Workshop on Demographic Analysis

Fertility:

Reverse Survival of Children & Mothers

With Introduction to Own Children Methods

Reverse Survival of Children and Mothers

In this lesson we introduce a method allowing estimation of fertility *without data on births*

- Uses principle of reverse survival
  - Estimates annual births in the past by reverse survival of children to the time of birth
  - Estimates women at reproductive ages in the past (by 5-year or 1-year ages)
- Thus, estimates an annual TFR series for the past
- Introduce the Own Children Method – a more refined way to reverse survive using survey data

Reverse Survival - assumptions

There are several ways to perform reverse survival. The simple version which follows makes the following assumptions (except for the first, alternative methods make similar assumptions):

- ASFRs are constant (could also be interpolated if earlier ASFR estimates exist prior to the new census)
- Mortality is constant (yet mortality could also be varied)
- Net migration equals zero.
- Census coverage of the population is equally complete among all children and all women.
- There is no age misreporting.

Reverse Survival

Basic data requirements of the simple method:

- Children by single year of age (0-9 or 0-14)
- Women at childbearing ages, and 10-15 years beyond childbearing ages (e.g. 15-64), by single years of age
- Estimate of the ASFR pattern (e.g., for the year prior to the census)
- Mortality (survival) statistics by age (from a life table)

How does reverse survival work to produce TFR estimates?

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Reverse Survival of Children

Counts of children in 2010 census are reverse survived to estimate annual births (which are then allocated based on assumed ASFRs and numbers of females by age).

	2010	2009	2008
BIRTHS	1131	1232	1205
0	1110	1079	1174
1	998	1057	1085
2	1004	1031	1052
3	1000	1021	1018
4	990	988	982
5	968	962	968
6	943	949	937
7	930	918	916
8	900	898	912
9	880	894	889
10	885	880	883
11	871	874	867
12	865	859	847
13	850	838	
14	830		

Reverse Survival of Females, e.g. to Age 35-39

Counts of 30-34 year-old females in a **2010 census**, and reverse survived 30-34 year old females in 2009 and 2008. These form annual denominators for ASFRs at 30-34.

	2010	2009	2008
30	**1000**	1008	1022
31	**998**	1014	1018
32	**1004**	1010	1008
33	**1000**	1000	986
34	**990**	978	960
35	**968**	953	947
36	**943**	939	916
37	**930**	909	896
38	**900**	889	901
39	**880**	894	887
40	**885**	880	881
41	**871**	874	866
42	**865**	859	845
43	**850**	838	
44	**830**		

Reverse Survival – Example from a 2010 Census

Reverse-Survived ASFR 30-34 Estimated for Year:

For ASFRs 30-34:
Numerators
Denominators

	Reverse Survived ASFR at age 30-34 in:				
	2010	2009	2008		
	ASFRs in These Years Based on Those in 2010 who were aged:				
Births	0	1	2		
	(allocated to age 30-34 based on ASFR assumptions)				
Females Aged	30	31	32		
	31	32	33		
	32	33	34		
	33	34	35		
	34	35	36		

Reverse Survival

The simple method is based on the following algebra:

- Reverse survives single age children to get an annual series of births (above)
- Reverse survives single-age women to estimates those of childbearing ages during each year (above)
- Compares reverse-survived annual births to births from
  - Reverse-survived females at childbearing ages
  - the fixed ASFR pattern
- Uses discrepancy between reverse-survived total births and births based on the fixed ASFR pattern to scale up/down the fixed ASFR pattern each year.

