Survey data vs. register data: A comparison of indicators in fertility research

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1. INTRODUCTION

Fertility measures – such as the mean number of children, the share of childlessness or the mean age at childbirth – are key indicators of the demographic behaviour of population. These indicators are generated from vital statistics and population counts and regularly published by the National Statistical Offices (NSO). In general, these data are usually of high quality. However, a major shortcoming of this type of data is that data from vital statistics are only able to provide general indicators, as the information is of low detail. More refined measures, such as the number of children by level of education, can usually not be generated based on vital statistics data. For German speaking countries, even order specific fertility information was not available until recently[1].

Given the limitations of vital statistics, the question arises whether survey data are able to provide additional information. Social surveys are representative samples of the population. However, they only contain limited sample size which is why the standard errors around the derived indicators are usually large. Additionally problems of unit- and item- non-response raise the question to what extent these datasets can be used to provide reliable structural indicators for fertility research.

This paper analyses the advantages and shortcomings of the two approaches of generating indicators of fertility patterns on the example of German speaking countries (Austria, Switzerland and Germany). Investigations from surveys are essential for understanding how socioeconomic and cultural factors determine family formation patterns. The main purpose of surveys is usually not deriving summary fertility indicators, anyway this paper uses the comparison with vital statistics data to see how reliable the survey data on fertility are and whether they cover the reality sufficiently. The major question is to see if fertility indicators based on individual-level survey data differ substantially from those reported in vital statistics. The comparative approach of the paper allows assessing the quality of selected survey data.

The consistency of surveys for deriving fertility indicators was evaluated in the past, for example comparing U.S. fertility surveys (Swicegood, Morgan, Rindfuss 1984), Italian FFS and Multiscopo (Rendall et al. 2008), German GGS (Kreyenfeld et al. 2010), GGS of

[1] Germany has started to collect order specific fertility information in 2008, Switzerland did so in 2006 and Austria has already reformed their statistics in 1984.

selected Eastern-European countries (Burkimsher 2008) or FFS data generally (Festy and Prioux 2002).

As stated by Swicegood, Morgan and Rindfuss, "survey data on objective phenomena including demographic behaviour are considered to be less susceptible to study effects, but the issue cannot be treated as negligible" (1984: 20). Apart from the problem of unit- and item- non-response, there emerges another problem when using surveys for fertility research: Childless women are usually underrepresented, especially at young age, while women with kids, especially housewives, use to be overrepresented in the sample. As found for FFS surveys: "In most cases, the FFS overestimates the fertility levels as calculated from vital statistics. ...The FFS overestimates total fertility rates by more than 10 per cent in Austria, Spain, Switzerland, the Czech Republic and Slovenia." (Festy and Prioux 2002: 23). In this paper we evaluate, whether such inconsistencies are persistent among surveys in German speaking countries.

2. DATA AND METHOD

The method of evaluating surveys' reliability concerning fertility is by comparing the summary cohort and period indicators with those derived from vital statistics. In fact we use always only one question from the surveys – the question on the number of own children asked to women. Based on this information we derive mean number of children per woman by cohort, and the parity composition by cohort (concentrating on childlessness). The survey design varies across surveys, therefore while in FFS we have single simple question on the number of kids (v302: "How many children have you had altogether?"; FFS 1992), in GGS the questionnaire is more complex and the information can be derived only after connecting several questions. SHP is focused on households and requires merging of household and personal data files to obtain desired information.

As a benchmark we use fertility summary indicators derived from vital statistics (numbers of births or fertility rates by age/cohort of mother and birth order) and from census (parity distribution of women by cohort). This indicators are published on the *Human Fertility Database* (HFD, www.humanfertility.org) which contains many age and birth order specific indicators, together with the summary indicators, based on the data obtained from NSO's of Austria, Germany and Switzerland (and other countries). Additionally we refer to the *Geburtenbarometer* (www.oeaw.ac.at/vid/barometer), which provides highly reliable estimates of cohort parity distribution in Austria, based on 1991 and 2001 Census and the fertility rates in consecutive years.

For our validation study we consider the following indicators: Mean number of children, proportion of childless women and parity distribution by cohort. If not separately referenced, three year moving average was calculated for each indicator derived from survey samples. Not all these indicators are comparable for all respective countries (in particular in the year of the survey). The reason why we apply our calculations not only to the most recent available survey data is that we want to find out if we observe the same kind of discrepancies in surveys which have a similar design and the same goal of understanding fertility and family dynamics (e. g. FFS and GGS).

We used the sampling weights assigned by the survey institution if not mentioned separately. However, at the end we also discuss the possibility of reweighting the data by

generating adjusted weights towards the actual measured parity-specific distribution of a population.

2.1 Evaluated surveys

The first Fertility and Family Survey (FFS) for Austria was conducted in 1995/96 by Statistics Austria and coordinated by the Austrian Institute for Family Studies (UN/ECE, 1997). It surveyed detailed fertility and family histories, fertility intentions, life biographies, contraceptive use and other socio-economic information among 4581 female and 1539 male respondents (age range: 20-54), with response rate of 72%.

The second wave, called Generations and Gender Survey (GGS) was conducted in 2008/09. The total of 3001 female and 1999 male were surveyed (age range: 18-45), with response rate of 61%.

In Switzerland the Fertility and Family Survey was conducted in 1994/95. The sample contains 3881 female and 2083 male respondents born between 1945 and 1974, therefore aged 20 to 49 at the time of the interview. At the moment there has been no following GGS in Switzerland. For this reason we concentrate also on the Swiss Household Panel (SHP), started in 1999 with waves each year, contain a wide range on social and economic information and also on fertility intentions. We are using the wave from 2000 since the benchmark distribution of women by the number of live-born children in Switzerland is available only from the 2000 Census (December 5). Before 2000 the Swiss registration system collected birth data by parity only within marriage.

In Germany there has been conducted a variety of surveys in recent years (FFS, GGS, SOEP, Familiensurvey, Birth Survey, GLHS, PAIRFAM). We evaluate FFS and GGS surveys in this study. The Fertility and Family Survey for Germany was conducted in 1992 and cohorts born between 1952 and 1972 were surveyed. In this paper we use sample for Western Germany only. The first wave of the German GGS was carried out in 2005. German GGS contains 5,407 female respondents aged 17 to 79 years.

