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WHO HAS MORE CHILDREN IN SWITZERLAND: SWISS OR FOREIGN WOMEN?

WHY THE TFR IS A MISLEADING MEASURE

MARION BURKIMSHER; CLÉMENTINE ROSSIER; PHILIPPE WANNER

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Authors

Burkimsher, M. (1)

Rossier, C. (2)

Wanner, P. (2)

Abstract

The Swiss Federal Statistical Office publishes data showing that the TFR of foreign women is much higher than for Swiss women. However, statistics from household registration (STATPOP) and from the Family and Generations Survey (FGS) indicate that foreigners have slightly smaller families than Swiss women. How can we reconcile this apparent contradiction? To do this we follow the fertility of cohorts of Swiss and foreign women through their reproductive life. In addition to birth registrations and population totals by age (the input data for calculating the TFR) we also include data on how many children women have at the time of their immigration, emigration and naturalisation.

Using these input data, we compiled the fertility profiles of Swiss and foreign women aged 15-49 (cohorts 1965-2001); these correspond well with the FGS and household register data. Most immigrants arrive childless and start childbearing in the years following arrival; hence, younger foreign women in Switzerland have higher fertility than Swiss women. However, the ongoing inflow of low fertility women 'dilutes' the average fertility of older foreign women. Naturalisation—which is more frequent for women with children—significantly impacts the fertility profile of 'Swiss' and 'foreign' women. We confirmed that the TFR gives an inflated impression of the ultimate fertility of foreign women, and under-estimates that of Swiss women, because foreign women are only in the receiving country (Switzerland) for the most fertile portion of their reproductive career. Our comprehensive fertility model covering the entire reproductive life course better describes fertility differentials by age and nationality.

Keywords

Comprehensive Fertility Profile | immigrant fertility | foreigner fertility | TFR | cohort fertility | naturalisation

Authors' affiliations

(1) Independent researcher affiliated to the University of Lausanne

(2) Institute of Demography and Socioeconomy, University of Geneva

Correspondence to

drmarionb@gmail.com

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1. Introduction

The aim of this paper is to reconcile two superficially contradictory observations: firstly, that the TFR of foreigners in Switzerland is significantly higher than the TFR of Swiss women; and secondly (using the data from household registers (2011-2014) and the Family and Generations Survey (FGS) of 2013) that Swiss women have slightly larger families, on average, than foreign women.

This is a complex story. After introducing definitions, giving an overview of the literature on how other researchers have tackled the question and the specifics of the Swiss situation, we then look in detail at the different measures of fertility. These point to a conflict of conclusions one could draw about the fertility of the native population versus foreign women. Then, by incorporating estimations for fertility at immigration, emigration and naturalisation, we develop a model describing the fertility by age of the Swiss and foreign subgroups and compare it with the data sources, finding excellent agreement. This reconstruction elucidates the processes which occur through the life course and which produce the differences by nationality of these two measures. This work demonstrates why the TFR is such a misleading measure for predicting cohort fertility of foreign women in particular.

2. Nomenclature

This study looks at residents of Switzerland both by their nationality and their migration status. To clarify, these are the meanings of the terms we use in this paper:

Swiss national or simply 'Swiss': individuals holding Swiss nationality. They may also hold additional nationalities. They may have had Swiss nationality from birth or gained it during their lifetime through naturalisation.

Foreigner: someone with any nationality(ies) but not including Swiss nationality. They may or may not have been born in Switzerland.

Immigrant: someone who has moved into Switzerland during their life, whatever their nationality. This includes those who spent some or most of their earlier life already in Switzerland but moved away for a period of time (e.g. to study or work) before coming back.

Emigrant: someone who leaves Switzerland to live elsewhere, either temporarily or permanently.

Period fertility: The TFR is an indicator of the intensity of births in a particular year.

Cohort fertility: The completed cohort fertility (CCF) measure is the actual number of children cohorts of women have had, on average, through their reproductive life.

Both the TFR and CCF are single numbers relating to either a year or a cohort (birth year). This study rejects the concept that fertility can be described by a single number, but instead develops a vector of numbers which describes the fertility of the whole set of women of different cohorts and in two population sub-groups (Swiss and foreign) who co-exist at a single point in time. We name it the Comprehensive Fertility Profile: it is a set of values for the fertility rate of women at each age (15-49) in a single year. This set of measures avoids the distortions caused by migration and postponement.

3. Literature review

The standard measure of fertility, the Total Fertility Rate, is incorrectly assumed by non-demographers to reflect the average number of children a woman will ultimately have, whereas it is actually a measure of the intensity of childbearing in a specific year (of the group of women in question). Sobotka and Lutz (2011) heavily criticised its use because, although it is a simple measure, it does not accurately reflect cohort fertility and is easily misinterpreted by policy-makers. The distortions to the TFR caused by postponement have been addressed extensively (the classic paper on this is Bongaarts and Feeney 1998); the distortions inherent in calculating the TFR of immigrants or the foreign population have received less attention.

The reason the TFR is so unhelpful in characterising immigrant fertility is because there is, commonly, a high intensity of childbearing in the years immediately after arrival in the new country following subdued fertility in the years preceding migration (Ng and Nault 1997; Robards and Berrington 2016; Toulemon and Mazuy 2004). The TFR for foreigners (as opposed to immigrants) is even more susceptible to distortion because women who stay longer in a country more often naturalise and are then no longer foreign nationals: therefore the TFR of foreigners tends to relate only to women who have been in the country for a relatively short duration – after they arrive but before they naturalise, which is also a period of peak likelihood for partnering and starting a family (Sobotka and Lutz 2011).

Few attempts have been made to date to attempt to correct the distortion inherent in the TFR for the immigrant population. Toulemon and Mazuy (2004) have carried out one of the

most comprehensive studies to date. They compared the fertility rates calculated using three methods, all using the large data set of the 1999 survey “Étude de l’Histoire Familiale” (EHF; Study of Family History in English): (1) A TFR measure, using estimated age-specific fertility rates which have been adjusted to account for the period of high childbearing soon after an immigrant arrives (2) The “own children method” (Cho, Retherford and Choe 1986, Chapter VIII) which reconstructs, for years prior to the survey, the age-specific period fertility rates by linking the mothers (by age) and the known ages of her children; and (3) A novel methodology they developed combining data on the fertility of immigrants at the time they arrived in France (by age of arrival) plus their fertility in subsequent years. They found that the third method indicated a much smaller excess in fertility of immigrants compared to native French residents—of the order of 0.5—compared to the TFR method which suggested an excess of 0.7 children/woman. Women who arrived between 14 and 21 years of age had the highest excess fertility compared to native French women. The authors acknowledge that one limitation of their analysis is that emigration and the (low) fertility of emigrants is not taken into account, and the fact that the younger that women arrive in the country, the longer they are likely to stay (and so be included in any survey).

Robards and Berrington (2016) also included the fertility of women prior to migration in their calculations of the fertility of immigrants to the UK and they also highlighted the high rates of fertility in the years soon after their immigration, these varying by age of arrival in the country and country of origin.

Several other studies have used the “own children method” to compare native and immigrant fertility, including studying immigrants from specific countries (Krapf and Kreyenfeld 2015; Wanner 2002; Abbasi-Shavazi and McDonald 2002; Dubuc 2009). In the latter three papers, the TFRs of prior years are calculated, which commonly indicate that (high fertility) immigrant populations approach the (low-fertility) regime of the host country after a period of time.

Yet another novel approach to compare the fertility of different ethnicities in the UK is that described by Dubuc (2009); the child-woman ratio (CWR). This is calculated as the number of children aged 0-4 to women aged 15-49. The TFR of a chosen ethnicity (e) is the $TFR(\text{full population}) \times (CWR_e/CWR_{all})$. Dubuc found comparable results from her (refined) own-child method and the CWR.

Wanner (2002) and Wanner and Fei (2005) used the census data of 2000 (which included a question on ever-born children and their years of birth) to derive the TFR of Swiss

and foreign women using the own children method. The first paper includes the TFR of 68 nationalities, showing a wide range, from 4.2 (Somalians) to 0.94 (Romanians). In the second paper a ‘standardised TFR of foreigners’ was calculated, by assuming that the distribution of foreign women by nationality had remained constant and identical to the 1981 distribution and calculating the ASFRs for different nationalities. As this ‘standardised’ measure was significantly lower than the non-standardised one (1.52 for 1997 compared to 1.85) the deduction was made that the new arrivals of the 1990s (many from ex-Yugoslavia) had higher fertility than the traditional immigrants from Italy and Spain.

Rojas, Bernardi and Schmid (2018) used the Family and Generations Survey in Switzerland to compare, for Swiss and foreign women of various origins, the transition to first and second birth. Both first- and second-generation women were studied and both the speed and likelihood of having a first or second child were compared using survival analysis. They found that, compared to Swiss natives, immigrants become parents younger and more often; they are less likely to remain childless. However, having a second child is less frequent and comes after a longer birth interval for migrants compared to native Swiss. Rephrasing in TFR terms, this would indicate that the TFR1 (the fertility rate for first births only) is higher for foreigners, but the parity progression ratio 1st-2nd is lower, compared to that for Swiss women.

4. Data sources

The following are the primary data sources used in this paper.

1. Decennial census. The last one was in December 2000; since 2010 population registers have supplied equivalent data. As well as supplying basic population numbers by age and sex, the 2000 census also provided a wealth of other information which has been exploited for this paper: number of biological children and their year of birth (up to the 5th or last); country of birth; nationality and year of naturalisation. However, it does not include the year an immigrant moved into Switzerland. The census data is ‘almost’ comprehensive; however, of women aged 20-39, 4.5% of Swiss women and 8.9% of foreign women did not respond, and although we suspect that many non-respondents are childless, we cannot confirm this.
2. Household register data (STATPOP), from 2010 onwards. This collates data from all households in Switzerland with information on the age, sex, nationality and country of birth of all co-residents in each household plus any change which has happened in the

previous year (birth, civil status, naturalisation) (SFSO, 2016a). The latest data available was from 2014. However, the relational links between members of a household are not recorded.

3. Birth registration by age and nationality of the woman, whether Swiss or foreign (the BEVNAT database). Since 2011 births by country of birth of mother (Switzerland or abroad) have also been recorded. From 1971 onwards the SFSO has published the TFR of Swiss and foreign women and, from 2011, by nationality and country of birth of mother. For the years 2000-2014 the SFSO have supplied us with births by biological birth order to Swiss and foreign women.
4. The PETRA database collated information about foreign residents up to 2009 (SFSO 2016b), since when the STATPOP database has been the source of equivalent information. These are the sources of estimates of the annual number of naturalisations by age and sex.
5. Family and Generations Survey 2013 (SFSO 2018). This was a representative survey of 17,000 respondents, covering women (and men) aged 16-79. It includes their nationality(ies), country of birth, their number of children and years of birth. Where applicable it also includes the age when they immigrated and naturalised. It is similar in focus to the Generations and Gender Survey, carried out in 19 other European countries.
6. Data from the Migration-Mobility Survey, a sample survey of immigrants who have lived in Switzerland for less than 10 years. This provides estimates of the proportion of mothers who arrive in Switzerland without their biological children.

