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Order-Specific Fertility Rates for Germany

Estimates from Perinatal Statistics for the Period 2001-2008

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Abstract: Until 2008, Germany's vital statistics did not include information on the biological order of each birth. This resulted in a dearth of important demographic indicators, such as the mean age at first birth and the level of childlessness. Researchers have tried to fill this gap by generating order-specific birth rates from survey data, and by combining survey data with vital statistics. This paper takes a different approach by using Perinatal Statistics to generate birth order-specific fertility rates for the period 2001 to 2008. Perinatal Statistics includes information on births that took place in German hospitals. Out-of-hospital births, which account for about 2 % of all births, are not included in the Perinatal Statistics. In a sensitivity analysis, we show how robust our estimates are to the inclusion of out-of-hospital births. Our general assessment is that the Perinatal Statistics is a valuable source for generating order-specific fertility rates, regardless of whether out-of-hospital births are included.

Keywords: Birth order · Fertility · Germany · Eastern and Western Germany · Perinatal Statistics

1 Introduction

Across Europe, we have witnessed a postponement of first-time motherhood, and an increase in the share of women who remain childless throughout their lives (*Sobotka* 2004). Despite the obvious importance of these social changes, it is remarkable to recall that, until very recently, some countries did not provide sufficient information to document this change in behaviour. Important demographic indicators, such as the mean age at first birth or the share of permanently childless women, were not available from vital statistics of countries such as Austria, Belgium, Luxembourg, Switzerland, Germany, France and the UK, because order-specific fertility information were not recorded in these countries. Most countries have since

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reformed their vital statistics and Statistical Offices have started collecting data on births by biological order. Austria did so in 1984; France in the year 1998, while England and Wales are expected to ratify a regulation stipulating that order-specific data can be collected from 2011 onwards. Germany's Statistical Office has collected this type of data since 2008, but has not published the data yet as the quality has not been fully checked.

Order-specific birth information will therefore soon be available for almost all European countries. However, we still lack order-specific fertility information for the past. Researchers have tried to fill this gap by drawing on other sources. Order-specific fertility information has been generated from survey data (*Toulemon* 2001; *Smallwood* 2002). Others have tried to combine survey data with vital statistics (*Birg et al.* 1990; *Kreyenfeld* 2002; *Handcock et al.* 2000).

This paper uses Perinatal Statistics to generate order-specific birth rates for the period 2001-2008, a period for which no birth order-specific information is available for Germany. The Perinatal Statistics has been monitored by the *Bundesgeschäftsstelle Qualitätssicherung* (BQS) (Institute for Quality and Safety). It includes clinical records for all children who were delivered in German hospitals. To our knowledge, it is the only data source that contains information on the biological order of hospital births at a population level for Germany. This data has primarily been used in the field of medicine, but some few demographic studies exist that used these data for analysing fertility behaviour (*Hullen* 2003; *Voigt/Hullen* 2005; *Birg/Flöthmann* 1996). These previous studies, however, were only able to draw on data from selected federal states, while this study uses data from the Perinatal Statistics for the whole of Germany for the period 2001 to 2008.

We have structured the paper as follows. In Part 2, we give a detailed account of the Perinatal Statistics provided by the BQS. Part 3 explains the method used to generate age- and order-specific fertility rates with this data. In addition, we provide some initial results on order-specific fertility behaviour in Germany. Part 4 investigates how robust our estimates are, if we not only use data from the Perinatal Statistics, which only includes hospital births, but also consider out-of-hospital births. In this section we additionally draw upon data on out-of-hospital births provided by the *Gesellschaft für die Qualität in der außerklinischen Geburtshilfe e.V.* (QUAG). Part 5 summarises the findings and concludes.

2 Data and variables

2.1 General description of the Perinatal Statistics

Data for this investigation comes from the BQS, which is an institution that monitors the quality of care in German hospitals. One of its responsibilities is to collect the clinical records of the maternity wards of all German hospitals. This initiative dates back to the *Münchner Perinatalstudie,* which was conducted in the period 1975-1977. The main goal of this study was to report on the quality of the maternity wards of all the clinics in the city of Munich. The *Münchner Perinatalstudie* was the

first step towards introducing a systematic statistics that contained the characteristics of a clinical birth, i.e., whether it was a stillbirth, whether a Caesarean was conducted, and whether other complications occurred during delivery or during pregnancy. This procedure was gradually implemented throughout Bavaria and was adopted in the other federal states over the course of the 1980s (*Bundesgeschäftsstelle Qualitätssicherung* 2002: 190). After German unification, the eastern German federal states joined the Perinatal Statistics. While it was initially voluntary, it became compulsory for the hospitals to collect this data in 1995 (*Bundesgeschäftsstelle Qualitätssicherung* 2008: 196). At that time, data collection was still organised on a federal level, and no central register had been implemented. Finally, in 2001, the BQS was assigned the task of establishing a nationwide registry. Since this time, it has been mandatory for all public and private hospitals to document all births (both still and live), and make these records available to the BQS, which stores this information in a data file called *Datensatz Geburtshilfe.*[1]

Data for the Perinatal Statistics are collected by the staff of the hospital where the woman delivers the child. The characteristics of a newborn, such as weight, sex and physical condition, are taken from the medical records of the child. Information on the medical background of the current and previous pregnancies is copied from the pregnancy record (*Mutterpass*) of the mother (*Jahn/Berle* 1996: 132; *Reime et al.* 2008). If this is not available, the mother is asked to provide this information. Additional data (such as smoking habits) are gathered by the staff upon admission to the hospital (*Voigt et al.* 2006; *Schneider et al.* 2008).

