Fertility and Infant and Early Childhood Mortality: Some Lessons on Stopping Behavior from Taiwanese and Dutch Cases.

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This chapter presents a preliminary exploration of issues surrounding the impact of infant and early child mortality on fertility behavior in Taiwan and the Netherlands. A particular concern is to assess claims made about the distinctive features of Chinese vs. European fertility behavior by the revisionist school of "anti-Malthusians" led by James Lee and Wang Feng and Zhao Zhongwei, in particular claims asserting the presence of 'deliberate fertility control" by Chinese in the late imperial period.[1] The bulk of this chapter focuses on the impacts child mortality and survival have on women's completed fertility and age at last birth ("stopping behavior"). Lee and Wang's finding of a low average age at last birth ("early stopping") in the Qing imperial lineage and the banner population of Daoyi is a key element in their revisionist "anti-Malthusian" view of marital fertility in historical Chinese populations. Do we find indications that couples "started to stop" once they were satisfied with their present family size? Under what circumstances did early stopping occur? We feel that measures such as the average age at last birth are inadequate to distinguish subfecund couples from "deliberate stoppers". Therefore, in this paper, we will work with the complete fertility history of individual couples. Basically, we ask simple questions: were couples that stopped at a low age of the wife blessed with surviving sons early in their "procreative career"? Conversely, did couples that supposedly stopped early voluntarily also have a low propensity to adopt children after their last child was born? A detailed comparison of fertility histories by final parity of completed marriages allows us to answer this kind of question. In addition, we compare multivarate models on parity progression that look at the effects on stopping of present family composition. The focus in this paper is on Taiwan, but where possible comparisons will be made with the Netherlands. In the case of the Netherlands deliberate parity-specific stopping is supposed not to have occurred among "pre-transitional" cohorts.

In the next section, we will survey the literature dealing with the relation between infant mortality, or infant survival, and early stopping. We will also describe our choice of data for this contribution. Then, we will present a first inspection of the fertility histories of both Taiwanese and Dutch women with an eye to determining the extent to which final parity is related to the experience of infant mortality. Next, we look at the relationship between child (or son) survival and age at last birth. In a subsequent section, we put adoption into the equation and look at the effect of the sex of the last child as well. Were couples more eager to stop when last child was male? Then, we compare our findings based on descriptive statistics with a multivariate model that predicts parity

[1] Lee and Wang, *One Quarter of Humanity*; Zhao, "Deliberate birth control".

progression while controlling for factors such as age of the mother, marriage duration and family composition. In a final section we test Zhao's assertion that mothers who had experienced reproductive success at a young age were particularly likely to stop childbearing early.

Women's Fertility and their Experience of Infant Mortality: Preliminary Considerations

The relationship between the number of children a woman bears and the number of children a woman loses to an early death has many dimensions. One dimension relates fertility to infant mortality through the impact of breastfeeding on birth spacing. In a society like that of early twentieth century Taiwan where the average period a child was breastfed extended well beyond the first year of life, the death of a child in infancy will cut short the amount of time the mother breastfeeds. This is important because of the role played by intense breastfeeding in the hormonal suppression of ovulation and menstruation. When ovulation is no longer suppressed by intense breastfeeding, the mother returns to a fecund state, and can be expected to conceive her next child earlier than might have been the case had her nursling survived the full period of breastfeeding. Thus we can expect that a woman who loses many children in infancy (by death, or, as we should not forget in the Taiwanese case, by adoption out) will have shorter intervals between births, on average, and thus in a given amount of time will bear a larger number of children. The same effect is found in Dutch society among the portion of the population breastfeeding for extended periods. This result requires no intent or special volition on the part of the woman or her spouse. So long as other factors affecting fecundability remain the same, this effect occurs automatically as the joint result of biological processes and breastfeeding customs. Our shorthand for the relationship connecting shortened breastfeeding and infant mortality to fertility will be the "lactation interruption effect".[2]

However, it would not be correct to assume the lactation interruption effect excludes all deliberate attempts to affect fertility. Because of the high value of sons, Taiwanese women are known to breastfeed sons for longer periods than daughters. This means birth intervals should be longer after a surviving son than a surviving daughter (the average interval after all births may show little difference between boys and girls, because higher male infant mortality reduces the average interval following male births). Women can speed their return to fecundability following the birth of a daughter not just by shortening the breastfeeding period but also by giving a daughter away in infancy and through female infanticide. The earlier return to fecundability speeds the possible conception of a boy. The deliberate shortening of the breastfeeding period following birth of a daughter may be seen as a woman's attempt to raise her fertility, and her prolonging the breastfeeding of a daughter could be interpreted as an attempt to limit fertility. However, prolonging the breastfeeding of a son was surely intended to ensure his survival, not to limit fertility. When might we expect the breastfeeding of a daughter to be prolonged as an attempt to limit fertility? Perhaps the daughters of women with many surviving sons were breastfed for longer periods and given away in infancy at lower

[2] Montgomery and Cohen, *From birth to death*, 2.

proportions than the daughters of women anxious to bear additional sons? The extent to which such practices were important can be demonstrated by analysis of birth interval spacing, a subject being dealt with in other contributions to this volume.[3]

A different pathway connecting infant mortality and fertility involves the role of planning and intent of parents in response to the experience of infant loss. Couples may take steps to increase their fertility to replace a lost child ("replacement") or in anticipation of child loss ("hoarding"). Wives in Chinese families were judged by their ability to produce male heirs for the family, and a woman who failed to produce sons lived an uneasy existence in her husband's family. But more was at stake in the survival of sons than status in the family. Women's long term welfare and security depended on raising sons to adulthood who would loyally support their mothers in old age. Maternal self-interest demanded that priority be given to raising sons. If no sons survived, a daughter (or adopted daughter) who married uxorilocally could serve as a son substitute. Daughters too had value, at least as insurance against the possibility of no sons surviving. Because of the cultural priorities of the Chinese family, married women understood that much was at stake in the raising of sons. This nexus of relationships and cultural premises stressing the importance of sons suggests that women who lost children, especially sons, in infancy or early childhood, can be expected to make a special and deliberate effort to conceive additional children, and perhaps to extend the usual period of childbearing to a later age. This pathway also suggests that women who lost few children, and were successful in producing surviving sons, might prefer to take more time between births, and perhaps to terminate their childbearing years earlier than their less fortunate sisters.

John Knodel identifies the replacement effect as one "whereby couples have replacement births in response to their own actual (as opposed to anticipated) experience with child loss"[4], but Knodel quickly *inverts* the notion to one that *links early stopping to experience with high rates of child survival*. He points out that the replacement effect assumes that limitation is practiced to some degree in the population at large. If limitation is absent we expect all couples to continue childbearing to the end of the reproductive span, regardless of their experience with child mortality. With no limitation, there would be no difference in the age at last birth between those who lost children in infancy and early childhood (and are assumed to want "replacement") and those who did not. Under such conditions Knodel suggests we may find instead of replacement by couples that have lost children in infancy earlier stopping by couples that have not.[5] Our shorthand for these relationships connecting infant mortality and fertility in the absence of limitation will be the "early stopping hypothesis." In theory, only if fertility limitation were broadly practiced would we expect to detect a replacement effect by which couples experiencing infant loss prolonged their childbearing in order to have additional births. In practical terms, given the relative nature of "early" and "late", it may be difficult to determine if a difference in age at stopping between two groups should be attributed to early stopping in one group rather than later stopping in the other.

Finally, an alternative hypothesis, which we shall call the "natural fertility hypothesis", states that couples continue childbearing to the end of the reproductive span and take no actions "to stop childbearing at any particular parity in order to limit family

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[3] Cf. Zhao, "Deliberate birth control", 743, Wolf, "Is There Evidence of Birth Control", 146.
[4] Knodel, *Demographic Behavior*, 393.
[5] Knodel, *Demographic Behavior*, 406.

size to a given number".[6] If there is no deliberate attempt to increase or decrease childbearing in response to infant and child mortality and survival, as the natural fertility hypothesis predicts, then we should find no relationship between women's ages at last birth and their experience of infant and child mortality. The natural fertility hypothesis predicts that women who lost children will have their last birth at ages similar to women who did not. All women are presumed to continue bearing children until the end of their reproductive spans regardless of their experience of child loss and survival; the only difference between them will be that women who lose children in infancy will have on average shorter birth intervals (due to the lactation interruption effect) that make possible a greater number of births within that span.

Note that in the Chinese case we need to distinguish stopping behavior as a response to son survival, not just child survival. The notion of natural fertility originates in attempts to identify limitation of family size without regard to the sex composition of offspring. In the context of Chinese son preference, our analysis must be sensitive to the presence of stopping behaviors as a response to survival of sons not just children overall. Both the replacement effect and the early stopping hypothesis predict that women with few surviving sons will have a higher age at last birth than women with many, and conversely that the more surviving sons a woman has, the earlier her age at last birth will be. An additional corollary holds that the earlier a woman has surviving sons, the earlier will be her age at last birth. [7]

Who are the Early and Late Stoppers?