5. Population structure and trends

We now look at the structure of the female population of reproductive age by country of birth and nationality (Figure 1), how the foreign population has changed in recent years (Figure 2) and the balance of immigration and emigration by age (Figure 3).

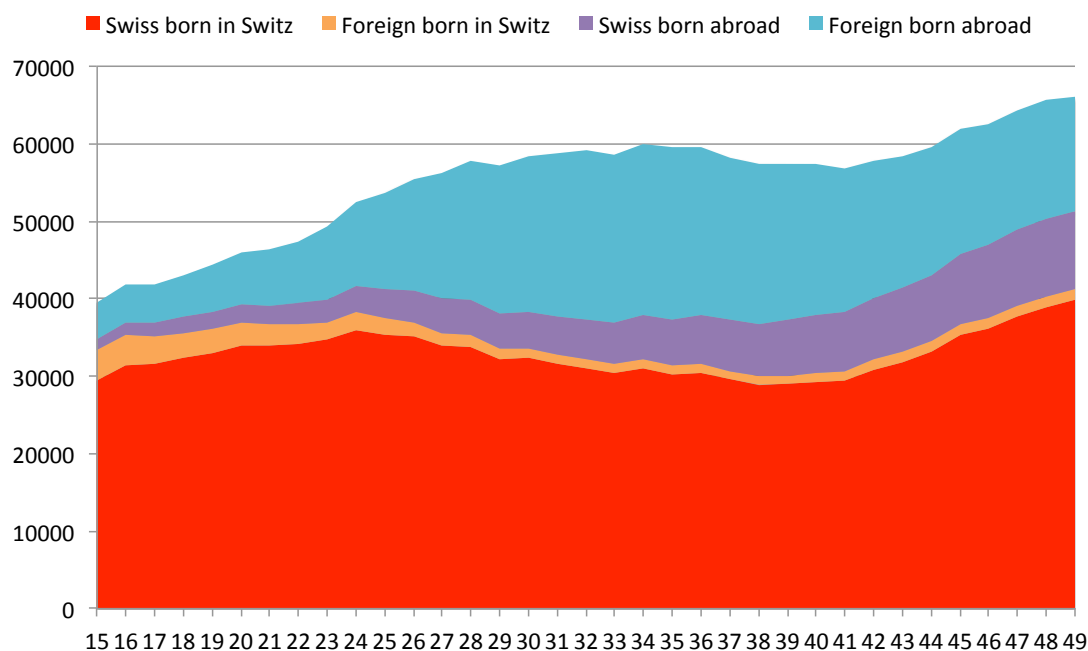


Figure 1: Nationality and country of birth by age: STATPOP 2016

Switzerland is unique in Europe for having a very high proportion of foreigners in its population, around a quarter (only Luxembourg has more; Eurostat 2018). Part of the reason for this is that being born in Switzerland gives no automatic right to Swiss nationality and naturalisation can be a slow and expensive process; hence a significant number of children born in Switzerland do not adopt Swiss nationality, even as adults; this is the light orange band on Figure 1. However, the “Swiss born in Switzerland” category in Figure 1 does include people who were born in Switzerland as foreigners but had naturalised before 2016. The purple band “Swiss born abroad” is primarily women who have naturalised during their life. The widening turquoise band shows the major influx of foreigners coming into the country in their 20s before they naturalise or re-emigrate.

Of particular note is that at age 19, three-quarters of the female population are “Swiss born in Switzerland” whereas by age 34 only half of women fall into this category.

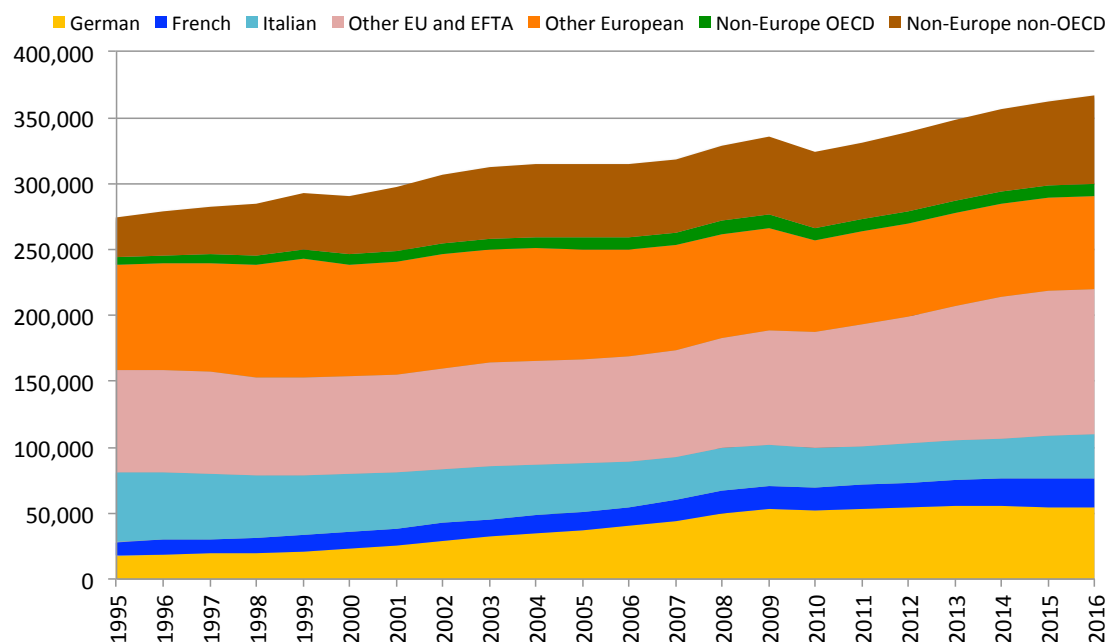


Figure 2: Foreign female population aged 20-39 inc., PETRA and STATPOP

Other EU and EFTA: Belgium, Bulgaria, Denmark, Finland, Greece, UK, Ireland, Luxembourg, Netherlands, Norway, Austria, Poland, Portugal, Romania, Sweden, Spain, Hungary, Slovakia, Czech Rep, Croatia, Slovenia, Estonia, Latvia, Lithuania (and smaller countries)

Other European: Albania, Turkey, Serbia, Bosnia, Montenegro, Macedonia, Kosovo, Moldova, Russia, Ukraine, Belarus

Non-European OECD: Chile, Canada, Mexico, USA, Japan, South Korea, Australia, New Zealand

Note: the kink from 2009-2010 reflects the change from the PETRA database to the household register system of collecting population data (STATPOP).

We can see from Figure 2 that more than half of the foreign population originates from low-fertility countries. Since 2000 the origin of the largest foreign group has changed from Italy to Germany, with the German population of young women more than doubling, but the Italian population shrinking. There has also been significant growth in the number of women from Eastern Europe (Hungary, Slovakia, Poland, Romania and Bulgaria) associated with Switzerland joining the Schengen area in 2008 and the EU-Switzerland bilateral agreement for free movement of 2009. Additionally, the growth in immigrants from non-European non-OECD countries is also significant.

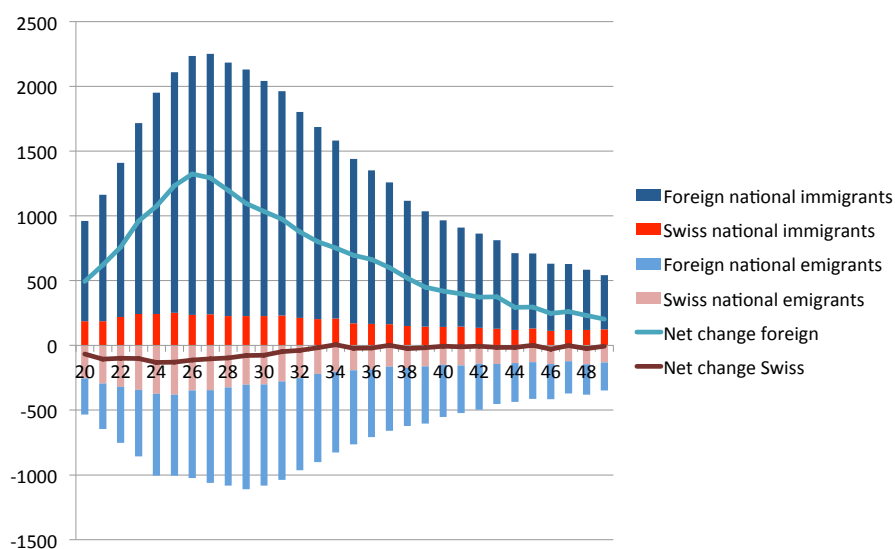


Figure 3: Immigration, emigration, net change; mean 2011-2014 STATPOP

We also need to bear in mind the ongoing flows into and out of the country. As can be seen in Figure 3, there is a net loss of Swiss women in their 20s (dark red line). However, immigration and emigration flows of foreign nationals dwarf the flows of Swiss women. Peak immigration (for 2011-2014) is at age 27 (dark blue bars), whilst peak emigration for foreign women is at age 29 (light blue bars). After age 33 there is a net neutral flow of Swiss women, whereas for foreign women it is still positive until at least the late 40s (blue line).

6. TFR of Swiss and foreign women

The SFSO has published the TFR for foreign women and Swiss women for each year since 1971 (Figure 4). The usual conclusion that is drawn from these statistics (shown in parallel with the increase in mean age at first birth) is that foreign women in Switzerland have more children than Swiss women.

The early years shown in Figure 4 show the sharp fall in the TFR at the end of the Baby Boom, partly caused by ongoing postponement in childbearing. From 1971 onwards, the mean age at first birth has risen almost linearly from 25 to almost 31 (considering all women). The mean age of first birth amongst foreign women, whilst also increasing, is significantly lower than for Swiss women, although the gap has narrowed since 2000.

