Kinship Network across the Life Course: The Case of French Generations Born from 1851 to 2000

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Abstract

This paper aims to investigate how kinship entourage evolves throughout an entire individual life course. Data are drawn from a micro simulated sample: the base population (1/100th of the French 1851 census) is submitted to mortality and fertility risks, as well as its generated offspring. For the generation of the nineteenth century, demographic forecasts are requested to provide unobserved vital rates. We show how kinship network is shaped across the life course by demographic change, historical events such as war and booms, and long trends like sustained low fertility. We also point out the interest of a whole biographic and wide historical perspective.

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1. Method

Results presented below rely mainly on micro simulation techniques in order to constitute theoretical individual biographies on the basis of the demographics of the relevant periods. The algorithm we used is implemented for R, and is for now limited to fertility and mortality. Starting from a base population (age structure by sex), the algorithm progressively age individuals, and submit them to probabilities of parenthood and/or death. Occurrences of vital events are determined by comparing a random number with the corresponding probability (function of age and Ego's year of birth).

Fertility is the first event to be simulated. When it is determined that a woman is to have her first birth, thus still being single, a father for her forthcoming offspring is selected. A desired mate age is randomly selected, assuming a normal distribution with mean and standard deviation corresponding to the year of birth of the child (the current year). A mate with that exact age is then randomly selected from the pool of potential fathers (childless men with that age). If the woman has already had a child, this step is skipped as all her children are considered to have the same father. Newborn, whose sex is determined randomly, are then introduced in the population as new entries.

The next phase of a one-year cycle is mortality. Probabilities of death are again compared with random numbers. For newborn from the previous phase, the probability considered is the one from birth to age zero. When death occurs, the individual is taken out of the population, put in the deceased population that will be fused back in once the simulation comes to an end. At the end of the run, the algorithm outputs a population file containing a series of information: year of birth and death, rank of birth, parity, identifiers (Ego, mother, father, and partner). The latter information is used to reconstitute Ego's kinship network.

This relatively simple model is allowed by a series of assumptions. Probably the most important is the total independence of mortality and fertility risks throughout generations. Mortality being only function of cohort and age, there is supposedly no transmission of risk of death throughout the lineage (genetic, behavioral, rank or parity related). The same holds for fertility: Ego's completed fertility is considered independent of his/her sibship size, or previous fertility history.

Another assumption, relatively to the stability of union, states that once a couple is matched, following a woman's first birth, it may only be dissolved by death (which blocks future fertility of the surviving mate). There is no disruption or family reconstruction possible. Thus, all the children from a woman have the same father, and half kinship cannot be taken into account.

Due to the stochastic nature of the method, micro simulation results are subject to random error (Van Imoff & Post, 1997). Several runs with same inputs can lead to different estimations. To take this into account, simulations results are often the mean of a series of independent runs. We chose an intermediate solution consisting in increasing the starting population size as its maximum acceptable (memory allocation and time), so that the random variation would be considerably reduced.

