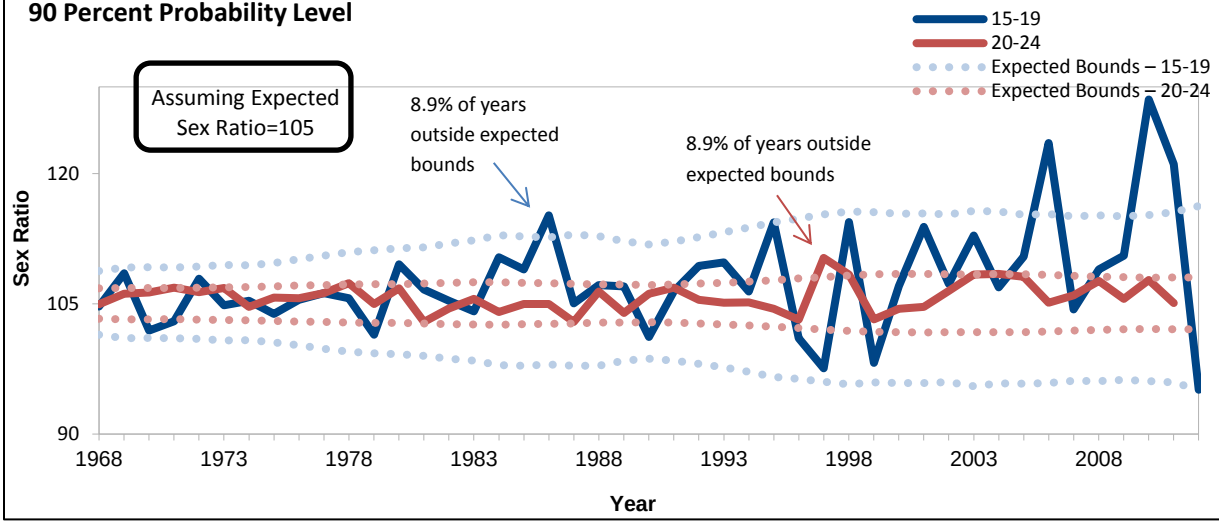


Figure 4. Swedish Sex Ratio at Birth by Age of Mother (25-34 Years Old): 90 Percent Probability Level

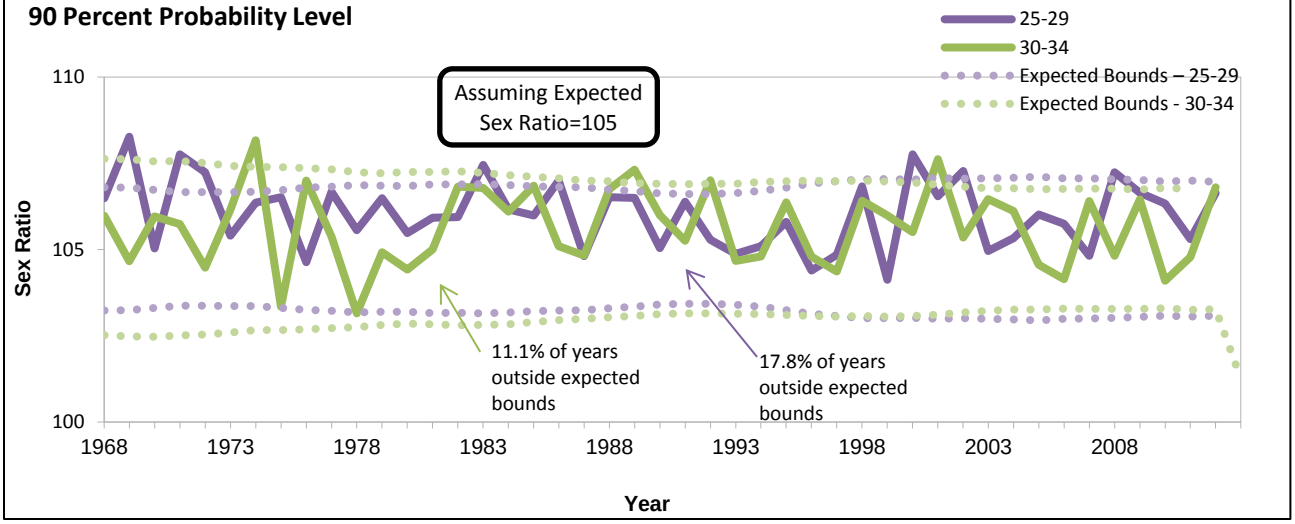
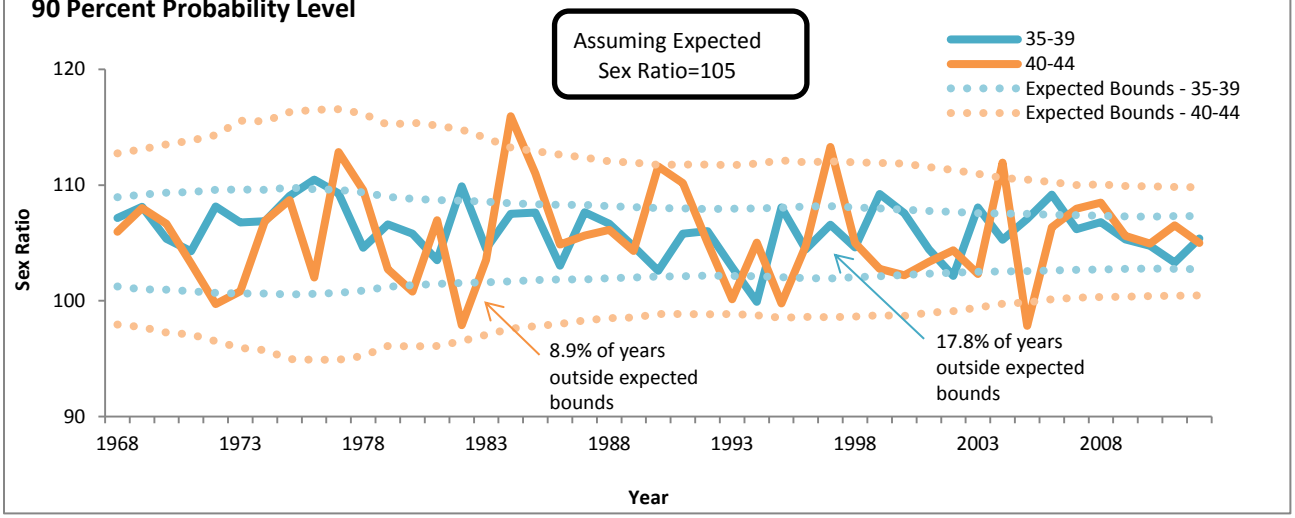


Figure 5. Swedish Sex Ratio at Birth by Age of Mother (35-44 Years Old): 90 Percent Probability Level



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