Parity-decomposition of the change in the Mean Age at Childbearing. Lessons for the timing of the second demographic transition.

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Abstract

In the theory of the second demographic transition the mid-1960s were identified as a turning point in terms of family and demographic behaviors that encompass ever-decreasing fertility levels and rapid postponement. However, evidence shows that the Mean Age at Childbearing (MAC) only started increasing in the mid-1970s in Western Europe and North America. The question is then to determine whether the statement of timing per se or the measure of the MAC should be revised. In this paper I show how the change in the MAC is influenced by the parity-unbalanced decrease in fertility, and propose a decomposition of this change between the effects of *pure* postponement and the parity-composition of the TFR, using Kitagawa's technique. Although it has often been identified by demographers, this compositional effect has never been precisely measured. After having isolated the share of the change in the MAC directly attributable to postponement, I show that the timing of the turning point in the postponement of childbearing must be relocated to the mid-1960s for USA and Canada, just as predicted by the theory of the second demographic transition. I also show that this parity weights-adjusted measure avoids the traditional pitfalls of using the yearly change in the MAC as a measure of postponement. I finally propose an alternative to Bongaarts and Feeney's tempo-adjusted TFR' that makes use of this parity-purged measure of MAC rather than the usual MAC.

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Introduction

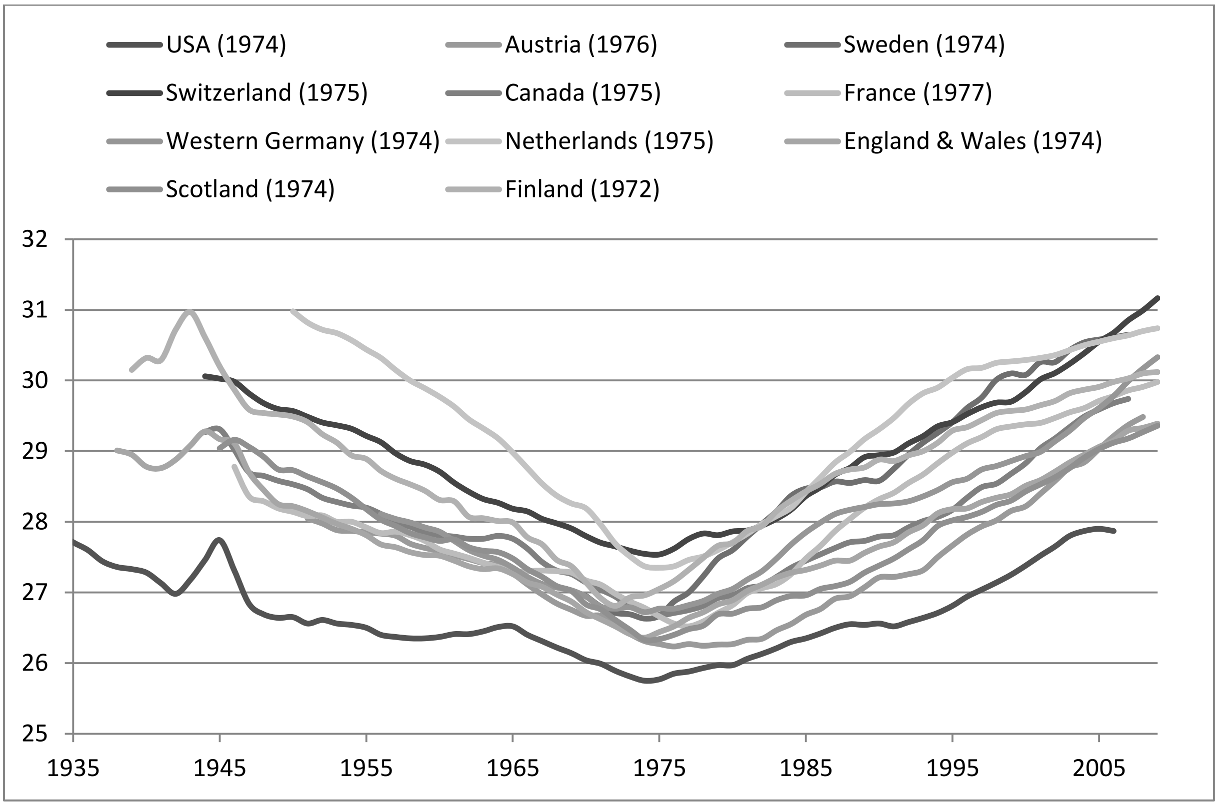
The theory of the second demographic transition was initiated by Lesthaeghe and van de Kaa in their 1986 seminal article (Lesthaeghe and van de Kaa 1986). The authors argued that the renewed decrease in fertility levels that was observed in the last third of the twentieth century in the Western World had different underlying causes and consequences than the first demographic transition (Notestein 1953). These new motivations were suggested earlier by another author.

Philippe Ariès introduced the idea that the motivations for declining birth rates before and after the baby-boom originated in two conceptions of the family. Whereas "the decline in the birth rate that began at the end of the eighteenth century and continued until the 1930s was unleashed by an enormous sentimental and financial investment in the child", the years following the baby-boom were "provoked by exactly the opposite attitude (…) where the child is one of the various components that make it possible for adults to blossom as individuals" (Aries 1980:649-650). This change in the motivations for fertility control had consequences that encompass a wide range of demographic variables, listed by van de Kaa as a decline in period fertility, partly resulting from postponement of births, a decline in the total first marriage rate associated with an increase in mean age at first marriage, as well as in divorce, cohabitation, and proportion of extra-marital births, and a generalization of modern contraception (Van de Kaa 2002:10).

According to the same author, these "fundamental changes in fertility and family formation in industrialized societies after the mid-1960s were truly revolutionary and occurred with surprising suddenness and simultaneity" (van de Kaa 2004:7). There seems to be indeed a quite general consensus to set the beginning of the second demographic transition around the mid-1960s. Van de Kaa notes that, when he was writing his 1986 article together with Lesthaeghe, "in both countries [The Netherlands and Belgium] almost every variable in the field of fertility and family formation had undergone very significant changes since the mid-1960s" (Van de Kaa 2002). Van de Kaa acknowledges though that this timing is only an estimation and that "in the search for a single measure to ascertain the situation we should not aim for a specific demographic variable, but at a measure capable of documenting changes in value orientation, in *Weltanschauung*, or in the spirit of the age" (van de Kaa 2004:9). In contrast with this quite fatalistic point of view, we see no reason why one should not try to estimate the evolution of each of these demographic variables over the last decades and, doing so, try to date each of their point of inflexion. If the second demographic transition really started in the mid-1960s, there should be signs of changes in these variables around this time.

A look at the evolution of the Mean Age at Childbearing (MAC) in eleven Western countries raises doubts about this timing (figure 1). Within only five years all of these countries experienced a reversal in the evolution of the MAC, the earliest turning point taking place in Finland (1972) and the latest in France (1977). All of this happened about a decade later than predicted by Ariès and van de Kaa.

Figure 1: MAC in eleven Western countries



Source: Human Fertility Database, year of the minimum value in brackets

There are two ways to interpret this result. Either we trust the figures and start questioning the timing of the second demographic transition that is usually given in the literature, or we call into question the figures. The latter requires a more intense investigation about what is the Mean Age at Childbearing and how it is calculated.

The MAC, as its names suggests, is a mean in many ways. For this paper we chose perhaps the three most obvious ones[2].