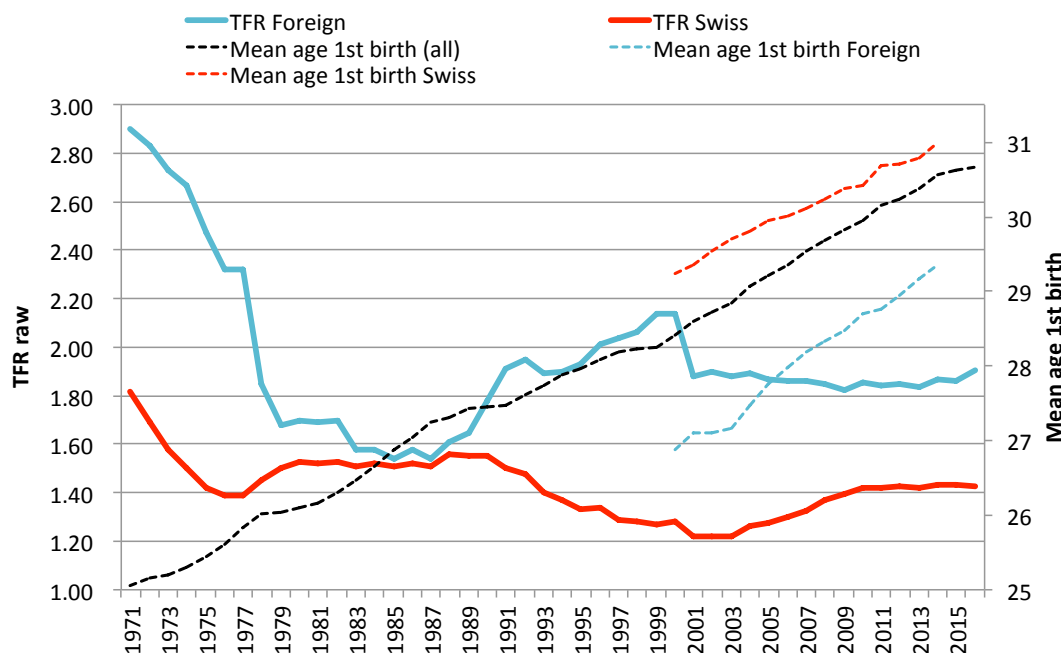


Figure 4: TFR of foreign and Swiss women and mean age at first birth, as published by SFSO: derived from BEVNAT and population statistics

Note: the sharp downward kink in the TFR of foreign women between 2000 and 2001 is because after 2000 births to asylum seekers and other temporary residents were no longer included in the statistics.

The impact of the fertility rates of foreign women on overall TFR has been significant and positive since at least 1971. It can be calculated as the TFR of the full population minus the TFR of just Swiss women. In the early 1970s, and again around the turn of the millennium, foreigner fertility boosted the TFR by over 0.2 child. During the 1980s the impact was only marginally positive. Between 2000 and 2009 it dropped from 0.2 to 0.1 and since then has been stable at that level. It should be noted that Switzerland has experienced the highest positive impact of foreigner fertility compared to other European countries (Sobotka 2008).

The description above applies to the standard way of calculating the TFR, i.e. from birth registrations linked to the female population by age. However, we can also calculate the TFR of years prior to 2000 years using the fertility data recorded in the 2000 census using the own-children method. We do not know, however, where the children were born (some will have been born outside Switzerland). We found that the “own-children TFR” for Swiss nationals (which includes women who have naturalised) and for all women born in Switzerland (which includes some women who remain foreign nationals) closely tracked that of the standard TFR of Swiss women as shown in Figure 4. However, the “own-children” TFRs

derived from the two different methods relating to foreign/born abroad women are significantly different from the standard TFR for foreign women (Figure 5).

Except during the 1980s the standard TFR exceeds that derived from the own-children method. One possible reason for the difference is that the standard TFR includes all women living in the country by age in a given year, whereas the census data only includes women who were still living in Switzerland in 2000; women who have emigrated in the intervening period are not included. However, we consider it unlikely that foreign women with larger families were more likely to emigrate (see section 9 to support this assertion). We believe the problem lies not in the own-children method but in the standard TFR calculation, which we discuss in section 13.

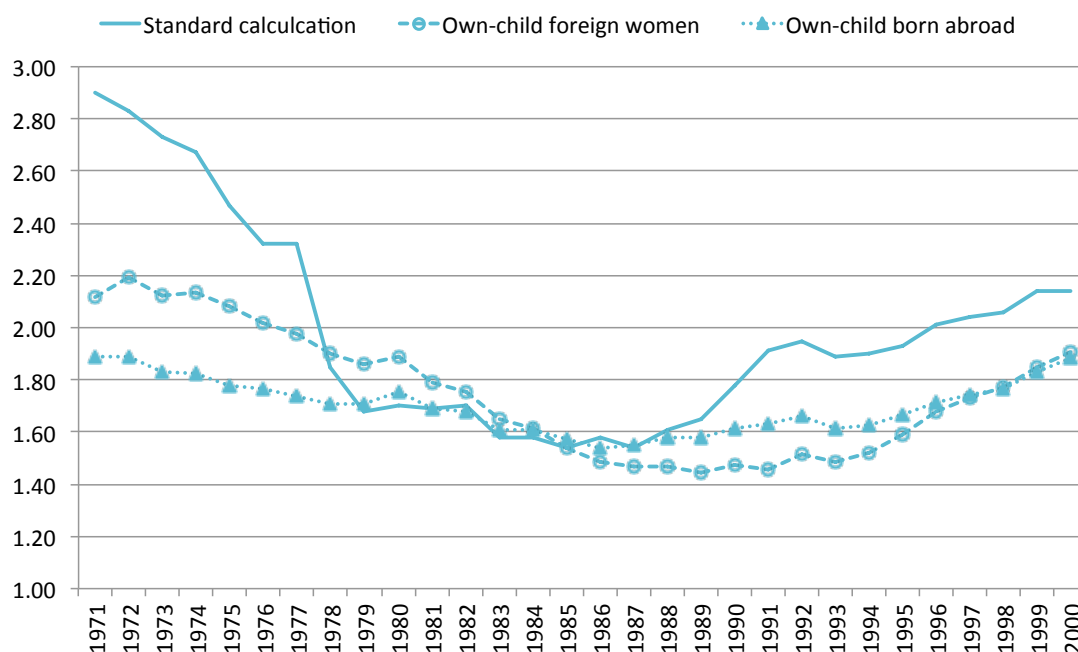


Figure 5: Standard TFR of foreign women (derived from vital statistics); TFR derived by own-children method from census 2000: of foreign women and of women born outside Switzerland

Note: only children up to birth order 5 were included in the own-children calculations, so they will be slight under-estimates. No adjustments were made for female mortality (none were necessary for child mortality as the census asked about ever-born children). The designation "foreign women" relates to their non-Swiss nationality in 2000.

7. Number of children from register data, FGS and census

We now look at the number of children women have, by age, from three sources. Firstly, using register data (STATPOP) we looked at households in which there was a woman aged 20-39 and counted any co-habiting children (or young adults) who were 15 years or more younger than her. As we only have information on co-habiting children, it is only an approximation of the number of children the woman has borne. In discussing these problems, Dubuc (2009) found evidence of over- and under-counting to be just a few percent, as did Krapf and Kreyenfeld (2015). A small number of children will have died (a rough estimate is 0.5% by the age of 15). Some children will be living apart from their mother (e.g. with their father, adoptive family, or in the country of origin) or there may be additional children in the household that are not those of the ‘mother’ (e.g. siblings who are much younger, step-children of a male partner, foster children or children of other relatives/friends). We make the cut-off at women older than 40 for this comparison, as after that age some children will have started to leave home. As for children yet to be born to women over 40, the fertility of women aged 40-49 from TFR data was 0.05 (for Swiss women in 2001) and 0.06 (for foreign women in 2001), rising to 0.09 (Swiss women in 2014) and 0.10 (foreign women in 2014).

The four graphs in Figure 6 show the parity distribution and average number of children by age of women from 20-39 by country of birth (Switzerland/abroad) and nationality (Swiss/foreign). We consider that the majority of women classified as ‘Swiss born abroad’ are immigrant women who have naturalised (in the census it was 81% and in the FGS it was 83%).

These graphs show that the FGS and STATPOP data are in reasonable agreement. The FGS gives a lower number of children for women in their 20s. The significantly lower fertility of foreign women in their 20s (6b and 6d) enumerated in the FGS compared to STATPOP gives some concern about its representivity for these ages. It is surprising that low fertility young women seem to be over-sampled in the FGS; this would contradict the findings of Kreyenfeld et al (2012).

The FGS shows higher fertility of women in their 30s compared to STATPOP. The biggest mismatch is for naturalising women in their early 30s (Figure 6c); this is possibly explained by the small sample size of the FGS. The ‘under-estimate’ of number of children in the STATPOP data for women in their late 30s reflects the fact that older children of young mothers are starting to leave the household at this stage. Comparing Swiss mothers (born in Switzerland) with mothers who immigrated into Switzerland after the age of 15 and who were

aged in their 40s, 31% of the former had at least one child aged over 18, whilst 42% of the immigrants did (FGS data).

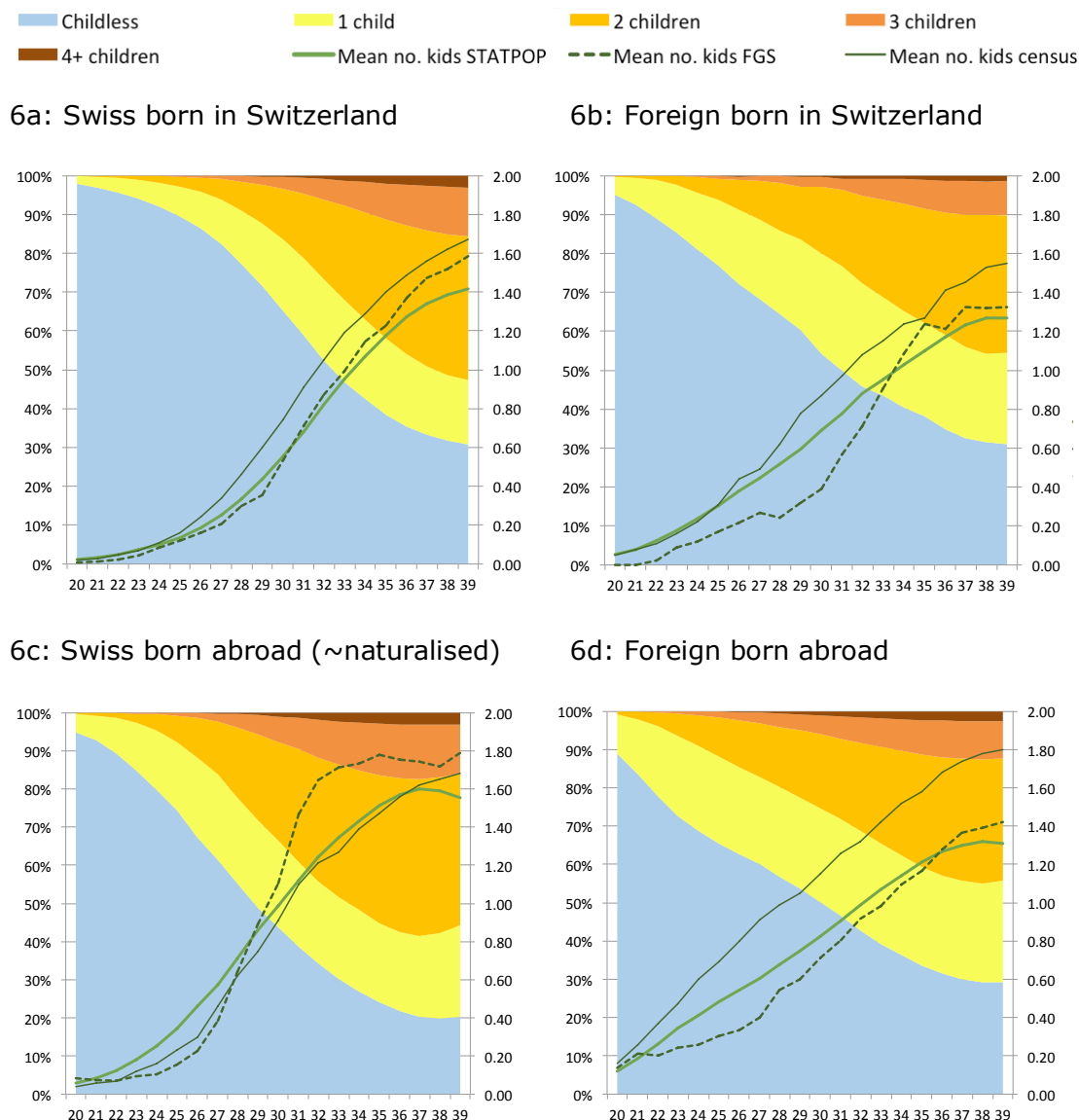


Figure 6: Mean number of children – STATPOP household registers (mean 2011-2014), FGS (2013, moving average of 5 year age bands) and census (2000), plus parity distribution by age of woman (STATPOP)

Looking at the changes that have happened since 2000 by comparing the census data with the other sources we see there has been a significant fall in the fertility of ‘Foreign born abroad’ women, from 1.8 to around 1.4 at age 39. There have also been fertility declines, though of a lower magnitude, of women born in Switzerland (both Swiss and foreign nationalities). However, the fertility pattern of naturalising women (‘Swiss born abroad’) has remained quite constant.