Lee and Wang construct a model of Chinese fertility in which a pattern of early stopping is one of three demographic mechanisms (the other two are late starting and long birth intervals) that they interpret as evidence of marital fertility restraint.[8] They cite the finding of a mean age at last birth for the women of Daoyi at age 33.5 (35 sui) (in completed marriages defined as those under observation until the woman is 46 sui), in contrast to much higher averages in European populations, as evidence of marital fertility control in Daoyi.[9] But Lee and Campbell make little further inquiry into the conditions under which a low age at last birth occurred that might test its relationship to marital restraint. They interpret a low age at last birth as evidence of intentional and voluntary "early stopping," without consideration of alternative possibilities.[10]

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[6] Knodel, *Demographic Behavior*, 252.
[7] Cf. Zhao, "Deliberate birth control", 747.
[8] Lee and Wang, *One Quarter of Humanity*, 88.
[9] Lee and Wang, *One Quarter of Humanity*, 89-90; Lee and Campbell, *Fate and Fortune*, 92-93, table 5.5).
[10] In the Daoyi population, Lee and Campbell acknowledge that an estimated half of all births were unregistered (one-third of male and two-thirds of female births), Lee and Campbell, *Fate and Fortune*, 66-67) (presumably these are unregistered non-survivors who never make the "first appearance" from which births are imputed. Accordingly, they adjust their fertility rates upward to compensate for missing births. However, no equivalent adjustment is made in the calculation of the ages at first and last birth. Adjusting for the missing first and last births would shorten the first birth intervals and raise the average age at last birth

The average age at last birth in a population is the product of many variables, and reflects the parity distribution, birth spacing, and age at first birth. When comparing populations, historical demographers commonly consider a lower average age at last birth an indicator of fertility control, but only when age at marriage is controlled. As Flinn notes for European populations, "the earlier women married, the earlier they tended to give birth to their last child".[11] *Early marriage especially reduces the age at last birth of the lowest parity women*. For two populations with identical parity distributions (and thus identical stopping patterns), a large difference in female age at first marriage will be enough to lower the average age at last birth of the population marrying earlier. A very large gap existed between the Taiwanese average age at marriage of 19.2 and the Dutch average of 26. We show in the table below that the early age at last birth of low parity women (1-6) is chiefly responsible for lowering the overall average age at last birth of the early marrying Taiwanese when compared to the late marrying Dutch. Indeed our comparison shows that having a lower average age at last birth does not prevent the early marrying Taiwanese from having a higher mean parity, which is hardly suggestive of fertility limitation. It is the early age at marriage that lowers the Taiwanese average age at last birth in the Taiwan-Dutch comparison, not intentional early stopping. Lee, Wang and Campbell fail to control for the much earlier age at marriage of the Chinese population when they claim that a lower age at last birth demonstrates Chinese marital fertility restraint compared to the Europeans. Instead it simply reflects the earlier Chinese age at marriage.

[Table 1 about here]

We can investigate the circumstances surrounding women's age at last birth using individual level data from household register databases. Conventional understandings of the pronatalism of the Chinese family would predict early stopping only in those cases where a couple has achieved a sufficient holding of surviving sons. These assumptions imply a relationship of stopping behavior to couples' experience of child mortality and survival in accord with the early stopping hypothesis (limitation otherwise absent) and the replacement effect (limitation widely practiced). If a relationship can be established that links child survival to early stopping, then it may be reasonable to conclude that birth limitation is the likely motivation, on the assumption that couples have become satisfied with the size and sex composition of their offspring sets. If however the relationship of child survival to early stopping is weak or nonexistent, then we may doubt that couples are consciously limiting their fertility in attempts to shape their offspring sets.

However, an early age at last birth in completed marriages may be a response not to child survival but to difficult births, poor maternal health, the emotional stress surrounding child mortality, or low coital frequency due to long marital duration, spousal separation or marital estrangement.[12] "Early stopping" thus may be a sign of secondary sterility or experience with difficult pregnancies or births that renders a woman unwilling to undergo the risks of additional childbearing. It is not plausible to claim that a woman whose last birth is at age 33, all of whose children died before age 5, is intentionally

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[11] Flinn, *The European Demographic System*,44.

[12] Knodel, *Demographic Behavior*, 378.

limiting her fertility, without additional evidence. Fertility limitation is a plausible motive for stopping only for women who have surviving children, and in the Chinese case, sons.

[Figure 1 about here]

If an early age at last birth may be a response to two quite divergent experiences with child mortality and childbearing, we must look for evidence of both kinds of early stoppers and ask which kind is more numerous when the last birth is at a given age: is it those that have many surviving children or those that have lost infants in relation to difficult pregnancies and birth traumas? As early stopping may be the product of either situation, evidence of the presence of early stoppers in the population is not itself evidence of intentional birth limitation. Indeed where we find an early age at last birth followed by death of spouse, divorce and a husband's remarriage, and for women who remain married, adoption of children, husbands acquiring concubines (behaviors inconsistent with an intention to limit fertility), and uxorilocal marriages arranged for daughters signaling failure to raise a son to adulthood, we justifiably see such events as indicative of involuntary cessation of childbearing. Thus, we need to probe our data for relationships between age at last birth, child mortality, and child survival that consider the fuller context of women's fertility decision making.

The Taiwan and Dutch Samples of Completed Marriages

Study of the fertility of marriages over their full length, especially when the cessation of childbearing is of interest, requires a set of "completed marriages".[13] The samples employed in this paper are of Taiwan and Dutch completed marriages in which women remained in first marriages and were continuously under observation from age at marriage to age 46.[14] These are stringent conditions. They have the effect of severely reducing the number of marriages that qualify for our samples. In many ways the marriages that survive to fulfill these conditions are clearly not "typical" marriages. Many women's marriages were interrupted by death or divorce and followed by remarriage, but excluding these from the sample is necessary to eliminate marital disruption as a reason for stopping childbearing at lower parities. Marriages are also eliminated from the sample if observation is interrupted by migration, either to areas outside the study area before the marriage reached completion or into the study area after the marriage was initiated. Restricting our sample to completed marriages lasting to at least age 46 is also necessary to ensure that even the later born children of these women remain under observation for at least some years (so we know with great certainty whether the children survived their first years of life) and that what appears to be the woman's last birth is indeed her last birth. The counts of births and infant and child deaths include only legitimate births.

Because the Taiwan household registers were open only from 1906 to 1945, the sample of completed marriages is restricted to a narrow birth cohort. The sample includes only women born before 1/1/1901 who reach age 46 by 12/31/45, the end of the register

[13] Knodel, *Demographic Behavior*, 407.

[14] The Taiwan sample also eliminates women married after the thirtieth birthdate to ensure that a minimum of 15 years of married life is observed for each marriage.

period. In addition, all women in the sample must marry after 1/1/1906 if their marital fertility is to be fully observed. As average age at first marriage is 19, most of the women marrying after 1906 will have been born after 1886. Of women born before 1886, only those marrying above the average age at marriage and after 1/1/1906 will enter the sample. The bulk of the women in this sample thus come from a narrow birth cohort born between the 1880's and 1901. Because fertility rates are known to have risen and mortality to have fallen from 1906 to 1946, limiting the sample to a narrow birth cohort has the advantage of minimizing compositional and period effects.

This paper draws data from the household registers of four Taiwan localities. Two sites come from southwestern Taiwan, Danei (N=277), which has a majority Hoklo population but also a significant plains Aborigine minority, and Jibeishua (Jibei)(N=49) which has a plains Aborigine majority population. Our third site, Zhubei (N=206), located in the northwestern county of Xinchu, had a population evenly divided between a Hoklo area (Jiugang) and a Hakka area (Liujia). The fourth site, Lukang (N=119), a medium sized town on the central western coast of Taiwan, is predominantly Hoklo. These four sites thus contain representatives of three of the four main ethnic groups of Taiwanese society, and are located in the three main regions of Taiwan (north, center and south). (In separate analyses we have found minimal systematic variation in fertility due to ethnic differences but larger differences related to locality.) We make no claims that the sample is "representative" of some all-Taiwan average, but note only that it is draws women from a diversity of local populations.