The Perinatal Statistics provides a rich set of variables for micro-level analysis for medical and demographic research. However, we should also point out some shortcomings of the data. First, the Perinatal Statistics does not include deliveries that take place at home, in birth centres, or in the offices of midwives.[2] These births make up for about 2 % of all births (see tab. 5). The fact that these births are not included in the Perinatal Statistics is a potential problem because women who opt for an out-of-hospital birth differ in several ways from women who choose the "standard" path of delivering their children in a hospital. Since women only rarely choose to have their first child at home or in a birth centre, out-of-hospital births are often births to older women who already have at least one child (*Loytved/Wenzlaff* 2007, see also fig. 4). We will turn to this issue again later on in a sensitivity analysis (part 4).

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1 When we talk about Perinatal Statistics, we mean the *Datensatz Geburtshilfe* of the BQS. The Perinatal Statistics were assessed through remote execution by sending SPSS syntax scripts to the BQS by email. In 2010, responsibilities have shifted and the "Aqua-Institut" is now monitoring this data (http://www.aqua-institut.de/).

2 If delivery was planned at home or at a birth centre, but the woman was transferred to the hospital during the process of giving birth, the birth was entered into the Perinatal Statistics. *Loytved and Wenzlaff* (2007: 9) show that in roughly 12 percent of all cases in which a birth was intended to occur at home or in a birth centre, the mother was transferred to a hospital. From the perspective of the Perinatal Statistics, about one percent of all deliveries in hospitals were originally expected to occur at home or in a birth centre (*BQS-Bundesauswertung* 2007: 103).

Another shortcoming of the Perinatal Statistics is that data quality varies quite substantially between the calendar years. Although it is mandatory for all hospitals to provide information on all births since 2001, the Perinatal Statistics does not cover all hospital births and not all German federal states in the early years. For 2001, Hesse, Schleswig-Holstein and Saarland did not provide any data to the central register of the BQS. In the subsequent years, these federal states participated, but some hospitals still failed to provide information. These gaps have closed over the years. Since 2004, almost all clinical births have been covered in the Perinatal Statistics.

2.2 Selection of sample

For this study, we use the Perinatal Statistics for the period 2001-2008. Since women can have multiple births, different observation units could be employed. Hence, it is possible to conduct investigations at the *"mother level"* or at the *"child level".* There are also analyses which used singletons only (*Krafczyk* 2007; *Voigt et al.* 2006). For our investigation, the observation unit is the *child*. This corresponds to the vital statistics, which mainly counts live-born children (and not births). To improve the flow of the paper, we use the word "birth" referring to live-born children. The total number of live-born children in the Perinatal Statistics for the period 2001 to 2008 is 4,982,707. In a few cases, it was not possible to identify the year of birth, the order of the birth or the age of the mother. These cases were deleted from the analysis. Furthermore, births in which the mother was older than age 50 or younger than age 11 were also omitted. This leaves us with 4,978,381 live-born children in the final data set.

Table 1 displays the number of births in our sample and compares it with data from the vital statistics provided by the Statistical Office. As can be seen in the table, differences between the vital statistics and the Perinatal Statistics are particularly large in 2001, but they decline over the years. The difference in coverage in the year 2001 can largely be attributed to the fact that Hesse, Schleswig-Holstein and Saarland failed to deliver their data. Coverage increases continuously, and in 2004 about 95 % of all births are covered in the Perinatal Statistics.

Tab. 1: Coverage of births in the Perinatal Statistics

	2001	2002	2003	2004	2005	2006	2007	2008	Total
Births in Perinatal Statistics	452,826	608,122	590,293	671,228	665,718	655,951	667,016	667,227	4,978,381
Births in Vital Statistics	734,475	719,250	706,721	705,622	685,795	672,724	684,862	682,514	5,591,963
Perinatal Statistics/ Vital Statistics	0.62	0.85	0.84	0.95	0.97	0.98	0.97	0.98	0.89

Source: *Statistisches Bundesamt* (2009a), BQS Perinatal Statistics (own estimates)

2.3 Variables

The variables used in our analysis are age, birth order and region. The age of the mother was generated by the BQS, which provided the data. It was generated by subtracting the birth year of the child from the year of birth of the mother. Age is used in single age categories. We also distinguish between western Germany and eastern Germany, the latter one including the city-state of Berlin.[3] Our key variable of interest is the order of birth, which is broken down into the following categories: first-, second-, third-, fourth- and higher-order births. The order of the birth was generated by adding a "one" to the number of previously live-born children. One aspect that required special attention concerns the multiple births. For singletons, the birth order can be generated by simply adding a one to the number of previously live-born children. This strategy needed to be modified for multiple births, because the numbers of previously born children do not take into account the current birth. In other words, if a woman gives birth to twins and does not have any prior children, the number of previous live births is zero in the Perinatal Statistics. If we would apply the same strategy as for singletons, we would assign erroneously both children the birth order one. We corrected this bias by assigning one of the twins the order "one", the other one the order "two".[4]

Table 2 tabulates the distribution of births by birth order and calendar year in our final data set. The table shows that about 50 % were first-; 35 % second-; 10 % third-; and 5 % fourth- and higher-order children.[5]

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3 The German Statistical Office usually excludes Berlin when it generates fertility rates by eastern and western Germany (*Kreyenfeld*/*Pötzsch*/*Kubisch* 2010). It is, however, a problem to exclude Berlin from the Perinatal Statistics. In contrast to the vital statistics, which uses the place of residence of the mother, the Perinatal Statistics surveys the place of birth of the child. This means that we cannot generate the fertility rates by federal state, because we would have to use a different definiton of region for the weights and for the base population than in the Perinatal Statistics. This is particularly true for Berlin, because some women who live in the federal state of Brandenburg choose a hospital in Berlin to deliver their child.