Comparing childlessness, we see that naturalised women (6c) have the lowest proportion, whilst amongst the other three groups around 30% are still childless at age 39. Foreign women (6b and 6d) have a higher proportion of one-child families than Swiss women (6a and 6c), whereas the latter have a higher proportion of 2-child families.

To summarise, data on actual family sizes (FGS and STATPOP) indicate that foreign women, by the age of 39, have lower fertility than Swiss women.

8. Inconsistency between the TFR and actual number of children

We now look at summary statistics of the TFR and the data of actual children from the sources described in the previous section (Table 1).

Table 1: Fertility indicators from different sources (census data in grey as it is older data but is included for comparative purposes)

	TFR		Average no. children all women		
	av. 2001-2009	2014	Census 2000 - age 39	STATPOP 2011-14 age 39	FGS 2013 - average 37-41
Swiss born in Switzerland	1.29	1.42	1.67	1.42	1.58
Swiss born abroad (~naturalised)		1.58	1.68	1.55	1.79
Foreign born in Switzerland	1.87	1.47	1.55	1.27	1.32
Foreign born abroad (immigrants)		1.94	1.80	1.31	1.42
	Children/mother estimated from TFR		Average no. children just mothers		
	TFR/ TFR1 av. 2001-2009	TFR/ TFR1 2014	Census 2000 - age 39	STATPOP 2011-14 age 39	FGS 2013 - average 37-41
Swiss born in Switzerland	2.07	2.13	2.21	2.05	2.07
Swiss born abroad (~naturalised)			2.07	1.95	2.01
Foreign born in Switzerland	1.81	1.87	2.08	1.83	1.93
Foreign born abroad (immigrants)			2.18	1.85	1.86
	Childlessness %				
	(1-TFR1) av. 2001- 2009	(1-TFR1) 2014	Census 2000 - age 39	STATPOP 2011-14 age 39	FGS 2013 - average 37-41
Swiss born in Switzerland	38%	33%	25%	31%	23%
Swiss born abroad (~naturalised)			19%	20%	11%
Foreign born in Switzerland	-3%	0%	25%	31%	31%
Foreign born abroad (immigrants)			17%	29%	23%

Note: in FGS the 'Swiss born abroad' include those with Swiss or double nationality (including Swiss)

In FGS the 'Foreign born in Switzerland' include those who only have foreign nationality plus those have double nationality (including Swiss)

The 'Foreign born abroad' are non-naturalised immigrants

The 'Swiss born in Switzerland' include those who were born in Switzerland with foreign nationality but who have since naturalised

For all measures, it is the nationality of the woman/mother that is being analysed, not those of her child/children

Looking at the first section of Table 1 (as already shown in Figure 4), the TFR indicates that foreign women have significantly higher fertility than Swiss women. However, the STATPOP, like the FGS we already mentioned, show that Swiss women have more children than foreign women. The difference is particularly marked for the measure for “Foreign born abroad” women, i.e. immigrants.

The second section shows the number of children per mother. This can be estimated from the TFR data when births by (biological) birth order are known, by the simple calculation $TFR/TFR1$. From this information it is clear that Swiss mothers have larger families than foreign mothers. There has been a fall in the family size of all women since 2000, but this has been especially marked for “Foreign born abroad” women (immigrants).

Looking at childlessness (3rd section of Table 1) gives us an indication of how part of the discrepancy arises. When we calculate childlessness from the TFR1 it gives ‘impossible’ values for foreign women because the TFR1 of foreigners is close to or even exceeds 1. A TFR1 value greater than 1 has been seen in population-wide contexts, such as during the Baby Boom years in the United States (Bongaarts and Feeney 1998) and the Czech Rep, the Netherlands and Italy (Sobotka 2003). The cause is a high intensity of first births, which can happen when women across a wide span of ages are entering motherhood for the first time, and/or when the mean age at first birth is getting younger – or, in this case when immigrant women, who are childless in their 20s, arrive in the country.

The estimate of childlessness derived from the TFR of Swiss women is also problematic: it is too high. There is a simple explanation for this: ongoing postponement of mean age at first birth (Figure 4). This well-known distortion can be easily compensated for using the Bongaarts-Feeney correction (1998).

A final point to note is the low fertility of foreign women born in Switzerland (both from the TFR and actual number of children). This echoes the work of Rojas et al (2018) who found subdued fertility of second-generation immigrants in Switzerland. It could also be a reflection of differential rates of naturalisation, which we discuss in a later section.

Having described the apparent discrepancies between the TFR and measures of cohort fertility in detail, we now develop a model to describe more accurately the fertility differentials between the two groups. For that we need data, in addition to births to Swiss and foreign women, on the number of children they have at immigration, emigration and naturalisation.

9. Fertility of women at immigration and emigration

STATPOP data can give us estimates of the number of children that arrive with an immigrating woman and who leave with an emigrating woman. As children do not necessarily arrive at exactly the same time as their mother then these are measures of the change in the

household over the year. It is likely to be an under-estimate of the number of children that immigrating women actually have for two reasons. Firstly, we know from the Migration-Mobility Survey that women arrive in Switzerland with somewhat fewer children than they have borne; occasionally these are young children left with relatives, more often they are older children continuing their education or early work life elsewhere. For women under 35, more than 90% of mothers arrive with their children; however, this drops to 85% for women 35-39, 70% for women 40-44, and just over half for women 45-49. The second reason the STATPOP data is likely to be an under-estimate is that it relates to the end of each year and some women will arrive towards the end of a calendar year to be joined by their children early the following year.

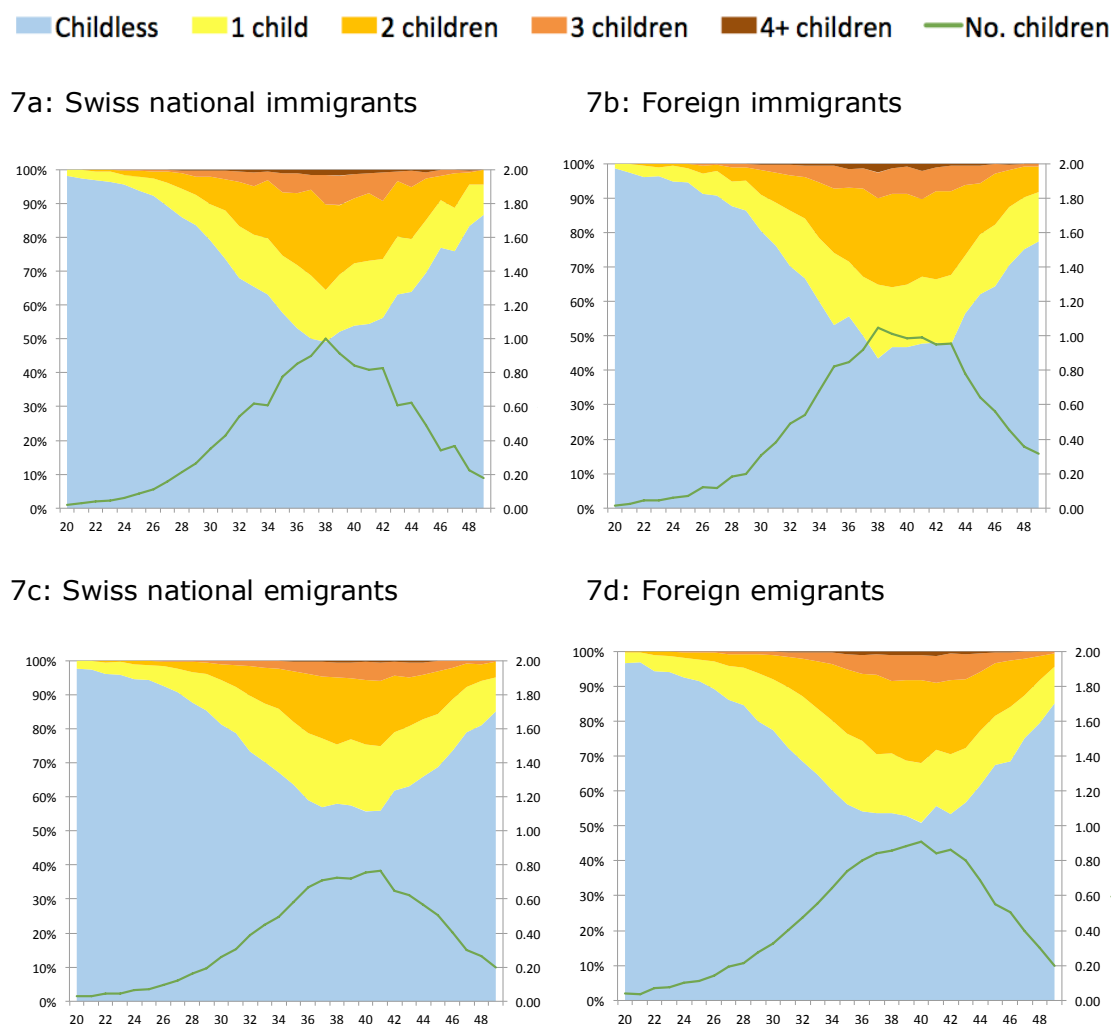


Figure 7: Number of children in households of immigrants and emigrants in year of arrival/departure: mean of STATPOP data 2011-2014

Although there are slight differences, the fertility profiles (by age) of women who move country (immigrate/emigrate, Swiss/foreign) are really quite similar. The people who move country (both immigrants and emigrants) are predominantly childless. However, during their

30s, women are increasingly likely to migrate with a (small) family in tow. Foreign immigrants arriving with three or more children are exceptionally rare.