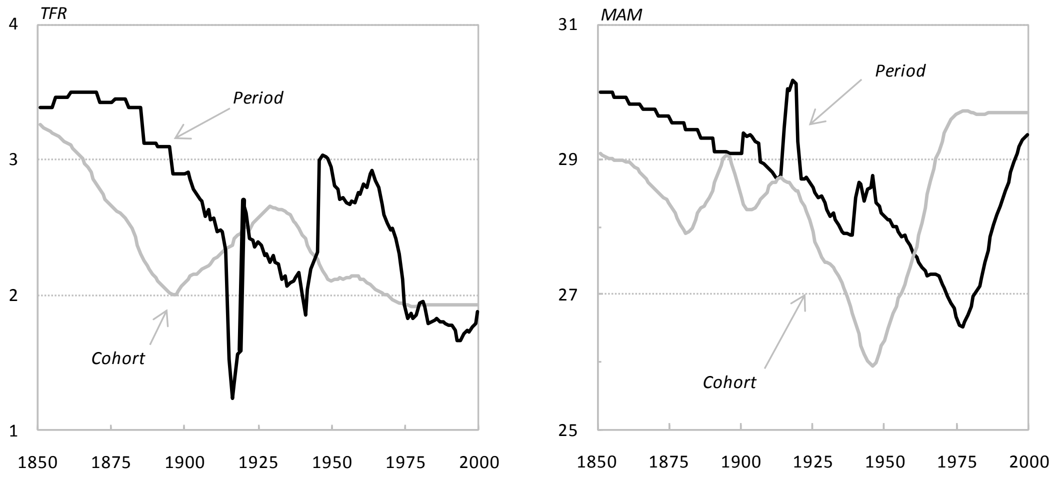
2. Data

Data collection covered mortality, fertility and partner-search preferences for the 1850-2000 periods. These different data sources have been completed by assumption about future trends for the 21st Century.

Fertility

Period age-specific fertility rates for 1851-1900 come from the work of Festy (1979). These rates, aggregated in five year age groups, have been scattered in one year of age by adjustment of a Beta function (Pressat, 1995). Computed for five years periods, 1851-1855, 1856-1860, …, 1896-1900, these ASFR have been supposed constant for each year of these intervals. Similar rates have been collected for the 20th Century by the INSEE (Daguet, 2002). Fertility trends have been held constant for period after 2000.

Figure 1 – Total fertility rate and mean age at motherhood in France (1851-2000)



Partner-search preferences

If the model doesn't simulate nuptiality, it introduces nonetheless one partner-search characteristic: the age difference of parents. Being function of the year of birth of a couple's first child, a series of measure have been taken from INSEE (Daguet, 2002) for the 20th Century. For birth during the second half of the 19th, statistics of the age difference *at marriage* have been collected (SGF, 1901) and judged adequate under the hypothesis that partner-search behavior is the same whether parents are married or not. These series have been adjusted to match one another tendency of the other source. It has also been held constant for births occurring after 2000.

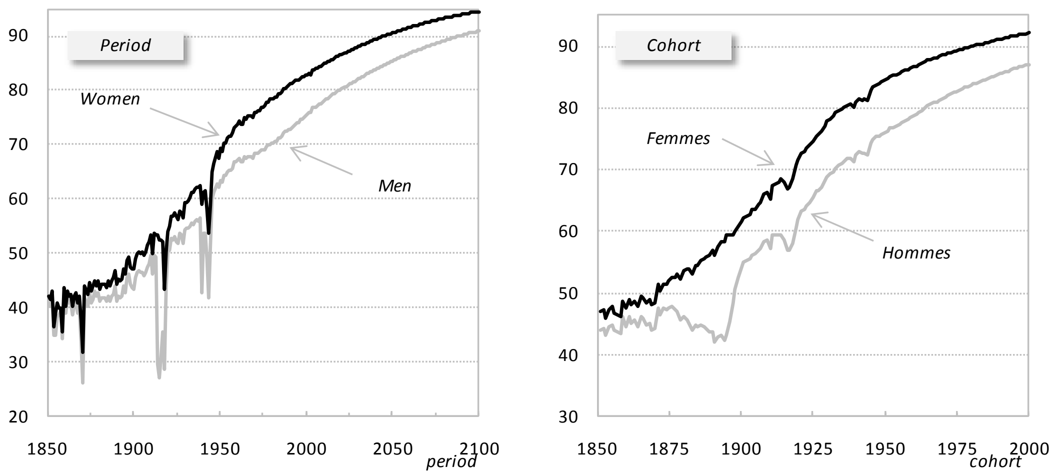
Mortality

As for fertility, most of the mortality data comes from the work of Vallin & Meslé (2001). These data only run to 1997, they have been completed by those recently observed in the period 1997-2005, and available in the Human Mortality Database.

For future mortality trends, we used forecasts made by these authors, from 2006 only. An adjustment factor has been computed in order to match the series of projected trends from 1997 to those observed until 2005.

All the probabilities have been extended to complete period life table, and then transformed into cohort life table. From the period life table, prospective probabilities of dying have been first computed. Knowing that these probabilities are also the series of cohort probabilities, they have been restructured in cohort life tables.