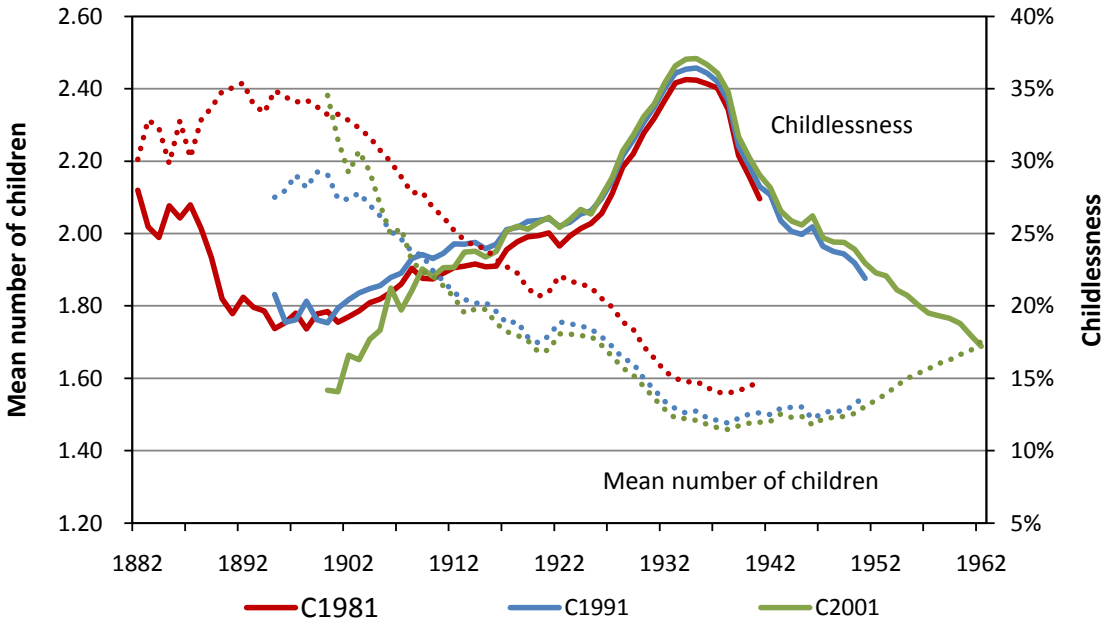
2.2 Benchmark data

For comparison we use data published on Human Fertility Database and Geburtenbarometer. These data recalculate official statistics data to obtain year-by-year cumulated fertility rates and the parity distribution of female population. This allows us to compare Austrian surveys FFS 1995/96 and GGS 2008/09 and Swiss household panel wave 2000 with corresponding data on cohort mean number of children and childlessness. The Swiss FFS 1994/95 and West-Germany FFS 1992 we are able to evaluate only based on cohort mean number of children, but there is no benchmark parity distribution available. German GGS 2005 is evaluated using Micro-census data.

The three Population Censuses prepared and conducted by Statistic Austria, which included a question on the number of children ever born to each woman aged 15+, took place in 1981 (May 12), 1991 (May 15), and 2001 (May 15) (HFD, 2009a). Data from the 1991 and 2001 Censuses show a substantially lower proportion of childless women past reproductive age than the 1981 Census. For women born between 1900 and 1930, the 1991

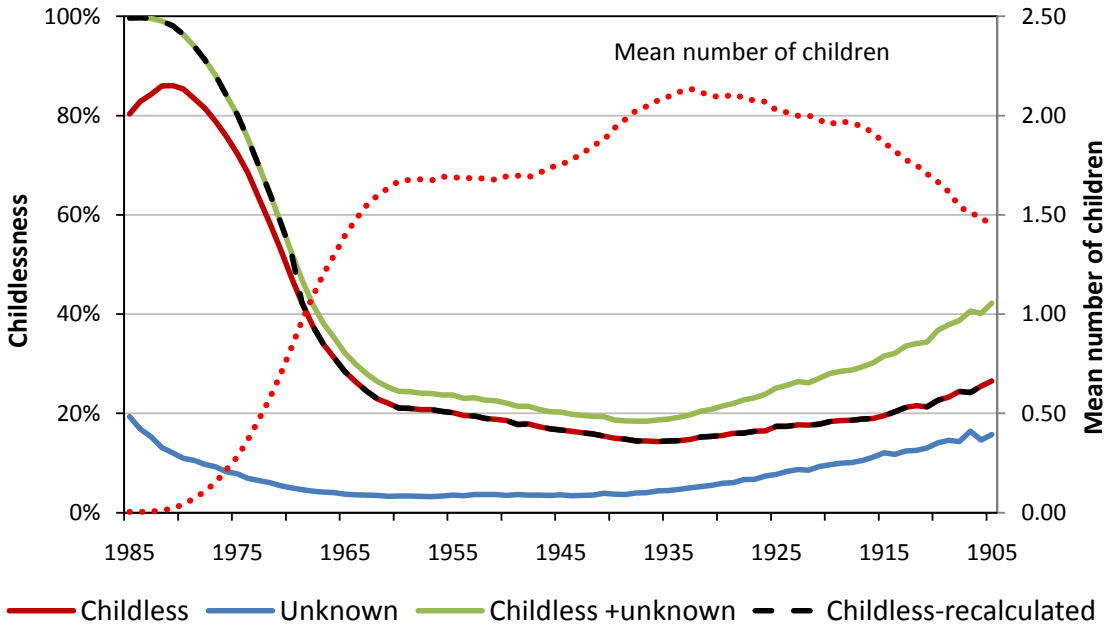
Census suggests that the share of childlessness is lower by 2-6% (see Figure 1). This could partly be attributed to the change in the questionnaire, whereas a slightly higher mortality of older childless women cannot account for such a large difference (see also Prskawetz et al. 2008: Fn. 7). These differences however do not affect estimates of the exposure population of women in reproductive age by age and parity for 1984–2008 (HFD, 2009a).

Figure 1 Mean number of children and childlessness by cohort; Austrian Censuses



In Swiss census 2000 data, women of unknown parity are reported (5.9% of total). The number of women with an unknown number of children varies with age, and is especially high among very young and very old women. Because this figure correlates with the number of childless women at young ages, we suspect that most of young women of unknown parity are in fact childless. For young age up to 30 we consider women with unknown number of children as childless, after age 30 we take only women stating having no children as childless (dashed black line in Figure 2).

Figure 2 Proportion of women with no children and with unknown number of children, and the mean number of children by cohort, 2000 census for Switzerland



An important reference source for Germany is the recent micro-census from 2008 that contains the question on the number of children. Since we have no information on order-specific fertility data from vital statistics, the micro-census is the most reliable data source to generate benchmark fertility indicators (Statistisches Bundesamt 2009).

