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The Frequency of Twin Births in France. The Triple Influence of Biology, Medicine and Family Behaviour

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Abstract

PisoN Gilles, Couvert Nadège.- The Frequency of Twin Births in France. The Triple Influence of Biology, Medicine and Family Behaviour The proportion of twin births stood at 15 per 1,000 in France in the early eighteenth century and returned to this level in 2000 after falling substantially in the intervening period. It has risen by 70% since the early 1970s under the dual influence of infertility treatments, which explain two-thirds of the rise, and increased age of childbearing, which accounts for the other third. After analysing the variations in twinning rate in France over time, the article examines the various contributing factors and focuses on two in particular: voluntary birth control and selection by fecundity. Women who have produced twins less frequently undertake additional pregnancies than women who have had a single birth. The consequences of a twin pregnancy on the probability of additional childbearing are measured by analysing the histories of almost one million French women recorded in successive family surveys. Lastly, the article examines the twinning peak recorded in France during the First World War and just afterwards, in 1919. This peak can be attributed to an effect of selection of the most fecund couples, who also have a higher propensity to produce twins.

Résumé

Pison Gilles, Couvert Nadège.- La fréquence des accouchements gémellaires en France. La triple influence de la biologie, la médecine et des comportements familiaux La proportion d'accouchements gémellaires, 15 p. 1000 en France au début du XVIIIe siècle, a retrouvé ce niveau en 2000 après avoir été nettement en dessous entre temps. Elle a notamment augmenté de 70 % depuis le début des années 1970, sous les effets combinés des traitements contre la stérilité, qui expliquent les deux tiers de la hausse, et du retard des maternités, qui en explique un tiers. Après avoir retracé l'évolution du taux de gémellité en France, l'article passe en revue ses différents facteurs avec un intérêt particulier pour deux d'entre eux : la limitation volontaire des naissances et la sélection par la fertilité. Les femmes qui accouchent de jumeaux s'engagent moins souvent dans d'autres grossesses que celles qui accouchent d'un seul enfant. Les conséquences de la survenue d'une grossesse gémellaire sur la probabilité d'agrandissement de la famille sont mesurées en analysant près d'un million de biographies féminines françaises recueillies par les enquêtes Familles. La France a enfin connu un pic de gémellité pendant la première guerre mondiale et juste après, en 1919; il vient d'un effet de sélection des couples les plus fertiles, qui sont aussi les plus prédisposés à avoir des jumeaux.

Resumen

Pison Gilles, Couvert Nadège.- La frecuencia de nacimientos de gemelos en Francia. La triple influencia de la biologia, la medicína y las pautas familiares La proporción de nacimientos de gemelos, que era del 1 5 por 1000 en Francia a principios del siglo XVIII, volvió a alcanzar este nivel en el 2000, después de haber estado muy por debajo entre estos dos periodos. Desde principios de los setenta, en concreto, tal proporción ha aumen- tado en un 70% debido al efecto combinado del tratamiento contra la esterilidad, que explica dos tercios del aumento, y del retraso de la maternidad, que explica el tercio restante. Este articulo traza la evolución de la tasa de nacimientos de gemelos en Francia y analiza sus causas, con especial énfasis en dos de ellas: la limitación voluntaria del numero de nacimientos y la selección a través de la fertilidad. La frecuencia de nuevos embarazos es menor entre las mujeres que dan a luz a gemelos que entre aquellas que dan a luz a un solo hijo. El articulo mide las consecuencias de la llegada de gemelos sobre la probabilidad de aumento de la talla familiar en base al análisis de un milión de biografias femeninas francesas obtenidas a través de las encuestas Familias. Los nacimientos de gemelos alcanzaron su maximo en Francia durante la primera guerra mundial y justo después de esta, en 1919; tal aumento es debido al efecto de selección de las parejas más fertiles, que son también las más predispuestas a dar luz a gemelos.

The Frequency of Twin Births in France

The Triple Influence of Biology, Medicine and Family Behaviour

Gilles PISON* and Nadège COUVERT*

The biological dimension may sometimes appear to be the determining—or even exclusive—factor underlying certain trends observed by demographers. In some cases, however, the influence of individual and social behaviour is decisive. In this article, Gilles PISON *and* Nadège COUVERT *make use of long data series to provide a clear demonstration of this fact. The proportion of twin births has varied continuously since the eighteenth century at least, due to changes in the age of childbearing, wars, voluntary birth control or, more recently, the advent of techniques to overcome infertility. To mention just one of the remarkable results presented here by the authors, two-thirds of the increase in the twinning rate—from 0.9% to 1.5% of births—observed over the last thirty years can be attributed to medical infertility treatments.*

The proportion of twin births—approximately one in 100 births in France until recently—was long considered to be a constant of the human species, depending only on biology, much like the proportion of male to female births, fixed at around 105 boys for 100 girls. Yet the rate of twin births has varied since the eighteenth century in France, rising at times and falling at others. And, since the beginning of the 1970s, the proportion of twin births has increased spectacularly, by almost 70%. How can these variations be explained? In this article, we show that a variety of factors, relating to both biology and behaviour, are involved. Because it is sensitive to effects where biology, medicine and society interact, the rate of twin births is a valuable indicator of biological and social change.

In the first part of this paper, we examine variations in the rate of twin births in France, particularly in the twentieth century, and we review

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the principal underlying factors. In the second and third parts, we examine in detail two factors which have thus far not been extensively studied: the voluntary limitation of births and selection through fecundity. Regarding the first factor, we study the extent to which a twin birth, an unanticipated event in the life of a family, modifies intended fertility. In particular, we seek to determine whether women who give birth to twins are less likely to undertake another pregnancy than women who give birth to a single child, while studying the consequences of such behaviour on the rate of twin births. In the third part, which addresses the issue of selection through fecundity, we focus on the First World War period during which the rate of twin births attained surprisingly high levels. We explain that this phenomenon can be attributed to a selection effect on more fecund couples. As demonstrated through the study of cohorts of newlyweds, hyperfecund couples have a higher twinning rate than their less fecund counterparts.

I. Variations in twinning rates in France since the eighteenth century: the role of "traditional" factors

In France, in the year 2000, 15 out of every 1,000 births—approximately 1 in 70—was a twin birth (INSEE). This figure may well represent a new record, for the past two centuries at least. Figure 1 demonstrates this point, retracing the variation in twinning rates as far back as existing national data permit. Figure 2 provides more specifics, using the same data to show annual variations limited to the past hundred years only. Estimates of the twinning rate for the eighteenth and early nineteenth century are drawn from the Louis Henry historical survey of France[1] (Gutierrez and Houdaille, 1983). Though survey data cover rural communities only, they represented 85% of the total population at that time. The twinning rate was high, approaching 15 per 1,000 in the first half of the eighteenth century (Figure 1). It decreased in the second half of the century, falling to under 10 per 1,000 over the period 1790-1829. From 1858, annual estimates became available through registration statistics (Statistique de la France and INSEE; Daguet, 2002). They show that the twinning rate stood at around 10 per 1,000 in the second half of the nineteenth century. It then increased in the 1890s, and the upward trend continued into the first decade of the twentieth century. The First Word War saw a sudden and short-lived rise (Figure 2)[2], though the twinning rate returned to just under 11 per 1,000 after the war, fluctuating annually between 10 and 11 per 1,000, and re-

[1] Data for this survey are drawn from family records derived from traditional marriage registers in a sample of 100 French parishes during the period 1670-1829 (Séguy, 2001). Records include information on all births to married couples. The data are of good quality.

[2] There was no increase during this period in other countries engaged in the conflict, notably Germany, though the peak in twinning rates just after the war was observed in many countries (see below). The increase in France during the war years coincides with an increase in the mean age of childbearing (Figure 3), as we will see below.

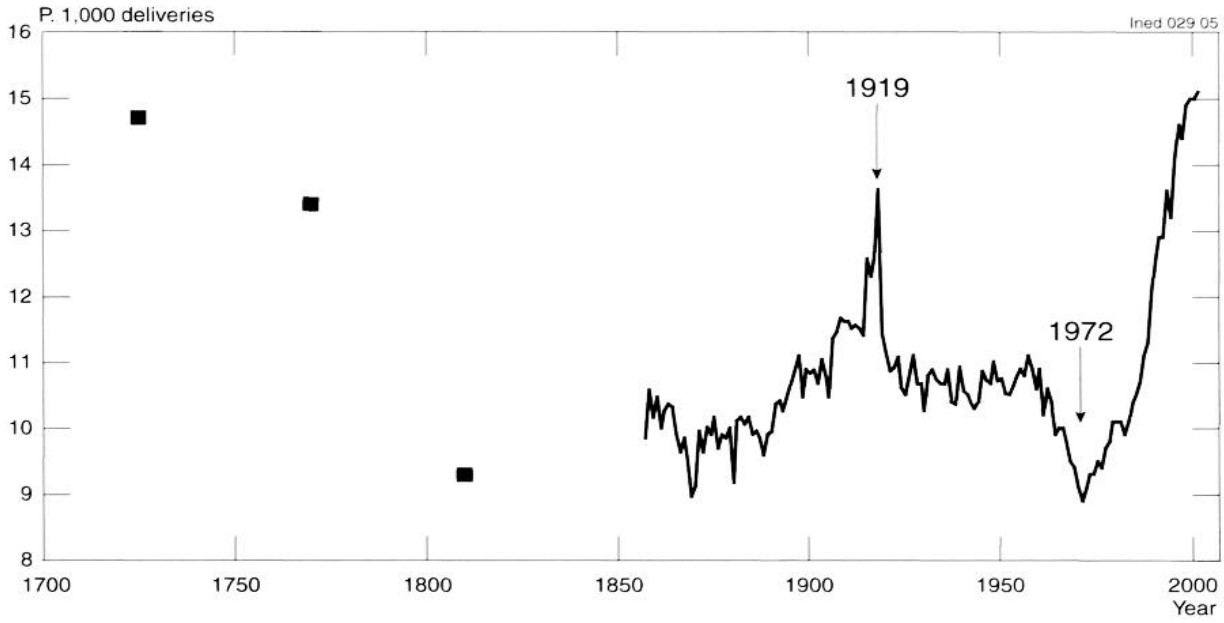

Figure 1.– Variations in the twinning rate in France from 1700 to 2002

Notes: Before 1858, measurements correspond to periods (1700-1749, 1750-1789, 1790-1829) and the dots are placed in the middle of each period; from 1858, the proportion of twin births is the ratio of twin deliveries (of live-born or stillborn children) to the total number of deliveries (of live-born or stillborn children).

Sources: Before 1858, Hector Gutierrez and Jacques Houdaille (1983); between 1858 and 1900, *Statistique générale de la France*; from 1901, Fabienne Daguet (2002).

mained at this level until the early 1960s. A slight downward trend was observed from the end of World War I to the end of World War II, followed by a small upward trend in the following 20 years. In the early 1960s, the proportion of twin births fell, reaching a low point of 8.9 per 1,000 in 1972. It then rose again quickly and almost continuously until the late 1990s before levelling off at around 15.0 per 1,000 in recent years. Far from being a constant, the twinning rate has thus varied significantly from one period to another over the past three centuries, the highest rate being almost twice as high as the lowest. How can these variations be explained?