4 We first generated a "master table" that contained the number of all children by order, age and region. Furthermore, we generated a "multiple birth table" that contained multiple births by order, age and region. From the master table, we subtracted half of all multiple births of a given order. These children were then added to the next birth order. For simplicity, we assumed that all multiple births are twin births.

5 Data by age and region have been made available as a MPIDR Technical Report (http://www.demogr.mpg.de/en/publications/technicalreports.htm). This report also contains a detailed description of the potential of the Perinatal Statistics. The Perinatal Statistics provides a rich source for demographic analyses as detailed information on past pregnancies, live and still births, abortions and miscarriages. Unfortunately, this data cannot be used to generate exposure rates as pregnancy dates of past pregnancies are not included.

Tab. 2: Number of live-born children by birth order, absolute numbers and column percent

	2001	2002	2003	2004	2005	2006	2007	2008	Total
Absolute numbers									
1st child	220,525	294,635	285,152	324,693	321,622	315,772	324,234	325,759	2412,390
2nd child	156,934	211,359	206,091	233,625	231,540	226,136	228,948	228,698	1723,330
3rd child	51,166	69,566	67,159	77,217	76,703	77,599	77,577	76,900	573,885
4th+ child	24,202	32,563	31,893	35,693	35,854	36,444	36,258	35,870	268,777
Total	452,826	608,122	590,293	671,228	665,718	655,951	667,016	667,227	4,978,381
Column %									
1st child	49%	48%	48%	48%	48%	48%	49%	49%	48%
2nd child	35%	35%	35%	35%	35%	34%	34%	34%	35%
3rd child	11%	11%	11%	12%	12%	12%	12%	12%	12%
4th+ child	5%	5%	5%	5%	5%	6%	5%	5%	5%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%

Source: BQS Perinatal Statistics (own estimates)

3 Method and first results

3.1 Estimating order-specific fertility rates from Perinatal Statistics (Method 1)

Our main goal is to use the Perinatal Statistics to generate age- and order-specific fertility rates for Germany. Since fertility patterns in eastern and western Germany continue to differ (*Konietzka/Kreyenfeld* 2007), we will estimate separate fertility rates for eastern Germany (including Berlin) and western Germany (excluding Berlin). In order to generate these rates, the number of births and the base population of women are necessary. Data on the number of women by age and region (eastern and western Germany) comes from German vital statistics. A problem arises when calculating fertility rates because the Perinatal Statistics does not include all births. In order to calculate birth rates, we weighted the data of the Perinatal Statistics to match the total number of births in Germany.

We have constructed a weighting factor that considers age, year and region (eastern and western Germany). Let B^V be the number of births in the vital statistics, B^P be the number of births in the Perinatal Statistics, $\hat{B}$ be our estimated number of births, i be the order of the births, and w be the weighting factor. The weight accounts for age *(a),* year (*t*) and region (*r*). The weighting factor is generated by the ratio of the number of births in the vital statistics and the number of births in the Perinatal Statistics:

$$w(a,t,r) = \frac{B^V(a,t,r)}{B^P(a,t,r)} \tag{1}$$

In the next step, the numbers of births for each order *i* from the Perinatal Statistics B_i^P, differentiated into age *(a),* year *(t)* and region *(r)*, are multiplied by the weights. This gives the estimated number of births:

$$\hat{B}_i(a,t,r) = B_i^P(a,t,r) \times w(a,t,r) \tag{2}$$

To generate age- and order-specific fertility rates, the estimated births are related to the number of women by age, region and calendar year.

3.2 Preliminary results on order-specific fertility behaviour in Germany

It is beyond the scope of this paper to provide a comprehensive overview of eastern and western German fertility dynamics. However, we still seek to provide some basic demographic indicators based on our estimated values. Table 3 displays the order-specific TFR, while table 4 shows the mean ages at childbirth.[6] Figures 1 and 2 graph these indicators.

Tab. 3: Order-specific TFR (ages 15-44)

	2001	2002	2003	2004	2005	2006	2007	2008
Eastern Germany								
1st child	0.66	0.66	0.67	0.69	0.67	0.67	0.69	0.71
2nd child	0.38	0.39	0.40	0.42	0.41	0.42	0.45	0.46
3rd child	0.11	0.11	0.11	0.12	0.12	0.13	0.13	0.14
4th+ child	0.06	0.05	0.06	0.06	0.06	0.06	0.07	0.07
Total	1.21	1.21	1.23	1.28	1.26	1.28	1.34	1.38
Western Germany								
1st child	0.69	0.68	0.67	0.67	0.66	0.65	0.67	0.67
2nd child	0.48	0.47	0.48	0.48	0.47	0.46	0.47	0.47
3rd child	0.15	0.15	0.15	0.16	0.15	0.16	0.16	0.16
4th+ child	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Total	1.38	1.37	1.36	1.37	1.35	1.34	1.37	1.38
Germany								
1st child	0.68	0.67	0.67	0.68	0.66	0.65	0.67	0.68
2nd child	0.46	0.46	0.46	0.47	0.46	0.46	0.47	0.47
3rd child	0.14	0.14	0.14	0.15	0.15	0.15	0.15	0.16
4th+ child	0.07	0.06	0.07	0.07	0.07	0.07	0.07	0.07
Total	1.35	1.34	1.34	1.36	1.34	1.33	1.37	1.38