Interesting to note is that Swiss national immigrants (7a) have slightly higher fertility than Swiss national emigrants (7c) i.e. they return to Switzerland after having had a child/children elsewhere. In contrast, foreign emigrants (7d) have slightly higher fertility than foreign immigrants (7b) i.e. they leave (often to return to their home country) after having had a child/children in Switzerland. It is also worth noting that foreigners moving into and out of Switzerland (7b and 7d) have lower fertility than Swiss women immigrating/emigrating (7a and 7c).

The base data we use for number of children at immigration and emigration are the STATPOP values shown in Figure 7 (a-d) up to the maximum value (around when women turned 40). After this age then, rather than a sudden fall, the values were chosen manually to decline slightly after that age (Table 2). We consider that the apparent high proportion of childless women in their 40s shown in the STATPOP data is an over-estimate of actual childlessness. The likely reason is that they leave their older and young adult children in their home country; they arrive in Switzerland without accompanying children, which would imply they are ‘childless’, even though they are not. The FGS gives some support for this (see Figure 8).

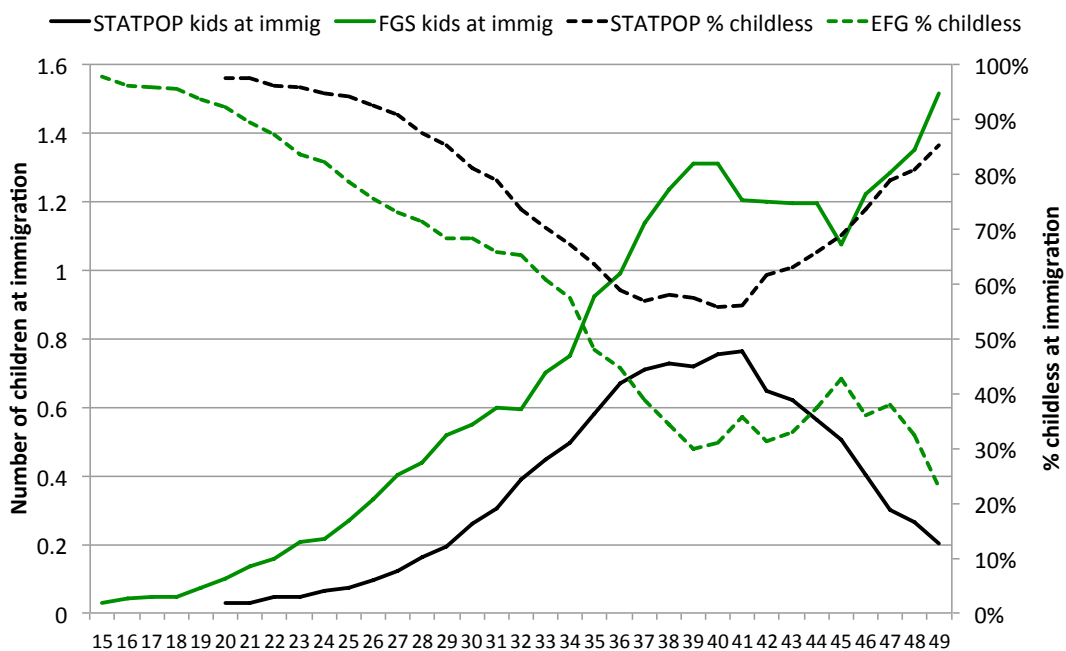


Figure 8: Number of children at immigration and % childless

Note: for the FGS, women of both Swiss and foreign nationalities were included. The FGS is smoothed data for 5 year rolling age groups and covers all sampled women (aged up to 80). The STATPOP data is the mean for foreign women immigrating for years 2011-2014.

Table 2: Fertility rates by age at immigration and emigration as used in the Comprehensive Fertility Profile calculations

	Swiss immigs	Swiss emigs	Foreign immigs	Foreign emigs
15	0	0	0	0
16	0	0	0.01	0.01
17	0	0	0.01	0.01
18	0	0	0.02	0.02
19	0	0.02	0.02	0.03
20	0.01	0.03	0.02	0.04
21	0.03	0.03	0.03	0.04
22	0.05	0.05	0.04	0.07
23	0.05	0.05	0.04	0.08
24	0.06	0.07	0.06	0.10
25	0.07	0.07	0.09	0.11
26	0.12	0.09	0.11	0.14
27	0.12	0.12	0.16	0.19
28	0.19	0.16	0.21	0.21
29	0.20	0.19	0.27	0.28
30	0.31	0.26	0.35	0.33
31	0.38	0.31	0.43	0.40
32	0.49	0.39	0.54	0.47
33	0.54	0.45	0.62	0.56
34	0.68	0.50	0.61	0.64
35	0.82	0.58	0.78	0.74
36	0.85	0.67	0.85	0.80
37	0.92	0.71	0.90	0.84
38	1.05	0.73	1.00	0.86
39	1.01	0.72	0.99	0.88
40	0.99	0.76	0.98	0.91
41	0.99	0.76	0.97	0.90
42	0.98	0.75	0.96	0.89
43	0.97	0.74	0.95	0.88
44	0.96	0.73	0.94	0.87
45	0.95	0.72	0.93	0.86
46	0.94	0.71	0.92	0.85
47	0.93	0.70	0.91	0.84
48	0.92	0.69	0.90	0.83
49	0.91	0.68	0.89	0.82

One further comment on Figure 8: there are two likely reasons why the fertility at immigration is higher in the FGS sample than for the STATPOP data. The first is that the FGS sample covers women aged 15-79 and fertility has fallen for women across those cohorts. Secondly, the FGS samples only those women who have immigrated and subsequently stayed in the country. It cannot reflect very mobile childless women who arrive, stay only a short time and then leave again. A strong assumption was made for the base data in Table 2: that there has been no trend over time in the fertility of women at migration.

10. Fertility of women at naturalisation

Data on the number of children that women have at naturalisation is the most difficult statistic to obtain (we have had to deduce it from various sources) and there have been several trends over the past decades: in the number of naturalisations (rising), the age at which people naturalise (also rising), and (hence) the number of children they have at naturalisation.

Several important changes in the naturalisation rules over the past decades have occurred. In the 1970s women who had lost their Swiss citizenship (because of marrying a non-

Swiss man, for instance) could regain their Swiss nationality by request. Up until the end of 1991 a foreign woman who married a Swiss man automatically gained Swiss nationality (and may thereby have lost her existing nationality); this statute was then dropped with the introduction of the new law on citizenship. Foreign women marrying a Swiss man (and vice versa) are eligible to apply for fast-track citizenship, although this still takes several years (SwissInfo 2018). One of the countries which until recently allowed only single citizenship was Germany; however, since 2007 German women can have dual citizenship of Switzerland and Germany (and many older German women living in Switzerland have been doing so; SwissInfo 2007).

There has been a rise in naturalisations since the mid-1990s, especially amongst older women since 2012 (many of these being German) (Figure 9).

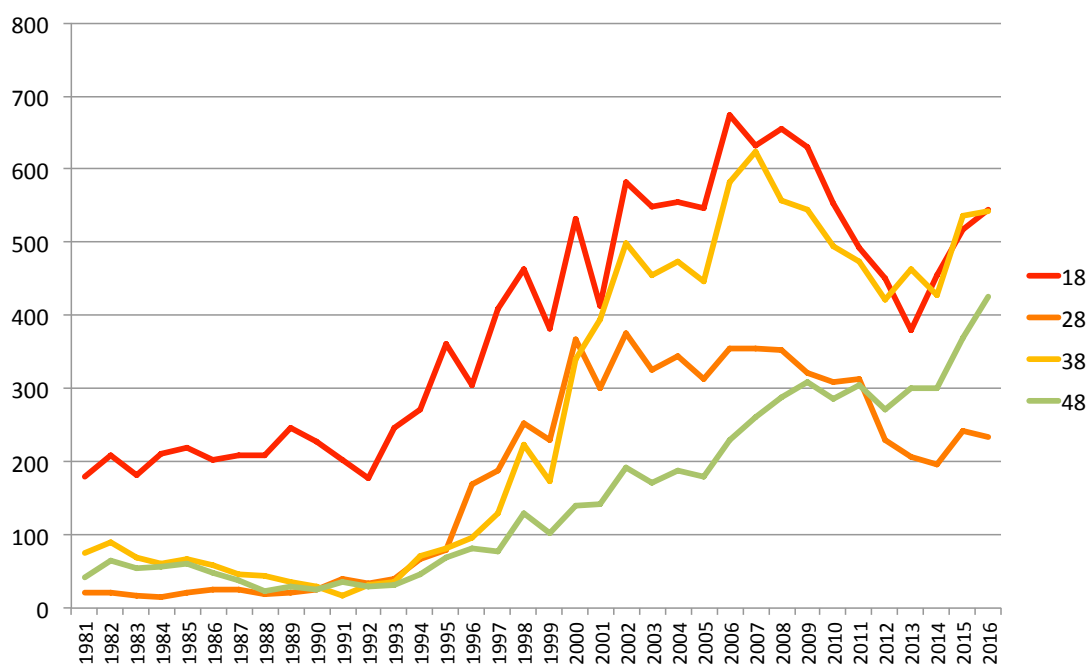


Figure 9: Number of foreign women becoming naturalised Swiss 1981-2016, at ages 18, 28, 38 and 48

Naturalisation has traditionally been part of the transition to adulthood and this remains the case for many children who grew up in Switzerland. There are several links between naturalisation and fertility, as described in Pecoraro (2012). Firstly, childless women tend, if possible, to become naturalised before starting a family. This is confirmed from the FGS data on women of reproductive age: 62% of mothers had naturalised before (or in the same year as) the birth of their first child. Secondly, women who have children choose to naturalise when the duration of stay is long enough; childless women have a slightly lower propensity to naturalise.

The outcome is that naturalised women have a fertility around 0.2 higher than foreign women as they reach their 40s, as seen in Figure 6c and Table 1.

To estimate the number of children that women have (on average, by age) at the time of their naturalisation we analysed several data sources. The census data of 2000 gives the year of naturalisation, as well as the years of birth of children. From this we can deduce the number of children a woman had in the year she naturalised (black continuous line 1 in Figure 10). We also know, from the census data, the number of children of all women who are ‘Swiss born abroad’ (81% of these women are naturalised) (black dashed line 2 in Figure 10). The fertility profile by age turns out to be very similar for these two sets. STATPOP (averages from 2011-2014) can provide two similar data sets: data set 3 (red continuous line) for number of children at naturalisation and data set 4 (red dashed line) for all women ‘Swiss born abroad’. Unlike for the census data, these latter two differ significantly and line 3 is markedly lower. We wonder whether the reason for the particularly low fertility for the years 2011-2014 was a surge in the naturalisation of low-fertility German women after the possibility of them gaining dual nationality after 2008. Our fifth data set (green continuous line 5) is that from the FGS for children at naturalisation (for all women under age 50) – a smoothed line of 5 year rolling averages. Although the FGS fertility curve is higher than that from the other sources for ages up to the late 30s, it agrees that fertility at naturalisation of women aged about 40 is around 1.7.