First, the MAC is a measure of central tendency of the fertility schedule. It is computed by the weighted average of the age at childbearing (*x)*, the weights being in this case the age-specific fertility rates *f(x)* (equation 1). It gives a cross-sectional estimate of how old women would be at the time they give birth if they followed the current fertility schedule during their entire life. From this point of view, a change in the MAC is due to the postponement or anticipation of births. This is what people usually have in mind when they think of the timing of births, but the MAC can be influenced by other mechanisms than "pure" postponement as we will just see.

$$MAC = \frac{\int f(x) \cdot x dx}{\int f(x) dx} \qquad \text{Equation 1}$$

[2] Additionally to those three examples, one could have highlighted for instance the racial composition of the fertility (e.g. in the US, Black and Hispanic mothers are on average younger than White, and if the formers take a larger share of the fertility this might influence the MAC downwards), or the educational composition of the fertility (e.g. higher educated women tend to have their children later, hence an increasing share of the higher educated women in the population will increase the MAC). By decomposing these different influences on the MAC, it could be theoretically possible to evaluate their validity in the theories of childbearing postponement.

Secondly, the MAC is traditionally computed on the age-specific fertility rates, i.e. the age-specific ratio between the number of live births (not the maternities) and the female exposure. If we were to measure the mean age at childbearing from the point of view of the mothers, which can be argued as a better measure of the timing of births, we would need to use the number of maternities, independently of the plurality of births. To do so, we would need to use the age-specific maternity rates *m(x)* computed from the ages-specific twinning rates *t(x)* (equation 2). Hence, a change in the distribution of *t(x)* could have an influence on the MAC, without any contribution of the actual timing of the maternities. This was the case in the United States, where the twinning rate surged at ages 30+ in the last two decades as a consequence of the use of fertility drugs. In this country, vital statistics show that "the twinning rate has climbed 42 percents since 1990, and 70 percent since 1980", and "the largest growth has been among older mothers, especially those aged 35 years and over. For example, among women aged 20-24 years the twin birth rate increased 31 percent between 1980 and 2004, compared with an increase of 133 percent for women aged 40-44 years" (Martin et al. 2006:25-26, see also appendix 1). The question of the influence of multiple births on the MAC has not received the attention it deserved, although one can argue that even those sky-rocketing figures (probably the highest in the world) might have a quite moderate effect on the MAC, given the low level of fertility above the age of 40. For instance, using the 2004 figures for *t(x)* (Martin et al. 2006:26) and *f(x)* (Human Fertility Database), the MAC computed on the maternity rates would be only 12 days below the one computed on the fertility rates (27.34 vs. 27.37 years old).

$$MAC = \frac{\int m(x) \cdot x dx}{\int m(x) dx}$$ Equation 2[3]

Thirdly, the MAC can be expressed as a mean of means. In this case, the total MAC is the weighted mean of each parity-specific MAC. From this point of view, the total MAC is thus influenced not only by the change in the timing of each birth order (or parity), but also by the share of each parity in the TFR (equation 3). This second confounding effect has potentially a much more important impact than the one of twinning rate and therefore we will now concentrate on this specific question.

$$MAC = \frac{\sum_i MAC_i \cdot TFR_i}{TFR}$$ Equation 3[4]

From the above we infer that the measure of the MAC can be somehow misleading. What we generally use as the measure of central tendency of the fertility schedule, the traditional MAC, might not evolve exactly in the way that we are interested in. This paper will tackle the following question. To which extend the strong increase in the MAC observed since the 1970s in Western Europe was due to the real postponement of the timing of childbearing?

The first step of our analysis will be to highlight the mechanisms through which declining fertility can affect the MAC.

[3] Where $m(x) = f(x) \cdot (1 - t(x)) + t(x) \cdot \frac{f(x)}{2} = f(x) \cdot \left(1 - \frac{t(x)}{2}\right)$, and t(x) is the number of live born infants in double deliveries per 100 live births. Pluralities above 2 are ignored here because of their extremely rare occurrence, i.e. 2‰ of all births in the United States in the 2000s (Martin et al. 2006:25).

[4] Where MAC_i is the mean age at childbearing for birth order i, and TFR_i is the total fertility rate for birth order i. The latter requires using as exposure the person-years lived by women who have already experienced i-1.

After having well identified the problem, our second goal will be to find an adequate method in order to split the effects of the "pure" postponement of the births from the "disturbing" effect of the parity-composition of the TFR.

Only then will we be able to tackle the central question, i.e. the real timing of the onset of the second demographic transition. After having adjusted the measure of the MAC will the beginning of the postponement of births remain as late as observed so far (i.e. in the mid-1970s), or will it shift back to the 1960s as predicted by the theory?

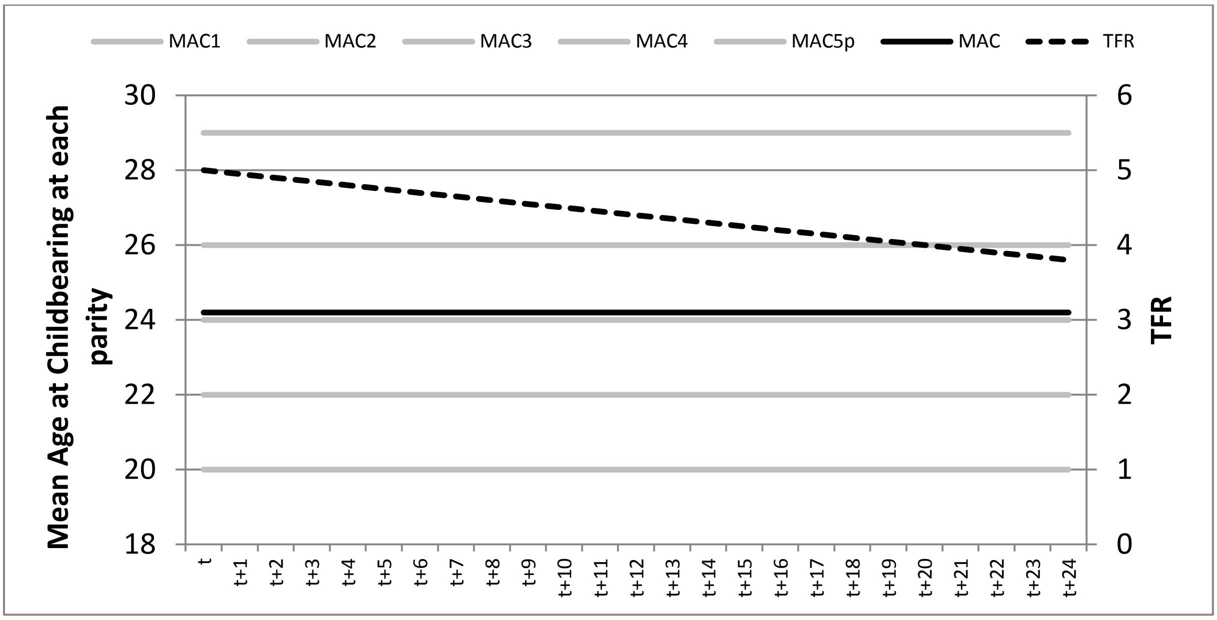
For this purpose, we will rest mainly on data from the Human Fertility Database that offers the most easily available source of comparable international fertility measures.

1. How changing fertility levels influence the timing of childbearing

The mutual influence of level and timing of fertility have been given a prominent attention since the publication of Bongaarts and Feeney's 1998 method of tempo-adjusted TFR (Bongaarts and Feeney 1998). The emphasis has however been on the effects of postponement (i.e. increasing MAC) on period measures of fertility (i.e. TFR). The opposite effect, although often acknowledged, has received much less attention. One of the examples of such concern can be found directly in Bongaarts and Feeney's article: "shifts in relative quantum at different birth orders can magnify, attenuate, and even reverse the trends implied by order-specific mean ages at childbearing" (Bongaarts and Feeney 1998:281). They illustrate this statement with the US total and parity-specific trends between 1965 and 1974, during which "the quantum of higher-order births declined much more rapidly than the quantum of first and second births" so that "the combined effect of these weight changes is so large that it more than offset the rise in the means at each order" (Bongaarts and Feeney 1998:281). Other examples of such concerns can be found elsewhere (e.g. Véron 1993), but this has not lead to the formulation of a practical measurement tool. Usually, demographers get around this obstacle by observing one or several parity-specific MACs, especially the mean age at first child, henceforth MAC_1. Doing this, they are forced to observe several variables (MAC_is), and loose in readability what they gained in accuracy. No tool has yet been proposed to capture the joined effects of the change in each of the MAC_i, freed from the confounding effect of the changing parity-composition of the fertility. Before coming to this point, let us imagine two different situations in which fertility reduction can have an influence on the MAC or not.