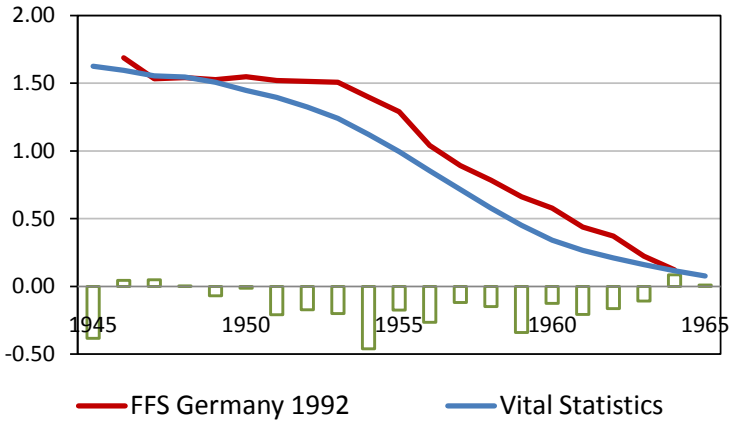
3. RESULTS

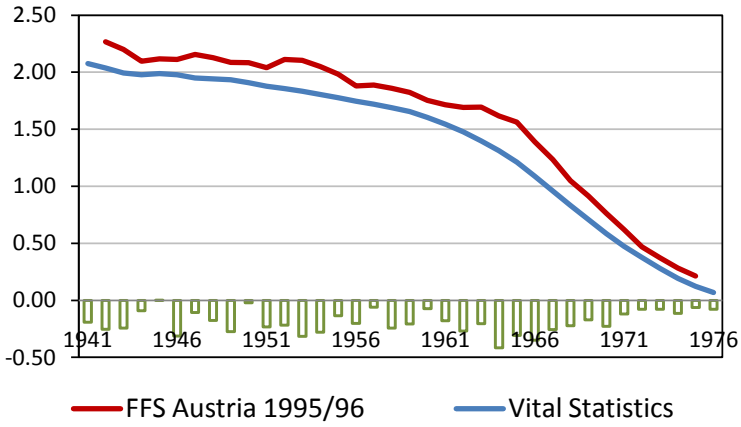
In this section we discuss results of comparison of various fertility indicators derived from surveys with the vital statistics data. Presented graphs provide fast overview of the results. More detailed results by 5-year age groups and including tests of statistical significance of the differences are given in Appendix Tables.

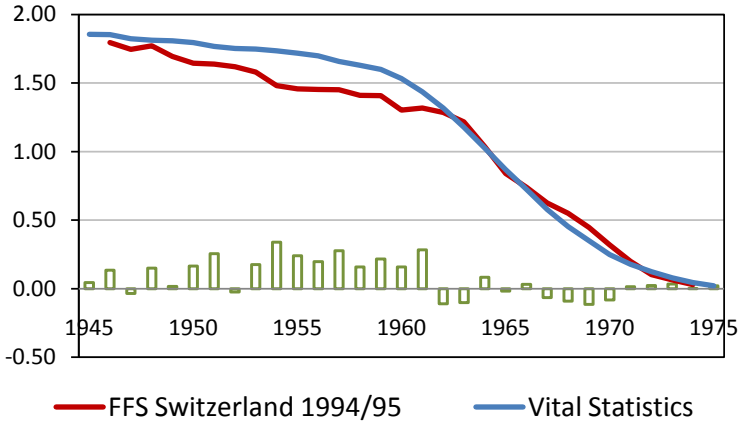
By comparing the mean number of children by cohort derived from FFS surveys conducted in the 1990s in all three German speaking countries with vital statistics data, we observe an overestimation of the cohort fertility rate for Western Germany as well as for the Austrian sample of about 0.2 children (Figure 3). As indicated in the Appendix these estimates are statistically different from the reference data. Only for the cohorts 1952-1956 we can conclude that the German FFS sample follows the parity composition of Western German population.

In contrary the Swiss FFS slightly underestimates the completed fertility rate, but not significantly within the 95-percent confidence interval (Table A2). From the comparative perspective the differences are not the same although all countries conducted the surveys in very similar way.

Figure 3 Mean number of children by cohort; FFS sample for Germany, Austria and Switzerland