The Dutch sample is drawn from women born between 1800 and 1860 in five localities. These localities include urban Amsterdam (N=36), urban and rural parts of Utrecht (N=198), the medium sized provincial town of Nijmegen (N=105), the proto-industrial agricultural community of Borne in the eastern province of Overijssel (N=98), and the agricultural community of Akersloot in North Holland (N=166). Throughout this chapter parity distributions are used in preference to single figure summary measures to explore and represent women's actual fertility experience. Parity distributions of women's completed fertility document the range and heterogeneity of fertility that characterize human populations. Thus parity distributions are in many ways a superior measure compared to age specific fertility rates that focus solely on pacing and reduce real variation to averages of women's experience, and total fertility rates that sum those averages (without regard to differences in marital duration). Mean parity also better reflects the average of women's actual fertility (determined by both duration and pacing of childbearing), compared to total fertility rates. Total fertility rates are based on the statistical fiction of a synthetic cohort experiencing a succession of age specific fertility rates, and thus assume in the case of total marital fertility, contrary to fact, that women are married the entire fertile period, age 15-49. Total marital fertility rates derived from synthetic cohorts can be seriously misleading when comparing populations, such as the Chinese and the Europeans, which have different ages at marriage and marital durations and real differences in mean parity. Our parity distributions present the actual experience of women in completed marriages. We use tables organized by parity, number of surviving sons, and age at last birth to display a variety of indicators that characterize the experience of women at different parities, and ages at last birth.

Figures 2 and 3, presenting the parity progression ratios and the parity distributions (also tables 2 and 3 below) provide an overview of childbearing in our sample marriages. The parity progression ratios confirm that both populations are characterized by natural fertility where parity specific limitation is absent. The parity progression ratios show the proportion of women progressing to the next birth remaining at .80 or above from parity one until parity five in the Netherlands and until parity seven in Taiwan; after that the ratios decline slowly and are still above .50 at parity eleven in both samples. Such patterns are typical of natural fertility populations where women do not control their fertility.[15]

Figure 2 and 3 about here

The mean final parity of women (excluding zero parity) was 6.98 births in Taiwan and 5.73 births in the Netherlands. Differences in mean age at marriage, about 19 in Taiwan and 26 in the Netherlands, cause marital durations and the number of years from first to last birth to diverge widely (discussed below), with the Dutch only partly making up for late marriage and short durations by a more rapid pace of childbearing. Figure three shows that the distribution of individual women by parity was highly dispersed around the average parities. Excluding zero parity women, women having one to three births were 15.6% of the Taiwan population and 25.6 % of the Dutch population. Women having nine or more births were 33% of the Taiwan population and 19.3 % of the Dutch population. Thus in both populations at least 45% of childbearing women were substantially below or above the mean parity. In the Taiwan sample 57% of women had seven or more births while in the Dutch sample 51% had six or more births.

Infant mortality at 15.8 per 100 births in Taiwan was just slightly lower than the rate of 16.7 per hundred in the Netherlands (see tables 2 and 3). The proportion of children who survived to age one but died by their fifth birth date was 12.0 per hundred in Taiwan and 10.3 per hundred in the Netherlands. Thus both our populations combine high natural fertility with high levels of infant and child mortality.

No conclusions should be drawn from the large difference in the proportions at zero parity between the two populations. This is most likely an artifact of differences in sample construction (the Taiwan sample excludes women married after age 30, many of whom bore no children, while the Dutch sample does not) as well as real differences in average age at marriage between the samples (circa 19 in the case of Taiwan and circa 26 in the case of the Dutch). Completed marriages do not provide an appropriate sample for estimating the proportion of women sterile in a population, especially given the higher likelihood in Taiwan that infertile women will be divorced compared to fertile women.[16] (Wolf 1995: 155-164).

Fertility and Infant Mortality: Cause or Consequence?

We begin our exploration of hypotheses linking infant and early child mortality and women's fertility behavior with tables 2 and 3 below which present distributions of women by their completed fertility and the number of infant losses experienced by these women.

[15] Lutz, *Distributional Aspects of Human Fertility*, 50.
[16] Wolf, *Sexual Attraction and Childhood Association*, 155-164.

What relationship, if any, does the broad distribution by parity have to the experience of infant mortality? The lactation interruption effect and replacement both assume that infant mortality is independent of parity, and that women increase their parity in response to infant loss. In tables 2 and 3 if we look at the columns headed "infant deaths per woman", we notice that women who had more births were also more likely to have lost one or more of those births in infancy than women who had fewer births. At first glance this suggests that the lactation interruption effect and/or replacement must be playing a strong role because women at the highest parities have lost the most births. But it also suggests other possibilities we must consider. We know that the risks of infant mortality are higher for high parity births. Some deaths of this nature are likely contributing to the total numbers of infants lost to women at high parities. Another possibility is that high parity women have more crowded birth spacing that leads to higher rates of infant morality, which then in recursive fashion results in foreshortened birth intervals and more births (the "crowding hypothesis"). Is infant mortality a cause of high fertility (as the lactation interruption effect and replacement assume) or its *consequence* ?

If infant mortality were a consequence of high fertility, we would expect to find that infant deaths per births increases regularly with parity. When we look at the columns headed "infant deaths per 100 births" we learn that there is a much weaker and inconsistent relationship between the probability of an infant dying and parity. In the Taiwan case, infants born to women at the highest (11-14) and also the lowest (1-3) parities were more likely to die than those born to women at middling parities. A similar pattern is found in the Dutch case, where infants born to women at parities 9-13 were more likely to die than those born to women at middling parities. The increases in the rate of loss per infant born (to a maximum of 63% and 66% over the averages for the Taiwanese and Dutch respectively) is much less than the increase in the numbers lost per woman (to a maximum of 3.3 and 3.75 times the averages). If women at higher parities suffer more infant losses per woman it is primarily because the more children born, the greater the likelihood that one child will die, and only secondarily because the probability of infant mortality (per birth) increases with parity. Though women are more likely to have suffered an infant loss at higher parities this does not demonstrate that such losses were a cause of their progressing to higher parities. Average closed birth intervals in both samples also decline with increasing parity and the number of infant deaths per woman; but is this because short intervals raise infant mortality, or is infant mortality via the lactation interruption effect reducing the average birth interval? That infant mortality is not independent of parity complicates our analysis of the responses to it, and we must beware in our interpretations of the data of assuming the causal arrow flows in only one direction.

[Table 2 about here]

[Table 3 about here]

At the lowest parities in the Taiwan sample the rates of infant loss per birth are also elevated (though to a lesser extent than at high parities) but infant deaths per woman are among the lowest. We know that the risks of infant mortality are higher for first births. Deaths of this nature are surely a significant proportion of the infants lost to women who remain at these low parities, which suggests that for some of them early experience with infant loss may signal difficulties in childbearing that terminate further childbearing, rather than spurring it to higher levels.

Both tables show that women experiencing broadly similar rates of loss per birth have widely divergent total numbers of births. In general these patterns give at best weak support to the crowding and replacement hypotheses. Women who had fewer than average births did not lose fewer infants per birth, and cannot be said to have stopped childbearing early because more of their children survived. And women having higher than average births did not all lose more infants per birth, nor can these women be said to have continued childbearing to higher parities because they lost a higher proportion of births in infancy.

Nevertheless, the increase with parity in the average number of infant deaths *per woman* shown in these tables suggests a strong relationship between women's experience of infant mortality and their fertility. But is that relationship explained by the early stopping hypothesis and/or replacement (women whose children survive stop earlier than women with fewer surviving children) or by the lactation interruption effect in conjunction with natural fertility (women continue bearing children to the end of their reproductive lives at a pace determined by the time spent breastfeeding surviving infants)? The lactation interruption effect predicts that women whose children survive bear fewer children because breastfeeding slows their pace of childbearing compared to women who lose children in infancy. The early stopping hypothesis predicts stopping when women reach a satisfactory number of surviving children or sons in contrast to the natural fertility hypothesis that predicts stopping only when fecundity declines (either due to secondary sterility (early) or old age (late)) without regard to the number of surviving sons. To test these alternative explanations we need to explore our data further for evidence that would discriminate between these two hypotheses.

Age at Last Birth and Surviving Children and Sons

If some women were stopping childbearing "early", did they do so in terms of parity, age, or number of surviving children and sons? Our tables relating completed parity and infant mortality showed large numbers of women stopping at every parity up to 12 and even higher but told us little about the circumstances characterizing these women. Did women stopping at lower parities have more surviving sons in the case of the Taiwanese, and surviving children in the case of the Dutch, than women stopping at higher parities? And did they do so at younger ages or after shorter childbearing periods, defined here as the years from first to last birth? The importance of producing surviving sons to the long term welfare of women in the Chinese family, meant that Taiwanese women were strongly motivated to continue childbearing until they could be sure that at least one son would survive. The early stopping hypothesis predicts that Taiwanese women with many surviving sons will stop childbearing earlier than women who have few or no surviving sons and who must continue childbearing until they reach a satisfactory number or come to the end of their reproductive period. Will we find analogous patterns for Dutch women anxious to produce surviving children and sons?