Figure 2 - Period and cohort life expectancy in France (forecasts from 2006)



Base population

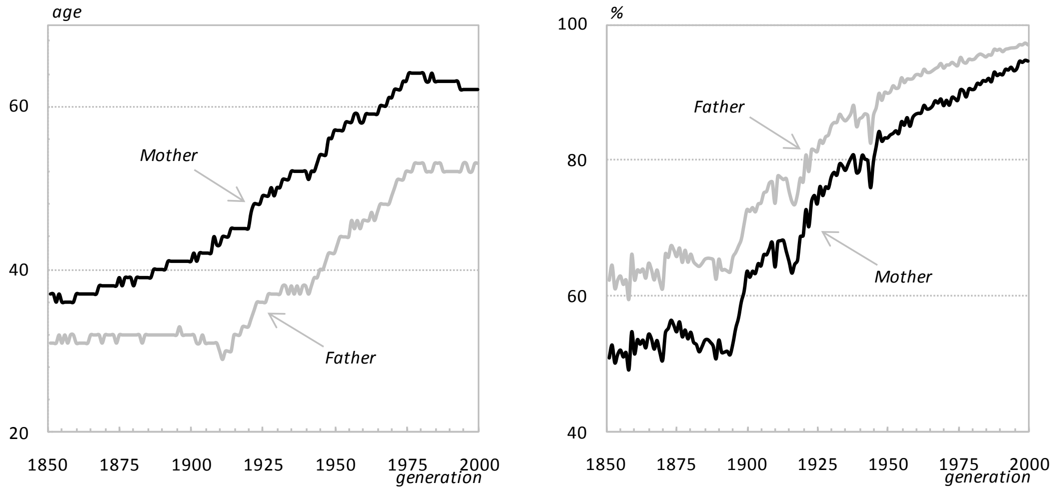
The starting population of our simulation has been provided by the 1851 French census, slightly corrected (Tabah, 1947). A proportion of 1/100th of the 36 million individuals has been introduced in the model, in respect with the population structure at census.

3. Results

Ascending kin

Joint survival with parent shows difference according to the parent's sex (Figure 1)– Total fertility rate and mean age at motherhood in France (1851-2000). Survival with mother has risen constantly since the 1851 cohort; from 37 years, the median lifetime with mother rises up to 64 for the last cohorts of the 70's. Younger cohorts should expect this median lifetime to slightly reduce itself, given the postponement of childbearing, and the consequently rising age of mother at birth. Coexistence with father shows a more contrasted pattern; a relative constancy for cohort of the 19th century, a slight decrease for the first ones of the 20th before rising again after WWI. After stagnation due to WWII, the median age rapidly rose up, to remain constant since the 70's, as for mothers.
The proportion of individuals of each cohort that will experience one parent's death, and thus know a part of life without this parental figure, hasn't shown any particular tendency throughout the second half of the 19th century, oscillating near 50% for the mother, to more than 60 % for the father. With cohorts born from the late 19th, the proportions rose, only stopped by a decrease during the two WW periods.

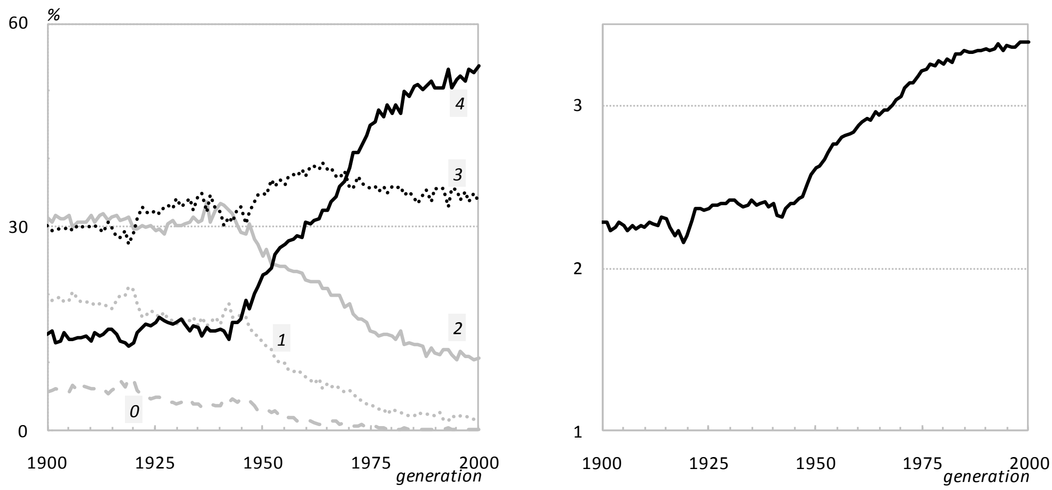
Figure 3 – Median length of life with parents (left) and proportion experiencing parental death (right)