Scaling Fixed ASFRs Based on Reverse-Survived Births

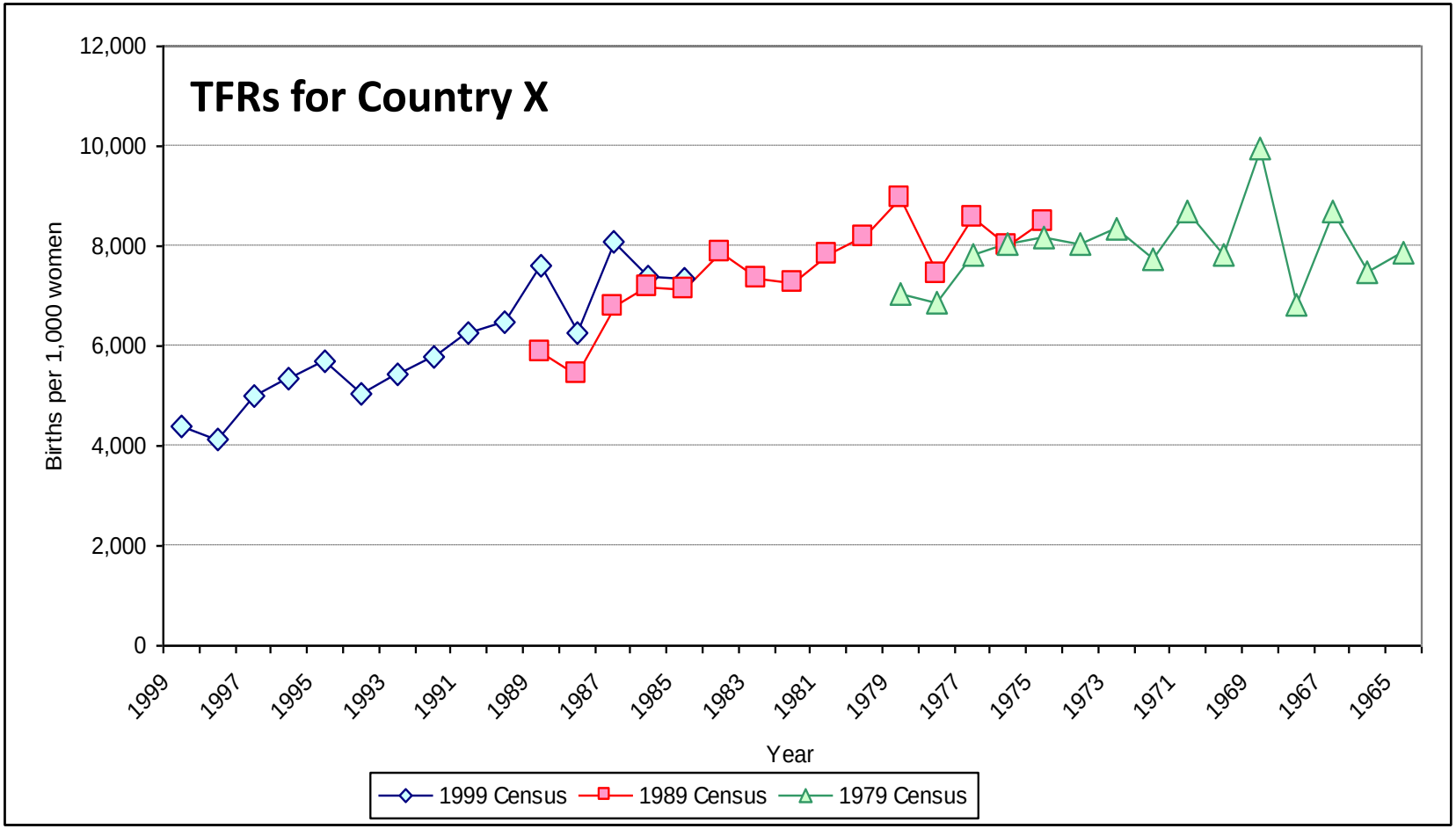
Age		2008	2007	2006	2005
15	Numbers	878,593	874,463	860,698	844,419
20	of	796,632	777,803	759,335	739,560
25	Females	660,298	582,948	507,188	432,503
30		366,326	393,957	422,755	454,765
35		462,682	459,384	454,870	448,795
40		420,044	409,448	401,344	392,034
45		354,113	337,958	319,017	303,582
	Assumed ASFR Pattern	Implied Births By age (Females x Fixed ASFRs)			
15	0.0404	35,495	35,328	34,772	34,115
20	0.1550	123,478	120,559	117,697	114,632
25	0.1689	111,524	98,460	85,664	73,050
30	0.1338	49,014	52,712	56,565	60,848
35	0.0815	37,709	37,440	37,072	36,577
40	0.0360	15,122	14,740	14,448	14,113
45	0.0045	1,594	1,521	1,436	1,366
TFR	3.10				
	Sum Births by Age	373,935	360,760	347,654	334,700
	RevSurvBirths	*377,249*	*347,737*	*341,481*	*377,249*
	Scaling Factor	1.009	0.964	0.982	1.127
	Annual TFR Estimate (3.10 x Scaling Factor)	3.13	2.99	3.05	3.49

Reverse Survival

Advantages:

- Fertility estimates can be derived without data on birth levels (just the shape of the ASFRs)
- Fertility estimates can be determined from *any* census or survey with single year population distributions, not just from a demographic survey
- Method is as close to a direct method as an indirect method can get
- The method is straightforward to implement in Excel
- One can string together reverse-survived estimates from successive censuses (see the following graph)

Reverse-Survived TFR Estimates Across Successive Censuses to Check for Consistency



Reverse Survival Method

- Some Limitations:
- Results are biased by 1) child underreporting in general and 2) excess underreporting by age (e.g. 0 & 1) – to smooth over this bias, results can be aggregated by 5-year ages (see UN *Manual X*).
- Method used assumes age-specific fertility is constant.

  In many settings, this will not be a problem because the shape of the ASFR curve is fairly stable within a 10-year period.
- Method cannot estimate annual fertility change by social characteristics (e.g. education of mother, etc.)

The Own-children Method

The Own Children is a more refined reverse survival method without the 2nd and 3rd limitations just noted. The basics:

- Concept of reverse surviving children and mothers is the same as for the basic method.
- Yet household micro-data is used to link children to mothers of a particular age (ASFRs may thus vary) or social characteristic (level of education).
- Most linkages made directly through household data, When children not living with their mothers, linkages must be made through inferences.

The Own-children Method

Data required:

- A distribution of the population by single years of age
- The number of children under 15 years of age living with their own mothers ("matched children"), classified by both their own single years of age and their mothers' single years of age.
- The number of children under 15 years of age not living with their own mothers ("unmatched children"), classified by their own single years of age.
- The total number of women, by single years of age.

The Own-children Method

Procedure, step-by-step:

- Matching of children with their natural mothers by age of child and age of mother.
- Adjustment of numbers of children for “non-own children” (children who cannot be matched)
- Rejuvenation (reverse-survival) of mothers to birth year of each child and rejuvenation of each child to its birth year based on its age at interview.
- Calculation of age-specific fertility rates using rejuvenated children and rejuvenated women for each year over the past 15 years or so.

The Own-children Method

Procedure:

The technique requires special tabulations matching children with their natural mothers. Once children and mothers are matched, the number of children and the female population are rejuvenated in such a way that children are continuously linked to their mothers, by age. This procedure allows the estimation of the number of births, by age of mother, for each year. Based on the number of births by age of mother and the female population, age-specific fertility rates are calculated.

The Own-children Method and the East-West Center Program FERT

The Own-children Method - Advantages

Advantages Over Basic Reverse Survival Methods:

- The technique provides estimates of the total fertility rate as well as age-specific fertility rates without requiring any simplifying assumptions concerning the age pattern of fertility.
- The estimates are derived from micro-data, so one can estimate fertility trends for mothers with different social characteristics (e.g. education, income, etc.).

The Own-children Method - Limitations

Although the Own-children method provides more refined estimates, it comes with its own limitations:

1. When direct linkages of children to mothers is not possible, inferred linkages may be in error.
2. The software is currently in DOS-based format and is cumbersome to use.
3. As was the case for more basic reverse survival techniques, reporting completeness can differ sharply by age of child and by mother's age.

Question – Are the additional computational efforts required by the Own-children method worth it?

Group Activities

Demonstration and application of reverse-survival techniques using census/survey age distributions and a fixed ASFR pattern.

For More Detail

Michael Levin, 2007. “Own Children Fertility Estimates Using Demographic Health Survey Data: Methodology and Comparisons.” Combined with the East-West Center’s manual ***EASWESPOP: Fertility Estimate Programs*** in your workshop handout. Or, see Levin-OwnChildrenExtract.pdf on your workshop CD.

References

Cho, Lee-Jay, 1973. "The own-children approach to fertility estimation: an elaboration," in ***Proceedings of the International Population Conference, Liège 1973***, International Union for the Scientific Study of Population. Liège.

Grabill, Wilson, 1942a. "A method for calculating growth and net reproduction rates from census data," Master's dissertation submitted to the American University. Washington D.C.

References

Grabill, Wilson and Lee-Jay Cho, 1965. "Methodology for the measurement of current fertility from population data on young children," in *Demography*, vol. 2, pp. 50-73.

Retherford, R. and L. J. Cho, 1978. "Age-parity-specific birth rates and birth probabilities from census or surveys data on own children," in *Population Studies*, vol. 32, pp. 567-581.