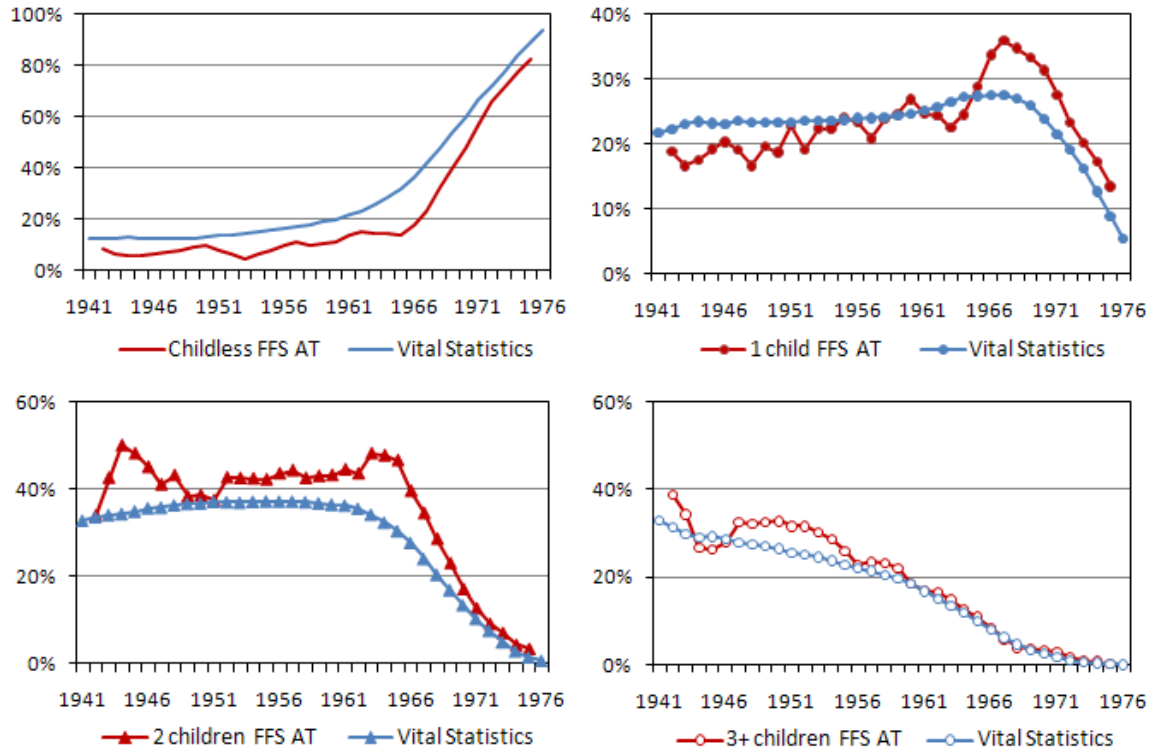




A more detailed view on the parity structure by cohort is only provided for the Austrian FFS sample as compared with HFD data (Figure 4). Unfortunately there is no proper source for Switzerland to apply the same parity specific analysis for the FFS because before 2000 there was no biological birth order in the Swiss birth registration included and therefore no benchmark parity composition data are available for period before 2000. Instead we evaluate the Swiss Household Panel (Wave 2000). Also for Germany there are no comparable data for the cohort parity distribution in 1992 available.

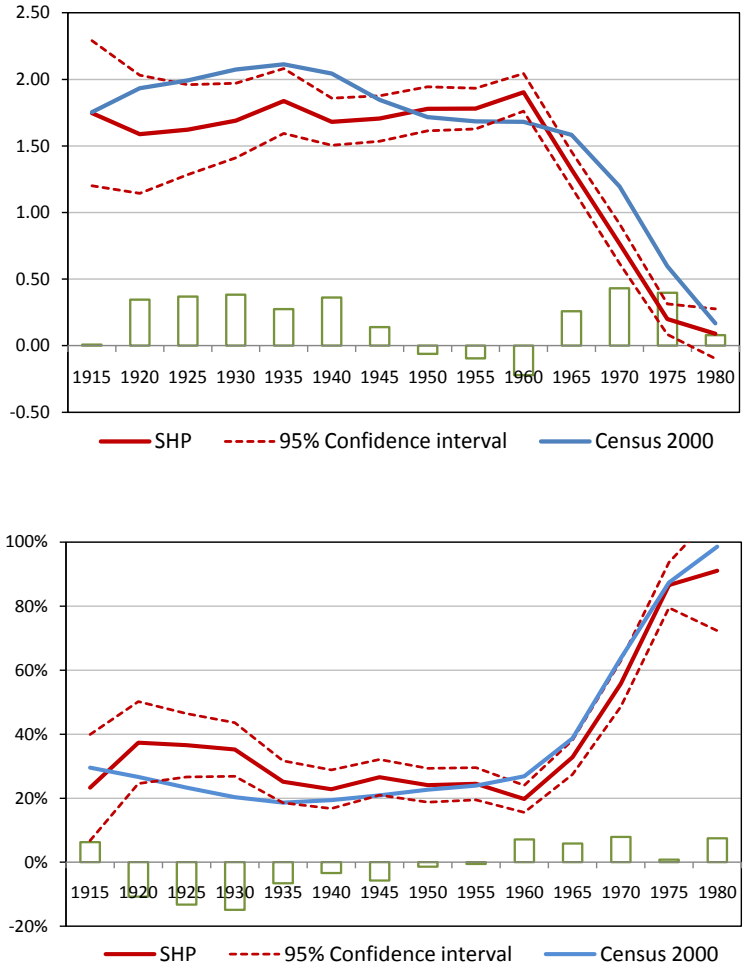
In the Austrian FFS the sample corresponds to the birth cohorts from 1941 to 1976, which means the age range of the respondents was 20 to 54 years at time of the interview. It seems that childless women have been under-sampled in general while two child mothers have been over-sampled. Older women with one child are also underrepresented. Oversampling of mothers is very pronounced for the cohorts born around 1965. For women with three and more children a slight overestimation is shown for the older cohorts while for the younger cohorts there is a very good agreement.

Figure 4 Parity distribution by cohort; FFS for Austria



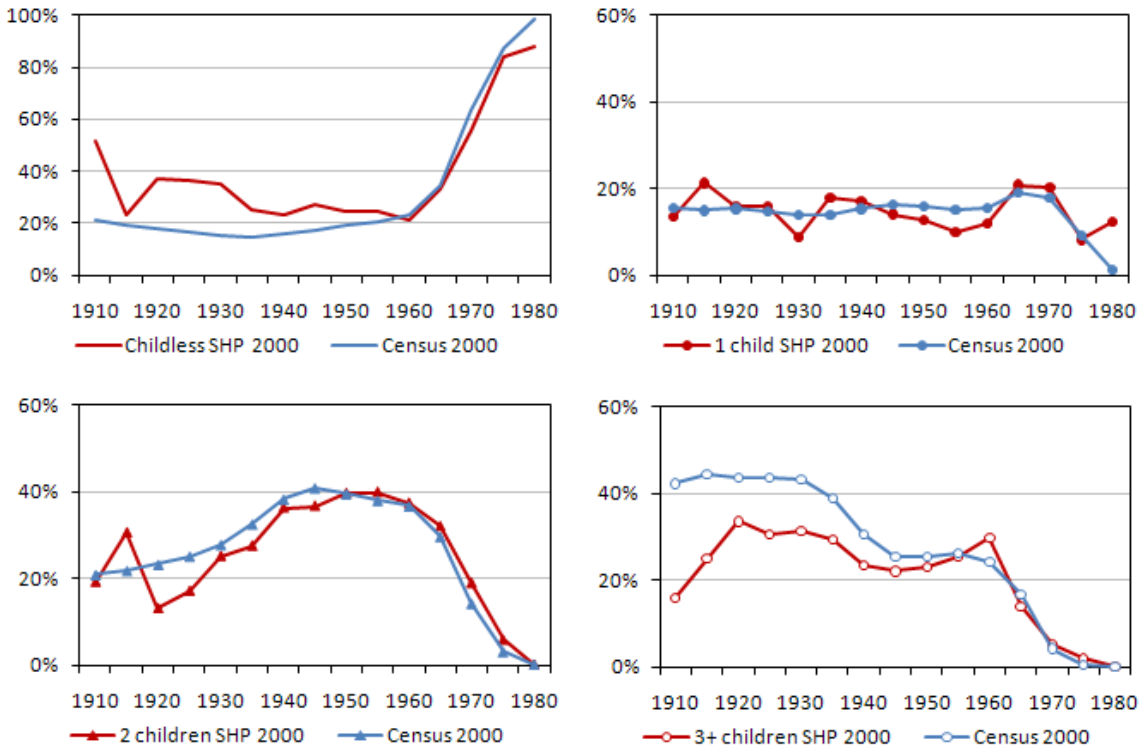
In the next step, we apply a similar comparison for Switzerland using the Swiss Household Panel (SHP) compared with the Swiss Census 2000. The estimates of the mean number of children over 5-year cohorts are significantly lower for the older cohorts and for the younger ones. However, different pattern is seen for the indicator of childlessness. While the SHP level of childlessness is too low for the older cohorts, the estimates are slightly too high for women born in the 1960s and younger (Figure 5).