Mortality and fertility also influence the number of older kin (grandparents, great-grandparents) still alive at Ego's birth (Figure 4 and Figure 5). Again, the situation has remained somewhat constant for cohorts born before the end of WWII; around 5% of the newborn didn't know any of their grandparents, 15-20% knew only one, around 30% two or three and roughly 15% had the chance to know all of them. For cohorts born since the 50's, this last proportion has constantly risen ; since the one born in 1970, it is the major situation (38%) and the 1985 cohort was the first one whose half of individuals still had four grandparents at birth. Configurations with none or only one have nowadays almost disappeared, the one with two represent only 10% of the younger cohorts, and the one with three a little bit more that 33%.

Cohorts born during the first half of the 20th didn't know more than 2.5 grandparents. Their followers saw this number increase, and the younger ones (since the late 60's) knew more than 3 (3.3 for the 2000 cohort).

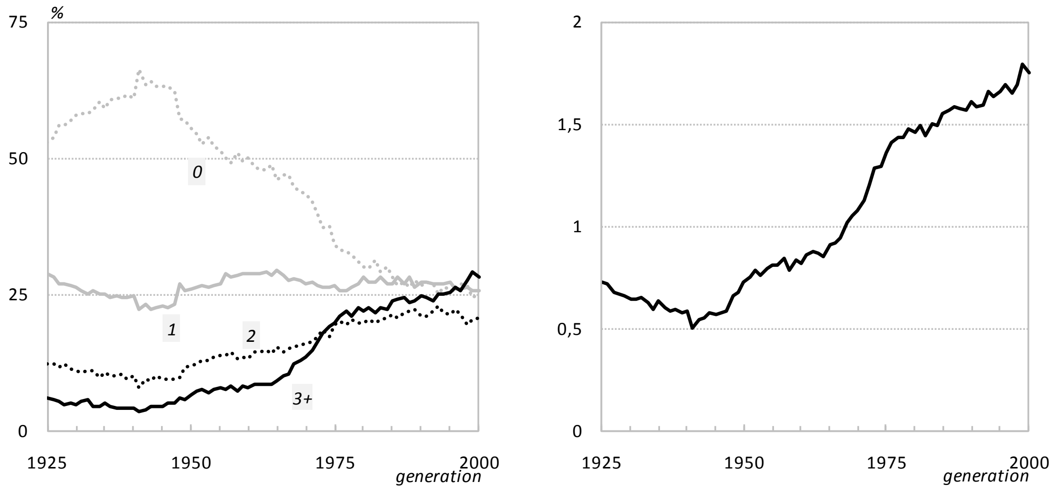
Figure 4 - Cohort distribution by number of grandparents alive at ego's birth (left) and mean number of grandparents alive (right)



The case of great-grandparents shows an interesting contrast (Figure 5); before the 50's, the proportion with no second degree ancestor has kept rising (52% for 1925, 62% for 1948). Moreover, this proportion has remained predominant until the mid-50' cohorts. The other