Source: BQS Perinatal Statistics (own estimates), *Statistisches Bundesamt* (2009a)

6 In the tables and graphs, we have used ages 15-44, because we only had aggregated values on the number of births from the vital statistics for the ages 45 and older and 14 and younger. In order to generate order-specific fertility rates for these ages, we would have had to generate a separate weighting factor.

Tab. 4: Mean age at childbirth by birth order (ages 15-44)

	2001	2002	2003	2004	2005	2006	2007	2008
Eastern Germany								
1st child	26.12	26.35	26.60	26.85	26.97	27.07	27.29	27.47
2nd child	29.32	29.54	29.66	29.86	29.94	30.10	30.45	30.67
3rd child	31.42	31.64	31.62	31.62	31.63	31.83	32.07	32.21
4th+ child	33.15	33.23	33.09	33.00	33.10	33.21	33.08	33.34
All births	27.94	28.14	28.34	28.55	28.68	28.85	29.10	29.30
Western Germany								
1st child	27.43	27.57	27.74	27.95	28.10	28.26	28.49	28.69
2nd child	29.88	30.04	30.15	30.30	30.43	30.57	30.78	30.98
3rd child	31.46	31.57	31.65	31.79	31.87	31.96	32.19	32.35
4th+ child	33.06	33.09	33.19	33.26	33.32	33.41	33.49	33.56
All births	28.99	29.14	29.28	29.46	29.60	29.76	29.97	30.15
Germany								
1st child	27.14	27.32	27.50	27.73	27.87	28.02	28.25	28.45
2nd child	29.81	29.96	30.08	30.23	30.35	30.49	30.72	30.92
3rd child	31.51	31.58	31.66	31.76	31.83	31.94	32.17	32.33
4th+ child	33.12	33.12	33.19	33.21	33.28	33.37	33.41	33.52
All births	28.80	28.96	29.11	29.29	29.43	29.59	29.80	29.99

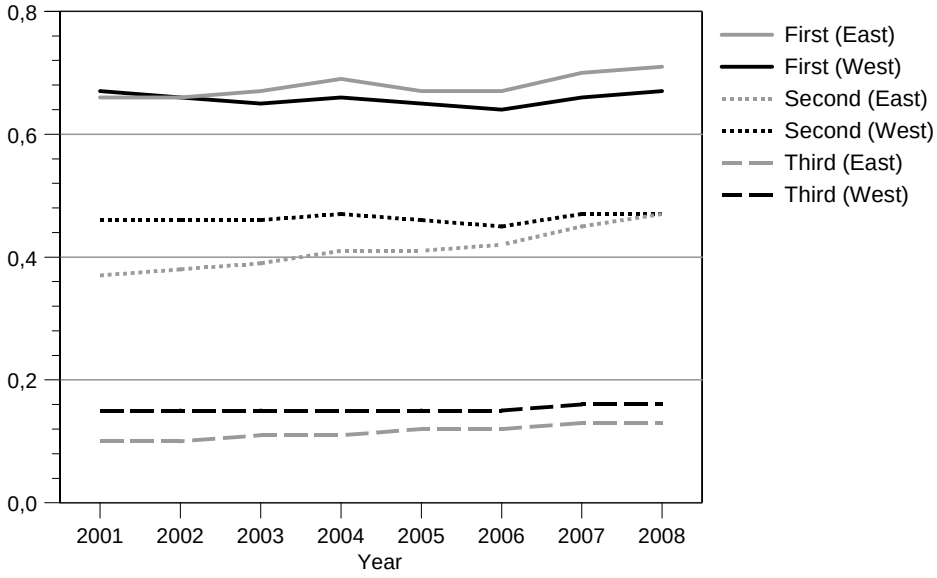
Notes: Mean ages were generated based on age-specific fertility rates.
Source: BQS Perinatal Statistics (own estimates), *Statistisches Bundesamt* (2009a)

Regarding figure 2, changes in the age at first birth are most remarkable. In 2001, western German women were, on average, 27.4 years of age at first birth; by 2008, they were 28.7 years old. This finding suggests that the trend towards postponing the first birth has not yet halted, despite the fact that West Germany was one of the countries where fertility postponement started rather early. Ages at second birth have increased to a lesser extent than ages at first birth. For higher-order births, there is basically no change over time in the mean age at childbirth. The results also show that the order-specific TFRs did not change much between 2001 and 2008.

In eastern Germany, there is a stronger increase in the age at first birth than in western Germany. We observe an increase in the age at first birth of about 1.5 years between 2001 and 2008. However, eastern German women are in 2008 still one year younger at first birth than their counterparts in the West. East-West differences in the age at second birth are smaller, which suggests that eastern Germans space first and second births farther apart than western Germans.