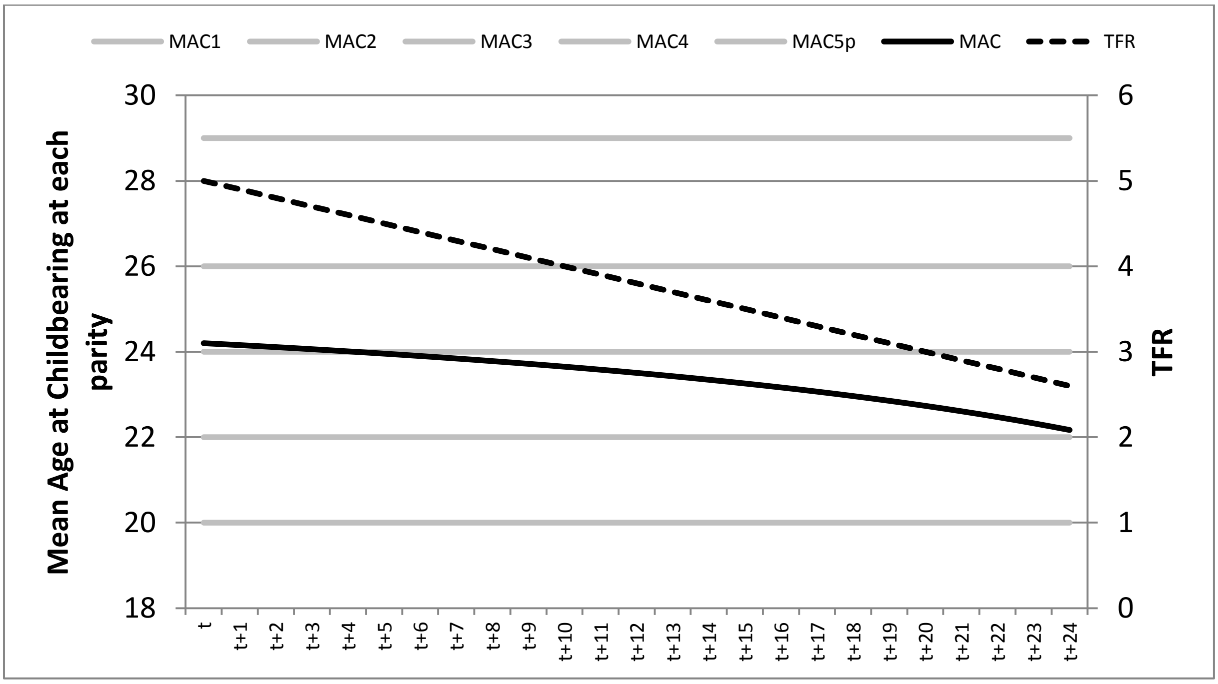
First, let us imagine a population in which each parity-specific MAC is stable, so no real postponement is actually under way. Meanwhile, the level of fertility decreases at the same pace for each birth order. In this case, the general MAC will not be influenced and will remain stable, just as all the parity-specific MACs (figure2).

Figure 2: Evolution of MAC in a first imaginary population



Secondly, let us imagine a population in which each parity-specific MAC is stable, so there is still no real postponement. However, this time, the fertility declines quicker at higher birth orders than at lower ones. This corresponds approximately to what has been observed particularly in Western countries over the last decades. In this case, the general MAC will be mechanically pulled down because of the growing relative importance of lower parities in the TFR, despite the stable parity-specific MAC_is (figure 3). This decrease in the MAC is thus totally due to compositional effects and does not reflect a real anticipation of births. Of course, in real populations, both effects are likely to occur simultaneously and will either counterbalance or reinforce each other, making them more difficult to distinguish. The challenge is then to propose a method that allows differentiating the effects of "pure" postponement and the ones attributable to compositional effects.

Figure 3: Evolution of MAC in a second imaginary population



2. Distinguishing schedule and compositional effects

The problem we face is the one of the decomposition of the difference between two means (in this case, the same mean at different points in time). This question has already been tackled by several authors, among which Evelyn Kitagawa offered a both elegant and useful answer (Kitagawa 1955). She showed how decomposition technique could provide an alternative to standardization in the quest for interpretation of the differences between two rates. Whereas the standardization procedure requires computing conditional rates, i.e. representing a hypothetical state where one alters the reality (e.g. the population composition) in order to compare the remaining differences to each other, the decomposition technique aims to "allocate the difference between two crude rates into components which reflect differences in specific rates of the two groups, on the one hand, and differences in their composition, on the other hand" (Kitagawa 1955:1172). As we can see, the idea is very similar, but the advantage of the decomposition technique is to work directly on the difference between the rates without having to interpret conditional rates whose meaning might not be straightforward.

Although Kitagawa focused on rates, her formula is perfectly generalizable to any weighted mean. Let us take for instance the Crude Death Rate (CDR). From its usual definition, we can show that it can be defined as a mean too, where the structure of the population *p(x)* acts as weights on the age-specific mortality rate $\mu(x)$ (equation 4).

$$CDR = \frac{deaths}{population} = \frac{\int \mu(x) \cdot p(x) dx}{\int p(x) dx} \qquad \text{Equation 4}$$

Kitagawa's formula applicability to any form of weighted mean was recently demonstrated and modernized by considering the variable *v* of interest and the weights *w*, and expressing the difference in the mean of *v* as follows (Canudas Romo 2003:18).

Equation 5

$$\bar{v}(t+h) - \bar{v}(t) = \Delta\bar{v}(t)$$
$$= \left[\sum_x \frac{\frac{w_x(t+h)}{\sum_x w_x(t+h)} + \frac{w_x(t)}{\sum_x w_x(t)}}{2} \cdot \left(v_x(t+h) - v_x(t)\right) \right]$$
$$+ \left[\sum_x \frac{v_x(t+h) + v_x(t)}{2} \cdot \left(\frac{w_x(t+h)}{\sum_x w(t+h)} - \frac{w_x(t)}{\sum_x w(t)} \right) \right]$$

The first term of the decomposition estimates the share of the change in $\bar{v}$ "due to changes in the variables v_x at every value of x. (…) The other term is the change in averages due to changes in the normalized weights" (Canudas Romo 2003:18-19). This formula can in turn be adapted very easily to the analysis of the annual change of the MAC by replacing *v* by the parity-specific MACs, and w by the parity-specific TFRs. Doing so, the change of the general MAC can be expressed as follows.