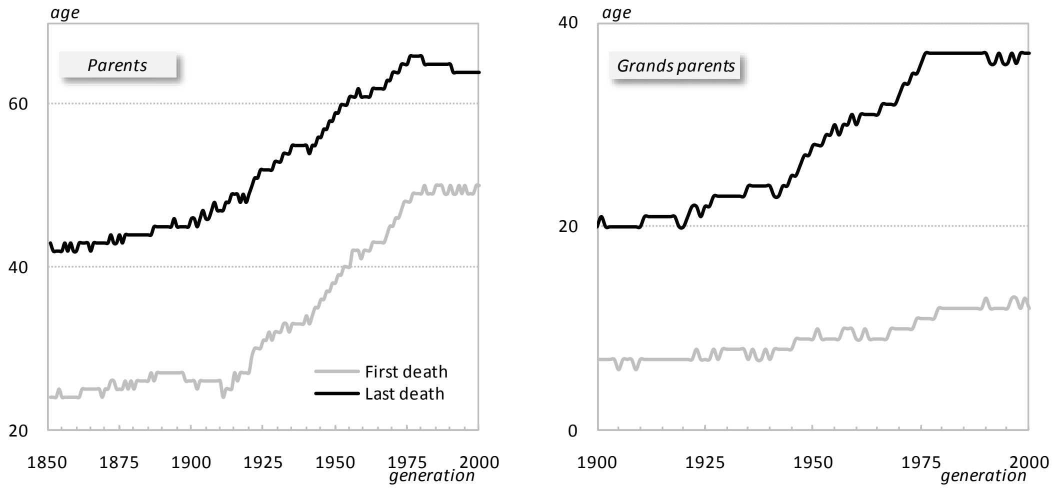
configurations decreased until the late 40's, as later cohorts have witnessed a progressive increase of the proportion with two or more alive at birth. The four combinations considered here progressively equals each other at 25% since the 80's. Let's notice that knowing 3 or more became dominant for cohorts born in the last years of the 20th.
From a mean point of view, the number of great grandparents alive at Ego's birth has decreased until the end of WWII, before slightly increasing for two decades, more rapidly until the late 70's. Younger cohorts know between 1.5 and 2 of these ancestors.

Figure 5 - Cohort distribution by number of great-grandparents alive at ego's birth (left) and mean number of great-grandparents alive (right)



If there is progress in the number of ancestors alive at birth, what can be said about their progressive disappearance throughout Ego's life? For parents, the earlier cohorts had about more than 20 years before their parents generation started to disappear, and 40 before complete orphanhood (Figure 6). If the tendency is also to increase until the 70's, a slight slow can be observed for the first death for cohorts born in the early 1900, once again either because they died before their parents did or their parents died before they did but at a younger age. Stagnation is observed for the first death since the 70's, and even a decrease for the last one. Grandparents show the opposite tendency: the span of life in which their disappearance occur has lengthened from about 13 years for the 1900 cohort, to 25 years for those born since the mid-70's. The first grandparental death has made little progress (from 7 to about 13), but the last one has rapidly increased after WWII to reach a median age of 37 years for the 2000 cohort.

Figure 6 - Median length of life before first and last death of parental figure (left) and grandparental figure (right)

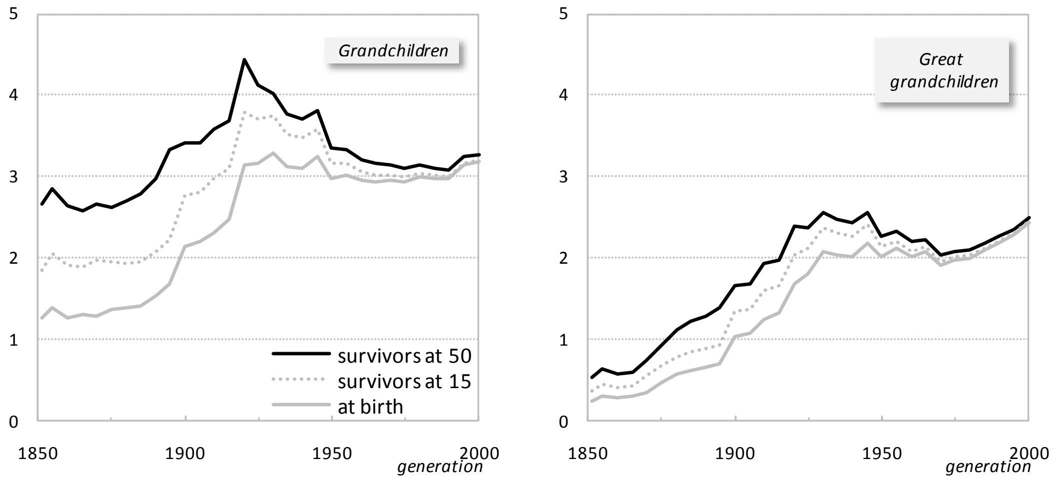


Descending kin

The number of descending kin Ego will survive with depends on both mortality (of Ego), and fertility schedule and intensity (his/her and descending kin's as well). Whatever the degree of offspring, we first notice that there is less difference in size regarding of Ego's survival through childbearing years (Figure 7). This is simply due to progress of child and adult mortality, which has almost assured the survival from birth to age 50. More important, we notice that the size of this kinship has been increasing since the 20's, and show diverging pattern thereafter. For grandchildren, it thus first rose from 2.7 to 4.5 and fell to 3 in the 90's, and went up again to 3.3 for the 2000 cohort. For great-grandchildren, from 0.5 to 2.4 in the 1920's, it fell to another minimum of 2 in the 70's before increasing again to 2.5 for the last cohort.