"Surviving children" and "surviving sons" are defined as those who survived early childhood and lived to at least age five. The definition used here selects survival to age five in order to balance two countervailing pressures, identified by Knodel "This age…. encompasses the age range of most pre-adult mortality, while minimizing the chance that the parents will have become sterile by the time of the child's death".[17] If we are to observe mothers employing limitation and replacement strategies in response to the survival and loss of previously born children, the child's death must occur before the end of the mother's reproductive period. Mothers are likely to have remaining childbearing capacity to adjust their birth planning to the death of a child as late as age five even in the case of later born children. It is also important from the point of view of sample construction that children of mothers continuously under observation to at least age 46 are also highly likely to remain under observation to age five.

The tables below present data on numbers of births, surviving children and sons, infant losses, and age at last birth for women in completed marriages. Tables 4, 5 and 6 display these data organized by age at last birth, number of surviving sons, and completed parity for the Taiwanese, and table 7 displays the data for the Dutch by completed parity. All tables show a *consistent positive relationship between age at last birth, number of births per woman, and number of surviving children and sons per woman*. Women could produce more surviving children and sons only by having more births and extending childbearing to a later age. The average age at last birth was 37.45 years in Taiwan, which is similar to Zhao's finding of an average age at last birth of 38.2 in the 1982 one-per-thousand population fertility survey[18], and much higher than the reported age of 33.5 for Daoyi village in the nineteenth century.[19] Women in the Netherlands who married and had first births much later than the Taiwanese stopped childbearing at an average age of 39.5 years. Women who stopped childbearing earlier than the average age at last birth had below average numbers of surviving children and sons while women who continued bearing children to later than average ages were rewarded with above average numbers of surviving children and sons. Thus there is no indication that women continued bearing children to late ages because of a failure to produce surviving children as the replacement hypothesis predicts; if anything they enjoyed, and presumably wanted, a surplus. Contrary to the predictions of the early stopping hypothesis, early stoppers had fewer than average surviving children and sons.

Zhao found a similar positive relationship between age at last birth and the number of children born in his analysis of women's ages at last birth by the sex composition of their children, and he recognizes that "this is to be expected because a large family size naturally requires a longer time to achieve".[20] But Zhao interprets the pattern differently, emphasizing the low fertility of those who stopped at younger ages as evidence of deliberate limitation, while ignoring the high fertility of those who continued even though they had numerous sons.

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[17] Knodel, *Demographic Behavior*, 407.
[18] Zhao, "Deliberate birth control", 735.
[19] Lee and Campbell, *Fate and Fortune*, 92-93.
[20] Zhao, "Deliberate birth control", 739.

Is there any indication in the tables of a relationship between experience of infant and child mortality and age at last birth? Did women continue to have births to later ages because they experienced higher-than-average losses among their children? Is there a "positive relationship between the age of mother at last birth and the number of previous child deaths"?[21] The number of infant deaths experienced by a woman bears a direct relationship to the number of births; the more births the greater the probability that any one newborn will suffer an early death. This direct relationship between number of births and number of infant deaths per woman shows up clearly in the tables organized by parity. But did women having higher numbers of births also suffer a higher rate of infant loss per birth? Or a lower proportion of surviving sons and children per birth? And did this high rate of loss affect their age at last birth?

There appears to be a weak and somewhat inconsistent relationship between infant deaths per birth and parity, as discussed above. In tables 6 and 7 organized by parity we find that at high parities, 11 to 14 for Taiwanese and 10 to 13 for the Dutch, a lower than average proportion of births have survived to age five and a higher than average proportion of births have died in infancy. These high parity women also have higher ages at last birth. This suggests that these women may have continued childbearing to such high parities and late ages because of infant and child losses, in accordance with replacement. But when we look at the numbers of surviving children and surviving sons per woman produced by these high parity women it is clear that overall they were *more* successful than even their above average but lower parity sisters.

In tables 4 and 5, organized by age at last birth and by number of surviving sons of Taiwanese women, we find that women stopping childbearing early (especially those stopping by age 29) and women with fewer than average surviving sons experienced higher rates of infant death per birth and lower rates of child and son survival than women stopping at later ages and women having higher-than-average numbers of surviving sons. Thus the tables organized by age at last birth and number of surviving sons show that Taiwanese women stopping early and with fewer surviving sons had more infant deaths per birth rather than fewer. This pattern is contrary to what the replacement hypothesis would lead us to expect. The women who continue childbearing to later ages are more successful in avoiding infant and child loss per birth, and better able to achieve the benefits of a larger number of surviving children and sons.

We are thus left with strong hints that infant and child mortality played a role in preventing some low parity women from continuing childbearing, and somewhat weaker hints that infant and child mortality played a role in delaying stopping by some high parity women who had already produced above average numbers of children. But these are minor notes in an overall picture showing a consistent positive relationship between age at last birth, number of births per woman, and number of surviving children and sons per woman that accords well with the natural fertility hypothesis that women continued childbearing to the end of their reproductive spans with little regard to their experience of infant and child loss.

[Table 4 about here]

[21] Knodel, *Demographic Behavior*, 418

[Table 5 about here]

[Table 6 about here]

Early stopping further explored

What explains early stopping if it is not an early satisfaction with the number of surviving sons and a desire to limit subsequent childbearing? Is such early stopping voluntary, part of a deliberate birth limitation strategy, or is it involuntary, and perhaps the result of secondary sterility, infertile husbands, marital estrangement or other difficulty that makes further childbearing either impossible or dangerous to the health of the woman? First of all, we look at the effect of an early *start*.

If women were limiting their births after achievement of a satisfactory holding of surviving sons, we might expect that on average those who started their childbearing period early would stop early and those who began late would stop late, as claimed for the imperial lineage.[22] According to Zhao Zhongwei "women's age at birth of their last child (or son) was positively related to their age at having a first child (or son)".[23] The result of such a pattern would be a convergence of childbearing spans around a narrow range of years. Table 8 below, organized by age at last birth, shows that the Taiwanese women who stopped childbearing at the youngest ages (up through age 26) started on average at the earliest ages, while the remaining women had starting ages that cluster within a narrow range around the average of 21.2. This gives the impression that there may be a weak positive relation between early starting and early stopping as predicted by the revisionists. However, for the entire range of stopping ages a strong positive relationship emerges between women's age at last birth and their number of childbearing years. The result shown in Table 8 is a greater number of years of childbearing the later the age at which women have their last birth, rather than a convergence of the spans, regardless of starting or stopping ages. Tables 9 and 10, organized by number of surviving sons and completed parity, show an *inverse* relationship between starting and stopping ages, rather than a positive one, and a strong positive relationship between the length of the childbearing span and the number of surviving sons in table 9, and births in table 10. These tables show that the most fertile women in Taiwan had the longest childbearing periods, achieved by starting early and stopping late, while the least fertile started late and stopped early, and had short childbearing spans. From the perspective of surviving sons and parity, it appears the *early stoppers were not early starters* who have achieved their childbearing targets early, and are not deliberately limiting their fertility but are more plausibly women who had their fertile years cut short involuntarily, before they could achieve a higher number of surviving children and sons. We find that the same inverse relation between starting and stopping ages, and positive relation between length of childbearing span and the number of births, also characterize the Dutch parity distribution in table 11.

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[22] Wang, Lee and Campbell, "Marital fertility control", 393.
[23] Zhao, "Deliberate birth control", 750.

More direct evidence of intent surrounding age at last birth comes from the patterns of adoption employed by the Taiwanese women (Dutch women did not have the option of adopting). We interpret adopting a child after the last birth not only as evidence that women were not satisfied with the size or sex composition of their offspring sets but also that stopping may not have been voluntary. Certainly adding another mouth to feed to the family contradicts the notion that early stopping is a deliberate means of limiting family size. The strong son preference of the Taiwanese family might lead us to expect that more boys would be adopted than girls, but it also meant that few families gave up boys for adoption. Thus adoptions were in fact overwhelmingly female; 84.8% of our sample's 564 total adoptions were female. Families adopting girls could use them as son substitutes; if no sons survived they could arrange a uxorilocal marriage to continue the family. Foster daughters could also serve as little daughters-in-law, and be married at maturity to a son of the family at little expense and much potential gain to the domestic control exercised by the mother-in-law cum foster mother. In larger families, a surplus daughter might be sent out at the same time a foster daughter was brought in; this was a means of unloading unwanted daughters and replacing them with little daughters-in-law in preparation for an anticipated minor marriage to a son. In these circumstances adoptions resulted in no net gains in numbers of children.

Our tables report any adoption occurring after the last birth regardless of sex. The highest proportions adopting after the last birth are found at the earliest ages at last birth (table 8), among those with no or only one surviving son (table 9), and at the lowest completed parities (table 10). These patterns strongly suggest that women, far from being satisfied with the size and sex composition of their offspring set when stopping childbearing so early and with so few children, were in fact strongly dissatisfied. Reinforcing this conclusion is the number of children ever adopted (without regard to timing of adoption) per woman (as no account has been taken of daughters given out, these are gross and not net numbers adopted). Women stopping at the youngest ages (table 8), having the lowest number of surviving sons (table 9), and having the lowest number of births (table 10), have always adopted more than the average number of adopted children per woman. Thus the number and timing of adoptions cast serious doubt on notions that early stopping can be interpreted as intentional fertility control.