1. Factors affecting the frequency of twin births

To understand variations in the frequency of twin births, it is important to take into account the existence of two types of twins, identical twins and fraternal twins. Biologists call them monozygotic and dizygotic twins, by reference to their different origins:

—Identical (monozygotic) twins originate from a single egg or zygote, produced by the fertilization of an ovum by a spermatozoon. In the course of its development, before the end of the second week following fertilization, the single ovum splits into two. The two embryos resulting

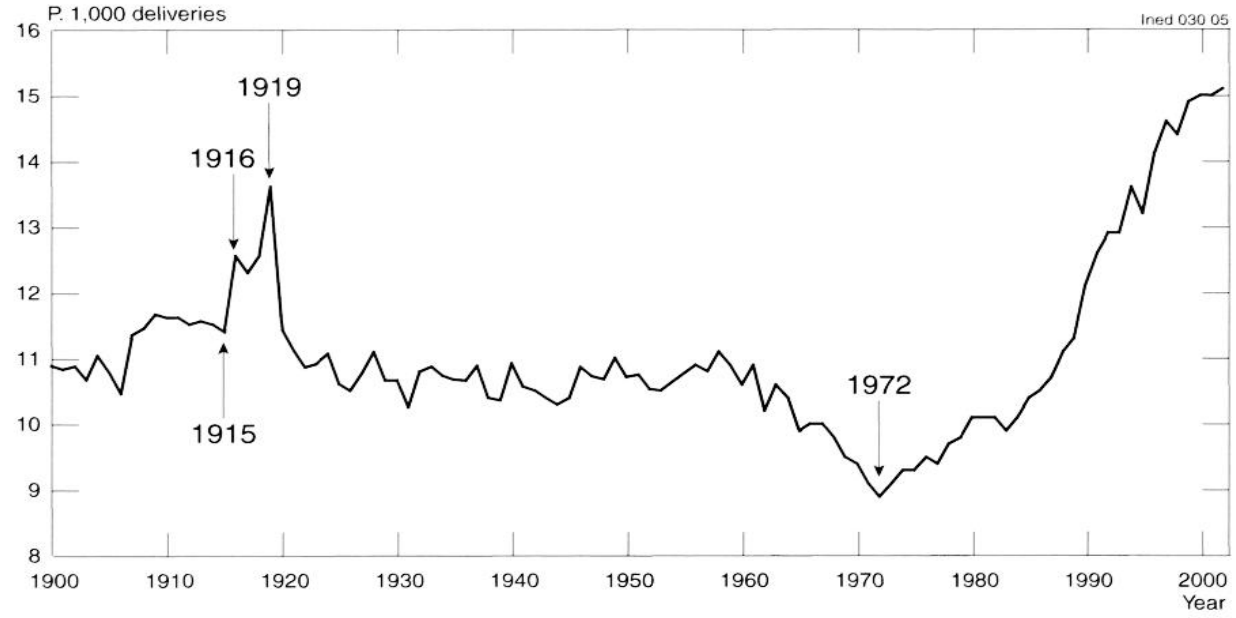

Figure 2.– Variations in the twinning rate in France from 1900 to 2002

Note: The proportion of twin births is the ratio of twin deliveries (of live-born or stillborn children) to the total number of deliveries (of live-born or stillborn children).
Source: Fabienne Daguet (2002) and Beaumel et al. (2004).

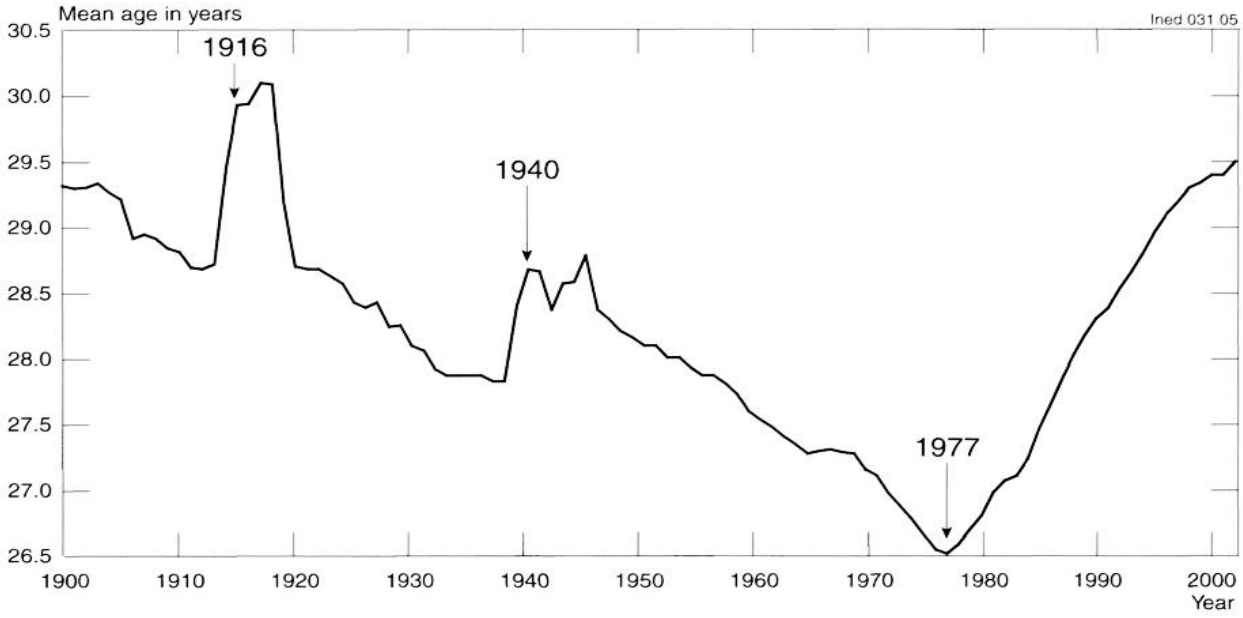

Figure 3.– Variation in mean age of childbearing in France from 1900 to 2002

Source: Fabienne Daguet (2002) and Beaumel et al. (2004).

from this division are genetically identical, which explains why identical twins look exactly alike. In particular, they are always of the same sex.

—Fraternal (dizygotic) twins result from the ovulation and fertilization of two different ova during the same cycle. Each ovum is fertilized by a separate spermatozoon, so the twins that develop from the two ova or zygotes are no more similar, from a genetic standpoint, than two siblings. In particular, they may be either of the same or of different sex, both situations occurring with approximately the same frequency.

Identical and fraternal twins thus correspond to two very different biological phenomena: identical twins are the result of an anomaly of embryo development, similar to cloning, while fraternal twins are the result of dual ovulation and dual fertilization, due to the release by the ovaries of two ova during a single cycle. While the apparent outcome is the same, the two phenomena are independent and are ruled by separate laws. This is demonstrated by examining variations in the frequency of both types of twins.

The proportion of identical twin births is always between 3.5 and 4.5 per 1,000, regardless of the mother's age, birth order, or geographical origin. A similar proportion is observed among all mammals, except for some armadillos whose females systematically give birth to monozygotic quadruplets or octuplets (Bulmer, 1970). Litters of dogs, cats and sows, for example, are typically made up of "fraternal" twins. Over the past 30 years, the frequency of identical twin births has nonetheless significantly increased in industrialized countries, rising by a third, for example, in France (Daguet, 2002). Moreover, all women appear to be equally exposed to the risk of having identical twins, whether or not they have previously given birth to twins.

Conversely, the proportion of fraternal twin births is highly variable. The principal factors accounting for this variation are:

Mother's age. Starting from a level close to zero at puberty, the proportion steadily increases, peaks at age 36 to 37, then rapidly decreases, returning to zero at menopause (Bulmer, 1970; see also Figure 5). This pattern reflects the levels of follicle-stimulating hormone (FSH), whose peak triggers ovulation. Levels of the hormone in the bloodstream steadily increase with age, resulting in a rise in the frequency of multiple ovulations. However, loss of ovarian function and the mortality of fertilized ova and embryos also increase with age and become common as menopause approaches. After age 36 or 37, they counteract the increase in multiple ovulations, which explains the drop in the rate of fraternal twins beyond that age.

Birth order. The age-adjusted rate of fraternal twin births rises with birth order, as shown in Figure 4, derived from U.S. statistics for 1964 (Heuser, 1967). These variations, which are nonetheless smaller than those

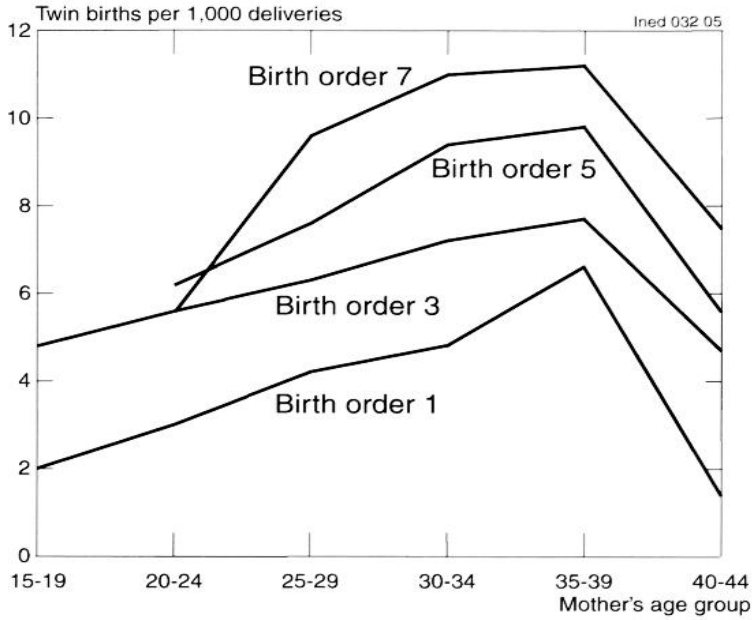

Figure 4.– Variations in the frequency of fraternal twin births by age of mother and birth order (USA, 1964)

Note: To simplify the figure, only odd birth orders are represented.
Source: R.L. Heuser (1967) cited by Bomsel-Helmreich and Mufti (1991).

related to age, have been interpreted as resulting from a physiological phenomenon (Henry, 1975), though the mechanism is unknown.

Region of the world. In all populations, similar variations associated with the mother's age and birth order are observed, but overall levels are different. For example, on a planetary scale, until the 1970s, sub-Saharan dizygotic twin birth rates adjusted for age and birth order were approximately twice as high as European rates, and four to five times as high as those of China and Japan. These variations are largely due to genetically-based hormonal differences[3].

Individuals and families. Fraternal twin births have a tendency to be repeated among the same women, and this partly genetic predisposition is also found among the sisters and daughters of women who have had twins.

[3] FSH levels are higher, on average, among women belonging to populations with higher twin birth rates than among women from populations with low twin birth rates. These hormonal differences are largely genetic. This explains, for example, why the twinning rate has until recently been much higher in the U.S. "black" population than in the "white" population. The rate for the "black" population is between European and African rates. This makes sense, since the African-American population results from the mixing of populations of European and African origins.

2. *The role of changes in age of childbearing in France*

Variations in the multiple birth rate in France, by age of the mother, are represented in Figure 5 for three periods: 1700-1829 (in five-year age increments), 1965-1967 and 1995-1997 (in one-year age increments). The measures presented here include all multiple births (but they would be practically the same with only twin births, which represent 98 to 99% of all multiple births). Further, these measures do not distinguish between identical and fraternal twins. As we previously mentioned, only the latter vary with the mother's age, since identical twins occur with approximately the same frequency regardless of age. Consequently, the frequency of all categories of twins varies considerably with the mother's age group. From 5 per 1,000 before the age of 20, it increases steadily up to age 36-37, where it reaches almost 15 per 1,000 in 1965-1967 and almost 20 per 1,000 in 1995-1997 (Figure 5). The main difference from one century to the next is a slightly lower twinning rate in the eighteenth century compared with the twentieth, at every age up to 35 and, conversely, a higher twinning rate at ages 40-44.