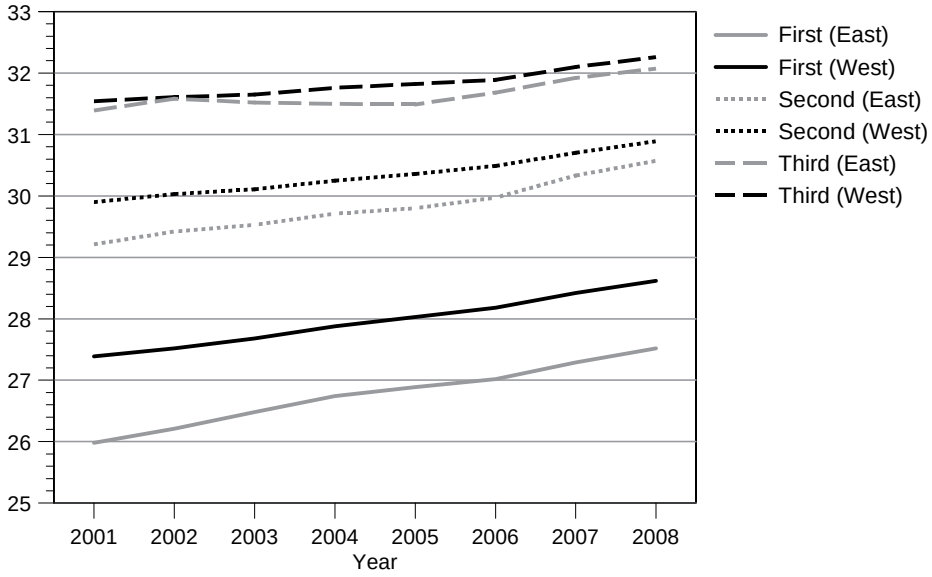
The most surprising finding for eastern Germany is the strong increase in the TFR for second births (see fig. 1). Given that second birth rates dropped radically in eastern Germany after unification (*Sackmann* 1999; *Huinink* 2005; *Kreyenfeld* 2009), this result could represent a first indication of a recuperation of second birth rates. Compared to the pattern in western Germany, one still needs to draw attention to the low progression ratios to the third child. During GDR-time, third and higher or-

Fig. 1: Order-specific TFR (ages 15-44)



Source: BQS Perinatal Statistics (own estimates), *Statistisches Bundesamt* (2009a)

Fig. 2: Mean age at childbirth by birth order (ages 15-44)



Notes: Mean ages were generated based on age-specific fertility rates.
Source: BQS Perinatal Statistics (own estimates), *Statistisches Bundesamt* (2009a)

der birth rates were rather low (*Kreyenfeld* 2004) and our investigation based on the Perinatal Statistics suggests that low progression ratios to the third child are still a characteristic of contemporary eastern German fertility.

4 Sensitivity analysis

4.1 Statistics on out-of-hospital births (QUAG Statistics)

A key question for our analyses is how robust the estimated number of births is given the fact that the Perinatal Statistics does not include all births. In particular, the question arises of whether the results are biased because home births are not included. Until recently, no information on out-of-hospital births has been available, and medical as well as epidemiological studies used only hospital births for their investigations. In 1999, however, the midwives in Germany founded the *Gesellschaft für Qualität in der außerklinischen Geburtshilfe e.V.* (QUAG). The aim of QUAG, like the BQS, is to monitor the quality of medical care. A questionnaire similar to the one used in collecting the Perinatal Statistics is conducted for out-of-hospital births. Although participation is voluntary, about 80 % of all out-of-hospital births are covered in this data source, which we refer to as QUAG Statistics in the following (*Loytved* 2009: 6). Because the variables available in the QUAG Statistics are almost the same as the ones used in the Perinatal Statistics, the two sources can be combined in a straightforward manner.

An essential measure of quality for the QUAG Statistics is how many of all out-of-hospital births are included in the data set. Table 5 compares the number of births in the QUAG Statistics with the calculated total number of out-of-hospital births in Germany.[7] As can be seen from this table, coverage of the out-of-hospital births in the QUAG Statistics ranges from 68 to 91 %. This is substantially lower than the coverage of the Perinatal Statistics. However, the sample size is still high enough to give us a reasonable estimate of the age and parity distribution of out-of-hospital births.

4.2 Age structure of out-of-hospital births

The share of out-of-hospital births is, at 1 to 2 % of all births, rather low (see tab. 5). However, they differ from hospital births systematically by order and age of the mother. This can be discerned from figure 3 and figure 4 exemplarily for the year 2008. Figure 3 plots the age pattern of births in the Perinatal Statistics and in the

7 Unfortunately, there are no official records on the total number of out-of-hospital births in Germany. They can neither be generated from the Perinatal Statistics as this statistics is not complete during the first years after the central register had been established. The data in table 5 therefore comes from the *„Gesundheitsberichterstattung des Bundes"* (*Statistisches Bundesamt* 2009b). We should note, however, that this is probably the upper benchmark for the actual amount of out-of-hospital births (*Loytved* 2009: 6).

Tab. 5: Coverage of births in QUAG Statistics

	2001	2002	2003	2004	2005	2006	2007	2008
Number of births in QUAG Statistics	8,245	8,219	8,561	8,686	8,305	8,315	8,188	8,280
Out-of-hospital births in Germany*	9,841	11,236	9,415	12,130	12,260	10,859	10,997	9,799
Number of births in Germany	734,475	719,250	706,721	705,622	685,795	672,724	684,862	682,514
Coverage of out-of-hospital births in QUAG Statistics	84%	73%	91%	72%	68%	77%	74%	84%
Share of out-of-hospital births out of all births in Germany	1%	2%	1%	2%	2%	2%	2%	1%

* The number of out-of-hospital births was generated as the difference between the number of births in the vital statistics and the number of hospital births taken from the *Gesundheitsberichterstattung des Bundes* (*Statistisches Bundesamt* 2009b).