The last remaining measure presented in the Taiwanese tables is the proportion of last born children who are male. Given the son preference of the Chinese family, and a desire to have as many surviving sons as possible, women may have felt more secure stopping further childbearing if their last born was a male child. High proportions male of last births may indicate that couples waited to have a son before stopping further childbearing. However, there appears to be no consistent relationship between proportion male of last born and either age at last birth (table 8) or completed parity (table 10). There is however a strong likelihood that women with five or more surviving sons will end with a male birth (Table 9). Thus it appears that women who had achieved twice the average number of surviving sons were likely to stop further childbearing following the birth of a boy, but we note that the average age at last birth of these women is already much higher than average. If this is 'early stopping" it could have little effect in preventing additional births.

Table 8 about here

Table 9 about here

Table 10 about here

Table 11 about here

The general picture of the childbearing patterns of married women that emerges from these tables reveals no clear signs of the practice of fertility limitation. Taiwanese and Dutch women who came close to the average numbers of births and the average ages at last birth were likely to produce the average numbers of surviving children (5.18 and 4.28) and sons (2.66 and 2.24). Does this represent a "target" family size around which women converge? Rather than a large number of women reaching this target with only a few women exceeding the target, as might be expected if replacement and fertility limitation by early stopping were important determinants of women's childbearing, women are broadly dispersed across a wide range of levels of total births and numbers of surviving children. Sizeable numbers of women had below average numbers of births and surviving children and sons and sizeable numbers exceeded those levels by more than one birth.

A better view of these childbearing patterns is that there are two groups of women, a subfertile group of early stoppers and a fertile group. Members of the first group are women whose fertility was impaired or interrupted before they reached the average number of surviving children. This group of women had below average numbers of births and surviving children, earlier ages at last birth, shorter childbearing periods, and because they were dissatisfied, more adoptions. This is a record of failure and disappointment, not one of birth targets attained followed by limitation. It appears likely that these women's childbearing was cut short prematurely by couple infertility or other problems making childbearing dangerous for the woman's health, and not by voluntary choice.

On the other hand we have more fertile women who enjoyed greater success in producing surviving children and sons. This group of women reached or exceeded the average number of births and surviving children, but they did this by continuing childbearing for a longer period and having their last birth at or above the average age. Those who were fortunate to reach the average number of surviving children early did not stop but continued to bear children and surviving sons, adding to their prior success. The 28.5% of fertile Taiwanese women having four or more surviving sons (table 9) and the 27.8% of fertile Dutch women having eight or more births and more than six surviving children (tables 7 and 11), had significantly longer childbearing periods and later ages at last birth, and apparently saw no benefit in stopping earlier.

Family Composition and Parity Progression

Figure 2 has shown that, overall, parity progression ratios in Taiwan were higher than in the pretransitional Netherlands. A much lower age at marriage can probably acount for this. However, it has often been asserted that the duration of marriage, with its inverse relation to coital frequency, is an autonomous factor in itself and should be taken into account when marital fertility is analysed.[24] To some extent, these factors balanced one another. Thus, notwithstanding their later age at marriage, Dutch women might have been quite fertile because their marriages were “fresher” than those of their Taiwanese counterparts of the same age. Controlling for age at marriage and marriage duration simultaneously will allow us to look from yet another angle at the motivation to stop or to continue child bearing.

We can surmise that, at least before the fertility transition, couples were more “satisfied” when they had at least two sons and at least one daughter.[25] One son was needed to inherit headship status and to take care of the rites connected with the ancestral cult. At least one other son was needed as a reserve and to provide additional labour. At least one daughter was needed to assist with household chores. Also, she could bring in a bride price. Thus, couples who had not achieved this minimum “target” would be more likely to continue with child bearing than couples otherwise similarly situated (especially with regard to age at marriage and marriage duration). At each parity, we ask what the probability is that another child will come. For instance, in Taiwan at parity eight this probability is .695 and thus the probability of “stopping” is .305 (see Figure 2). In a logistic regression model, the probability (p) of the dependent variable stopping is calculated in terms of *odds*, that is the probability of a “yes” divided by the probability of a “no” (p/(1-p)).[26] In our example the odds are .305/.695. The regression coefficients of the independent variables are the natural logarithms of the odds. By exponentiating them, we obtain *odds ratios*. These indicate the increase in the odds of the dependent variable being a yes resulting from an increase of one unit in the independent variable (Menard 1995). Again, we work with completed marriages only. In the model we include variables for the age of the mother at the time the present child was born and the duration of her marriage. We also include the length of the previous birth interval. By doing this we control for subfecundity, either caused by unfavourable health conditions of the couple or by prolonged breastfeeding. We assume that the longer the previous interval, the higher the chance that stopping will occur. To measure the effect of the family composition at the time the present child was born, we have created four dummy variables: 1) less than two sons survive (including the one just born) and no daughter; 2) less than two sons survive (including the one just born) but at least one daughter; 3) at least two sons survive (including the one just born) but no daughter and 4) at least two sons survive (including the one just born) and at least one daughter. By taking the last variable as the reference, we assume that the non-ideal family compositions (1-3) will result in lower odds of stopping. Finally, when couples had some kind of target, we expect that their odds of stopping decreased when the present child died quickly. Obviously, in populations that did not restrain their fertility in any parity-specific way, this kind of replacement behaviour is not to be expected.

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[24] Van Bavel, “Does an effect of marriage duration”.
[25] See also Skinner, “Family Systems and Demographic Processes“
[26] Menard, *Applied logistic regression analysis*.

In Tables 12 and 13 we present the outcomes of our calculations. Since we look at the effect of children present on the odds of stopping, we have substracted daughters who had been adopted out in calculating the family composition at each parity in the Taiwan case. Both tables show the paramount importance of both age and marriage duration in predicting the odds of stopping. Also, their impact increases with parity. For instance, at parity eight in Taiwan, the effect of an additional year of the mother's age at marriage is to shift the odds by 41% in favour of stopping. At the same parity, each additional month that the couple had been married, increases the odds of stopping by 4%. Interestingly, the Dutch model (Table 13) is quite significant already at low parities, whereas the Taiwanese model gains significance per parity. Clearly, in The Netherlands age at marriage is already relevant to explaining the end of childbearing when only a few children have been born. As we expected, there is a direct relation between the length of the previous birth interval and the odds of stopping. However, this is only significant in a limited number of the models.

The influence of the actual family composition is very limited. Interestingly, we find slightly more evidence of "targeting" in the Netherlands than we do in Taiwan. For instance, having less than two surviving sons (but at least one daughter) lowered the chance of stopping in the Netherlands both at parity five and eight. Similarly, there is no systematic evidence that deceased children were replaced. The death of a child within one year was only significant at parity four in The Netherlands and parity nine in Taiwan. Overall, our results confirm that the experience of infant and child mortality/survival had at best a very weak effect on the fertility decision-making of couples. Instead the models confirm that stopping was mainly determined by age at marriage and marriage duration.

[Table 12 about here]

[Table 13 about here]

Does Success at an early age Lead to Limitation?

Did married women, as they neared the end of their childbearing years, cut short their fertility based on their previous success in producing surviving sons? Zhao Zhongwei has argued on the basis of his analysis of China's 1982 one-per-thousand population fertility survey that "Women who had their first surviving son at younger ages ceased childbearing earlier, while those who had their first surviving son at older ages stopped later".[27] Zhao interpreted a few months difference in mean age at last birth between groups of women having five year differences in age at birth of first surviving son as evidence of deliberate stopping behavior.

In his own test of the hypothesis relating age at birth of first surviving son and age at last birth, Zhao limited his sample to those bearing a first child at ages 15-19.[28] He reasoned that women who "started childbearing at roughly the same age" could be expected to have very similar ages at last birth except for differences in sex composition and survivorship of offspring that led some women to stop childbearing earlier than

[27] Zhao, "Deliberate birth control",747.
[28] Zhao, "Deliberate birth control",747, table 5.

others.[29] As age at first birth appears positively related both to age at birth of first surviving son and age at last birth, age at first birth may well be confounding the relationship between age at birth of first surviving son and age at last birth. We can control for age at first birth by dividing our sample into two subsamples, women having their first birth at ages 15-19 and ages 20-24, both of which will include a sizeable number of women, with the latter group having their first birth close to the average age at first birth of 21. Zhao imposed additional controls on his large sample by requiring that the women in the sample have a birth at age 28 or 29 and have both surviving sons and daughters before age 30. We will control for outlying ages at last birth by requiring that the age at last birth be greater than 30, and limit the sample to those having a first surviving son before age 30, but will not take into account the presence of surviving daughters before age 30.