Equation 6

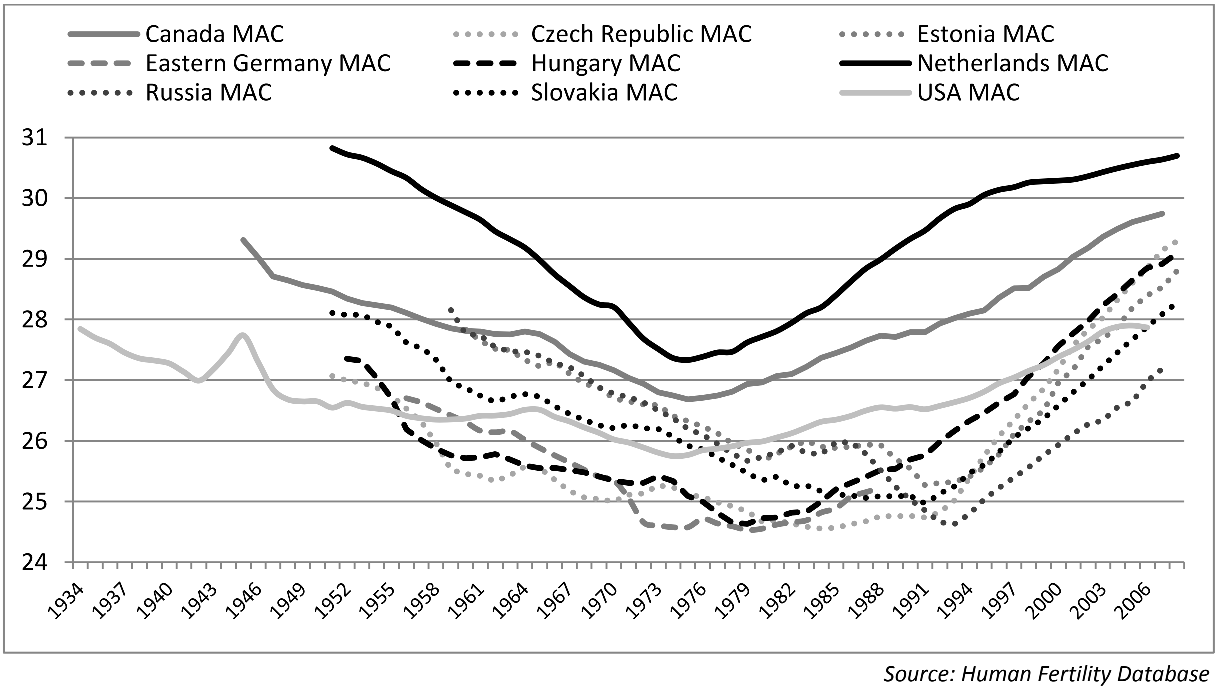
$$\Delta\overline{MAC}(t) = \sum_i \left(\frac{\frac{TFR_i(t+h)}{TFR(t+h)} + \frac{TFR_i(t)}{TFR(t)}}{2} \right) [MAC_i(t+h) - MAC_i(t)] + \sum_i \frac{MAC_i(t+h) + MAC_i(t)}{2} \left(\frac{TFR_i(t+h)}{TFR(t+h)} - \frac{TFR_i(t)}{TFR(t)} \right) = \Delta MAC_{\text{schedule}} + \Delta MAC_{\text{weights}}$$

In other words, the change of the mean age at childbearing is the sum of two components, one due to the change in the schedule of childbearing (ΔMAC_S), and a second one due to the weights of each birth order in the TFR (ΔMAC_W). The former corresponds exactly to the object that we wanted to isolate in order to eliminate the disturbing effects of an unevenly falling fertility rate. We thus have here the tool required to test the timing of the onset of the increase in the age at childbearing, a key element in the theory of the second demographic transition.

3. The timing of the onset of the second demographic transition

In figure 1 we observed that, contrarily to van de Kaa's assumptions, the mean age at childbearing in most Western countries did not start increasing before the mid-1970s. Figure 4 presents the observed MAC in nine countries selected from the Human Fertility Database for their data availability by birth order. The countries that did not offer parity-specific data prior the 1960s were excluded. We can observe generally the same pattern as in figure 1, which is to say for the three Western countries (USA, Canada and the Netherlands) a sharp increase starting simultaneously in the mid-1970s. Moreover, we observe a similar phenomenon for Hungary and Eastern Germany in the early 1980s, and third movement in the early 1990s concerning Eastern European countries (Czech Republic, Estonia, Russia and Slovakia).

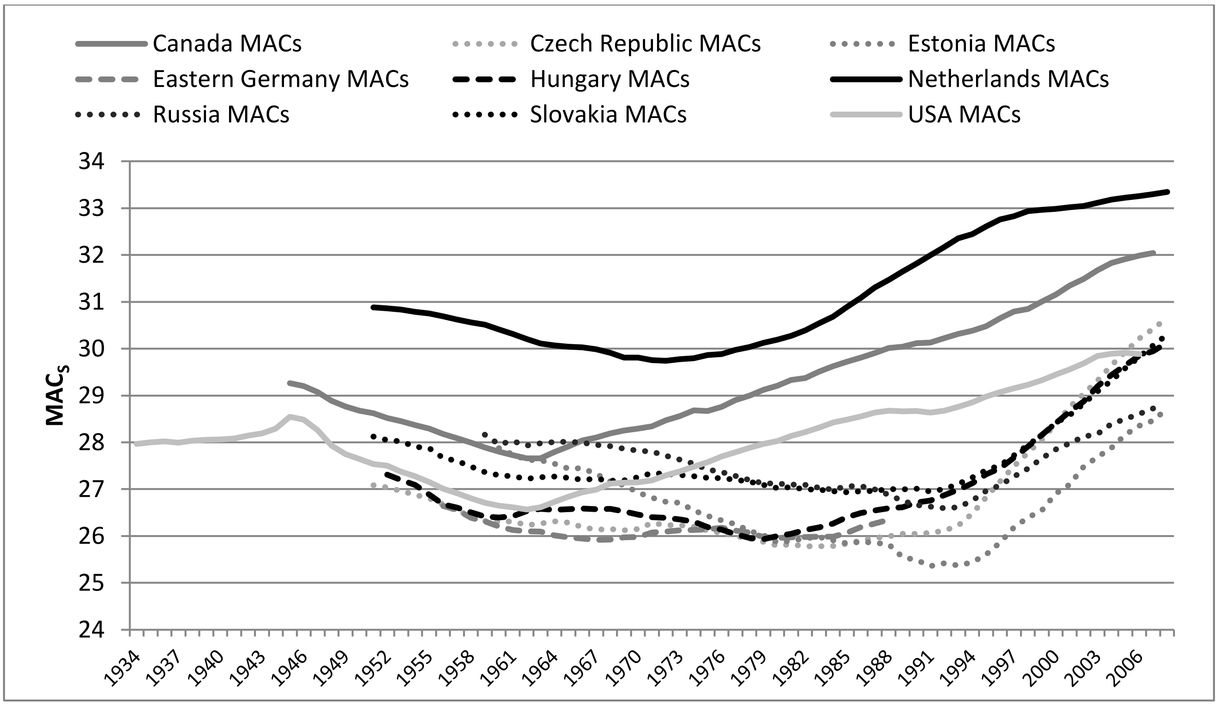
Figure 4: MAC in nine countries of the Human Fertility Database



Source: Human Fertility Database

Are those observations still valid when confronted to our new adjusted measure? By applying successive values of ΔMAC_S to the first available value of MAC, we can draw a similar picture of the evolution of the timing of childbearing, but ignoring this time the effects of the changing weights of each parity. Figure 5 shows indeed a much different reality than figure 4. The United States and Canada now start the transition much earlier. When adjusting for parity-specific weights in the TFR, the MAC starts increasing as early as the mid-1960s, precisely the timing predicted by van de Kaa.