It is likely that rates were under-estimated for the eighteenth century. The infant mortality of twins is much higher than that of singletons, everywhere and for all time periods (Pison, 1989). In the past, lower birth-

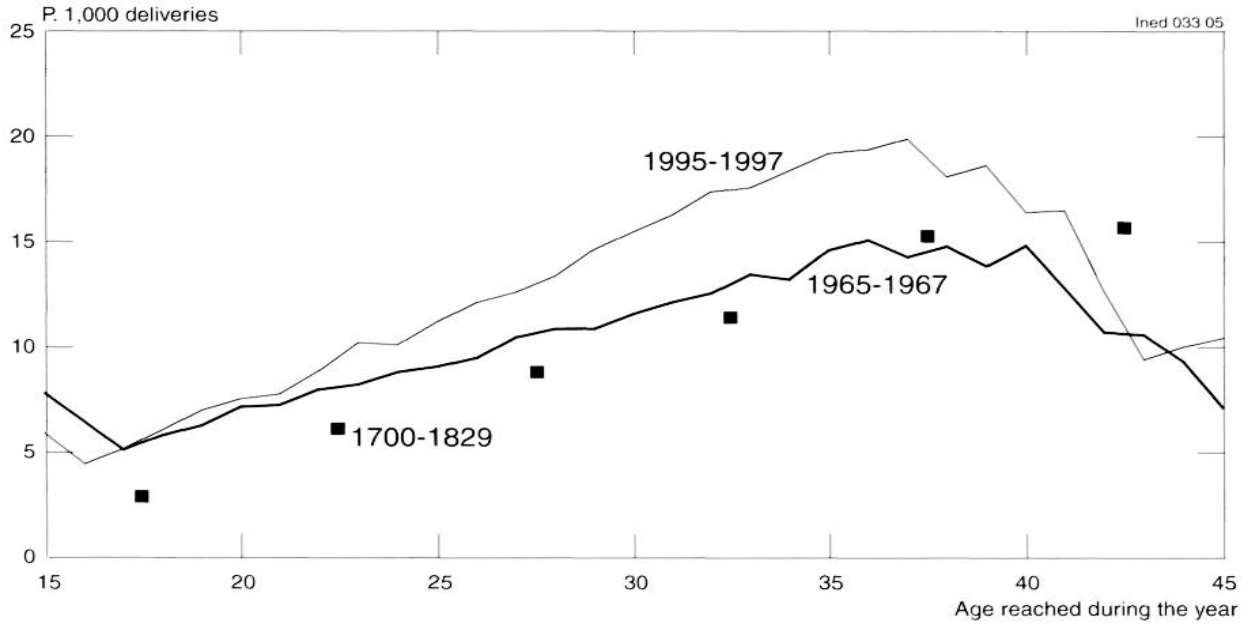

Figure 5.– Variations in multiple birth rates in France by age of mother

Note: Measurements for the period 1700-1829 are by five-year age group.
Sources: Period 1700-1829, Hector Gutierrez and Jacques Houdaille (1983); periods 1965-1967 and 1998-1997, Fabienne Daguet (2002).

weight, prematurity, and complications of childbirth, frequently associated with multiple births, often led to infant death. It is possible that not all births were declared when one or both twins died before delivery (stillbirth) or within a few days of birth. Under-registration, which particularly affected twins, must have decreased with the decline in overall mortality and no longer occurs today in France. Correcting for under-registration is difficult, because its magnitude in the past is unknown.

In the twentieth century, if one excludes the relatively small number of late pregnancies beyond age 40, the twinning rate for all age groups increases as the mean age of childbearing itself rises. Age of childbearing has varied considerably in France over the past 100 years (Figure 3). From a level slightly above 29 years of age at the beginning of the twentieth century, it dropped to 26.5 in 1977, then rapidly rose again, reaching more than 29 at the end of the 1990s. The change in the twinning rate is partly linked to these variations in the timing of childbearing. The twinning peak of the First World War thus partly results from the rise in the mean age of childbearing during war years due to the postponement or prevention of marriages by war. Many of the women who had children in wartime were already married before the war began, and there were few young brides among them. Further, young women who were nonetheless able to marry during the war had few children, since their husbands were often away on the front. While the mean age of childbearing was close to 29 between 1910 and 1914, it increased sharply in 1915, remained at a level close to 30 during 1915-1919, then dropped back to pre-war levels (Figure 3). During the Second World War, childbearing was also temporarily delayed, though the rise in the age of childbearing was not as pronounced. Oddly, it did not produce a rise in the twinning rate. Presumably, other factors caused a simultaneous decrease, neutralizing the effect of delayed childbearing. We will return to this point below.

Conversely, when the mean age of childbearing decreases, as it did in the 1960s and 1970s, the twinning rate falls. The trend reversal at the end of the 1970s, with the rise in age of childbearing, is concomitant, to within a few years, with the twinning trend reversal. But earlier or later childbearing only partly accounts for the changes in twinning rates.

3. Baby boom twins

We can neutralize the influence of birth timing on twinning rates by calculating the rate for each age group (Figure 6) and by estimating a standardized twinning rate based on a constant age distribution of mothers, equal by convention to that of the year 1985 (Figure 7). The resulting curves still show a twinning peak during World War I, indicating that the temporary rise in age of childbearing is not the only factor involved. Similarly, the drop in the twinning rate in the 1960s and its renewed rise

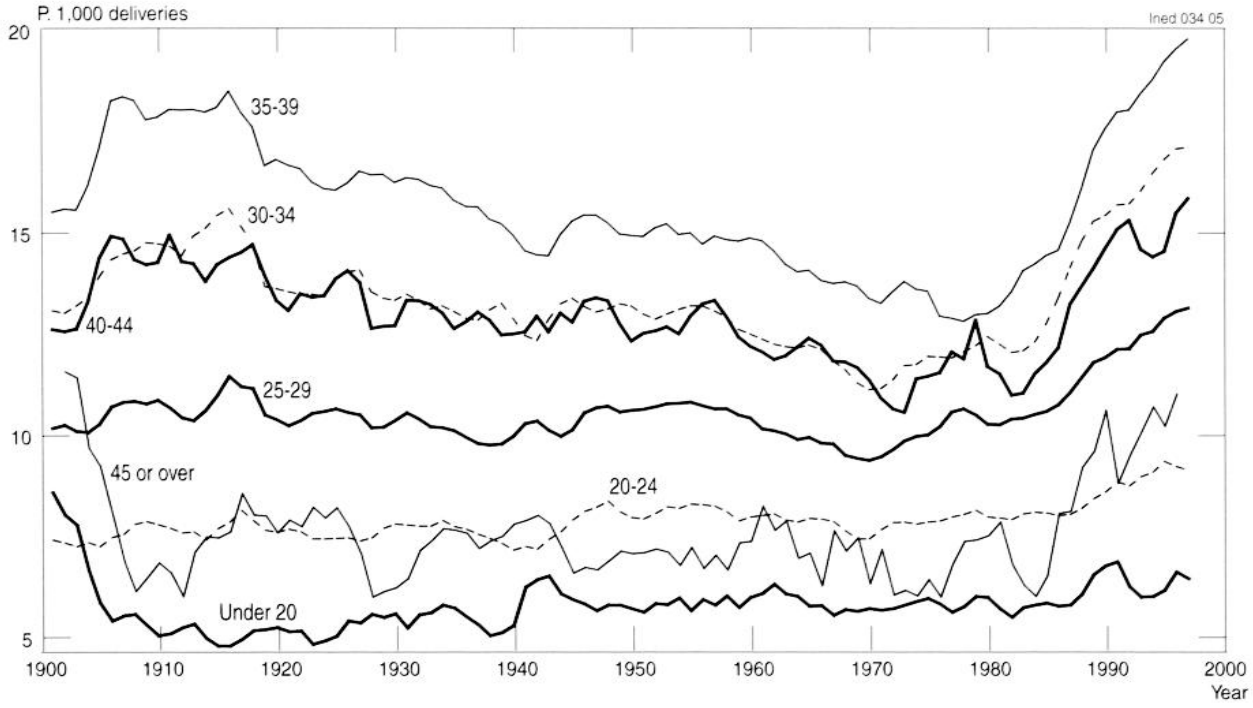

Figure 6.– Variation in twinning rate by mother's age in France during the twentieth century

Note: Up to age 44, three-year moving averages, age 45 and above, five-year moving averages.
Source: Fabienne Daguet (2002)

from 1972 are observed for almost all ages, thereby also affecting the standardized twinning rate.

Following the World War I twinning peak, discussed further below, the twinning rate returned to a lower level in 1920 and then began a steady decline among women between the ages of 25 to 44, increasingly pronounced with age (Figure 6). This decline continued and even accelerated during the Second World War, and the standardized twinning rate reached its low point during that period (Figure 7). The stability of the actual twinning rate can be attributed to a rise in the mean age of childbearing during this period which offset the lower rate at each age. The secular downward trend was interrupted in 1945. The rate increased again slightly for several years, for practically all ages. Then, after having reached a temporary maximum, it began to fall again, with the decline becoming more significant from the mid-1960s. On the curve of standardized twinning rates, this period of slightly higher twinning rates in a context of a secular decline is clearly apparent (Figure 7). It corresponds to approximately twenty years of higher fertility, from 1946 to 1966. The rapid ensuing decline in the twinning rate reflects the drop in fertility in the late 1960s and early 1970s (Figure 8). The slightly higher twinning rate at each age, from 1946 to 1966, is most likely linked to the baby boom, as demonstrated below. Had

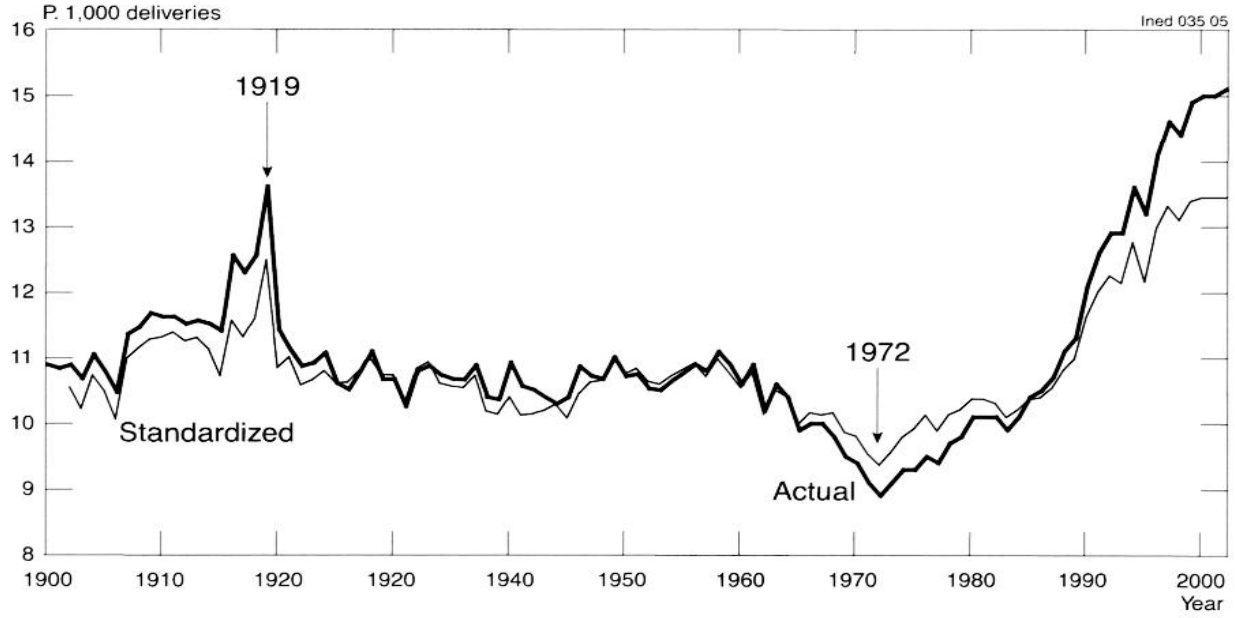

Figure 7.– Variation in twinning rate in France from 1900 to 2002, with constant age distribution of mothers (that of 1985)

Note: Bold line: actual twinning rate (taken from Figure 2); thin line: standardized twinning rate.