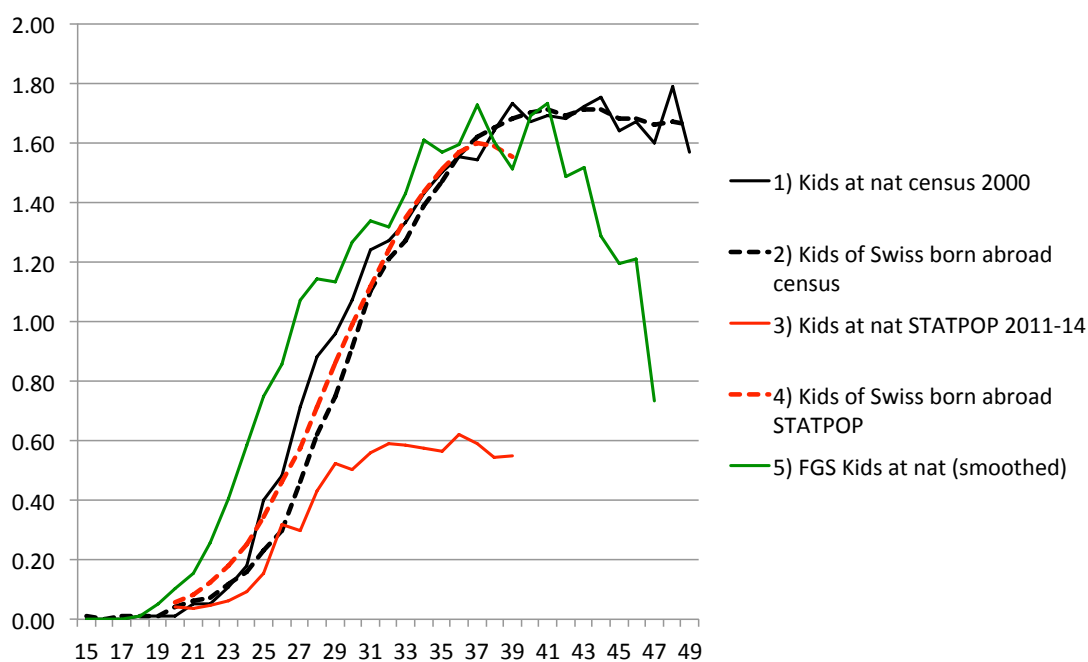


Figure 10: Data sources to estimate number of women at naturalisation

Data sets 1, 2 and 4 show good agreement and so a combination of these were used for the fertility of women at naturalisation and a table of values for years 1981-2016 was compiled as follows:

1. For the years 1981-2000, the direct values of children at naturalisation as calculated from the census 2000
2. For 2001-2016, ages 15-19, an extrapolation (constant values) of the census data on children at naturalisation (fertility at these ages is very low indeed)
3. For 2001-2011, ages 20-37, an interpolation of children at naturalisation in the year 2000 from the census and the STATPOP data on number of children for ‘Swiss born abroad’ women (mean of years 2011-14).
4. For 2011-2016, ages 20-37, the mean fertility of ‘Swiss born abroad’ women from STATPOP for the years 2011-2014 (the mean for those four years was used across the six years).
5. From 2001-2016, ages 38-49, an extrapolation (constant values) of the values in the census of the fertility of Swiss born abroad women.

The compiled data set for the average number of children at naturalisation for years 1981-2016, ages 15-49, is shown in Appendix table 4.

11. Methodology for calculating the Comprehensive Fertility Profile (CompFerProf)

The aim of the model described here is to give an estimate, for Swiss and foreign nationals, the average number of children borne by women of each age (15-49). In this respect it is a period snapshot of the estimated average family size (cohort fertility so far) of each cohort of women by nationality that year. As we have fertility and population data from 1981-2016 then we know the full fertility history for women born in 1966 and 1967 (i.e. from when those cohorts reached 15 through to when they reached 49) but not for women older than that (they were already over 15 when the records begin). For younger cohorts we only know their fertility history for part of their reproductive life.

The calculation process considers “incoming” and “outgoing” children for each cohort of women as they pass through each age. “Incoming” children are from births and immigration

and, for Swiss women, naturalisation. “Outgoing” children are from emigration and, for foreign women, naturalisation. Note that we look at the number of children by the nationality (Swiss or foreign) of the mother, not the child, and this is her nationality in a particular year.

The formulae for net increase in number of children for each group of women is as follows:

$$\text{Swiss women: Births}_S + [\text{Imm}_S \times r_S (\text{imm})] - [\text{Emig}_S \times r_S (\text{emig})] + [\text{Nat} \times r(\text{nat})]$$

$$\text{Foreign women: Births}_f + [\text{Imm}_f \times r_f (\text{imm})] - [\text{Emig}_f \times r_f (\text{emig})] - [\text{Nat} \times r(\text{nat})]$$

where:

Births_S are births to Swiss women at each age.

Imm_S are the number of immigrants of that age of Swiss nationality.

$r_S (\text{imm})$ is the mean number of children (fertility rate) that Swiss immigrants bring with them into the country.

Emig_S are the number of emigrants of that age of Swiss nationality.

$r_S (\text{emig})$ is the mean number of children that Swiss emigrants have at the time they emigrate.

Nat is the number of women of each age who naturalise.

$r (\text{nat})$ is the mean number of children women have at the age when they naturalise.

Births_f are births to foreign women at each age.

Imm_f are the number of foreign immigrants of each age.

$r_f (\text{imm})$ is the mean number of children (fertility rate) that foreign immigrants bring with them into the country.

Emig_f are the number of emigrants of that age of foreign nationality.

$r_f (\text{emig})$ is the mean number of children that foreign emigrants have at the time they emigrate.

After calculating the cumulative net ‘incoming’ children for each cohort these are divided by the population of women of each age (for years 2013-2016). See Appendix for a summary of the data tables. Table 3 below shows a summary of the results for 2016.

Table 3: *CompFerProf of Swiss and foreign women 2016*

Age	Cohort	Cumulative net children of Swiss women	Swiss women 2016	Number of children Swiss women	Cumulative net children of foreign women	Foreign women 2016	Number children foreign women
15	2001	2	30764	0.00	0	9118	0.00
16	2000	13	33033	0.00	21	8731	0.00
17	1999	33	33314	0.00	38	8770	0.00
18	1998	94	34374	0.00	102	8518	0.01
19	1997	206	35206	0.01	258	8681	0.03
20	1996	376	36447	0.01	530	9106	0.06
21	1995	718	36371	0.02	942	9526	0.10
22	1994	1229	36962	0.03	1607	10064	0.16
23	1993	1919	37621	0.05	2433	10458	0.23
24	1992	3165	39229	0.08	3636	11611	0.31
25	1991	4818	39073	0.12	5311	13160	0.40
26	1990	6856	39212	0.17	6870	14630	0.47
27	1989	9454	38454	0.25	8592	16248	0.53
28	1988	12453	38335	0.32	11391	17696	0.64
29	1987	15922	36750	0.43	13371	19483	0.69
30	1986	20403	37043	0.55	16145	20357	0.79
31	1985	24759	36488	0.68	18928	21403	0.88
32	1984	29459	36232	0.81	21492	22265	0.97
33	1983	33800	35766	0.95	23983	22908	1.05
34	1982	39872	36710	1.09	25946	22779	1.14
35	1981	43401	36153	1.20	28120	23216	1.21
36	1980	47743	36754	1.30	28997	23389	1.24
37	1979	49965	36281	1.38	29809	22824	1.31
38	1978	51722	35669	1.45	30436	21970	1.39
39	1977	53911	36175	1.49	30533	21773	1.40
40	1976	56265	36691	1.53	30469	21209	1.44
41	1975	58292	37023	1.57	29636	20598	1.44
42	1974	60811	38655	1.57	28905	19829	1.46
43	1973	63343	39869	1.59	27356	19201	1.42
44	1972	66040	41561	1.59	27252	18512	1.47
45	1971	70282	44305	1.59	25786	18055	1.43
46	1970	72735	45423	1.60	24959	17594	1.42
47	1969	76695	47613	1.61	24221	17154	1.41
48	1968	79491	49083	1.62	22962	16727	1.37
49	1967	81439	50015	1.63	22292	16492	1.35

This total is the sum of all the boxes shaded pink for Swiss/foreign (Appendix tables)

Ditto orange

Ditto yellow

Purple box is age when Swiss/foreign fertility swaps

Figure 11a shows the source of ‘incoming’ and ‘outgoing’ children for Swiss women in 2016 and Figure 11b the same for foreign women. The impact of naturalisation in increasing the flow of incoming children for Swiss and their loss on the ‘balance sheet’ for foreign women is particularly noticeable; it has a significantly bigger impact than migration. For both sets of women the gains and losses from immigration and emigration almost balance.