Figure 5: An adjusted measure of MAC



Source: Human Fertility Database, own calculation

This decomposition indicates that, as noticed by Bongaarts and Feeney in 1998, the US increase in the MAC between 1965 and 1975 was entirely due to the confounding effect of the decreasing share of higher parities in the TFR in the time of the baby-bust. Had this effect not been present, the MAC would have hit a lowest already in 1962, compared to 1974 in the original measure of MAC. The situation is very similar in Canada, where the turning point can be moved from 1975 back to 1961. The Netherlands, in contrast, show a very similar pattern regardless of the adjustment procedure. In this country the transition stretched over a much longer period covering the 1960s and 1970s, during which the adjusted MAC only fluctuated within 0.35 year (compared to changes of 0.2 year per year in average in the 1980s). The minimum was not reached before 1972, ten years after North America. The nature of this delay, which does not appear in the non-adjusted measure of MAC, would deserve a more thorough investigation. As the theory of the second demographic transition rests mostly on the changes of priorities toward family and individual achievement, a first guess would be to link this European delay to the time it took for individualistic conceptions to travel from the culturally dominant American sphere to Western Europe. Although this hypothesis requires additional investigation, it raises the question of the underlying causes of the second demographic transition. The current interpretation that points to the changes in family and individual accomplishment needs in turn to be explained by more general changes in the way people envisage their relationship to their kin and the society as a whole. The time lag observed between North America and the

Netherlands in our analysis opens a door to an extension of the theoretical ground of the second demographic transition.

Of the other states compared in figures 4 and 5, two show a clear difference. The formerly distinct transitions in Eastern Germany and Hungary appear much fuzzier after the adjustment. It seems that in terms of "pure" postponement, both countries also experienced a much slower transition from the 1960s to the 1980s, resembling (at a younger MAC level) the case of the Netherlands. The question if this pattern of slow transition is common to all European countries remains however, given the obvious differences of context between Eastern Germany, Hungary and the Netherlands during the Cold War.

Finally, the pattern of Eastern Europe remains quite unchanged in figure 5 compared to figure 4. An important part of the dramatic drop in MAC in Russia and Estonia in the late 1980s is cancelled out once the effects of decreasing higher birth orders are taken into account. Still, the timing of the transition remains stable in the early 1990s.

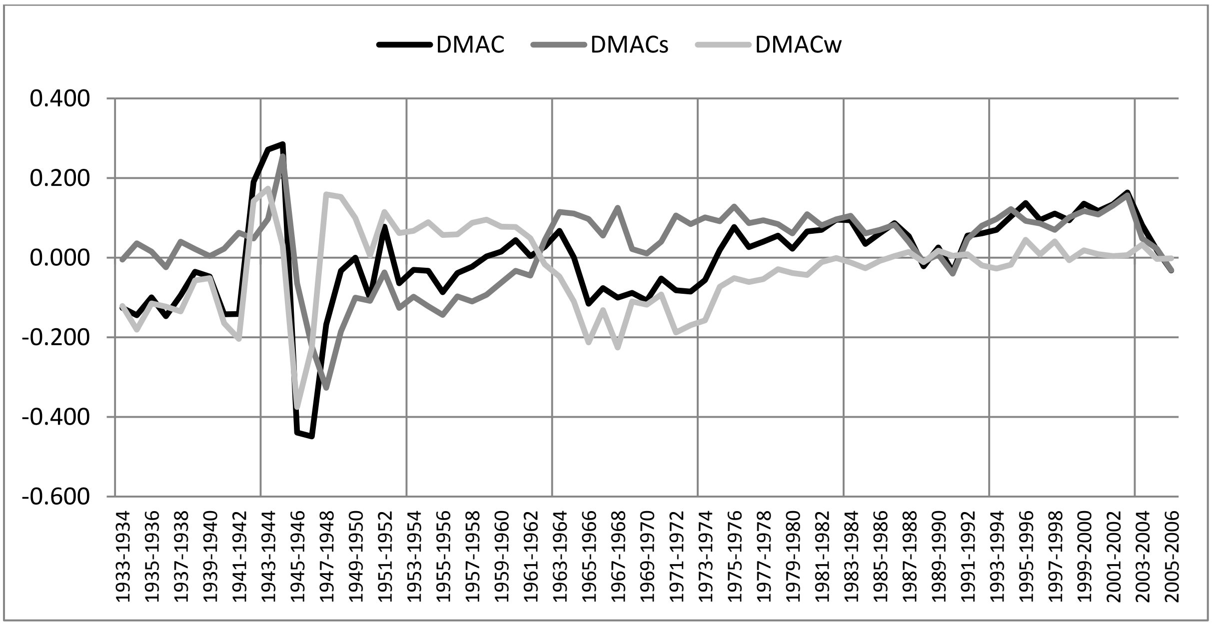
The use of the adjusted MAC_S proved to be a very strong tool in the analysis of the general pattern of the onset of the second demographic transition. It can provide moreover a useful mean of interpretation of more particular cases.

4. A closer look at certain cases

4.1 The American experience

The two North American cases, USA and Canada, show two very similar pictures. The former offers though a longer period of analysis and was thus chosen as a reference case. Four conclusions can be drawn from figure 6 that shows ∆MAC, the total annual change in the MAC, ∆MACs, the contribution of the schedule effect, and ∆MACw, the contribution of the change in the parity weights.

Figure 6: Decomposition of the annual change in MAC, USA, 1933-2006



Source: Human Fertility Database, own calculation

Firstly, we see that before the Second World War, the decline of the MAC was essentially an artifact of the progressive concentration of fertility in the first birth orders and that this decline had nothing to do with an anticipation of childbearing. This reflects probably the general trend in Western populations from the onset of the (first) fertility transition in the late nineteenth century (Coale and Watkins 1986). Henry's definition of fertility control puts a strong emphasis on the stopping behavior: "control can be said to exist when the behavior of the couple is bound to the number of children already born and is modified when this number reaches the maximum that the couple does not wish to exceed" (Henry 1961; Wilson et al. 1988:4). This had the consequence of flattening the shape of the age-specific fertility rates that was the sign of an unbalanced compression of fertility that mainly affected higher parities and hence decreased the MAC despite the absence of anticipation in the fertility schedule.

Secondly, the second World War was marked with a brutal raise in the MAC (about 2 months between 1942 and 1943, another 3 months the following year, and 3.5 months between 1944 and 1945), which was the result of the combined effects of postponement and parity-composition of the TFR. In other words, American couples who suffered economic and psychological insecurity chose (or were forced in the case of the mobilized soldiers) both to postpone all their births and to avoid having their first child (which was probably linked to the fact that US soldiers were mostly young men).