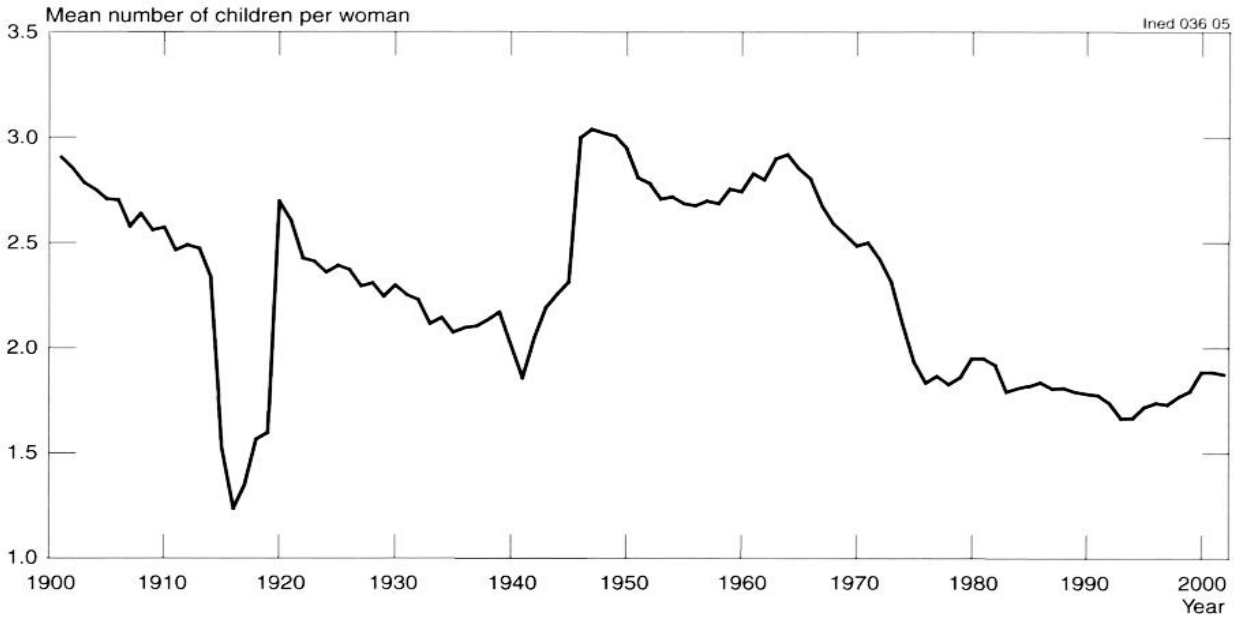

Figure 8.– Annual variation in fertility in France (total fertility rate)

Sources: Daguet (2002); Beaumel et al. (2002).

the baby boom not taken place, it is conceivable that the twinning rate would have continued the slow decline observed in every age group in the inter-war period. Pooling data for all births, instead of appearing stable during the entire period from the 1920s to early 1960s, the twinning rate would have declined steadily until it reached its low point in 1972.

We will return now to pre-industrial France and its overall twinning rate of 12.5 per 1,000 births over the period 1700-1829 (Gutierrez and Houdaille, 1983). With the same age distribution of mothers as that of 1985, the twinning rate would have been only 9.4 per 1,000, i. e. 10% less than in the twentieth century with the same distribution (though excluding the sharp rise in the past 30 years, since 1970, which is due to another mechanism, as discussed in the next section). So the relatively high twinning rate in the eighteenth century can be attributed to a high mean age of childbearing, with a large proportion of mothers belonging to age groups with the highest twinning rates. But adjusting for age and taking underregistration into account, the rate was probably similar to that of the twentieth century.

4. The role of infertility treatments

At the end of the 1970s, the rise in the age of childbearing in France contributed to the rise in the proportion of twin births. This was not the only cause, as witnessed by the rise in the twinning rate after adjusting for mother's age and rates by age. Infertility treatments also account for the increase (Toulemon, 1995; Blondel et al., 2002). It was in France, in 1967, that doctors first prescribed hormonal treatments to stimulate ovulation. While these treatments allow hypofecund women to conceive, they also significantly increase the risk of multiple pregnancies. Such treatments have become widespread, to the extent that nowadays, in France, almost half a million cycles are artificially stimulated each year, not including stimulations for in-vitro fertilization (IVF). IVF is offered when ovarian stimulation is ineffective[4]. The first success in France dates back to 1982. Since then, the number of attempts has increased rapidly, reaching close to 20,000 per year in France in the early 1990s, and doubling to 40,000 in 2001 (FIVNAT, 1995; FIVNAT, 1998; FIVNAT, 2002). To increase the chances of success, doctors who practice in-vitro fertilization often implant several ova[5] or several embryos at the same time—2.3 on average for all IVF techniques in 2001. This practice also increases the risk of multiple pregnancies. Almost one in four births following an IVF proce-

[4] For sterile couples for whom ovarian stimulation alone would not be effective, for example if the woman has no fallopian tubes, or has both tubes obstructed. IVF is proposed directly.

[5] One of the techniques used for a while, known as GIFT (Gamete Intra-Fallopian Transfer), involved removing ova and sperm, mixing them in a test tube and transferring the mixture without waiting until one or more ova were fertilized. Fertilization occurred in the woman's genital tract. This technique is rarely used today.

dure is a twin birth, compared to just under 1% when the pregnancy is achieved through natural means (FIVNAT, 1995; FIVNAT, 1998). IVF specialists have progressively become aware of the risks of multiple pregnancies, and have recently reduced the number of embryos transferred on each attempt. The number of ovules transferred in standard IVF procedures[6] fell from 2.7 on average in 1992 to 1.8 in 2001 (FIVNAT, annual reports, various years; de La Rochebrochard, 2003)[7].

The multiplication of infertility treatments over the past thirty years has led to an increase in the twinning rate, compounded by the increase due to delayed childbearing. The twinning rate rose from 8.9 per 1,000 in 1972 to 15 per 1,000 in 2000, representing a 69% increase. If the timing of fertility had not changed (being equal over the entire period to that of the year 1985), it would have risen from 9.4 per 1,000 in 1972 to 13.4 per 1,000 in 2000, an increase of only 43%. The delay in childbearing thus accounts for slightly more than one-third of the increase, and the development of infertility treatments accounts for slightly less than two-thirds.

II. The role of voluntary birth control

We will now return to the period from the First World War to the beginning of the 1970s, which preceded the recent rise in the twinning rate. As mentioned above, leaving aside the baby boom period, the twinning rate steadily declined in every age group above the age of 25. This decrease coincides with a decline in fertility and a smaller number of large families. This might be explained as follows: women who had twins during their first pregnancy, and who only wanted two children, attained their desired number of offspring in a single pregnancy. Further, those who wanted only one child produced more than they wished. These two types of women undertook an additional pregnancy less frequently than women who had had a single birth. The same reasoning can be applied to women who had three children in two pregnancies, i.e., with one twin birth, compared with women who had two single pregnancies. The risk of twin pregnancy varies between women, as previously discussed. A woman who gives birth to twins is more likely than a woman who does not to have twins again during a later pregnancy. If women of the first type, who are predisposed to having twins, less frequently undertake pregnancy than the others, they will be decreasingly represented in birth orders higher than

[6] I.e., excluding ICSI (IntraCytoplasmic Sperm Injection). ICSI is an in-vitro fertilization technique developed in 1992 which involves injecting a spermatozoid directly into the ovum using a micro-pipette. The use of ICSI has been increasing over the last ten years. It represented one in two IVF procedures in France in 2000 and 2001 (FIVNAT, annual reports 2000 and 2001) and more than one in two (54%) in 2002 (provisional annual report 2002).

[7] The smaller number of embryos transferred and the use of improved ovarian stimulation techniques explain why the twinning rate in France has levelled off since 1999.

one as voluntary birth control becomes more widespread. This phenomenon may account for the observed decline in the twinning rate during the twentieth century, prior to the advent of infertility treatments.

To test this hypothesis and, more generally, to study the effect of a twin birth on family formation, data were analysed from the last four Family Surveys conducted in France (in 1975, 1982, 1990 and 1999). Each of these studies surveyed a representative sample of several hundred thousand women (1/50th of the adult female population), and the total sample included more than a million women[8]. The surveys include a birth history of each woman. In particular, information is included on the sex, date of birth and birth order of each of their children (as well as the date of death, for children who later died). Our analysis is limited to women born after 1920, for reasons of sample size and also to reduce the risk of recall bias. It thus relates to a total of 850,987 women and 2,088,796 births, including 19,959 twin births.

1. Probability of a subsequent pregnancy following a twin pregnancy

The probability of further childbearing for a woman having just given birth to twins was calculated by comparing it with the probability of further childbearing for a woman whose family situation is similar, but who has never given birth to twins (i.e., the same number of pregnancies, or the same number of children). The probability of having another child was estimated on the basis of the time elapsed since the last birth. Results are presented as a "survival" curve for the status "has not given birth again", indicating for each period elapsed since the last birth the probability of not having any other children. Family survey data on birth spacing are affected by censoring. To account for censoring, survival functions were estimated using the Kaplan-Meier method. Figure 9 shows the corresponding curve for women interviewed in the 1999 family survey who had already given birth a first time between the ages of 25 and 30. Three years after childbirth, 32% had still not given birth again. After 20 years, the proportion is 22%. If, after a long period, the woman has still not given birth again, the risk of further childbearing is very low and the survival curve is almost horizontal. The level attained reflects the probability of not having another child, and the complement to one (78%) represents the probability of additional childbearing. In the remainder of this article, we will use for comparison the probability of not having another child reached at the end of a sufficiently long period, up to 10 years after menopause, i.e., age 60. The chosen limit is deliberately quite high. Probabilities of further childbearing thus calculated are indicated in Table 1. They

[8] The latest of these studies, the Study of Family History (Etude de l'Histoire familiale – EHF) 1999 surveyed a sample of 445,000 persons (men and women) representing the French population aged 15 and over (Cassan et al., 2000).