Table 14 below presents the characteristics for the subsamples of women having their first birth at ages 15-19 and ages 20-24, their first surviving son by age 30, and their last birth above age 30, according to age at birth of first surviving son. The average ages at birth of the first surviving son are 21.3 and 23.67 for the women having their first birth at ages 15-19 and ages 20-24, respectively (the average age is 24.3 for the whole sample of 576 women having a surviving son). For women having their first birth at ages 15-19 the table shows age at last birth is unaffected by the age at which these women bore their first surviving son. For women having their first birth at ages 20-24 the table shows age at last birth is actually later by half a year for women who bore their first surviving son earlier. When we compare the overall averages for the women having their first births at ages 15-19 and ages 20-24, we find women having their first births at ages 15-19 stopping only two tenths of a year earlier than women having their first births at ages 20-24, despite bearing a first child on average three and a half years earlier, and a first surviving son on average two and a third years earlier.

[Table 14 about here]

In sum table 14 shows that there is no relationship between age at last birth and age at birth of first surviving son when we control for age at first birth and require last birth be above 30. As in the case of our larger sample, in each of our subsamples the women who had their first surviving son at the earliest ages also had some of the longest childbearing periods, and often had larger than average numbers of births and total surviving sons.

Thus the women who had the advantage of producing a first surviving son at an earlier age, appear not to have used that advantage to stop childbearing at lower levels or earlier ages than less fortunate women. Instead they appear to have built on their success to have more children and more surviving sons than average. These women may have shortened their childbearing period by stopping early by a few months as Zhao discovered in his sample, but we would be misled if we thought the women who did so had reduced either their overall childbearing period or their number of total births.

Conclusions

[29] Zhao, “Deliberate birth control”,745-746.

To interpret as deliberate fertility limitation the "early stopping" by a few months of high parity women who had lower levels of infant loss or earlier ages at birth of first surviving son and at first birth (table 14) requires us to ignore that these same women have already exceeded the average number of births and surviving sons and the average childbearing span. To see women having the earliest ages at last birth when viewing the entire parity distribution as practicing deliberate fertility limitation ("early stopping") (tables 4 through 8) requires us to ignore the lower-than-average number of births and surviving sons of women whose childbearing period has been cut off.

When we look at the full range of women by parity distribution, number of surviving sons, and ages at last birth, and at a broad array of their experiences, including infant loss, age at first birth, and number of adoptions, we see women in a context that single indicators strip away. This broader context suggests both that many women failed to achieve a desired number of surviving sons, and that another sizeable group met and surpassed the average. Overall we find a broad continuum of women less and more successful in producing surviving sons, but rarely any hint that women limit their fertility once they have achieved the average or family ideal of two sons and a daughter.

Our overview of women's fertility, based on our examination of a number of characteristics of women according to their age at last birth, parity, and number of surviving sons has produced no convincing evidence of replacement and fertility limitation. Instead we have found that women who met early success in producing surviving sons were more likely, not less, to have higher fertility than women who were less fortunate. The characteristics of early stoppers, who had fewer surviving sons, fewer births overall, more adoptions, and fewer childbearing years, controvert the notion that they were practicing fertility limitation, and suggest that they likely suffered impaired couple fertility (secondary sterility, spousal infertility, morbidity, etc.), or troubled marital relationships.

The fertility pattern of married women overall is better characterized by the natural fertility hypothesis that women continued childbearing to the end of their reproductive period regardless of their previous loss of children or success in producing surviving sons.

This paper has reported information on fertility in tables showing the full range of women's completed fertility. Parity distributions are unique in reporting the experience of the many women at the extremes of low and high fertility (the low extremes would be even more heavily populated if we had not restricted the sample to women continuously married). One looks in vain in the many works of modern historical demography and family reconstitution for reports of actual parity distribution. There are thousands of pages on fertility in the works of Knodel, Wrigley, Leridon, Bongaarts and Potter, and Wood but not one (?!) parity distribution that reports the actual distribution of women by completed fertility.[30] Lutz and Pullum et. al. are the exceptions.[31] Instead there is an overreliance on measures of central tendency and on statistical fictions such as the total fertility rate based on averaged age-specific fertility rates for a synthetic cohort. Averages

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[30] Knodel, *Demographic behavior*; Wrigley, Davies, Oeppen and Schofield, *English population history*; Leridon, *Human Fertility*; Bongaarts and Potter, *Fertility, Biology and Behavior* ; Wood, *Dynamics of Human Reproduction.*

[31] Lutz, *Distributional Aspects of Human Fertility*; Pullum, Tedrow and Herting, "Measuring Change and Continuity".

that recklessly strip away the full context of women's experience can be highly misleading. As summary measures average rates may be indispensable, but they should not be allowed to erase the experience of the many women outside the average. The 'average" experience acquires meaning only when contrasted to the experience of women at the extremes who failed to meet or who surpassed the average. The experience of women whose fertility diverges from the average sheds invaluable light on the experience of all women. The full range of experience, not its central points, should be the starting point for studies of fertility.

[Table 15about here]

Lee and Wang support their claim that early stopping is a general feature of Chinese "marital restraint" in contrast to pretransition European populations with three items of data: earlier mean age at last birth, short reproductive span, and high proportions subsequently infertile.[32] They first cite evidence from their case studies of Daoyi and the imperial lineage of a mean age at last birth of married wives of 33 to 34 that is much earlier than that of the Europeans (circa age 40). Our finding of a mean age at last birth of 37.4 for the Taiwanese and 39.5 for the Dutch agrees with the general proposition that mean age at last birth is earlier for Chinese than Europeans, though the gap is nowhere so extreme as Lee and Wang claim on the basis of their evidence, and even rather small considering the much earlier mean ages at marriage (19.2 vs. 26) and first birth (21.2 vs. 28.5) of the Taiwanese compared to the Europeans.

A more fundamental question arises regarding Lee, Wang and Campbell's assumption that differences in average age at last birth between European and Chinese populations reflect differences in stopping behavior.[33] As noted above (pages 4-5) historical demographers commonly consider differences in average age at last birth as indicators of fertility control but only when age at marriage is controlled. A very large gap existed between the Taiwanese average age at marriage of 19.2 and the Dutch average of 26, and it is the early age at last birth of low parity women (parities 1-6) that is chiefly responsible for lowering the overall average age at last birth of the early marrying Taiwanese when compared to the late marrying Dutch (table 1). Indeed Table 15 shows that having a lower average age at last birth does not prevent the early marrying Taiwanese from having a longer reproductive span and despite longer birth intervals, a higher mean parity, which is hardly suggestive of fertility limitation. It is the early age at marriage that lowers the Taiwanese average age at last birth in the Taiwan-Dutch comparison, not intentional early stopping. Lee, Wang and Campbell fail to control for the much earlier age at marriage of the Chinese population when they claim that a lower age at last birth demonstrates Chinese marital fertility restraint compared to the Europeans. Instead it simply reflects the earlier Chinese age at marriage.

Lee and Wang go on to argue from their data that "Whereas on average a European mother had a reproductive span between first and last birth of 14 years, the average Chinese mother had a reproductive span of only 11 years." We find just the opposite: Taiwanese women's mean reproductive span (childbearing years) of 16.2 years was much longer than Dutch women's 11.0 years. Thus our findings contradict Lee and

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[32] Lee and Wang, *One Quarter of Humanity*, 88-90.

[33] Lee and Campbell, *Fate and fortune* , 92; Lee and Wang, *One Quarter of Humanity*, 89.

Wang's claim that "Despite their late starting, Chinese couples also stopped childbearing far earlier than pretransition couples in the West".[34]

The third item of evidence cited by Lee, Wang and Campbell in support of their claim that early stopping is a general feature of Chinese fertility is the age pattern of stopping as represented by the proportions subsequently infertile by age.[35] The proportions of married women not fertile after a stated age for the Taiwanese, European and Liaoning (Daoyi) populations are presented in table 16 and figure 4 below. The Taiwanese age pattern of stopping agrees closely with that of the Europeans[36] (Leridon 1977: 101-2), while that for Liaoning diverges significantly. Thus we must disagree with Lee and Wang's larger claim that "The Chinese and European age patterns of stopping are thus fundamentally different. European populations contain few early stoppers and follow an exponential pattern of increase, with a rapidly rising rate after age 35; Chinese populations contain many early stoppers and follow a logistic pattern of increase with a slowly tapering rise. The two curves clearly reflect two distinctive fertility patterns and cannot be transformed simply by shifting or compressing." Instead, we find on the basis of the sample of Taiwanese completed marriages that the proportion of early stoppers remains low and increases rapidly only after age 35.