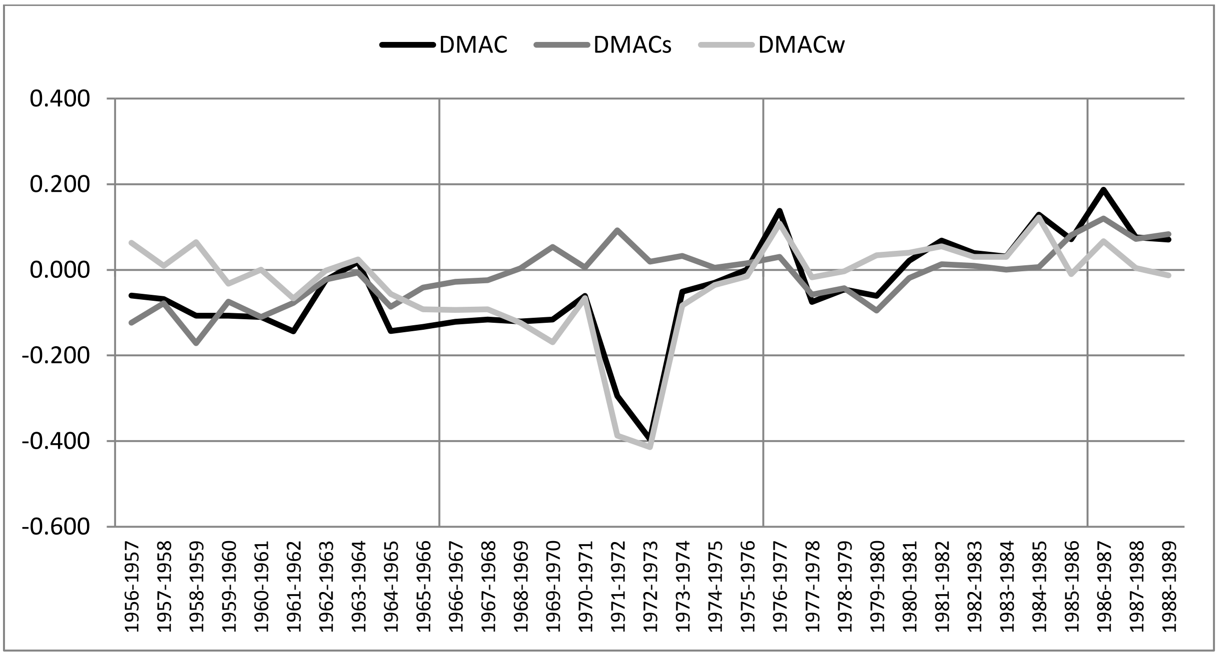
Thirdly, the American post-war rapid economic growth (1945-1975) was apparently witnessed a decrease in the MAC. With the exception of 1951-52 and 1958-65, the only eight years during which the yearly change in MAC was positive (although weak), the whole period was marked with a decline of the mean age at childbearing. This apparent steady decline hides in reality two distinct periods, from 1945 to 1963, and from 1963 to 1975. During the first period, the baby-boom, couples had their children increasingly younger, at a pace that was much quicker than the traditional measure of MAC suggests. If it had not been for the augmentation of higher parities births that formed the bulk of the baby-boom, the MAC would have decreased at the rhythm of one and a half month per year. This period represents the triumph of the *bourgeois* model of family, illustrated here by an early family formation, combined to an unleashed fertility allowed by a fast-growing economy. The second phase of the post-war period, from 1963 to 1975, witnessed a total reversal of this situation. After 1963, American couples were already postponing the birth of their children, a behavior that was masked by the baby-bust that consisted mainly in the reduction of higher parities fertility. That is why we can conclude that in terms of real postponement of childbearing, North America already entered the scheme of the second demographic transition in the mid-1960s.

Finally, the period after 1975 eventually experienced a directly observable increase in the MAC, as the MACs component took over the MACw component. Since the 1970s, the parity-composition effect has decreased steadily, leaving the observed MAC to reflect the sole fluctuation of the real postponement of births. This situation is explained by the stabilization of the TFR around two children per woman, without any further decrease in the higher parities. At their peak in 1962, the parities above 2 accounted for half of the births, before reaching a plateau in the early 1980s. Ever since, they represent no more than one quarter of all births every year.

4.2 The not-so-bizarre 1972 drop in East Germany

Eastern Germany's MAC history is marked by one brutal phenomenon that took place between 1972 and 1975. During these three years, the mean age at childbearing decreased by three to four months per year, before returning to a more stable state in the following years. Whereas elsewhere anticipation and postponements were quite progressive evolutions, in this case the drop of the MAC during those three years happened in an unpredictable way. This peculiar pattern should raise suspicion on the real nature of this drop. Indeed, figure 7 shows clearly that the entire drop can be explained by the parity-specific composition of the TFR, that is to say that in those years the share of the higher birth orders in the fertility level decreased sharply. In contrast, the weights-adjusted ∆MACs was not affected and even showed a slight postponement at this moment.

Figure 7: Decomposition of the annual change in MAC, Eastern Germany, 1956-1989



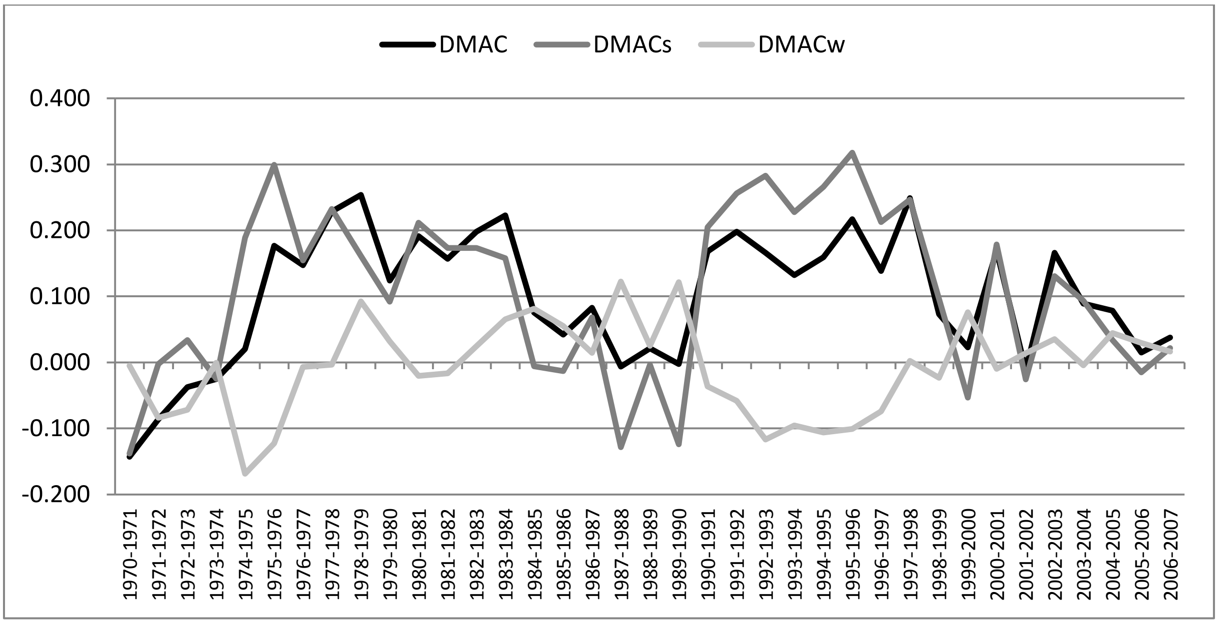
Source: Human Fertility Database, own calculation

This peculiar situation can be explained by the liberalization of access to induced abortion during the first three months of pregnancy. The principal effect of this policy change was a stronger drop of the births at higher parities than at first and second birth orders. As Buttner and Lutz showed in their analysis of the consequences of this new policy and the one that followed in 1976, holding other variables constant, the third parity was cut down by two from 1972 to 1973, whereas the first parity was only reduced by about 10% and the second by 30% (Buttner and Lutz 1990:549). In this case again, the decomposition of direct effects of postponement and compositional effects permitted to reveal the true nature of this apparent anticipation movement.

4.3 Sweden and its two economic downturns

The Swedish case is another particularly interesting one. Despite the fact that it was not selected on figure 5 due to its lack of parity-specific data before 1970 , this country still offers a profile worthwhile attention. Figure 8 shows that the observed MAC increased sharply in the 1970s, almost entirely due to real postponement effects. Whether we interpret this movement as a consequence of the second demographic transition or of the economic downturn of the mid-1970s, it is particularly worth noting the striking stop of this evolution in the late 1980s. In the Netherland, once the ΔMACs became positive, it remained so until the early 2000s when it flattened considerably. In this sense, Sweden resembles much more the American model, where the US (and to a lesser extend Canada) witnessed a stop in the progression of the postponement of births.

Figure 8: Decomposition of the annual change in MAC, Sweden, 1970-2007



Source: Human Fertility Database, own calculation

A second peculiarity in the Swedish case is the evolution of the MAC in the 1990s. As a consequence of the hard economic crisis that hit the country, the GDP decreased between 1990 and 1993 and unemployment rose from 1.7 to 8.3% in the same period and stayed over 7% until the late 1990s (e.g. Bergmark and Palme 2003). The effect on fertility was massive, with a 0.5 drop of the TFR in five years. The schedule of fertility was also affected, the MAC increasing at the pace of two months per year during the 1990s. But in the same time, the reduction of the fertility level hit the higher birth orders harder than the lower ones, which explains why the ΔMACw pulled the ΔMAC down during this period. This means that without this compositional effect, the MAC would have increased at an even higher pace, up to 3.2 months in 1996.