Figure 5 Mean number of children and childlessness by cohort; Swiss Household Panel (Wave 2000)



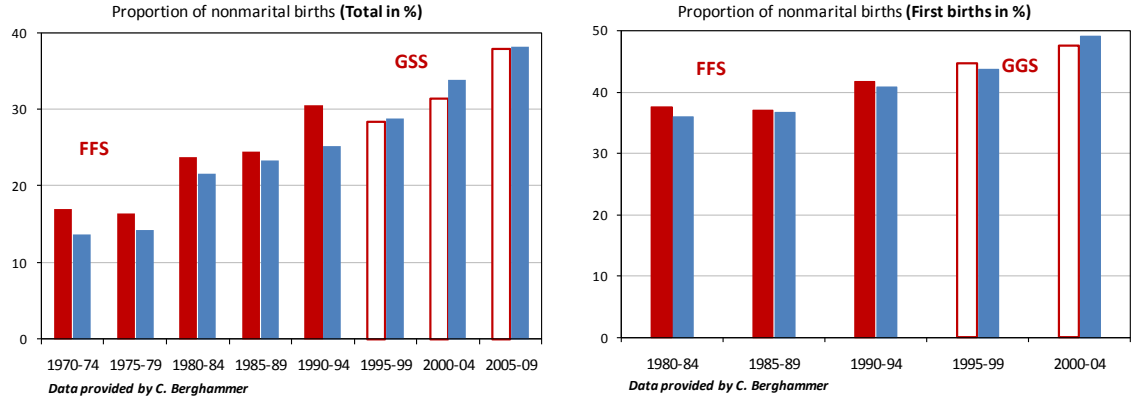
The Swiss Census from 2000 provides data on parity distributions that allow us a more specified comparison (Figure 6). We observe that childless women have been over-sampled in general while women with three or more children have been under-sampled. Both mismatches are very pronounced for the older cohorts. The best agreement we have for one-child mothers. By looking at the analysis of the parity distribution it appears that there are no systematic differences. We are not able to conclude that particularly childless women are under and larger families are over represented in surveys since the pattern is not constant across cohorts.

Figure 6 Parity distribution by cohort; Swiss Household Panel (Wave 2000)



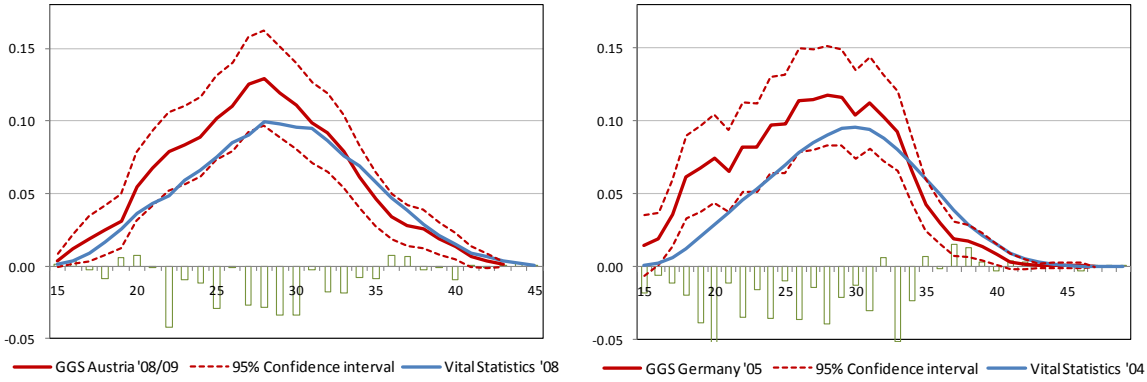
In the next comparison we focus on the share of non-marital births. We combine the Austrian FFS and the GGS sample in order to display longer time series (Figure 7). The increasing level of unmarried motherhood over time is well displayed in the survey data, although we observe mismatches over most of the time period between the survey estimates and the data provided by vital statistics (data from Statistik Austria). The share of total non-marital births is overestimated in FFS while it is slightly underestimated in the GGS sample. The same holds foor 1st birth order, where the differences are even more moderate.

Figure 7 Nonmarital births in Austria; FFS and GGS



Although cohort related indicators are better suitable for the comparison of survey with vital statistics data, we also derived period fertility measures. Age-specific fertility rates are computed for the three-year period before the survey. With this method we define a window of observation that starts 36 months before the survey, to which we attribute the exact number of events and exposure by the age of each woman. Every woman may contribute events and exposure to up to four different ages (see Rodriguez). For the reference data we use age specific fertility rates provided from vital statistics for the year that falls in the middle of our observation period, in other words 2004 for Germany and 2008 for Austria. There are marked differences in the age-specific fertility rates as derived from the GGS samples and from HFD reference data. However, the age-specific pattern is well reflected, although more precise in the Austrian GGS where the benchmark is within the confidence interval of the GGS estimates over all ages (Figure 8). In the German GGS the overestimation is very pronounced for younger ages and up to the age of 20 is statistically different from vital statistics. But we have to take into account that such kinds of computations are always based on very limited numbers of cases producing uncertainties for the estimated indicators.