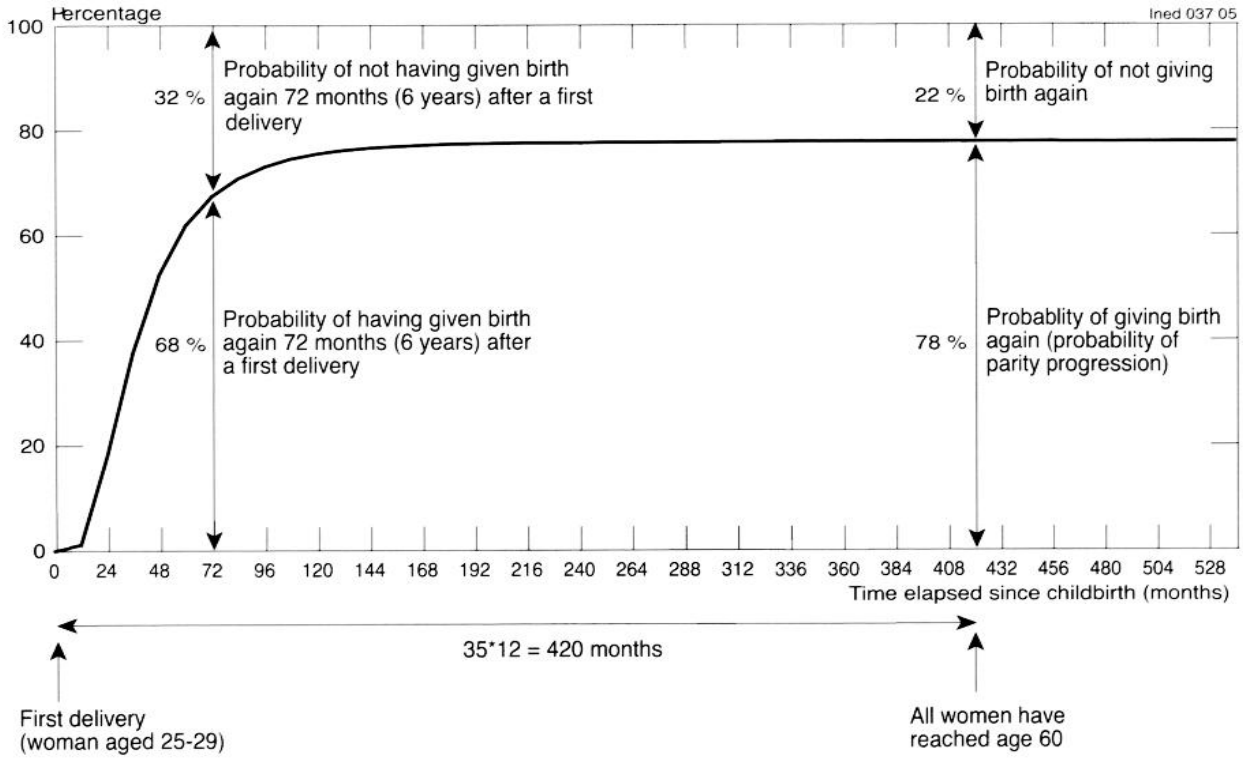

Figure 9.– Method for measuring the probability of giving birth again. The case of women who had a first birth at age 25-29 (France, Family History survey 1999)

are shown separately according to the number of children after the last birth, the nature of births (single or twin), and the woman's age at the time of the last birth.

The three following types of women are first compared: those who had a single child in a single birth, those who had two children in two single births, and those who had two children in one twin birth (Figure 10). The subsequent childbearing behaviour in the latter is similar to that of women who had two children in two single births. For example, among women aged 25-29 at the time of their most recent birth, 50% of those who first had twins later had another pregnancy, compared with 54% of those who had two children in two pregnancies. Among women aged 20-24, the difference is more pronounced, 67% and 73% respectively, signalling a lesser enthusiasm for a second pregnancy among women who gave birth to twins when they were young. Focusing on women who only had one pregnancy, and comparing those who had twins with those who did not, the difference is striking. Mothers of twins far less frequently undertake a second pregnancy than women who gave birth to only one child. Also, the gaps between the two types of women grow wider in the younger age groups, in parallel with the reduced probability for a woman who already has two children of producing a third. Ultimately, what counts is the

TABLE 1.– PROBABILITY OF HAVING ANOTHER CHILD ACCORDING TO THE NUMBER ALREADY BORN AND THE NATURE OF PREVIOUS BIRTHS (SINGLE OR TWIN) (%)

Cohort	Age of woman at last birth	Number of children after last birth					
		One child	Two children		Three children		
			Type of birth(s)		Type of birth(s)		
		One single birth	Two single births	One twin birth	Three single births	Single birth followed by twin birth	Twin birth followed by single birth
All cohorts	15-19	89	86	81	88	76	85
	20-24	84	73	67	75	64	70
	25-29	74	54	50	58	40	51
	30-34	56	35	36	37	26	37
	35-39	36	21	26	19	19	20
	40+	17	10	16	8	6	15
Women born between 1920 and 1934	15-24	86	82	75	85	77	80
	25-34	72	58	56	59	48	54
	35+	33	21	30	19	20	19
Women born between 1935 and 1949	15-24	86	72	69	73	62	68
	25-34	70	43	45	40	31	39
	35+	31	14	19	12	10	10
Women born between 1950 and 1964	15-24	85	67	63	64	53	61
	25-34	72	38	37	32	14	35
	35+	34	14	18	9	5	20
Women born between 1965 and 1979	15-24	85	68	53	62	39	64
	25-34	70	36	26	30	22	25
	35+	–	–	–	–	–	–

Sources: French Family Surveys (1975, 1982, 1990, 1999).

number of children; the manner in which they were obtained (in one or two pregnancies) does not exert much influence at this stage.

We will now look at the results for *women who already have three children*, by comparing those who had them in three pregnancies with those who had one twin birth and one single birth. Data are categorized according to whether the twin birth was the first or the second (Figure 11).

Among mothers of three children aged 25-29 at the time of their most recent birth, 58% of those who only had single births later undertook an additional pregnancy. The figure is 51% for those who gave birth only twice but with twins the first time and a single pregnancy the second time and just 40% for women who also had only two births, in the reverse order, starting with a single pregnancy and following it with a twin birth. Differences follow the same trend in every age group. All in all, mothers of three children who first gave birth to twins, then to a single child, behave in much the same way as those who had three children in three pregnancies. A portion of these two categories of women had a projected family size of at least three children. By contrast, a large fraction of those who had twins during the second pregnancy was probably not expecting to have a final count of three children but rather of two. They are therefore more likely to have exceeded the desired number of children. Comparing past generations with more recent ones, the gap between the two categories of women, in terms of the probability of a further pregnancy, has tended to increase. Among women born between 1920 and 1934 who were mothers of three children, 54% of those who first gave birth to twins followed by a single birth at age 25-34 later undertook a new pregnancy, compared with 48% of those who first had a single birth followed by twins. Among women born between 1950 and 1964, the proportions are 35% and 14% respectively (Table 1).

Lastly, we will focus on *women who had two pregnancies*, comparing those who had a twin pregnancy followed by a single one, with those who had two single pregnancies (Figure 12). The former undertook a new pregnancy slightly less frequently than the latter when the last pregnancy took place before the age of 30, though the gap is very small. For example, among women whose most recent pregnancy occurred between ages 25-30, 51% of the former had another pregnancy compared to 54% of the latter. When the latest pregnancy occurred between ages 30-35, the differences practically disappear (37% and 35%). For women who had another pregnancy after having twins, their family project was to have a large number of children, and the same proportion undertook a third pregnancy, to have a fourth child, as those who had also had two pregnancies, but with only two children.

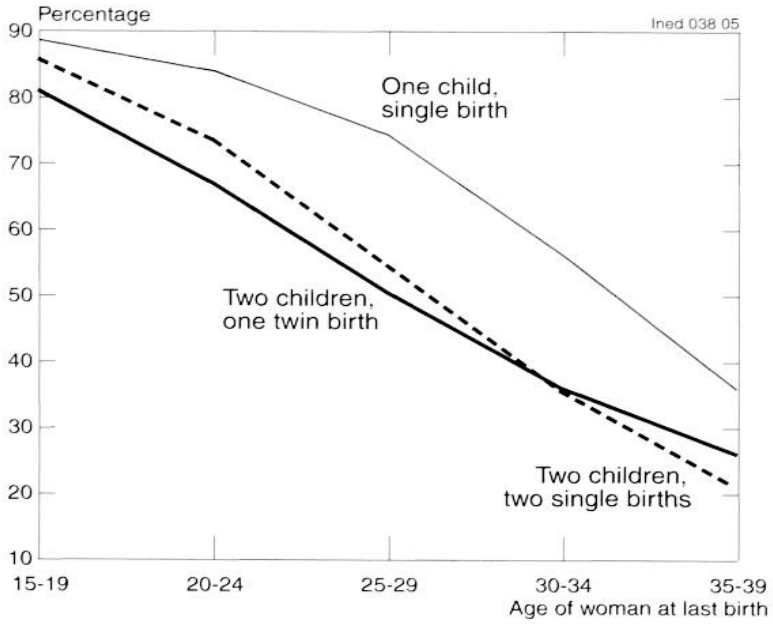

Figure 10.– Probability of giving birth again for women who have already had one or two children, by type of last birth (%)

Sources: INSEE, French Family Surveys (1975, 1982, 1990 and 1999).

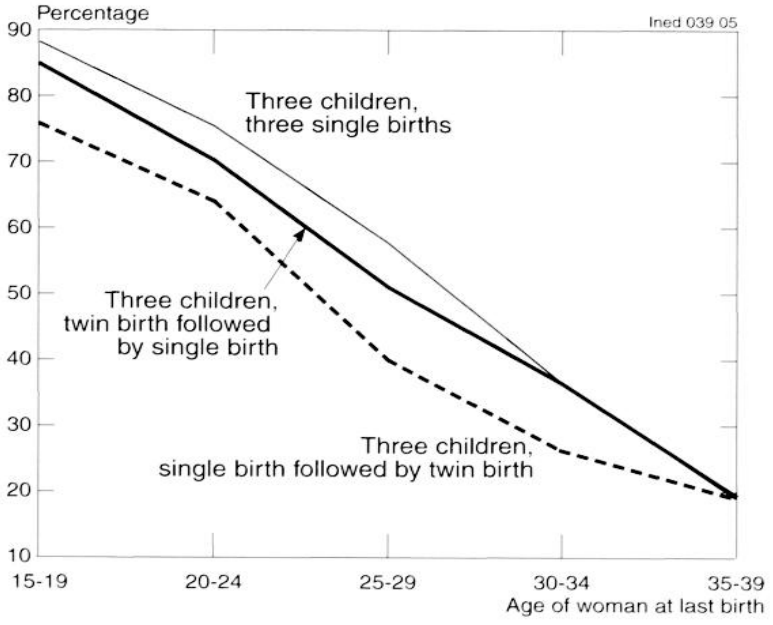

Figure 11.– Probability of giving birth again for women who have already had three children, according to whether or not they have had twins (%)

Sources: INSEE, French Family Surveys (1975, 1982, 1990 and 1999).