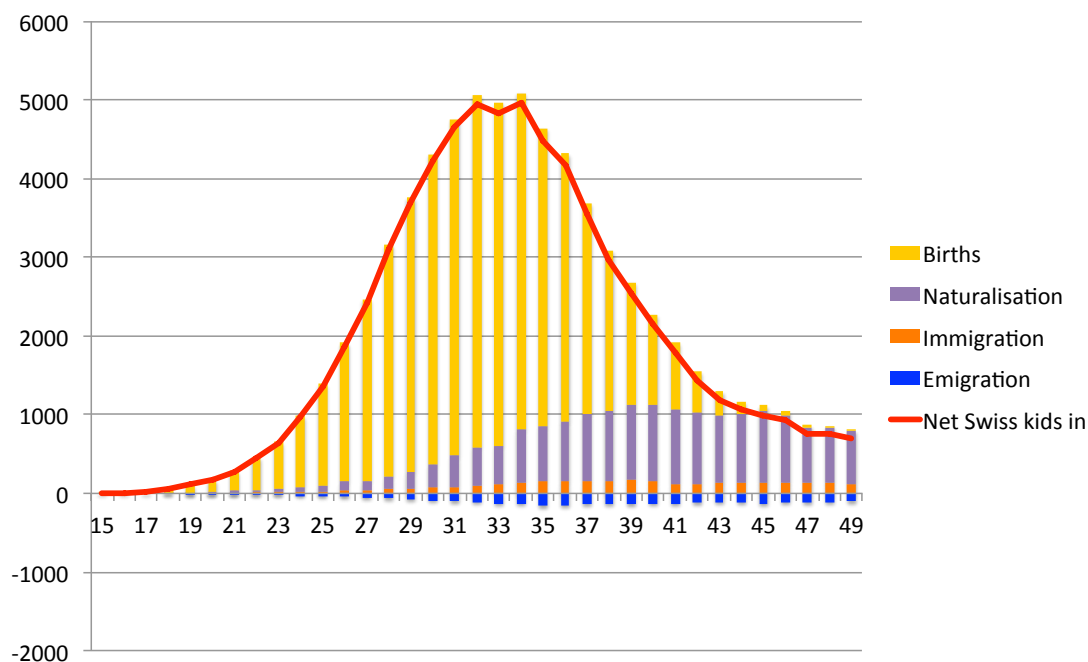


Figure 11a: Incoming and outgoing children of Swiss women 2016

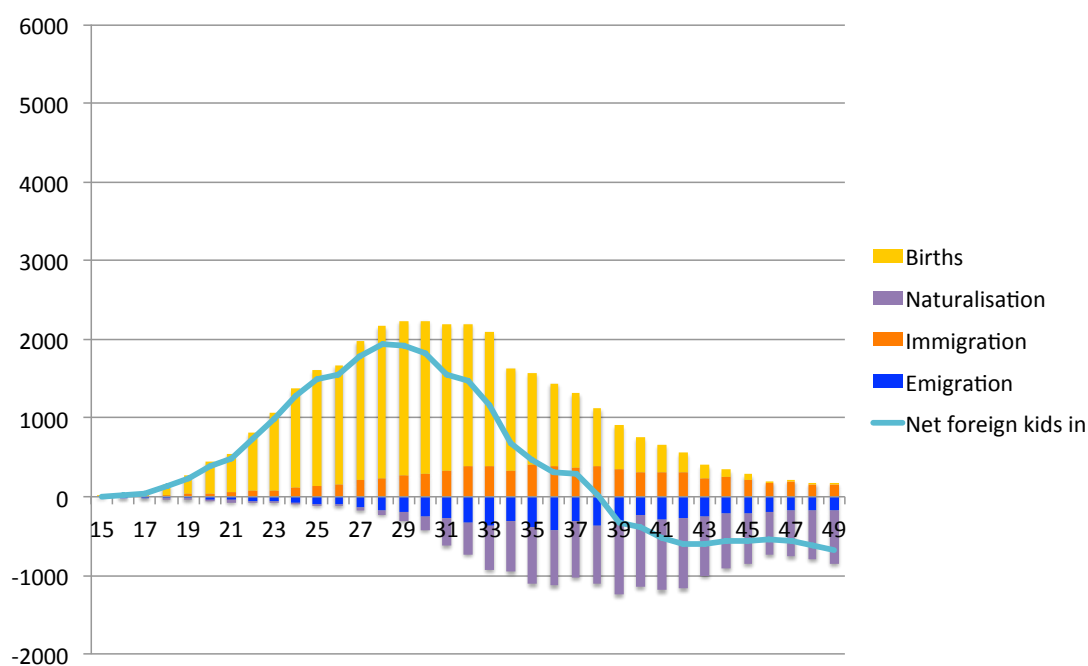


Figure 11b: Incoming and outgoing children of foreign women 2016

12. Comparing the CompFerProf with STATPOP data and FGS

We now compare the values obtained from the Comprehensive Fertility Profile calculations with the fertility data we have in the STATPOP data for 2013 and the FGS sample data from 2013. For clarity we have divided the graphs into those for ages 15-32 (Figure 12a) and ages 32-49 (Figure 12b).

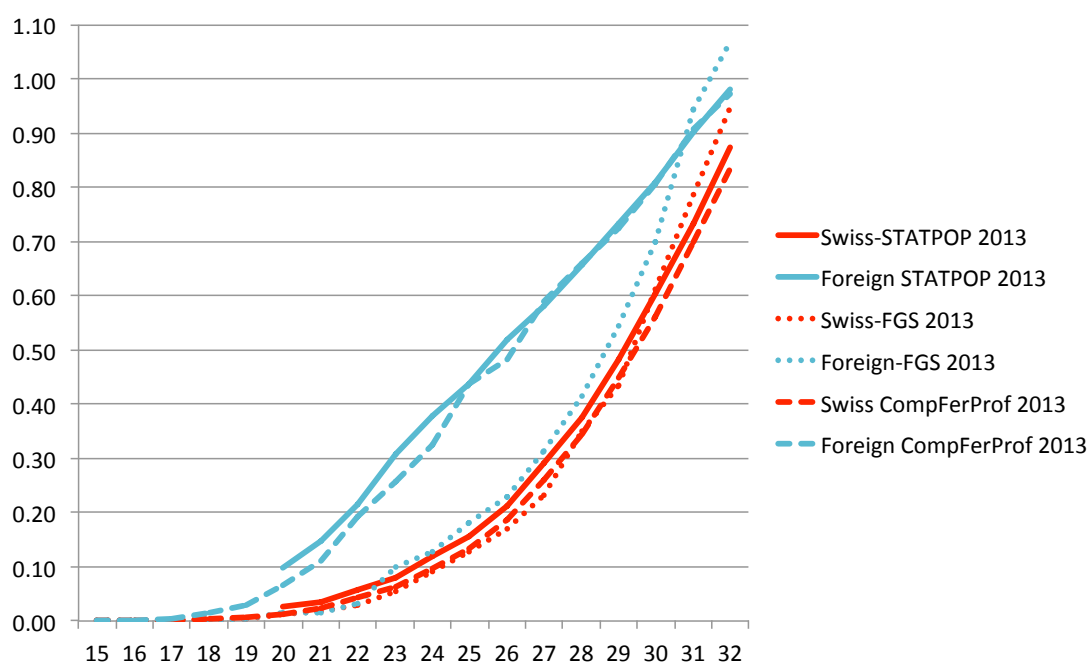


Figure 12a: Completed fertility of women up to age 15-32: FGS data is the moving average across 5-year age brackets

The story for women in the first half of their reproductive life is relatively straightforward: foreign women have higher fertility at young ages than Swiss women. The fertility rates from the three data sources for Swiss women match very well. The STATPOP and CompFerProf for foreign women also match closely. The FGS gives a lower estimate of number of children of foreign women of this age group but not Swiss women; this discrepancy was mentioned in section 7. For both Swiss and foreign women, the slight excess number of children seen in the STATPOP values for number of children (of Swiss and foreign women) probably indicates that a small number of children in addition to the woman's biological children are co-habiting in the household.

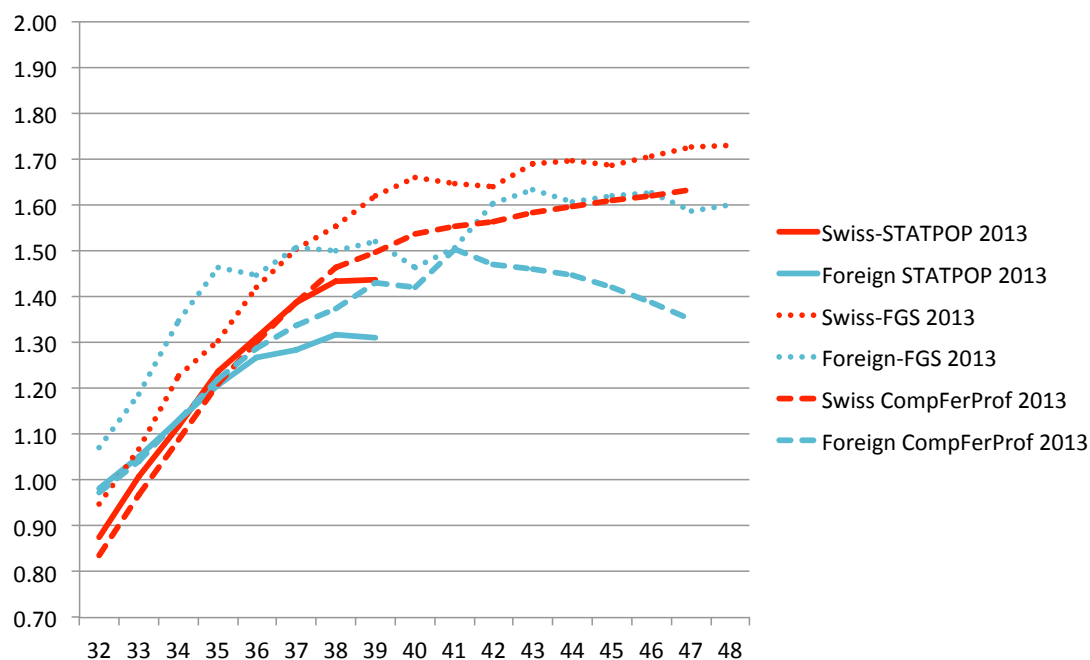


Figure 12b: Completed fertility of women up to age 32-49

The story of women in their mid-30s and 40s is more complex but is central to the explanation of the paradox between the TFR and how many children women actually have, as shown in Table 1. What we see in all three data sets is a reversal of which group has higher fertility – from foreign women at younger ages to Swiss women as they reach higher ages. For the CompFerProf and for STATPOP it occurs between the ages of 34 and 35, and for the FGS at age 37. From the calculation process of the CompFerProf we can observe several motors of this switch over, viz:

1. Swiss women are more likely to remain childless than foreign women and tend to start childbearing at older ages.
2. Swiss mothers, after starting childbearing later, have a higher propensity to have a second child after their first and after a shorter duration.
3. Women who naturalise have (slightly) higher fertility than foreign women who do not; and, concomitantly, women who have a family are more likely to naturalise. It is the effect of naturalisation that causes the CompFerProf for foreign women to drop after age 42.
4. Foreign emigrants have (slightly) higher fertility than foreign immigrants (Figure 7d and 7b).

- The ongoing influx of low fertility foreign women through the 30s and into their 40s ‘dilutes’ the average fertility of foreign women at these ages.

There is one further issue which causes the TFR to not reflect the number of children of immigrants, which we now discuss.

13. Migration and childbearing: how their association affects the TFR

As discussed in the literature review, immigrants commonly arrive in their new country childless: before their move they tend to have depressed fertility rates but it is common for childbearing to start soon after their arrival, especially if they arrive in their 20s (e.g. Toulemon and Mazuy 2004 p.8; Robards and Berrington 2016 p.1043). We confirm that this is also the case for new arrivals to Switzerland (Figure 13).