Source: BQS Perinatal Statistics and QUAG Statistics (own estimates), *Statistisches Bundesamt* (2009a/b)

QUAG Statistics. The figure supports previous findings that out-of-hospital births are mostly births to older women (*Loytved/Wenzlaff* 2007). Figure 4 plots the distribution of births by birth order in both the Perinatal and the QUAG Statistics. This figure shows that out-of-hospital births are more likely to be of higher-order births than hospital births. Only 17 % of births in the Perinatal Statistics of 2008 were of order three and higher, compared to 28 % in the QUAG Statistics.

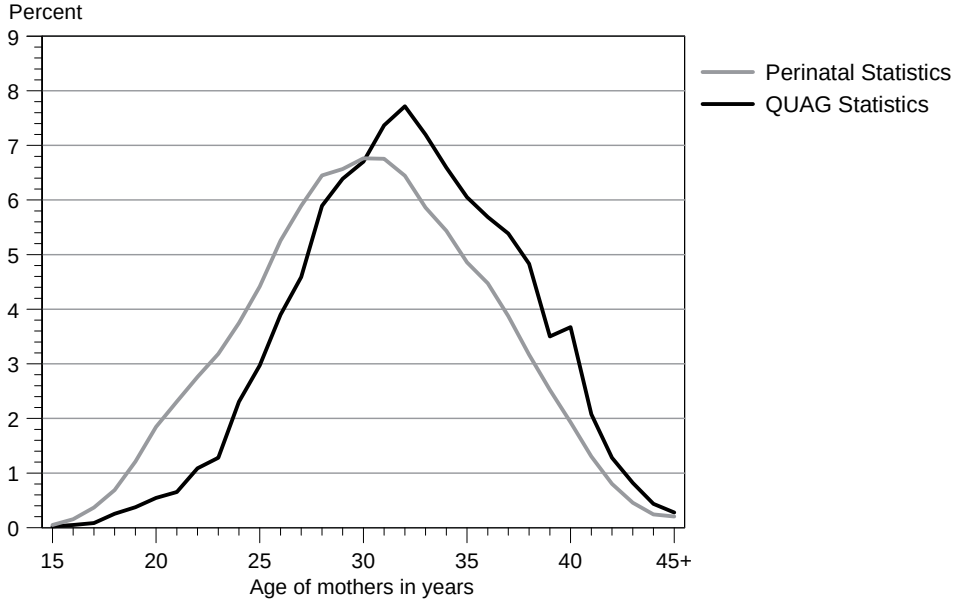
4.3 Estimating order-specific fertility rates from Perinatal Statistics and QUAG Statistics (Method 2)

The differences in the age structure between hospital and out-of-hospital births raise the question of to what extent our previous results (Method 1) are affected by the omission of out-of-hospital births. In the following, we address this issue by using additional information on out-of-hospital births. For this purpose, we have constructed a similar weighting factor as before (see part 3). However, instead of just using the births from the Perinatal Statistics, we also accounted for the births in the QUAG Statistics.

Let B^V be the number of births in the vital statistics, B^Q be the number of births in the QUAG Statistics, B^P be the number of births in the Perinatal Statistics, i be the order of the births, and w^* be the new weighting factor. The weight again accounts for age (a), year (t) and region (r). It is generated by dividing the number of births from the vital statistics by the sum of the number of births in the Perinatal and the QUAG Statistics:

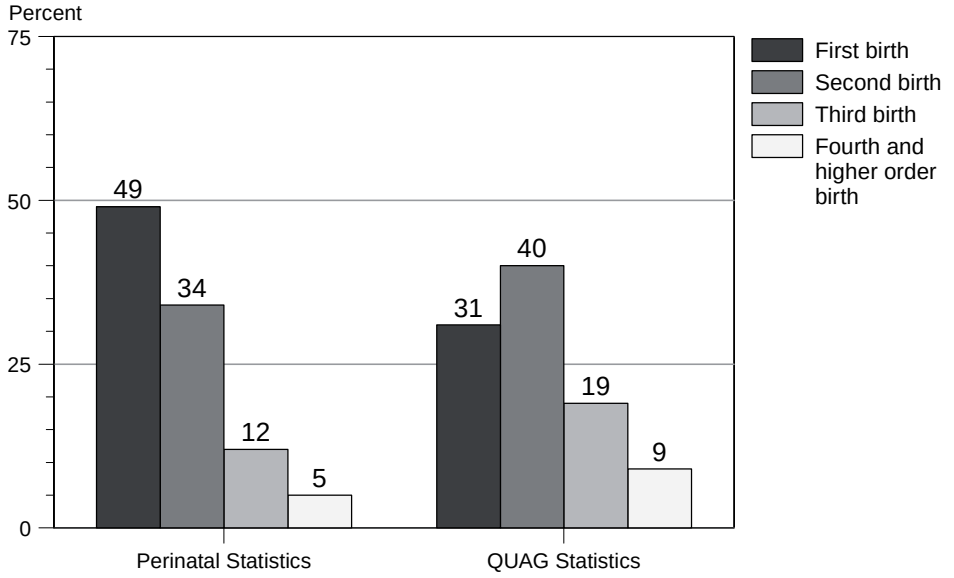
$$w^*(a,t,r) = \frac{B^V(a,t,r)}{B^P(a,t,r) + B^Q(a,t,r)} \tag{3}$$