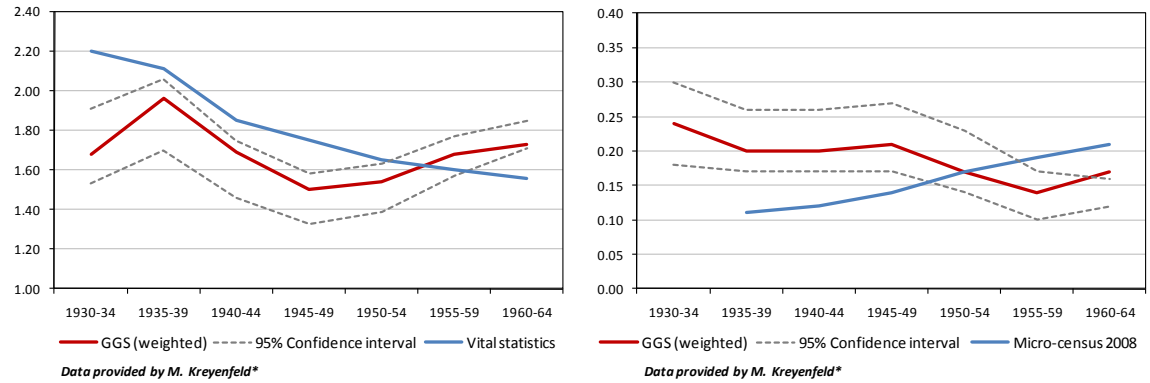
Figure 8 Age-specific fertility rates for Germany and Austria (3 years preceding the survey); GGS



As outlined in the paper of Kreyenfeld et al. (2010) fertility of the older GGS-cohorts[2] is too low, while it is too high for the younger cohorts, as compared to vital statistics and Micro-census data (Figure 9). The same bias holds for partnership histories. “In sum, the GGS gives wrong cohort fertility and marriage trends for Germany” (Kreyenfeld et al. 2010: 1).

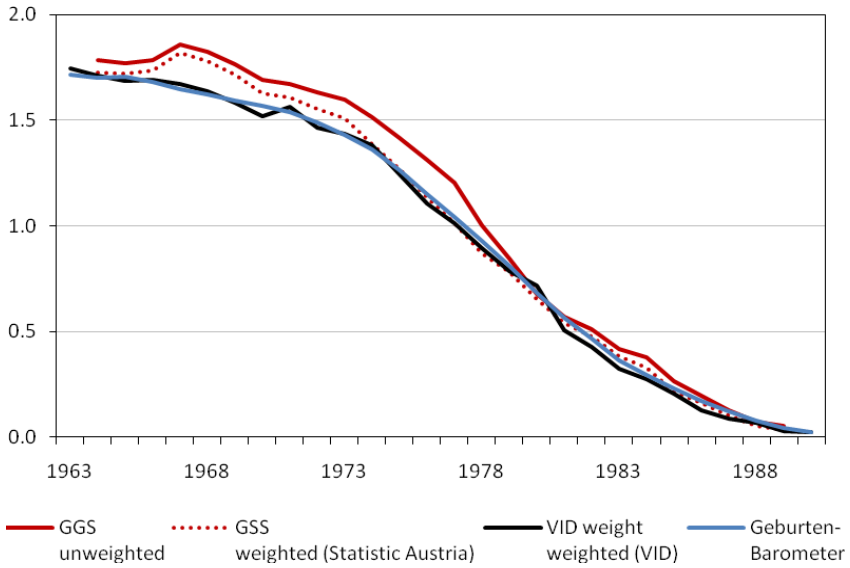
[2] The calculations were restricted to female cohorts who are resident in the western states of Germany.

Figure 9 Mean number of children and childlessness by cohort; GGS for Germany



In the last part of the study we describe the weighting strategy developed by the VID working team. The sample bias related to fertility estimates is also pronounced for the Austrian GGS sample, in particular for women with children (Figure 10). The sample weights assigned by Statistics Austria might be partly correcting that some members of the population are under or over reported since we only slight mismatches for childless women (Figure 10). However, the Austrian GGS overestimates the mean number of children even when using weights by Statistik Austria (Table A5). By incorporating the VID weights that adjust (additionally to age, sex, employment status, country of birth and living arrangements) also for the dimension parity for female respondents, we obtain results that do not differ from the vital statistics anymore (Table A6). The adjustment corresponds to the cohort-parity specific distribution according to *Geburtenbarometer* by the end of 2008 (see Buber 2010 for more detailed information). The aim of reweighting the sample is to reduce the differences in the mean number of children. In Figure 10 and Figure 11 we see how the discrepancies are calibrated after implementation of the VID weights.

Figure 10 Mean number of children and childlessness by cohort, using different weights; GGS for Austria