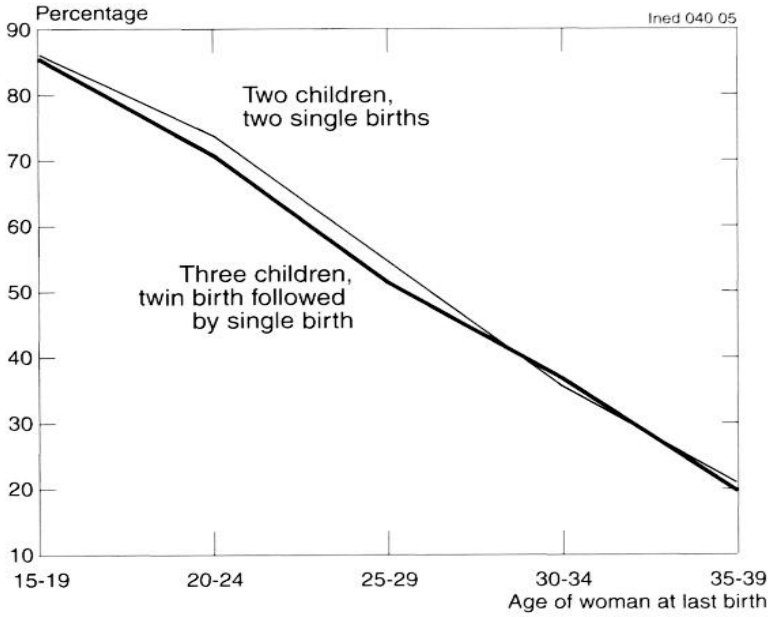

Figure 12.– Probability of giving birth again for women who have had a twin birth followed by a single birth (three children) and for those who have had two single births (two children) (%)

Sources: INSEE, French Family Surveys (1975, 1982, 1990 and 1999).

2. *Effect of the death of one or both twins*

Twins are fragile and are four or five times more likely to die at the beginning of their lives than singletons (Pison, 2000). It is not unusual for one or both twins to die, most frequently during delivery or in the following hours or days. Does the death of a newborn have the same consequences, in relation to later pregnancies, if it concerns a single birth or a twin birth? Figure 13 compares the frequency of an additional birth for a woman who has just given birth, depending on whether the last birth was a twin birth and whether the newborn child or children have died. All births are considered for this analysis, for all birth orders and all age categories. Deaths taken into consideration here are those which occurred at the time of birth or shortly afterwards, but in practice, the low frequency of newborn deaths led us to consider all deaths up to age one (though most occurred at the time of delivery or shortly thereafter). We did not distinguish women by age due to the small numbers involved.

Regarding the decision to undertake a subsequent pregnancy, women who gave birth to twins, one of whom died before age one, behave in a similar way to women who gave birth to a singleton who survived. Likewise, women who gave birth to twins who both died in their first year behave in much the same way as women who had a single birth followed by

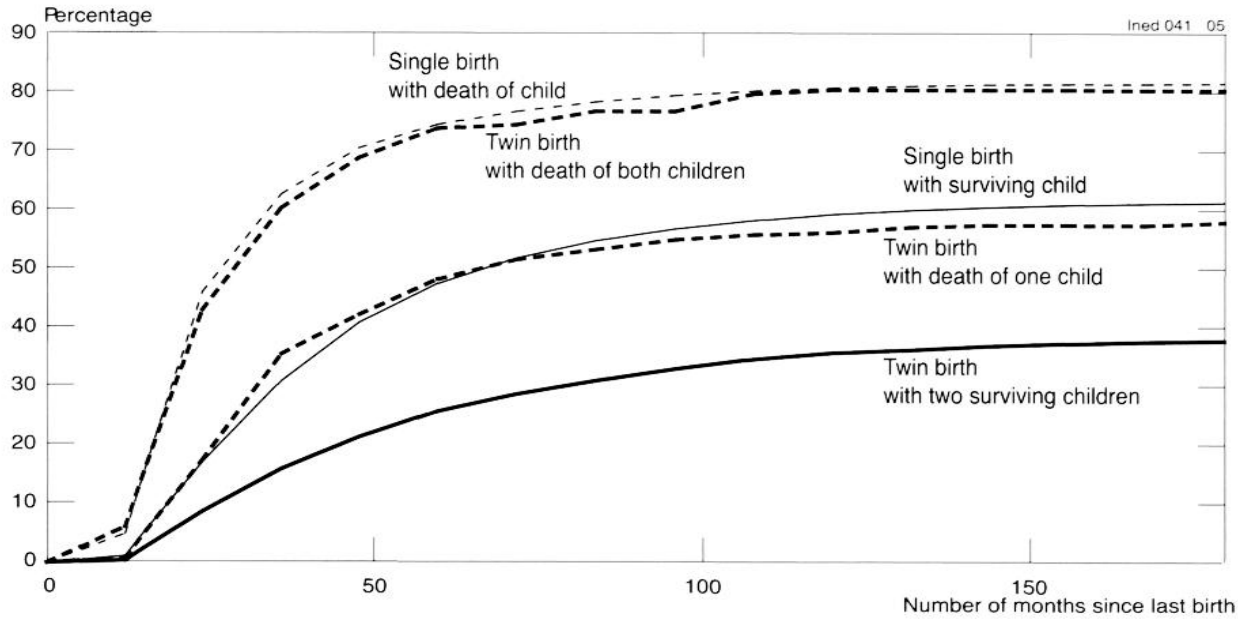

Figure 13.– Probability of an additional birth according to the time elapsed since the previous birth, its type and the death of one or more children

Sources: INSEE, French Family Surveys (1975, 1982, 1990 and 1999).

the death of the child. All in all, behaviours appear to be dictated by the number of surviving children.

III. The role of selection by fecundity: The high proportion of twin births in the First World War

1. The hypothesis of selection of the most fecund couples

We now return to the rise in the twinning rate during the First World War. One explanation for this might be the fact that many men were on the front during the war years, and a large proportion of conceptions occurred during leave periods. Leave was short[9], and the couples that succeeded in conceiving in this short time were the most fecund. Hyper-fecund couples or women thus contributed more to births than they did in peace time. If these couples or women had a greater propensity than others to have twins, selection through fecundity would have increased the proportion of twin births.

[9] Soldiers on leave stayed at home for an average of seven days during the first years of the war (from mid-1915 to the end of 1917) and ten days in the last year (end of 1917 to the armistice of 11 November 1918) (Cronier, 2004).

In 1919, the twinning rate reached a record level of 13.6 per 1,000 (Figures 1 and 2)[10]. Few weddings were celebrated during the war, and many single persons had to wait for the armistice or 1919 to marry. A compensatory peak in marriages was observed as a consequence. Further, previously married couples who were separated during the war were reunited as men returned from the front. This suggests that selection through fecundity may have occurred as described above. Among newlyweds and recently reunited couples, those who quickly achieved pregnancy were the most fecund, and therefore most likely to have twins. So the peak in the number of new or reunited couples would have logically been followed nine months later by a peak in the rate of twin births.

Which of the two phenomena, i.e., the formation of new married couples and the reuniting of previously married couples separated by war, played the greater role in the twinning peak of 1919? Figure 14 shows the monthly variation in marriages and births in France from 1911 to 1924. The birth curve has been moved back by 9 months to give a clearer picture of the variation in conceptions. Figure 14 shows that the number of marriages was very low during the war. After dropping sharply at the beginning, the number of marriages then progressively picked up again, though without returning to pre-war levels. After the armistice of 11 November 1918, the number of marriages rose quite rapidly, but did not peak until one to two years later. This increase began in January 1919, but remained insignificant until April, May and June 1919. Even for persons who had been engaged for a long time, weddings had to be prepared, and some waited for the right season to get married (as shown in Figure 14, April was traditionally the most popular month for weddings in France at the time). Further, persons who had not been engaged or who had lost their fiancé during the war had to find a new partner. The number of marriages finally took off in September 1919, maintaining a very high level during the 12 following months, and reaching its record high in April 1920.

Figure 14 shows that the rise in conceptions began in December 1918, the month immediately following the armistice, and reached its peak in April 1919, though the number of marriages recorded in that month was still small, lower than a normal pre-war month of April. The first wave of conceptions immediately after the war can thus be attributed to already married couples who had been separated during the war, and who were reunited after demobilization. So it was the reuniting of already married couples, rather than the wave of marriages, that mainly accounts for the 1919 peak in twin births.

[10] In most European countries for which statistics are available, the twinning rate peaked after the war, in 1919-20 (Italy, Germany, Switzerland, Austria, Hungary, Scotland—no statistics are available for England and Wales), or slightly later, in 1920-21 (Belgium, Netherlands, Denmark). But there was no such peak during this period in Sweden, Norway and Finland.

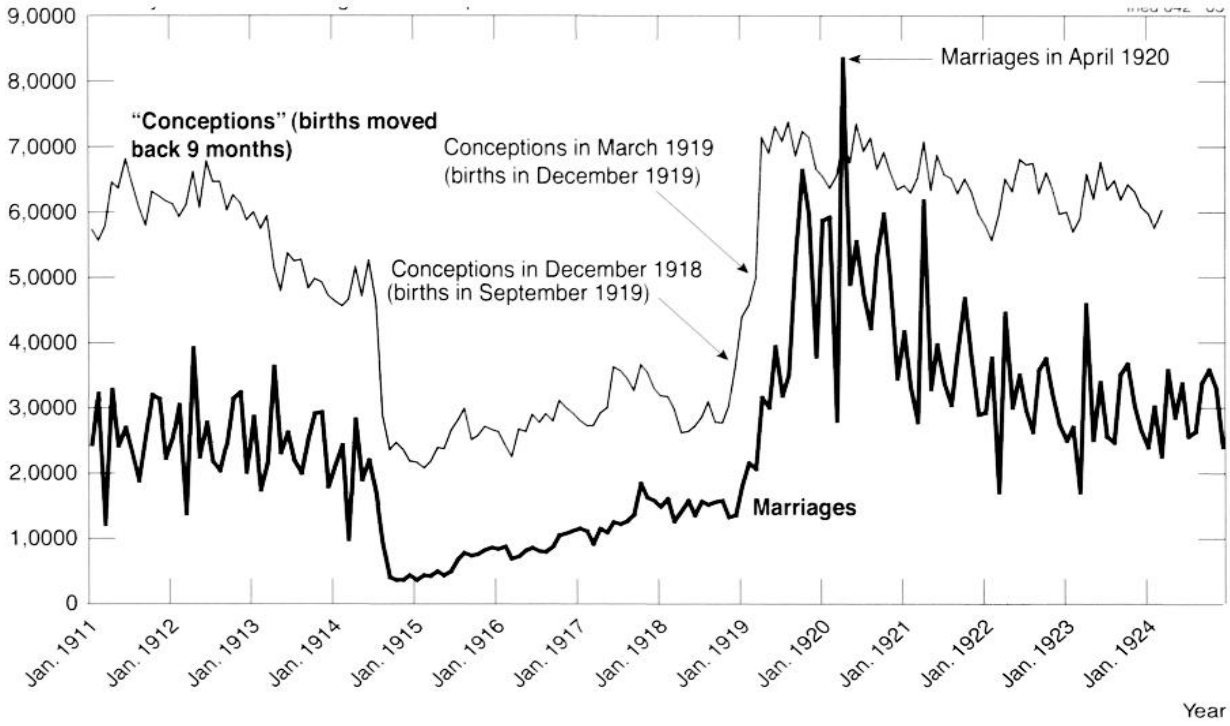

Figure 14.– Monthly variation in marriages and "conceptions"(a) in France from January 1911 to December 1924

(a) The number of "conceptions" is estimated here on the basis of the number of births nine months later.
Source: INSEE.