Fig. 3: Age pattern of births in Perinatal and QUAG Statistics in 2008 (percent of births by single ages out of all births)



Source: BQS Perinatal Statistics and QUAG Statistics (own estimates)

Fig. 4: Distribution of births by order in Perinatal Statistics and QUAG Statistics in 2008



Note: If percent do not add up to 100, this needs to be attributed to rounding errors.
Source: BQS Perinatal Statistics and QUAG Statistics (own estimates)

In the next step, the number of order-specific births B_i^P and B_i^Q by age (a), year (t) and region (r) from the Perinatal and the QUAG Statistics are multiplied by the new weights to obtain the estimated number of births:

$$\hat{B}_i^*(a,t,r) = \left[B_i^P(a,t,r) + B_i^Q(a,t,r)\right] \times w^*(a,t,r) \tag{4}$$

4.4 Comparison of estimates from Method 1 and Method 2

Table 6 compares the TFR from Methods 1 and 2. In the first half of the table (under the heading "Method 1"), the estimates that we derived from the Perinatal Statistics are displayed. In the second part of the table (under the heading "Method 2") are the estimates based on the Perinatal Statistics and the QUAG Statistics. The last part of the table gives the difference between both estimates. The comparison shows that both methods provide similar results. Differences in the TFR never exceed the value of 0.002.

Table 7 displays estimates of the mean age at childbirth by birth order. Again, we observe hardly any differences between the two methods. Thus, we can conclude that measures of centrality, like the mean age at childbirth or the TFR, are not affected by the fact that the Perinatal Statistics does not include births that have not occurred in hospitals.

Finally, figure 5 displays how the age pattern of births differs between the two methods in the year 2008. Here, we generated a ratio; i.e., we divided the number of births from Method 1 by the number of births from Method 2 for each age. As can be seen from the figure, differences between the two methods increase at higher ages. This is compatible with the idea that Method 2, unlike Method 1, accounts for out-of-hospital births, which are more prevalent at higher ages. However, the ratio is mostly between 0.99 and 1.01, which indicates that the differences in the estimated number of births between both methods do not exceed 1 %. It is only for the ages below 20 and above 40 that the differences can increase to up to 2 %. From this sensitivity analysis we conclude that it might be sufficient to just draw on the Perinatal Statistics to estimate order-specific fertility rates in the future.

Tab. 6: TFR by birth order (ages 15-44), comparison of Method 1 and Method 2

	2001	2002	2003	2004	2005	2006	2007	2008
Method 1								
1st child	0.683	0.675	0.669	0.676	0.663	0.652	0.675	0.680
2nd child	0.456	0.457	0.460	0.467	0.462	0.456	0.469	0.472
3rd child	0.142	0.144	0.144	0.148	0.147	0.152	0.155	0.155
4th+ child	0.065	0.065	0.065	0.065	0.066	0.068	0.070	0.070
Method 2								
1st child	0.681	0.673	0.667	0.675	0.661	0.651	0.673	0.678
2nd child	0.458	0.458	0.461	0.468	0.462	0.457	0.470	0.473
3rd child	0.143	0.145	0.144	0.149	0.148	0.152	0.155	0.156
4th+ child	0.065	0.065	0.066	0.066	0.066	0.069	0.070	0.071
Method 2 - Method 1								
1st child	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002
2nd child	0.001	0.000	0.001	0.001	0.001	0.001	0.001	0.001
3rd child	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
4th+ child	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

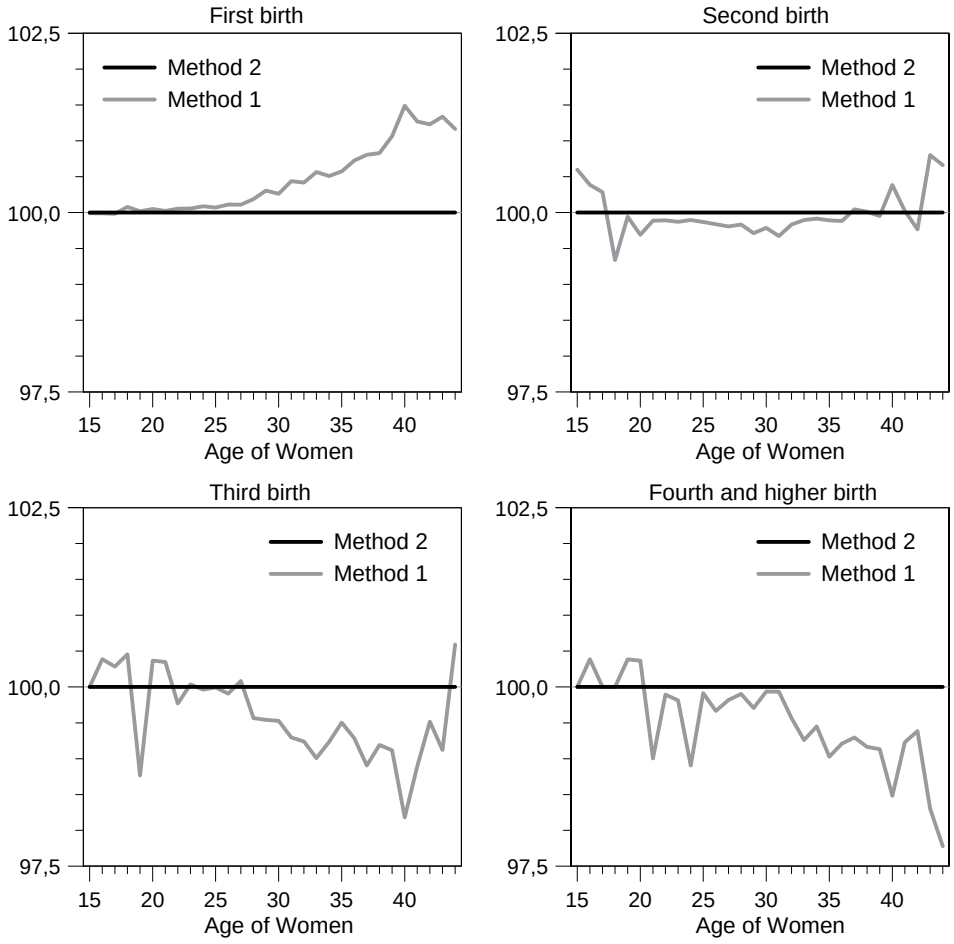
Source: QUAG Statistics and Perinatal Statistics (own estimates)