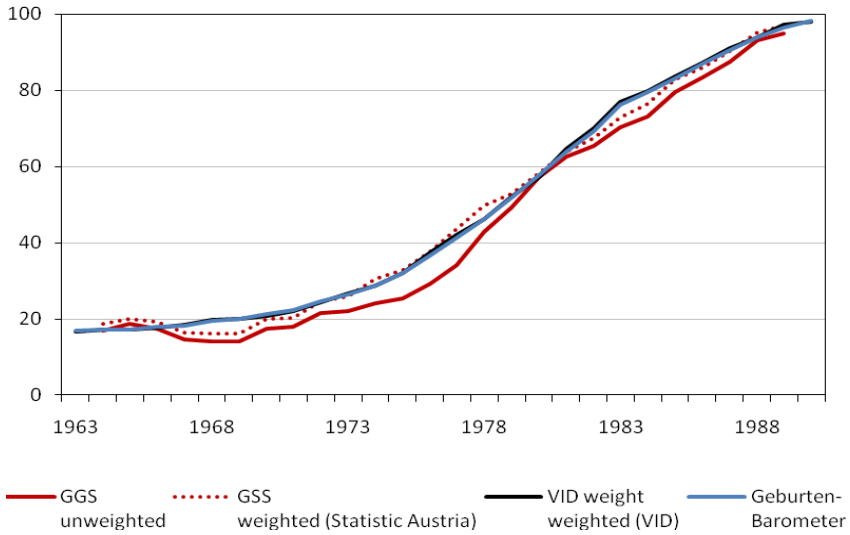
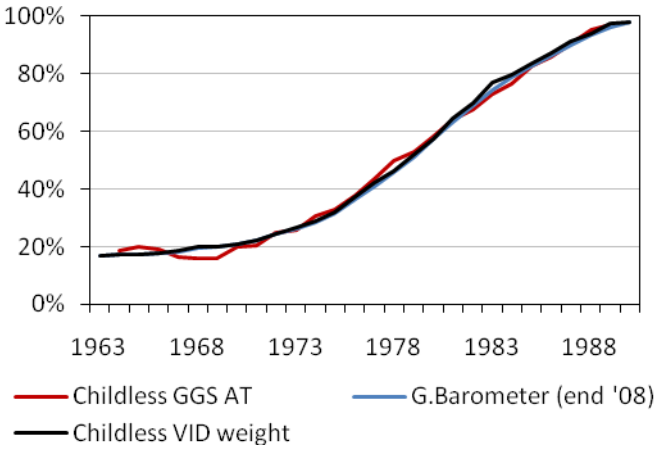
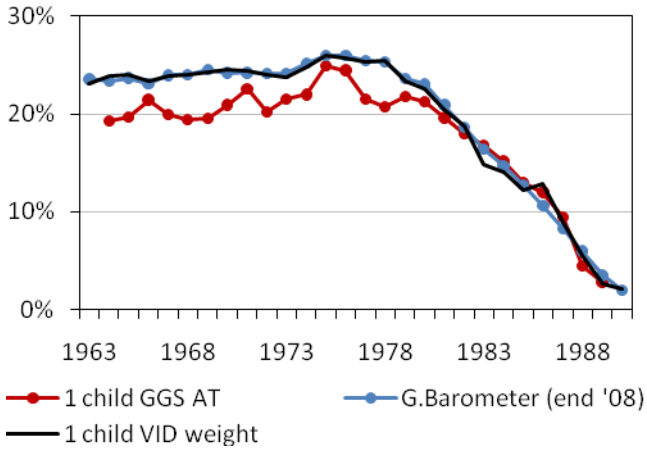
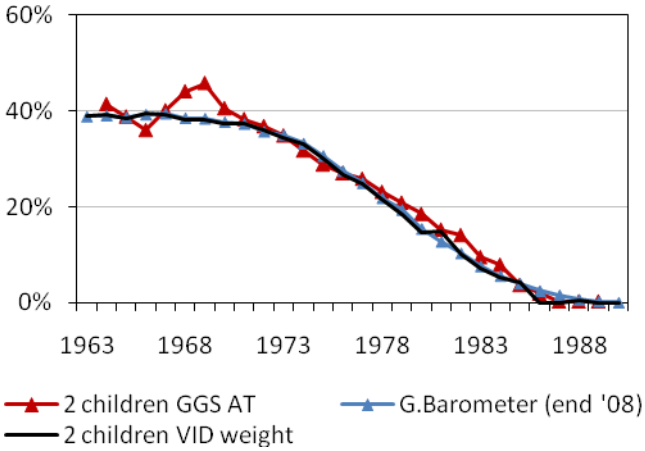
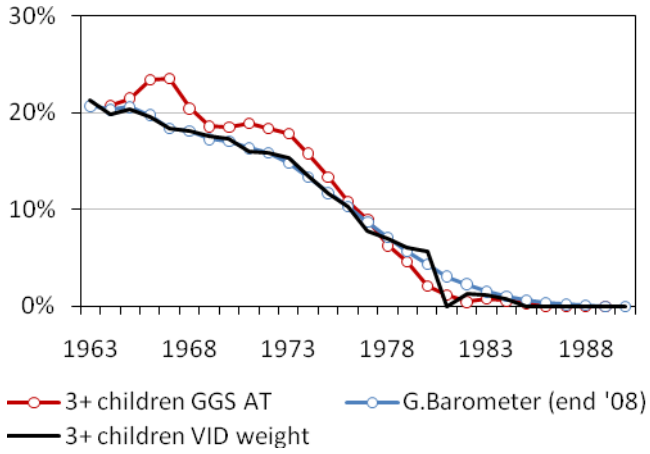


Figure 11 Parity distribution by cohort; GGS for Austria









4. SUMMARY AND CONCLUSIONS

Vital statistics or data from population censuses have an important advantage over survey data because they provide a complete number of recorded events or persons. Furthermore, events like births are precisely recorded by official registers. However, often the desired level of detail is not covered in vital statistics and it is necessary to fill the gap using survey data. On the other hand, survey data are limited due to several crucial issues. In most cases sample sizes are too small and time periods are too short to display long time trends and to cover quite many birth cohorts. Some questions may suffer from unit- and item- non-response. And, most importantly, individuals of certain socio-demographic characteristics may be underrepresented or overrepresented in the sample.

Hence, a clear validation is important for assessing the degree of reliance to the estimations from survey data. Table 1 gives summary of evaluation of six surveys that asked questions on fertility in recent decades in the German speaking countries. According to the results, most often the problem is with underrepresentation of childless women (and overrepresentation of women with more children), resulting in overestimation of the mean numbers of children. The reasons were discussed in Festy and Prioux (2002:23): "Women who had more children than average were over-represented in the samples. This could well be true: married women with children are probably easier to interview than single childless women. The more recent the period, the greater the over-representation of women with children. The clear reason for this is that mothers with newborn children are probably easier to "catch" than other women, because they spend more time at home where interviewers can reach them." Especially young childless women have most probably higher non-response rates than women that are home with the kids.

In one case (SHP 2000) the results showed opposite: underestimation of mean number of children and mixed results for childlessness. This might be due to different design of the panel, which is focused primarily on the households. Anyway, the childless women were still underrepresented at young age. Among older cohorts, childless women were on the contrary slightly overrepresented.

FFS Switzerland results were not significantly different from the benchmark vital statistics data.

Table 1 Overview of results

Survey	Childlessness	Mean number of children
FFS Austria 1995/96	underestimated	overestimated
FFS Switzerland 1994/95	???	OK
FFS West Germany 1992	???	overestimated
Swiss Household Panel 2000	mixed results	underestimated
GGS Austria 2008/09 - S.A. weights	underestimated	overestimated
GGS Austria 2008/09 - VID weights	OK	OK
GGS Germany 2005	mixed results	mixed results

One possible solution of correcting biased parity composition of women in survey is to use parity specific weights, like VID weights in Austrian GGS 2008/09 (Buber 2010). Otherwise, fertility indicators obtained from most surveys could be unreliable. As FFS surveys are already of rather old date, we recommend to use GGS 2008/09 with VID weights to study fertility in Austria.

For Switzerland, Swiss Household Panel may be used with caution, as there are certain cohorts with significantly different fertility behaviour from census benchmark, but also cohorts for whom the difference is insignificant (see Table A4 in Appendix).

For Germany, we follow the recommendation of Kreyenfeld et al. (2010) to not to use the GGS data for fertility research. It would be desirable to use some of the other surveys, focused on fertility behaviour of women, or the Micro-census.

In this paper we have shown that using survey data for fertility research is not without risks. One should be aware especially of the underrepresentation of childless women and hence the overall overestimation of fertility. Before deriving more detailed fertility indicators, one should try to evaluate simple summary indicators using high quality vital statistics or census data. Using parity specific weights is the recommended way of correcting biased parity composition of women in surveys.

ACKNOWLEDGEMENTS

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The paper also utilizes data from the projects Geburtenbarometer: Monitoring of Fertility in Austria and Vienna and from the Human Fertility Database.