2. *The most fecund couples have a greater propensity to bear twins*

To use the selection of the most fecund couples as an explanation for the rise in twinning rates during the war years and the twinning peak of 1919, we must hypothesize a link between fecundity and a propensity to have twins. This hypothesis derives from the observation that for a woman to produce non-identical twins, she must have a double ovulation. This phenomenon is rare, and is an indicator of high fecundity (this observation does not apply, in principle, to identical twins). To test the hypothesis, we re-analysed data from the French family surveys of 1975, 1982, 1990 and 1999 to examine whether, among newlyweds, those who achieved pregnancy more quickly had a higher rate of twin births than those who took longer to do so. As mentioned above, the survey interviewed more than a million women, representative of the French adult female population. Data collected include a history of unions and births for each woman. Our analysis was again restricted to women who declared having been married at least once, and having had at least one child. Women born before 1920

were excluded to reduce the risk of recall bias; most of the first births analysed here thus took place between 1940 and1999.

Women were categorized according to the time between their marriage and the first birth, and according to the type of birth—single or twin. To calculate this interval, the duration of pregnancy is taken to be 38 weeks on average, i.e., close to 8 months and 3 weeks from fertilization to delivery. Counting from the first day of the last period to birth, the duration is extended by two weeks, to a total of 40 weeks. For twin pregnancies, birth takes place on average three weeks earlier, i.e., 8 months after conception (Papiernik, 1991). The first group considered is that of women whose first birth occurred between 8 and 9 months after the date of their first marriage. For this group, conception took place very close to their wedding day: at the time of marriage or immediately thereafter. The other women were grouped into five categories according to the interval between their marriage and the first birth: 10-11 months, 12-17 months, 18-23 months, 24-35 months, and 36 or more months.

The relation between marriage and procreation in France changed considerably in the last quarter of the twentieth century. Births out of wedlock or preceding marriage represented less than one in every ten births until the end of the 1970s. Twenty years later, they represented two in every five (Munoz-Pérez and Prioux, 1999). Further, the last thirty years of the twentieth century saw the development of hormonal infertility treatments, as mentioned above. Couples wishing to conceive but failing to obtain a pregnancy after several months have increasingly resorted to treatment. As previously indicated, the effect of the treatments has been to considerably increase the risk of twin pregnancies. Because the treatments are increasingly used by hypofecund couples who take a long time to conceive, they have modified the relation between time to conception and the risk of twin pregnancy by increasing the risk when time to conception is long. To take these two new trends into account, pre-1970 births—taking place between approximately 1940 and 1969—were considered separately from post-1970 births—between 1970 and 1999.

Figure 15 shows the variations in twinning rates according to the interval between the first marriage and the first birth, for the pre- and post-1970 periods. The figure includes variations observed two to three centuries ago in France. Variations were estimated on the basis of data from the "Louis Henry" historical survey of France, and correspond to first marriages contracted between 1670 and 1829 (Henri Leridon, personal communication). The Appendix Tables 1 and 2 provide detailed results for the twentieth and eighteenth centuries respectively. Variations in the twinning rate in the eighteenth century (between 1670 and 1829) and in the twentieth century (between 1940 and 1969) are similar (Figure 15): when the birth takes place between 8 and 9 months after marriage, the twinning rate is between 9 and 10 per 1,000, whereas if it takes place later, the rate is lower, around 6 per 1,000 in the eighteenth century and 6 to 7 per 1,000 in

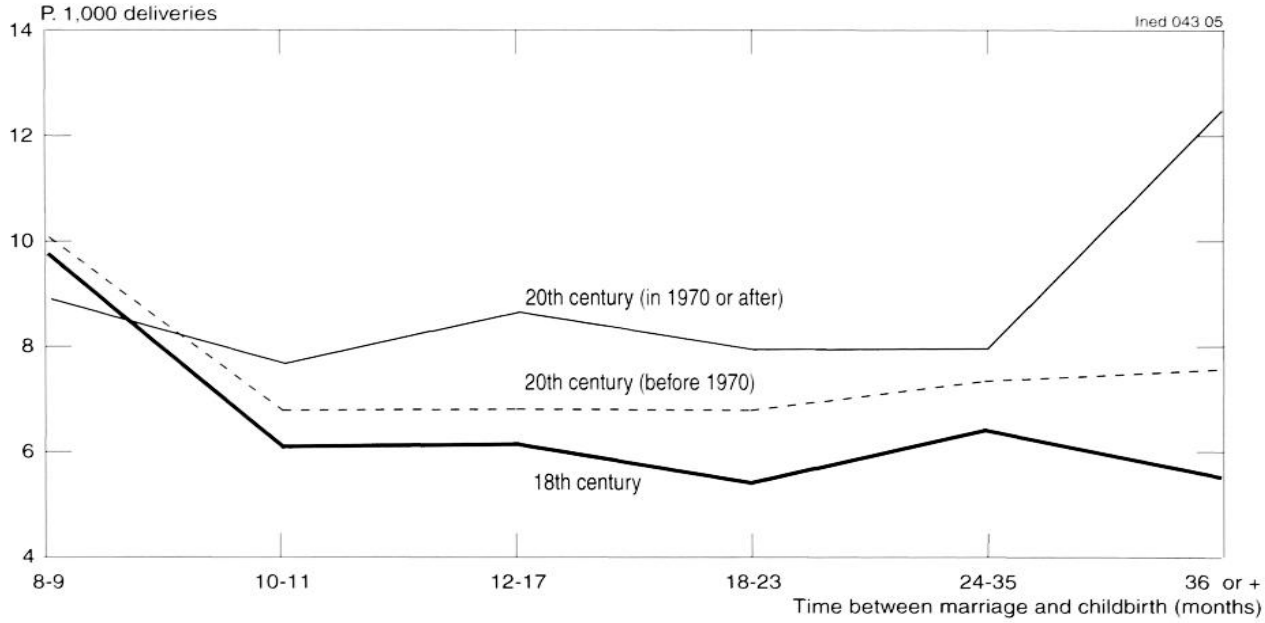

Figure 15.– Twinning rate for first births according to the time between marriage and childbirth. Comparison between the eighteenth and twentieth centuries in France

Sources: INSEE, French Family Surveys (1975, 1982, 1990 and 1999) and "Henry" survey of pre-industrial France (Henri Leridon, personal communication).

the twentieth century. For intervals exceeding a year and a half, the rate increases slightly in the twentieth century, but it remains at around 6 per 1,000 in the eighteenth century. After 1970, the same trends prevail as before 1970, but the difference in twinning rate between 8-9 months and 12-17 months is less marked, while the rise beyond a year and a half is more pronounced. In particular, women who give birth more than three years after their first marriage more frequently have twins, a trend linked to hormonal infertility treatments.

Figure 16 shows variations in the twinning rate for first births in the twentieth century by period (pre-1970 and post-1970) and according to the women's age at the time of their first birth, i.e., between 20 and 30, or between 30 and 40 (detailed results are given in Appendix Table 1). It confirms the influence of age on the twinning rate: married women who give birth for the first time at ages 30-39 more frequently have twins for this birth than women who do so at ages 20-29. Variations in twinning rate according to the interval between marriage and delivery are more pronounced for the older age group than for the younger one. Among the former, before 1970, 24 per 1,000 women giving birth between 8 and 9 months after marriage have twins, compared to 10 and 11 per 1,000, respectively, among those giving birth 10 to 11 months and 12 to 17 months after their marriage. After 1970, differences follow the same pattern. The novel aspect is the rise in the twinning rate for women who

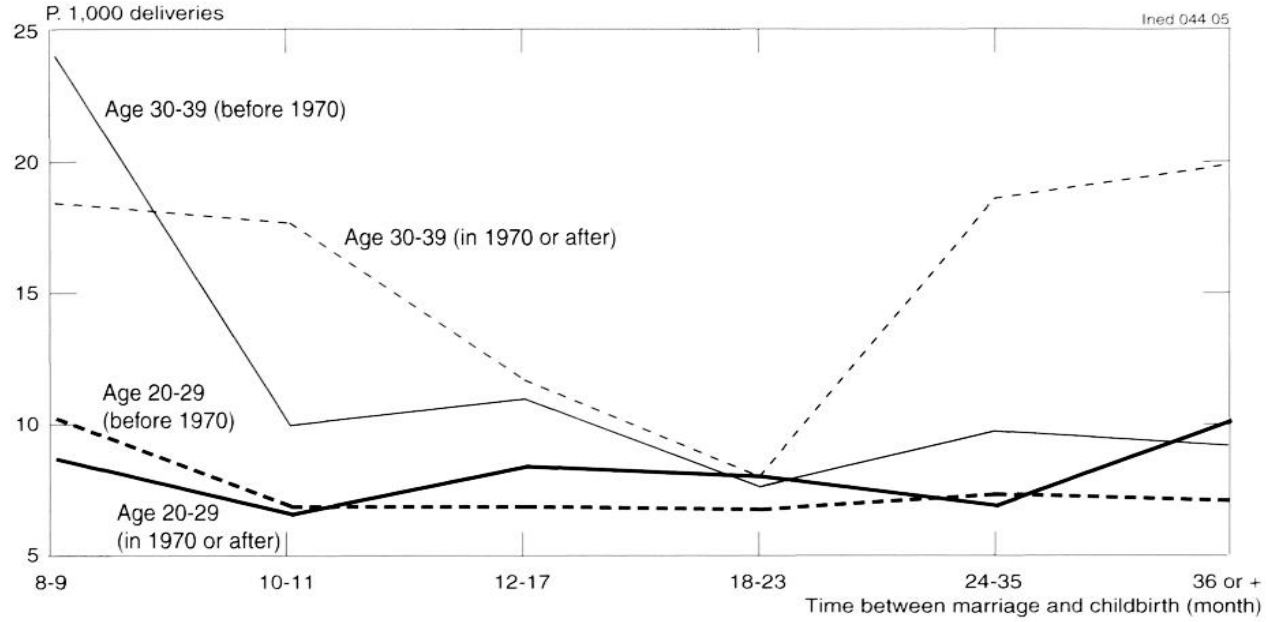

Figure 16.– Twinning rate for first births by mother's age, period and time elapsed between marriage and childbirth in the twentieth century in France

Sources: INSEE, French Family Surveys (1975, 1982, 1990 and 1999).

took a long time to conceive; it is particularly pronounced for women aged 30-39, who no doubt resort more frequently to infertility treatments.

The higher frequency of twin births among couples who achieve a pregnancy soon after marriage compared with those who took longer to conceive is thus observed for women of all ages and in all periods — be it the eighteenth century (between 1670 and 1829), the mid-twentieth century (between 1940 and 1969) or the end of the twentieth century (between 1970 and 1999). Hyper-fecund couples do indeed have a greater propensity to produce twins than other couples. This confirms the hypothesis that selection of more fecund couples explains the peak in twinning rates observed during the First World War.

There was no peak during the Second World War. On the contrary, the standardized twinning rate continued the decline that had begun in the 1920s, falling to some of the lowest levels recorded in the first half of the twentieth century. One explanation for this is the malnutrition that affected part of the population and which, when severe, reduces the frequency of twin pregnancies (Bulmer, 1970). Assuming that there was a nutrition-related decline, this decline was not offset by an opposite rising trend, as was the case during the First World War. Couples were separated by the mobilization of men at the beginning of the war, but mobilization did not last and many returned, while the remainder became prisoners. These prisoners had no leave, and none of their wives, even the most fecund, could conceive. At the end of the war, the prisoners returned, but

they were fewer than the men mobilized during the First World War. Moreover, the potential peak in twin births spurred by their return was masked by the more general rise linked to the beginning of the baby boom.