Tab. 7: Mean ages at childbirth by birth order (ages 15-44), comparison of Method 1 and Method 2

	2001	2002	2003	2004	2005	2006	2007	2008
Method 1								
1st child	27.144	27.325	27.502	27.726	27.875	28.017	28.251	28.446
2nd child	29.814	29.960	30.076	30.229	30.348	30.492	30.723	30.919
3rd child	31.505	31.582	31.662	31.764	31.830	31.940	32.169	32.331
4th+ child	33.120	33.115	33.189	33.213	33.280	33.369	33.415	33.519
Method 2								
1st child	27.128	27.312	27.489	27.714	27.862	28.003	28.237	28.432
2nd child	29.813	29.958	30.074	30.227	30.346	30.492	30.722	30.916
3rd child	31.514	31.592	31.673	31.773	31.840	31.948	32.183	32.346
4th+ child	33.140	33.129	33.201	33.223	33.295	33.387	33.430	33.533
Method 2 - Method 1								
1st child	-0.016	-0.013	-0.013	-0.011	-0.013	-0.014	-0.014	-0.014
2nd child	-0.001	-0.002	-0.002	-0.002	-0.002	0.000	-0.001	-0.003
3rd child	0.009	0.011	0.011	0.009	0.011	0.008	0.013	0.014
4th+ child	0.019	0.014	0.012	0.010	0.015	0.018	0.015	0.014

Notes: Mean ages were generated based on age-specific fertility rates.
Source: QUAG Statistics and Perinatal Statistics (own estimates)

Fig. 5: Ratio of estimated births from Method 2 and Method 1 by single ages, Germany 2008



Notes: Method 1: Estimates based on Perinatal Statistics;
Method 2: Estimates based on combination of Perinatal Statistics and QUAG Statistics (own estimates)

5 Summary and conclusions

Until recently, German vital statistics has not included order-specific fertility data so that important demographic measures, such as the mean age at first birth or the order-specific TFRs cannot be generated. The main goal of this paper was to delineate how this dearth of demographic data can be overcome by estimating order-specific fertility rates by using Perinatal Statistics. As Perinatal Statistics does not include all births in Germany, they had to be re-weighted in such a way that they matched the

official number of births from the vital statistics. Based on these estimates and additional data on the population of females, we have generated age- and order-specific fertility rates for eastern and western Germany, as well as for Germany in total.

We have also tried to assess the size of the bias created by the fact that out-of-hospital births, which account for about 2 % of all births in Germany, are not included in the Perinatal Statistics. Our sensitivity analysis has shown that the inclusion of out-of-hospital births (QUAG Statistics) does not have a noticeable impact on our estimates. In particular, measures of centrality, like the mean age at childbirth or the TFR by order of birth do not change in any substantial manner, if we additionally use data from the QUAG Statistics. Apparently, the share of out-of-hospital births is too small to affect our estimates to a significant degree.

We have also used this data to give a rough overview on the trends in order-specific fertility behaviour in Germany. Our estimates show that the age at first birth is continuously increasing in western and eastern Germany during the period 2001-2008. If one compares ages at first birth in both parts of the country, strong differences in the age at first-time-parenthood prevail. Women in the eastern states are more than one year younger at first birth than their counterparts in the western states in 2008. Another remarkable aspect about eastern German fertility is the strong increase in second birth rates in recent years which might suggest that eastern Germany has broken the "trend towards the one-child family" (*Huinink* 2005). Third birth rates have somewhat increased in eastern Germany too, but they are still much lower than in the western states of Germany.

Overall, this first investigation shows persisting differences in order-specific differences in behaviour between eastern and western Germany. It remains to be seen how these order-specific differences develop in the future and whether fertility behaviour in eastern and western Germany converges any further. As Germany has recently reformed its vital statistics and provided order-specific fertility information, it will be possible to merge the time series from the Perinatal Statistics with the one from the vital statistics to investigate the trend in order-specific birth behaviour.

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