In sum, our findings contradict on every score Lee and Wang's claims that the pretransition Chinese population in comparison to those of pretransition Europe is characterized by a much earlier mean age at last birth, a shorter reproductive span, and much higher proportions subsequently infertile with age. Claims by Lee, Wang and Campbell and Zhao that the historical Chinese population is one characterized by deliberate early stopping are, in light of the Taiwanese evidence, untenable.

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[34] Lee and Wang, *One Quarter of Humanity*, 88.

[35] Lee and Wang, *One Quarter of Humanity*, 89-90, Lee and Campbell, *Fate and Fortune*, 89, 92; Wang, Lee and Campbell, "Marital fertility control", 390-91.

[36] Leridon, *Human Fertility* ,101-102.

Figures to **Fertility and Infant and Early Childhood Mortality: Some Lessons on Stopping Behavior from Taiwanese and Dutch Cases**.

JOHN R. SHEPHERD, JAN KOK, YING-HUI HSIEH

Figure 1. Hypotheses relating age at last birth and experience of child survival:

	Experience of Child Survival:	
Age at Last Birth	Few children survive	Many children survive
Later	Replacement Strategy	
"Natural"	"Natural" Fertility (lactation interruption effect)	
Earlier	Involuntary Stopping	Early Stopping

Figure 2

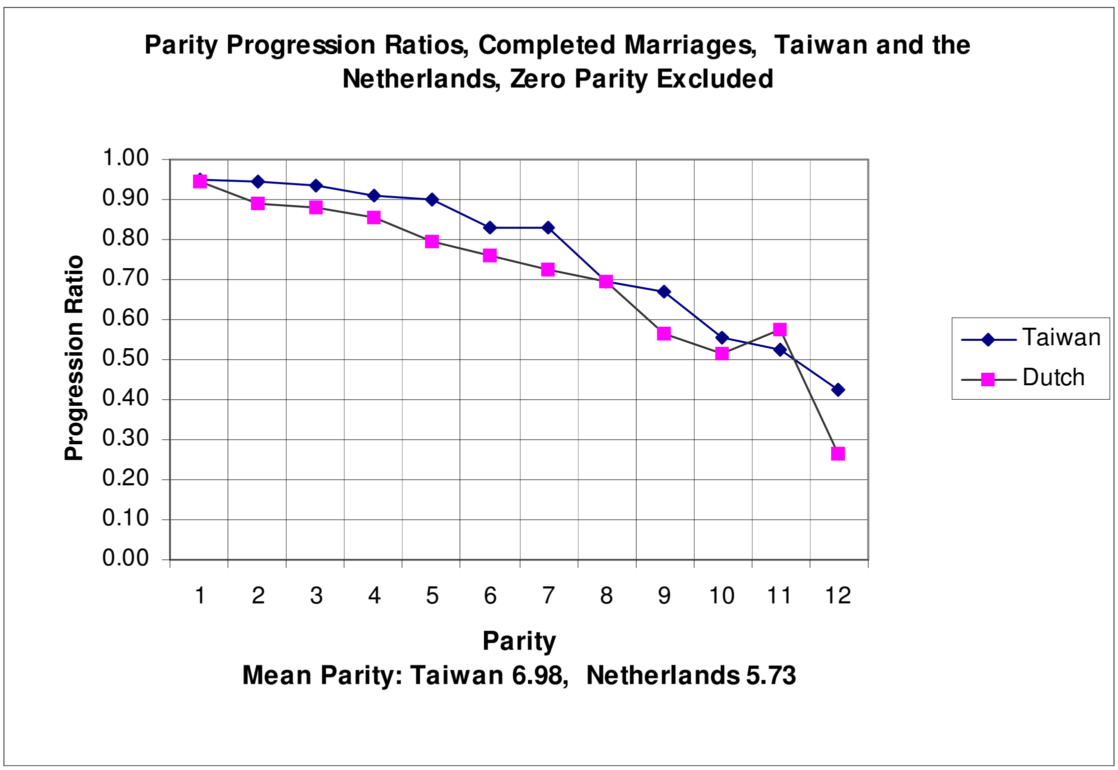


Figure 3

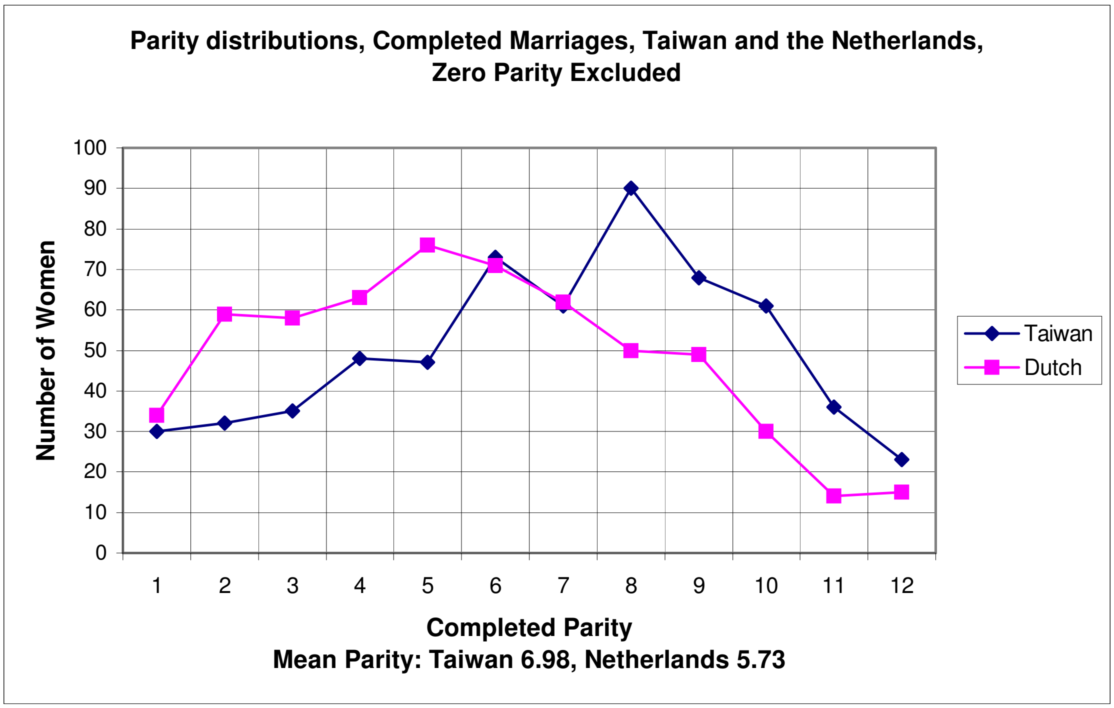
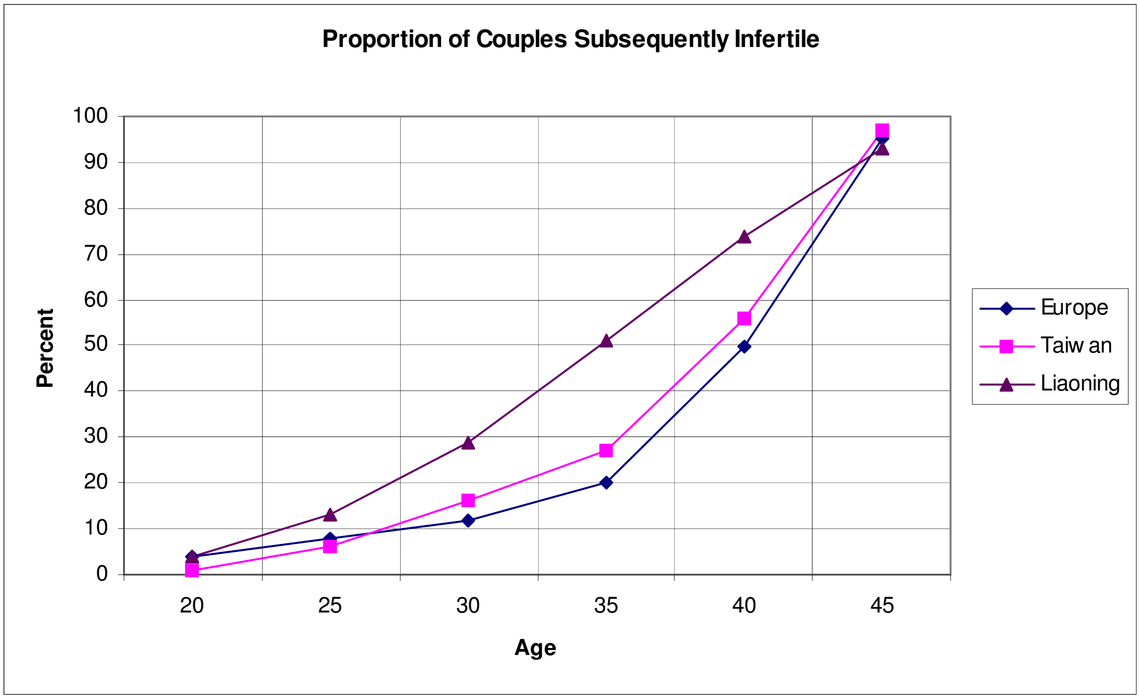


Figure 4.