We are thankful to Michaela Kreyenfeld, for providing us with the fertility indicators derived from German GGS, and to Caroline Berghammer, for providing us with the fertility indicators derived from Austrian GGS.

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APPENDIX TABLES

Table A1 Fertility indicators derived from FFS Austria (wave 1995/6, weighted), compared with HFD data

Birth cohort	Age at survey (approx.)	Childlessness			Mean number of children		
		FFS	HFD	diff.	FFS	HFD	diff.
1940 - 1944	51 - 55	7%	13%	*	2.21	2.03	*
1945 - 1949	46 - 50	7%	13%	*	2.14	1.96	*
1950 - 1954	41 - 45	7%	14%	*	2.07	1.86	*
1955 - 1959	36 - 40	10%	17%	*	1.89	1.72	*
1960 - 1964	31 - 35	14%	24%	*	1.70	1.47	*
1965 - 1969	26 - 30	26%	43%	*	1.21	0.96	*
1970 - 1974	21 - 25	63%	72%	*	0.51	0.38	*
1975 - 1979	16 - 20	85%	96%	*	0.18	0.05	*

Diff.: * = Survey values significantly different from benchmark at 5% confidence level

Table A2 Fertility indicators derived from FFS Switzerland (wave 1994/5, weighted), compared with HFD data and with Census 2000

Birth cohort	Age at survey (approx.)	Childlessness			Mean number of children		
		FFS	Census	diff.	FFS	HFD	diff.
1945 - 1949	45 - 49	16%	21%	*	1.83	1.83	
1950 - 1954	40 - 44	20%	23%		1.72	1.76	
1955 - 1959	35 - 39	22%	24%		1.69	1.66	
1960 - 1964	30 - 34	33%	-		1.32	1.30	
1965 - 1969	25 - 29	61%	-		0.60	0.59	
1970 - 1974	20 - 24	91%	-		0.12	0.14	

Diff.: * = Survey values significantly different from benchmark at 5% confidence level

Census results for younger cohorts not shown due to uncomparability

Table A3 Fertility indicators derived from FFS West-Germany (wave 1992, weighted), compared with HFD data

Birth cohort	Age at survey (approx.)	Childlessness			Mean number of children		
		FFS	-	diff.	FFS	HFD	diff.
1952 - 1956	45 - 49	18%	-		1.59	1.57	
1957 - 1961	40 - 44	22%	-		1.51	1.31	*
1962 - 1966	35 - 39	44%	-		0.94	0.72	*
1967 - 1972	30 - 34	81%	-		0.28	0.20	*

Diff.: * = Survey values significantly different from benchmark at 5% confidence level

Table A4 Fertility indicators derived from Swiss Household Panel (wave 2000, weighted), compared with Census 2000

Birth cohort	Age at survey (approx.)	Childlessness			Mean number of children		
		SHP	Census	diff.	SHP	Census	diff.
1910 - 1914	85 - 89	52%	34%		1.15	1.54	
1915 - 1919	80 - 84	23%	30%		1.75	1.75	
1920 - 1924	75 - 79	37%	27%		1.59	1.93	
1925 - 1929	70 - 74	37%	23%	*	1.62	1.99	*
1930 - 1934	65 - 69	35%	20%	*	1.69	2.07	*
1935 - 1939	60 - 64	25%	19%		1.84	2.11	*
1940 - 1944	55 - 59	23%	19%		1.68	2.04	*
1945 - 1949	50 - 54	27%	21%	*	1.71	1.85	
1950 - 1954	45 - 49	24%	23%		1.78	1.72	
1955 - 1959	40 - 44	24%	24%		1.78	1.69	
1960 - 1964	35 - 39	20%	27%	*	1.90	1.68	*
1965 - 1969	30 - 34	33%	39%	*	1.32	1.58	*
1970 - 1974	25 - 29	56%	64%	*	0.77	1.20	*
1975 - 1979	20 - 24	87%	87%		0.20	0.60	*
1980 - 1984	15 - 19	91%	99%		0.09	0.17	

Diff.: * = Survey values significantly different from benchmark at 5% confidence level

Table A5 Fertility indicators derived from GGS Austria (2008/9, weighted using weights of Statistik Austria), compared with Geburtenbarometer data

Birth cohort	Age at survey (approx.)	Childlessness			Mean number of children		
		GGS	Geb.bar.	diff.	GGS	Geb.bar.	diff.
1963 - 1964	44 - 45	16%	18%		1.82	1.69	
1965 - 1969	39 - 43	18%	20%		1.73	1.62	*
1970 - 1974	34 - 38	24%	27%		1.55	1.42	*
1975 - 1979	29 - 33	43%	46%		1.01	0.94	
1980 - 1984	24 - 28	68%	73%	*	0.48	0.39	*
1985 - 1990	18 - 23	91%	94%		0.10	0.08	

Diff.: * = Survey values significantly different from benchmark at 5% confidence level

Table A6 Fertility indicators derived from GGS Austria (2008/9, weighted using VID weights), compared with Geburtenbarometer data

Birth cohort	Age at survey (approx.)	Childlessness			Mean number of children		
		GGS	Geb.bar.	diff.	GGS	Geb.bar.	diff.
1963 - 1964	44 - 45	17%	18%		1.73	1.69	
1965 - 1969	39 - 43	19%	20%		1.65	1.62	
1970 - 1974	34 - 38	24%	27%		1.47	1.42	
1975 - 1979	29 - 33	42%	46%	*	1.01	0.94	
1980 - 1984	24 - 28	70%	73%		0.45	0.39	
1985 - 1990	18 - 23	92%	94%		0.09	0.08	

Diff.: * = Survey values significantly different from benchmark at 5% confidence level

Table A7 Fertility indicators derived from GGS Germany (2008, weighted), compared with Micro-census 2008

Birth cohort	Age at survey (approx.)	Childlessness			Mean number of children		
		GGS	M-census	diff.	GGS	M-census	diff.
1930 - 1934	73 - 77	24%	NA	NA	1.68	NA	NA
1935 - 1939	68 - 72	20%	11%	*	1.96	2.11	*
1940 - 1944	63 - 67	20%	12%	*	1.69	1.93	*
1945 - 1949	58 - 62	21%	14%	*	1.50	1.78	*
1950 - 1954	53 - 57	17%	17%	*	1.54	1.71	*
1955 - 1959	48 - 52	14%	19%		1.68	1.68	
1960 - 1964	43 - 47	17%	21%	*	1.73	1.61	*

Diff.: * = Survey values significantly different from benchmark at 5% confidence level