The Swedish case calls for more thorough research, especially concerning the so far unexplained drop of the ΔMACs in the 1980s and the link between the economic crisis and the postponement of births in the 1990s.

5. Links with tempo-adjusted measures of fertility

Tempo adjusted measures were introduced in order to correct period measures of fertility, such as the TFR, for the distortion caused by the postponement of births. It is not our point here to cover the multiple alternative measures that have been proposed over the last years. However, taking the most widely used one, i.e. Bongaarts and Feeney's TFR', we will show that it is possible to get to the same point using a slightly modified formula that makes use of our new parity-purged measure of MAC.

Bongaarts and Feeney's technique requires dividing each parity-specific TFR, henceforth TFR_i, by a value that is inversely proportional to the amount of postponement recorded in the current year (Bongaarts and Feeney 1998). This amount is measured by the annual change in the MAC for the birth order in question (equation 7).

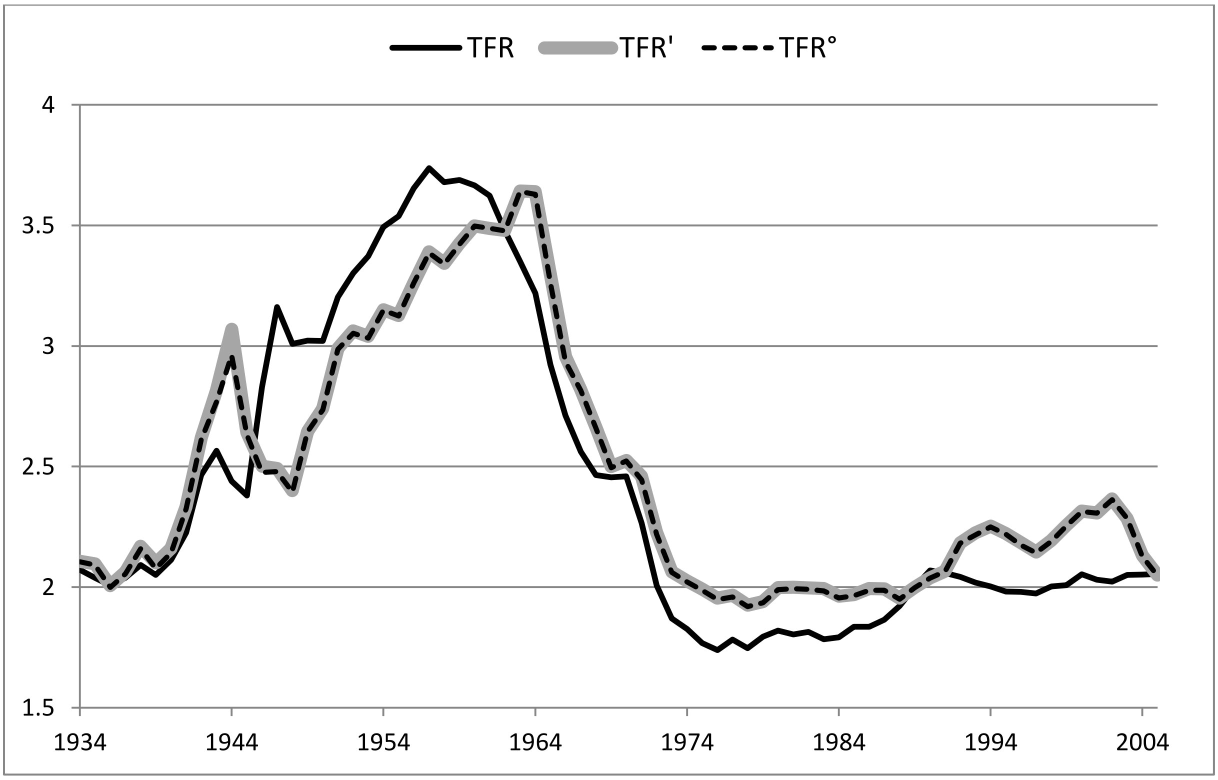
$$TFR' = \sum_i TFR'_i = \sum_i \frac{TFR_i}{1-\Delta MAC_i} \quad \text{Equation 7}$$

In order to avoid the pitfall of the "shifts in relative quantum at different birth orders" (Bongaarts and Feeney 1998:281), the authors computed first a tempo-adjusted measure of fertility at each birth order, and only then summed them up to obtained a total measure of the fertility. With the use of the ΔMACs, these two steps can be inverted to get a very similar result. To do so, we propose to first adjust for the parity composition of the TFR by calculating the ΔMACs, and then use it on the TFR for all birth orders to obtain an alternative to the TFR', hereafter TFR° (equation 8).

$$TFR° = \frac{TFR}{1-\Delta MAC_s} \quad \text{Equation 8}$$

The last question is now to determine if those two measures are identical or not. As a mathematical proof could not be proposed yet, we suggest testing this assumption empirically. The United States provide the longest series of all available countries in the Human Fertility Database, and we will therefore use it to test the association between TFR' and TFR°.

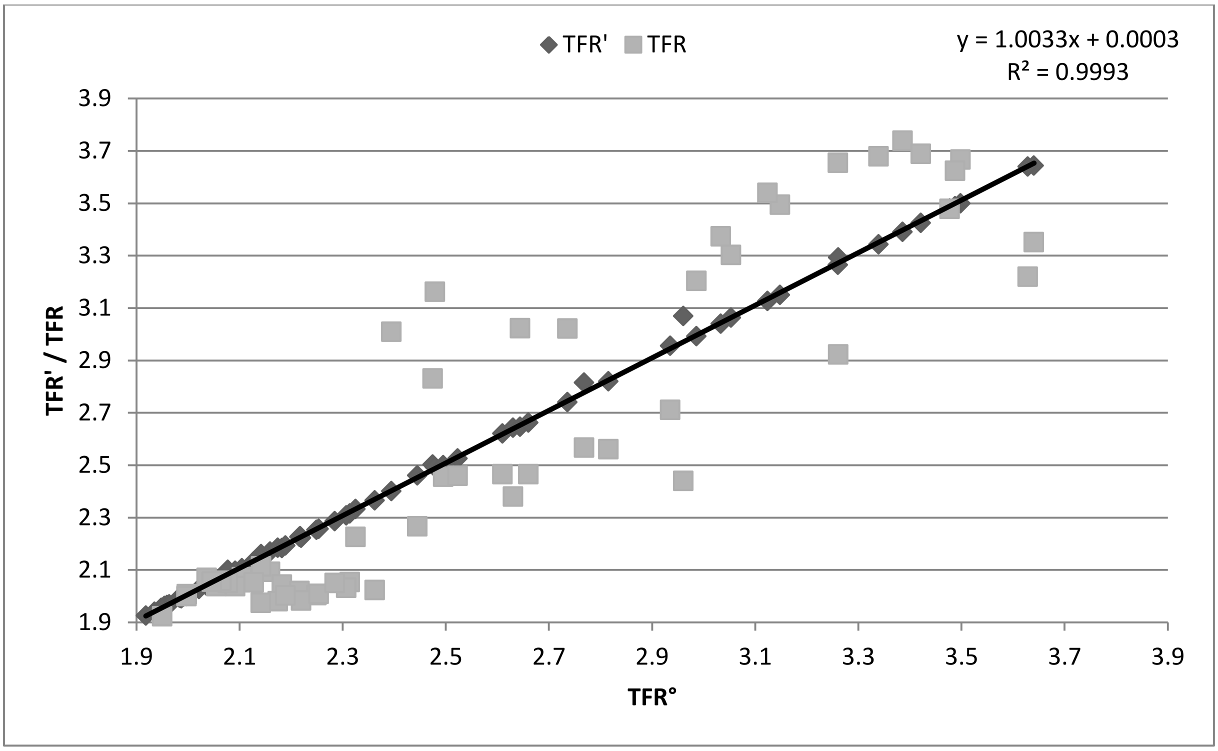
Figure 9: Different period measures of tempo-adjusted fertility, USA 1934-2005



Source: Human Fertility Database, own calculation

Figure 9 suggests that TFR' and TFR° are extremely closely related. They both indicate that the baby-boom that took place in the two decades after the Second World War was overestimated by the traditional period TFR by about 0.3 children per women during twenty years. Inversely, after taking account of tempo effects, the fertility levels of the last 30 years are increased by about 0.2 children per women. At all time, TFR° follows almost exactly the evolution of TFR'. The association between the two measures can be estimated with a simple linear regression (figure 10). The very high value of the R2 suggests that the two measures are practically identical, with the single exception of 1944, a year which witnessed the highest value (0.255) for ∆MACs in the whole period observed.