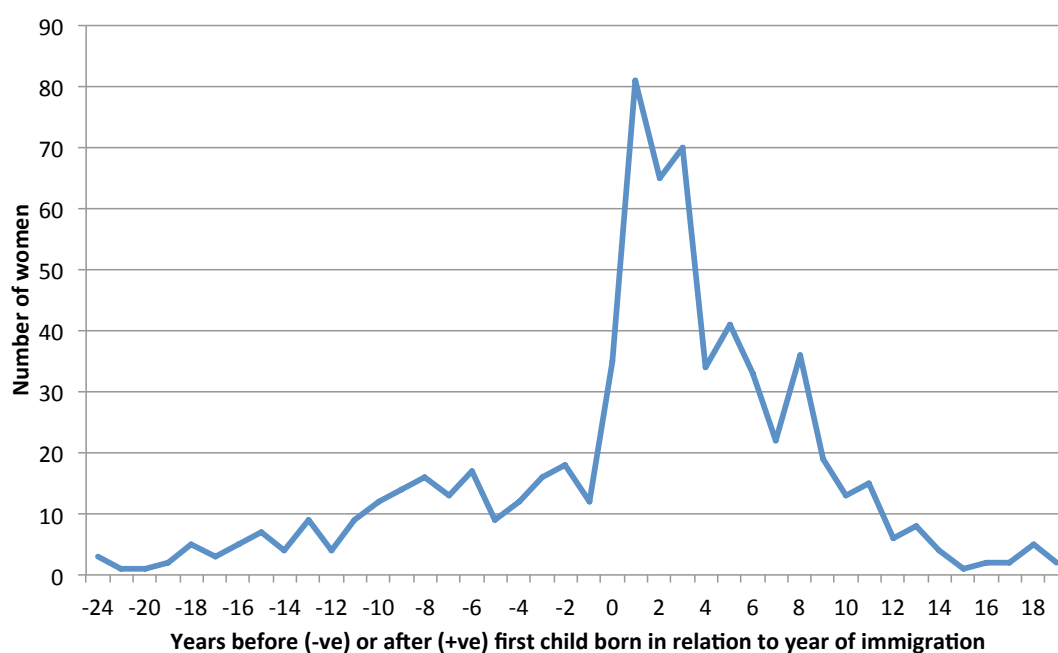


Figure 13: Spacing between immigration and first birth: FGS data for women who arrived in Switzerland aged ≥ 15 and aged ≤ 49 at time of survey (2013)

Let us now reflect on how this behaviour impacts the TFR. The TFR is a measure of the intensity of output of babies (Andersson 2006). We can see from Figure 13 that this intensity is strong in the years shortly following immigration.

The TFR would accurately reflect the “average number of children per woman” in a closed population with no immigration, emigration, mortality or change in the timing of

childbearing. In fact, even if there were significant migrant flows but the fertility of immigrants and emigrants were similar to those of natives at age of arrival/departure, then there would be no distortion. However, this is not the case for Switzerland.

The problem with the TFR calculation is that an immigrant is included in the denominator of the age-specific fertility rate (ASFR) calculation only after she has arrived in the country. The period of her reproductive life when she is in the new country is the time when she is most likely to be childbearing. In her country of origin, when she was childless, she was included in the denominator: this would deflate the TFR of that country. However, for the country in which she has children, but in which she spends only part of her reproductive life, the TFR is inflated.

We can see that this problem of post-arrival childbearing also applies to the own-children method of calculating the TFR, but to a lesser extent. For the years just prior to the census, then new arrivals will be over-represented. For years further back, however, then the TFR of immigrants will more accurately reflect their ‘true’ fertility (as seen in Figure 5, ‘women born abroad’). By contrast, the child-woman ratio (CWR) method described by Dubuc (2009) would be particularly susceptible to the distortion imposed by the high initial fertility of immigrants.

The TFR of immigrants reflects the duration of time they have spent in their new country (Toulemon and Mazuy 2004). A downward trend may reflect an increasing average duration of stay, although it could also reflect a change in actual behaviour or changes in the source countries. Trends in the TFR of foreign women could reflect changes in the average duration before naturalisation. Any interpretation of trends in immigrant or foreigner fertility should be treated with caution.

14. Conclusion

Switzerland is a country with a high foreign population and high levels of in- and out-migration: it also has population registers (STATPOP) together with rich fertility data from the census of 2000 and the Family and Generations Survey of 2013. Therefore, it provides an opportunity for exploring the differences in Swiss and foreign fertility in depth and investigating the disparity between the TFR and cohort fertility measures.

This study has included data not only on births by nationality (Swiss/foreign) but also fertility at immigration, emigration and naturalisation. These latter factors have not been included in previous studies of fertility differentials by origin or nationality. We built a model, which we term the Comprehensive Fertility Profile (CompFerProf), of each of the sub-populations. We believe that fertility is better described by a vector of values covering the ages 15-49, rather than a single indicator, the TFR, which is subject to several distortions. We feel that it is misleading of the SFSO to publish the TFR statistics for Swiss/foreign and ‘born in Switzerland’/‘born abroad’. The current published statistics are open to misinterpretation biased against immigrants, yet these are also published by other national statistical offices, such as the UK (Tromans, Jefferies and Natamba 2009). The TFR of foreign women is also commonly discussed in the demographic literature, as if it reflected ‘real’ (cohort) fertility, e.g. Sobotka (2008), Bagavos, Verropoulou and Tsimbos (2018).

From our detailed analysis, we found that, in Switzerland, although the difference in TFR between ‘Swiss’ and ‘foreign’ women is large (1.3 for Swiss women versus 1.9 for foreign women for the years 2001-2009), by age 40 ‘Swiss’ women have had slightly more children than ‘foreign’ women.

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The computation of the fertility of immigrants, emigrants and naturalised persons was done using tables produced by the NCCR On the Move in Neuchâtel.

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8. Foreign emigrants x mean fertility of emigrants with foreign nationality: Emigr x Fr (emig)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016			
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
16	5	4	4	4	4	3	3	3	3	3	3	4	4	4	4	4	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	
17	7	6	5	4	4	4	4	4	4	4	4	5	4	4	4	4	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	
18	19	19	16	13	12	11	12	12	11	11	12	13	12	10	10	10	8	8	9	8	8	8	7	7	7	7	7	7	8	8	8	8	8	8	7	9	9	9	
19	26	27	24	18	17	18	17	17	19	17	18	17	17	13	14	14	13	11	11	13	13	12	11	8	8	8	8	9	9	9	9	9	10	10	10	12	13	13	
20	29	30	29	23	25	25	25	25	25	24	24	24	22	20	19	17	15	14	13	13	13	12	11	8	8	7	7	8	8	8	8	9	9	9	9	9	9	9	
21	42	42	41	35	35	35	38	39	42	37	39	40	40	33	29	29	24	25	21	21	20	20	17	14	16	15	16	18	19	24	24	23	24	26	26	28	28	28	
22	52	53	50	46	47	50	49	52	53	58	58	58	50	46	42	43	39	33	32	32	30	29	28	27	27	28	28	30	33	42	41	41	44	44	43	43	49		
23	52	55	54	49	45	52	53	58	64	60	62	61	60	52	53	49	43	36	37	38	38	35	33	33	34	34	34	37	36	39	47	51	51	58	56	58	57	57	
24	71	73	73	67	65	67	75	84	92	86	92	93	92	72	71	72	63	57	54	52	57	55	49	50	49	54	54	62	76	73	77	82	90	90	86	86	86		
25	83	88	87	83	83	83	85	85	101	119	115	117	119	116	100	90	85	78	72	75	71	74	74	63	66	71	70	80	84	103	101	108	114	118	124	117	117	117	
26	98	100	98	95	95	100	108	112	134	133	140	149	148	128	119	114	104	96	92	89	98	85	85	86	80	86	94	99	98	124	117	113	130	143	146	146	134		
27	132	138	125	123	119	125	136	139	175	163	180	200	190	177	156	168	137	137	138	124	130	119	106	118	120	124	124	138	137	172	161	164	184	193	200	191	191	191	
28	180	180	163	146	153	159	162	175	188	197	225	259	255	220	211	225	186	190	187	169	174	162	143	157	166	156	168	168	184	245	218	227	239	247	249	272	272	272	
29	188	195	195	174	173	178	184	220	222	228	262	303	306	262	254	255	248	234	232	215	201	209	193	193	200	210	224	234	221	292	276	287	291	300	321	309	309	309	
30	244	242	238	216	230	219	210	236	288	297	309	386	351	341	353	338	321	315	324	278	292	264	225	266	275	266	295	305	286	370	348	379	396	421	414	442	442	442	
31	325	264	273	261	237	237	239	250	309	327	377	435	403	407	383	393	378	394	344	351	315	289	304	297	317	310	332	351	327	409	401	442	421	473	536	665	665	665	
32	353	338	322	311	284	284	271	276	311	350	397	499	467	450	448	464	483	446	431	403	400	378	348	385	411	421	407	412	418	496	478	493	567	563	617	624	624	624	
33	372	371	350	313	315	308	292	312	323	318	395	524	468	433	479	486	481	473	473	423	401	397	381	429	450	434	444	415	436	547	515	541	588	619	673	665	665	665	
34	338	317	329	300	254	262	289	273	305	310	365	462	422	416	423	443	460	435	468	420	419	369	359	397	391	444	426	408	396	487	464	521	539	573	595	629	629	629	
35	403	381	408	364	340	308	328	340	381	363	402	523	488	519	488	557	555	536	513	495	501	463	440	449	502	491	559	488	471	555	488	598	673	707	783	761	785	785	785
36	338	424	367	360	366	305	311	345	369	396	506	608	537	524	529	549	519	566	565	521	526	512	442	465	449	538	497	512	482	591	525	601	633	677	715	785	785	785	
37	340	315	374	349	332	322	308	332	302	360	424	494	508	483	472	514	536	515	526	533	444	470	420	461	462	534	503	458	533	551	478	595	597	691	678	694	694	694	
38	380	369	311	351	394	334	298	317	325	350	450	568	487	484	446	504	576	542	517	494	482	471	491	485	518	551	508	581	499	584	641	699	691	699	725	730	730	730	
39	333	303	314	273	364	310	310	276	359	332	405	489	491	436	422	454	474	505	465	413	466	426	419	458	469	529	475	499	425	553	487	549	568	596	688	683	683	683	
40	295	241	300	287	249	287	272	279	274	299	364	420	374	351	387	433	436	404	425	391	387	376	363	343	410	381	411	406	376	395	468	441	508	475	529	556	590	590	590
41	343	294	261	268	279	295	275	245	275	261	382	444	416	406	412	382	374	321	367	334	323	319	323	326	312	399	410	364	365	415	398	428	434	474	526	570	570	570	
42	276	263	227	231	245	234	188	236	281	281	338	360	331	341	313	363	304	324	367	334	323	319	323	326	312	399	410	364	365	415	398	428	434	474	526	570	570	570	
43	266	249	266	216	240	204	223	206	256	237	329	372	350	298	320	309	324	305	324	280	295	263	288	310	349	354	393	336	340	428	365	371	443	484	466	504	504	504	
44	259	222	236	238	194	214	176	205	169	212	310	370	300	302	289	306	358	284	325	290	285	258	226	294	295	306	343	338	310	370	328	357	391	406	427	483	483	483	
45	202	206	204	229	260	159	193	188	217	203	252	315	317	248	286	291	293	262	240	246	246	254	256	258	291	295	295	276	299	351	327	352	392	408	412	419	419	419	
46	205	196	194	200	227	199	182	180	173	205	306	359	322	325	259	305	277	290	247	218	225	246	248	236	259	313	230	270	311	282	321	383	370	381	418	418	418	418	
47	189	166	193	197	206	184	158	161	185	185	227	294	264	223	229	268	269	256	233	244	207	221	228	236	238	268	303	240	238	312	285	333	328	348	357	383	383	383	
48	170	175	194	179	175	185	187	182	176	177	222	275	239	229	253	305	270	250	248	234	188	199	203	207	233	238	278	203	220	265	244	313	315	319	348	348	348	348	
49	176	177	193	168	168	156	166	209	193	158	247	268	249	224	240	248	283	247	235	236	182	190	224	217	223	247	264	224	220	268	255	263	288	323	323	323	323	323	