Conclusion

We have shown that the proportion of twin births has varied in a range of almost one to two over the past three centuries in France. From close to 15 per 1,000 at the beginning of the eighteenth century, it returned to this high level at the end of the twentieth century after decreasing and remaining at a much lower level in the intervening period. The current high level can be linked to causes similar to those prevailing in the eighteenth century, but only partly so. High twinning rates at the beginning of the eighteenth century were principally due to the fact that women had their first child at a late age because they married late; furthermore, they continued to have children until older ages since birth control was not widespread. Thus, the mean age of childbearing was high, with a considerable proportion of births occurring at ages when the twinning rate is at its highest (35 to 40 years). At the beginning of the twenty-first century, the age of childbearing has risen once again, a fact which partly explains the recent rise in the twinning rate. But other factors not prevalent three centuries ago have also come into play, some of which reduce the twinning rate, while others cause it to rise.

Voluntary birth control is among the factors that reduce the twinning rate. Our analysis of data from French family surveys conducted in the last quarter of the twentieth century shows that nowadays, behaviours are influenced more by family size (number of already born and surviving children) than by the number of deliveries that have already occurred. On average, women who give birth to twins are less likely to become pregnant again than women who give birth to a single child. Women with a propensity to produce twins therefore tend to be increasingly under-represented in the fertile population, as the birth order rises. This trend is all the more prominent now that fertility is voluntarily limited and effective birth control methods are available. This is the first reason for the decline in the twinning rate observed at all ages over 25 until the 1970s. The same mechanism, reversed, accounts for the temporary twinning rate increase observed during the baby boom: birth control was relaxed, including among women with a propensity to produce twins who had already had a twin birth. Their proportion in the fertile population increased in comparison with the preceding period, leading to a rise in the twinning rate.

We have shown that throughout history, highly fecund couples or women produce more twins than their less fecund counterparts. This results in selection by fecundity which pushes up the twinning rate. This mode of selection becomes apparent under certain specific circumstances, such as during the First World War, when many couples were only together

for short periods of wartime leave and only the most fecund were able to conceive. The proportion of twin births increased as a consequence. When the soldiers returned at the end of the war, selection once again came into play, resulting in a temporary increase in the twinning rate in the first few months after demobilization. This selection mechanism operates continuously without producing visible fluctuations in the twinning rate, since under normal circumstances the number of reunited couples or of marriages is not subject to sudden variation.

The growing availability of infertility treatments in recent years is also one of the factors pushing up the twinning rate. It accounts for two thirds of the rise observed over the past thirty years, the other third being attributable to the increasing age of childbearing. Medicine is now interfering with biology and family behaviour, which, until recently, were the only factors affecting the twinning rate. But the further development and use of medically assisted procreation will have a major impact on the incidence of twin births in years to come.

Acknowledgements. We thank Fabienne Daguet for making available to us unpublished data on multiple births in France since 1900, and for reviewing this article. Cécile Lefèbre and Laurent Toulemon provided advice in analysing data from the 1999 Family History (EHF) survey. Maïté Ely and Arnaud Bringé provided documentary and statistical assistance. We also thank Béatrice Blondel, Élise de la Rochebrochard and Henri Leridon for their comments and suggestions about the manuscript.

APPENDIX TABLE 1.– PROPORTION OF TWIN FIRST BIRTHS ACCORDING TO TIME BETWEEN MARRIAGE AND DELIVERY. FRANCE, TWENTIETH CENTURY

Period	Period between first marriage and first birth	All women				Women aged between 20 and 29 at the time of delivery				Women aged between 30 and 39 at the time of delivery			
		Number of births			Twinning rate (per thousand)	Number of births			Twinning rate (per thousand)	Number of births			Twinning rate (per thousand)
		Single	Twin	Total		Single	Twin	Total		Single	Twin	Total	
Births before 1970	0-5 months	44,328	377	44,706	8.4	28,656	259	28,916	9.0	985	20	1,005	19.9
	6-7 months	32,594	192	32,787	5.9	23,997	154	24,151	6.4	881	8	889	9.0
	8-9 months	34,147	345	34,493	10.0	28,446	290	28,737	10.1	1,474	36	1,510	23.8
	10-11 months	49,974	338	50,318	6.7	42,629	290	42,925	6.8	2,532	25	2,557	9.8
	12-17 months	72,845	494	73,340	6.7	62,647	427	63,075	6.8	3,949	43	3,992	10.8
	18-23 months	37,122	251	37,374	6.7	32,593	218	32,811	6.6	2,538	19	2,557	7.4
	24-35 months	38,266	280	38,546	7.3	34,130	248	34,378	7.2	3,021	29	3,050	9.5
	36 months or more	57,071	431	57,508	7.5	41,531	293	41,827	7.0	14,621	133	14,756	9.0
Births in 1970 or later	0-5 months	26,045	217	26,264	8.3	16,743	149	16,892	8.8	1,211	22	1,234	17.8
	6-7 months	17,605	93	17,698	5.3	12,983	66	13,049	5.1	842	10	852	11.7
	8-9 months	11,175	100	11,279	8.9	9,011	78	9,092	8.6	860	16	877	18.2
	10-11 months	14,935	115	15,051	7.6	12,183	79	12,262	6.4	1,292	23	1,316	17.5
	12-17 months	31,132	271	31,406	8.6	26,046	218	26,266	8.3	2,842	33	2,875	11.5
	18-23 months	22,554	180	22,737	7.9	19,589	156	19,747	7.9	2,157	17	2,175	7.8
	24-35 months	29,869	239	30,112	7.9	26,525	182	26,710	6.8	2,777	52	2,830	18.4
	36 months or more	46,146	581	46,758	12.4	33,698	341	34,053	10.0	11,797	237	12,051	19.7
All	0-5 months	70,373	594	70,970	8.4	45,399	408	45,808	8.9	2,196	42	2,239	18.8
	6-7 months	50,199	285	50,485	5.6	36,980	220	37,200	5.9	1,723	18	1,741	10.3
	8-9 months	45,322	445	45,772	9.7	37,457	368	37,829	9.7	2,334	52	2,387	21.8
	10-11 months	64,909	453	65,369	6.9	54,812	369	55,187	6.7	3,824	48	3,873	12.4
	12-17 months	103,977	765	104,746	7.3	88,693	645	89,341	7.2	6,791	76	6,867	11.1
	18-23 months	59,676	431	60,111	7.2	52,182	374	52,558	7.1	4,695	36	4,732	7.6
	24-35 months	68,135	519	68,658	7.6	60,655	430	61,088	7.0	5,798	81	5,880	13.8
	36 months or more	103,217	1,012	104,266	9.7	75,229	634	75,880	8.4	26,418	370	26,807	13.8

Scope: Women born in 1920 or after, married at least once and having produced at least one child. Only the woman's first marriage and the first delivery are taken into account here. Women who gave birth to their first child before marriage are not included.
Sources: French Family Surveys (1975, 1982, 1990 and 1999).

APPENDIX TABLE 2.– PROPORTION OF TWIN FIRST BIRTHS ACCORDING TO TIME BETWEEN MARRIAGE AND DELIVERY. FRANCE, EIGHTEENTH CENTURY

Period between first marriage and first birth	Number of births			Twinning rate (per thousand)[a]
	Single	Twin	Total	
0-6 months	1,476	32	1,508	10.7
7 months	308	12	320	19.1
8-9 months	3,074	60	3,134	9.7
10-11 months	4,700	57	4,757	6.0
12-17 months	5,891	72	5,963	6.1
18-23 months	2,420	26	2,446	5.3
24-35 months	2,117	27	2,144	6.3
36 months or more	2,640	29	2,669	5.5

[a] Proportion of twin births. To convert from the number of children to the number of deliveries, the fact that for twin births there are two children but only one delivery must be taken into account. The odd numbers of twins can be explained by the occurrence of twin births in which one of the children was stillborn.
Scope: Marriages concluded between 1670 and 1830. Only the woman's first marriage and the first delivery are taken into account here. Women who gave birth to their first child before marriage are not included.
Source: "Henry" historical survey of France (Henri Leridon, personal communication).

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PISON Gilles, COUVERT Nadège.– **The Frequency of Twin Births in France. The Triple Influence of Biology, Medicine and Family Behaviour**

The proportion of twin births stood at 15 per 1,000 in France in the early eighteenth century and returned to this level in 2000 after falling substantially in the intervening period. It has risen by 70% since the early 1970s under the dual influence of infertility treatments, which explain two-thirds of the rise, and increased age of childbearing, which accounts for the other third. After analysing the variations in twinning rate in France over time, the article examines the various contributing factors and focuses on two in particular: voluntary birth control and selection by fecundity. Women who have produced twins less frequently undertake additional pregnancies than women who have had a single birth. The consequences of a twin pregnancy on the probability of additional childbearing are measured by analysing the histories of almost one million French women recorded in successive family surveys. Lastly, the article examines the twinning peak recorded in France during the First World War and just afterwards, in 1919. This peak can be attributed to an effect of selection of the most fecund couples, who also have a higher propensity to produce twins.

PISON Gilles, COUVERT Nadège.– **La fréquence des accouchements gémellaires en France. La triple influence de la biologie, la médecine et des comportements familiaux**

La proportion d'accouchements gémellaires, 15 p. 1 000 en France au début du XVIII^e^ siècle, a retrouvé ce niveau en 2000 après avoir été nettement en dessous entre temps. Elle a notamment augmenté de 70 % depuis le début des années 1970, sous les effets combinés des traitements contre la stérilité, qui expliquent les deux tiers de la hausse, et du retard des maternités, qui en explique un tiers. Après avoir retracé l'évolution du taux de gémellité en France, l'article passe en revue ses différents facteurs avec un intérêt particulier pour deux d'entre eux : la limitation volontaire des naissances et la sélection par la fertilité. Les femmes qui accouchent de jumeaux s'engagent moins souvent dans d'autres grossesses que celles qui accouchent d'un seul enfant. Les conséquences de la survenue d'une grossesse gémellaire sur la probabilité d'agrandissement de la famille sont mesurées en analysant près d'un million de biographies féminines françaises recueillies par les enquêtes Familles. La France a enfin connu un pic de gémellité pendant la première guerre mondiale et juste après, en 1919 ; il vient d'un effet de sélection des couples les plus fertiles, qui sont aussi les plus prédisposés à avoir des jumeaux.

PISON Gilles, COUVERT Nadège.– **La frecuencia de nacimientos de gemelos en Francia. La triple influencia de la biología, la medicina y las pautas familiares**

La proporción de nacimientos de gemelos, que era del 15 por 1000 en Francia a principios del siglo XVIII, volvió a alcanzar este nivel en el 2000, después de haber estado muy por debajo entre estos dos periodos. Desde principios de los setenta, en concreto, tal proporción ha aumentado en un 70% debido al efecto combinado del tratamiento contra la esterilidad, que explica dos tercios del aumento, y del retraso de la maternidad, que explica el tercio restante. Este artículo traza la evolución de la tasa de nacimientos de gemelos en Francia y analiza sus causas, con especial énfasis en dos de ellas: la limitación voluntaria del número de nacimientos y la selección a través de la fertilidad. La frecuencia de nuevos embarazos es menor entre las mujeres que dan a luz a gemelos que entre aquellas que dan a luz a un solo hijo. El artículo mide las consecuencias de la llegada de gemelos sobre la probabilidad de aumento de la talla familiar en base al análisis de un millón de biografías femeninas francesas obtenidas a través de las encuestas Familias. Los nacimientos de gemelos alcanzaron su máximo en Francia durante la primera guerra mundial y justo después de ésta, en 1919; tal aumento es debido al efecto de selección de las parejas más fértiles, que son también las más predispuestas a dar luz a gemelos.

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