Figure 10: Association between TFR' and TFR°, USA, 1934-2005



Source: Human Fertility Database, own calculation

Conclusion

The question of the timing of onset of the second demographic transition has not received enough attention until now. The majority of authors agree to situate it in the middle of the 1960s for reasons that are not always obvious. In this article we opted for a pragmatic approach and tackled this question by observing one of the principal variables related to the second demographic transition, the mean age at childbearing (MAC).

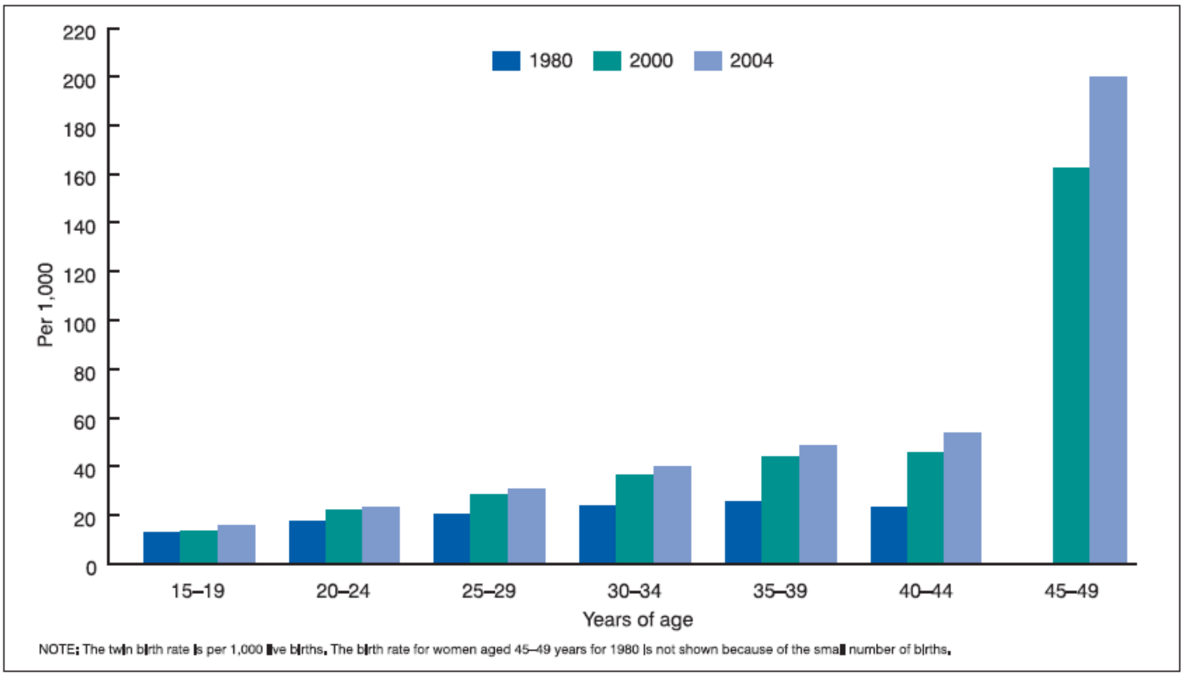
Whereas at first sight the MAC seemed to increase only in the mid-1970s, it became obvious that this measure was disturbed by the confounding effect of the unevenly declining fertility levels at each birth order. This phenomenon is not new to demographers, but it is remarkable that no proper tool has ever been proposed to differentiate the share of the change in the MAC directly due to the schedule of births, to the one due to the parity-composition of the TFR. Using Kitagawa's decomposition technique, we showed that those two effects could be distinguished in respectively ∆MACs and ∆MACw.

The application of this decomposition to a set of nine countries available in the Human Fertility Database showed that, at least in North America, the onset of the postponement of childbearing can be safely moved back to the mid-1960s, precisely the time predicted by the theory of the second demographic transition. The only Western European case, the Netherlands, did not seem to follow the same pattern though. There are reasons to think that the postponement of childbearing only started in Western Europe in the 1970s. The reasons of this time lag need to be further investigated for they would offer insights into the underlying causes of the change of attitude toward family and childbearing that occurred in the second part of the last century and had effects not only on the age at childbearing, but also on the marriage and divorce rates among others.

We finished demonstrating the convenience of this new parity composition-purged measure of MAC by showing how it can be used in an alternative measure of tempo-adjusted fertility, namely TFR°, inspired from Bongaarts and Feeney's TFR'.

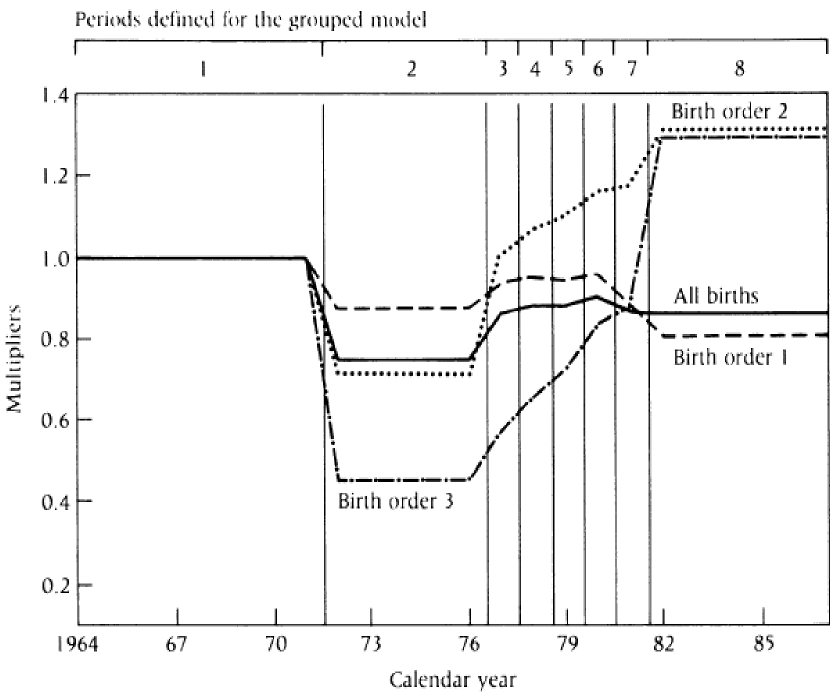
Appendix

Appendix A: Twin birth rate by age of the mother: United States, 1980, 2000 and 2004



Source: (Martin et al. 2006:26)

Appendix B: Estimated period effects (multiplier) on fertility for the age group 18-30 in the GDR by birth order, 1964-87 (multiplier for the period 1964-71 is set to 1)



Source: (Buttner and Lutz 1990:549)

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