Let us remind here that fertility is maintained constant after 2000, which probably produce, jointly with progress in life expectancy, the relative stabilization in the number of grandchildren. Given the level of fertility, it may echo into an increase in the availability of great-grandchildren, which are not necessarily more than in previous cohorts, but more "encountered" as Ego age older.

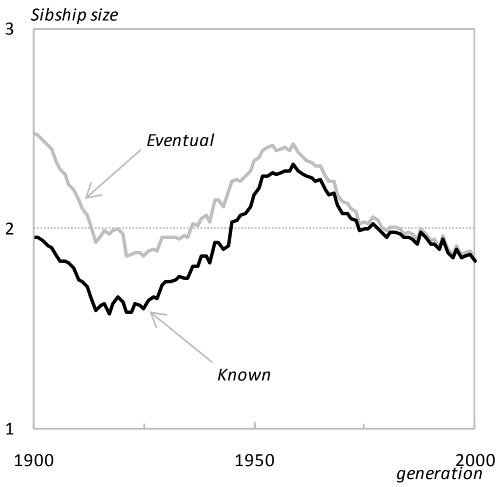
Figure 7 - Number of coexisting grandchildren (left) and great-grandchildren (right)



Lateral kin

We have also computed the number of consanguine siblings for these 150 generations (Figure 8). Results show decreasing difference between the eventual sibship size (the completed offspring of Ego's mother) and the known sibship. In past times, this difference could be due to premature death of children, which could cause Ego to be born after the death of any older siblings or reversely, to die before other siblings birth. Thus, even if fertility was high, past mortality seemed to have reduced the sibship size, notably in cohorts born before the post-WWII peace and disease free era.

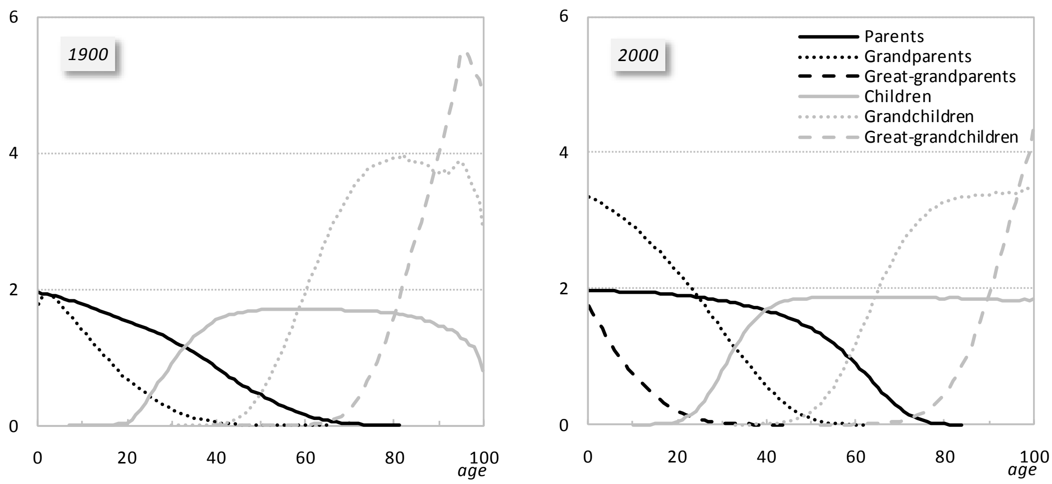
Figure 8 - Sibship size



Kinship network across the life course

The dynamics of kinship over the life course has somewhat evolved for cohorts born during the past century. Comparing 1900 and 2000 (Figure 9), we first notice that Ego live a longer period of life surrounded by parents and children. The distinction between generations has become less obvious: grandparents and grandchildren coexist longer around Ego. Nevertheless, there is no tendency towards the coexistence of two ascending and two descending as grandparents are already gone when grandchildren start to appear.

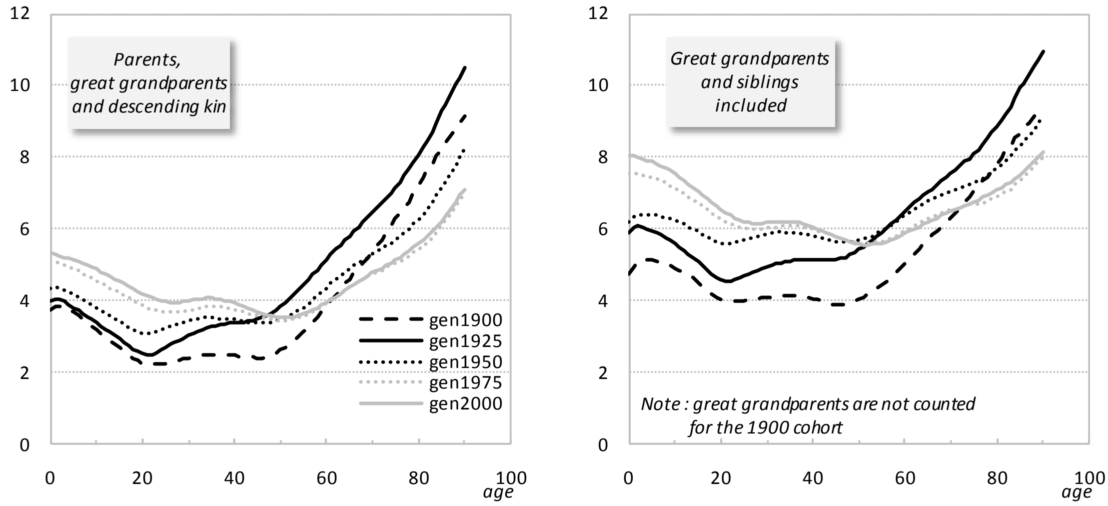
Figure 9 - Kinship network over the life course of cohorts 1900 and 2000



The total size of kinship shows a decrease during the first two decades of these cohorts lives (Figure 10). This is of course due the disappearance of older kin (grandparents and great-grandparents) and in less proportion of parents. After entering active childbearing years to the pivot age of 50, the number of kin show little or no increase as the replacement of generation occurs; parents die but children come to replace them. On exception seems to be the 1925 cohort who has entered these childbearing years at the beginning of the baby-boom. From their

20 to their 50, kin network rises not so surprisingly. After their 50 (sometimes earlier), cohorts become progressively oldest member of families, and their descending kin continues to rise, as their children bears offspring. At the age of 90, a survivor from the generation 1975 or 2000 shall have a descending kinship of about 7 individuals (children, grandchildren or great-grandchildren). This number varies between 8 or more than 10 for the older generations. We could point out the inversion between the 1900 and 1925 cohorts (the latter having more kin), due again to the baby-boom years, and progresses in life expectancy of children and young adults.

Figure 10 - Total number of kin over the life course (Cohorts 1900, 1925, 1950, 1975, 2000)



Conclusion

We have shown that, if kinship has varied, it has not been in the same proportion for every kin.
The number of ascending kin is rising as Ego survives for a longer period of time with parents and survives them more often, and as more grandparents and great-grandparents are still alive at ego's birth and coexist longer. These progresses are related to life expectancy, and we have shown how they are counterbalanced by the postponement of childbearing. On the other side, cohort born before the 50's showed an increase in the number of descending kin they'll coexist with. For the second half of the 20th century, the patterns diverge: relative constancy for grandchildren and a slight increase for great-grandchildren, as Ego survives longer. For these later cohorts, the size of sibship is constantly dropping, due to low fertility.
These results have to be taken with caution, mainly because of their stochastic nature, but also due to the assumption on which they rely for cohorts whose complete demographics have not yet been observed. Nevertheless, they illustrate the effect of the transition of kinship structures, how these are shaped by mortality and fertility trends.

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