Proportion of Couples Subsequently Infertile
Percent
100
90
80
70
60
50
40
30
20
10
0
20
25
30
35
40
45
Age
Europe
Taiw an
Liaoning

Tables to **Fertility and Infant and Early Childhood Mortality:**
Some Lessons on Stopping Behavior from Taiwanese and Dutch Cases.

JOHN R. SHEPHERD, JAN KOK, YING-HUI HSIEH

Table 1.Mean age at last birth by final parity.

	Taiwanese	N	Dutch	N
All parities	37.4	621	39.5	603
Parities 1-6	32.6	265	38.1	366
Parities 7 +	41.0	356	41.6	237

Table 2. Final parity and infant losses of Taiwanese women remaining in first marriages and continuously under observation from age at marriage (by age 30) to age 46 by births, surviving sons, infant deaths, etc., 1906-1946.

# Births	Number of Women	Total Births	Infant Deaths	Infant Deaths per woman	Infant deaths per 100 births:	Avg. Closed Birth Interval
0	30	0	0	0	--	--
1	30	30	6	0.20	20.0	--
2	32	64	13	0.41	20.3	5.4
3	35	105	23	0.66	21.9	3.65
4	48	192	33	0.69	17.2	3.57
5	47	235	24	0.51	10.2	3.5
6	73	438	59	0.81	13.5	3.04
7	61	427	56	0.92	13.1	2.93
8	90	720	117	1.30	16.3	2.74
9	68	612	75	1.10	12.3	2.56
10	61	610	85	1.39	13.9	2.53
11	36	396	79	2.19	19.9	2.33
12	23	276	59	2.57	21.4	2.13
13	10	130	33	3.30	25.4	1.93
14	5	70	18	3.60	25.7	1.97
15	1	15	2	2.00	13.3	1.86
16	1	16	1	1.00	6.3	1.49
Total	651	4336	683	1.10*	15.8	2.71

*Average excludes zero parity women.

Table 3. Final parity and infant losses of Dutch Women born before 1860 remaining in first marriages and continuously under observation from age at marriage to age 46.

# Births	Number of Women	Total Births	Infant Deaths	Infant Deaths per woman	Infant deaths per 100 births:	Avg. Closed Birth Interval
0	118	0	0	0	--	--
1	34	34	5	0.15	14.7	--
2	59	118	13	0.22	11.0	3
3	58	174	21	0.36	12.1	3.2
4	63	252	35	0.56	13.9	2.8
5	76	380	60	0.79	15.8	2.78
6	71	426	66	0.93	15.5	2.44
7	62	434	81	1.31	18.7	2.23
8	50	400	49	0.98	12.3	2.34
9	49	441	79	1.61	17.9	2.1
10	30	300	64	2.13	21.3	1.8
11	14	154	31	2.21	20.1	1.87
12	15	180	40	2.67	22.2	1.76
13	5	65	18	3.60	27.7	1.82
Total	704	3358	562	0.96*	16.7	2.33

* Average excludes zero parity women.

Table 4. Age at Last Birth of Taiwanese Women remaining in first marriages and continuously under observation from age at marriage (by age 30) to age 46 by births, surviving sons, infant deaths, etc., 1906-1946.

Age at Last Birth	# Women	Total Births	Births/ Woman	Surviving Children/ Woman	Surviving Sons/ Woman	Surviving Children/ 100 Births	Surviving Sons/ 100 Births	Infant Deaths/ Woman	Infant Deaths/ 100 Births
15-17	2	2	1.00	0.50	0.50	50.0	50.0	0.50	50.0
18-20	11	15	1.36	0.73	0.45	53.3	33.3	0.45	33.3
21-23	17	33	1.94	1.47	0.76	75.8	39.4	0.29	15.2
24-26	33	99	3.00	1.94	0.97	64.6	32.3	0.70	23.2
27-29	38	124	3.26	2.37	1.00	72.6	30.6	0.68	21.0
30-32	30	134	4.47	3.40	1.90	76.1	42.5	0.57	12.7
33-35	56	310	5.54	4.20	2.02	75.8	36.5	0.88	15.8
36-38	98	659	6.72	4.94	2.67	73.4	39.8	1.03	15.3
39-41	178	1477	8.30	6.10	3.11	73.5	37.4	1.35	16.2
42-44	138	1282	9.29	6.99	3.62	75.3	39.0	1.34	14.4
45-47	19	193	10.16	7.89	3.89	77.7	38.3	1.58	15.5
48-	1	8	8.00	7.00	4.00	87.5	50.0	1.00	12.5

50									
Total	621*	4336	6.98	5.18	2.66	74.2	38.1	1.10	15.8

*excludes 30 zero parity women.

Table 5. Surviving Sons of Taiwanese Women remaining in first marriages and continuously under observation from age at marriage (by age 30) to age 46 by number of surviving sons, births, age at last birth, infant loss, etc., 1906-1946.

# Surviving Sons	# Women	Total Births	Age at Last Birth	Births/ Woman	Surviving Children/ Woman	Surviving Children/ 100 Births	Surviving Sons/ 100 Births	Infant Deaths/ Woman	Infant Deaths/ 100 Births
0	51*	147	28.18	2.88	1.29	44.9	0.0	1.08	37.4
1	116	549	33.10	4.73	2.98	63.0	21.1	1.13	23.9
2	150	997	37.59	6.65	4.80	72.2	30.1	1.14	17.2
3	127	1015	39.73	7.99	5.98	74.8	37.5	1.25	15.7
4	92	795	40.71	8.64	6.85	79.2	46.3	0.93	10.8
5	44	415	41.62	9.43	7.77	82.4	53.0	1.09	11.6
6	25	245	41.22	9.80	8.00	81.6	61.2	1.04	10.6
7	13	135	43.17	10.38	9.23	88.9	67.4	0.38	3.7
8	2	22	41.59	11.00	9.00	81.8	72.7	0.50	4.5
9	--	--	--	--	--	--	--		--
10	1	16	42.09	16.00	15.00	93.8	62.5	1.00	6.3
Total	621*	4336	37.45	6.97	5.18	74.2	38.1	1.10	15.8

*excludes 30 zero parity women.

Table 6. Parity distribution of Taiwanese Women remaining in first marriages and continuously under observation from age at marriage (by age 30) to age 46 and age at last birth etc., 1906-1946.

# Births	# Women	Total Births	Age at Last Birth	Surviving Children/ Woman	Surviving Sons/ Woman	Surviving Children/ 100 Births	Surviving Sons/ 100 Births	Infant Deaths/ Woman	Infant Deaths/ 100 Births
0	30	0	--	0	0	--	--	0	--
1	30	30	24.07	0.73	0.40	73.3	40.0	0.20	20.0
2	32	64	28.34	1.53	0.84	76.6	42.2	0.41	20.3
3	35	105	28.97	2.06	1.14	68.6	38.1	0.66	21.9
4	48	192	33.09	2.79	1.31	69.8	32.8	0.69	17.2
5	47	235	35.92	4.06	2.02	81.3	40.4	0.51	10.2
6	73	438	37.32	4.71	2.47	78.5	41.1	0.81	13.5
7	61	427	39.23	5.52	2.89	78.9	41.2	0.92	13.1
8	90	720	40.28	5.83	3.14	72.9	39.3	1.30	16.3
9	68	612	41.16	6.90	3.54	76.6	39.4	1.10	12.3
10	61	610	42.11	7.56	3.89	75.6	38.9	1.39	13.9
11	36	396	42.20	7.61	3.72	69.2	33.8	2.19	19.9
12	23	276	42.36	8.04	4.09	67.0	34.1	2.57	21.4
13	10	130	42.14	7.80	3.90	60.0	30.0	3.30	25.4
14	5	70	44.40	9.60	3.60	68.6	25.7	3.60	25.7

15	1	15	44.55	12.00	3.00	80.0	20.0	2.00	13.3
16	1	16	42.09	15.00	10.00	93.8	62.5	1.00	6.3
Total	651	4336	37.45*	5.18*	2.66*	74.2	38.1	1.10*	15.8

*average excludes zero parity women.

Table 7. Parity distribution of Dutch Women born before 1860 remaining in first marriages and continuously under observation from age at marriage to age 46 and age at last birth etc.

# Births	# Women	Total Births	Age at Last Birth	Surviving Children/ Woman	Surviving Sons/ Woman	Surviving Children/ 100 Births	Surviving Sons/ 100 Births	Infant Deaths/ Woman	Infant Deaths/ 100 Births
0	118	0	--	0	0	--	--	--	--
1	34	34	34.9	0.85	0.53	85.3	52.9	0.15	14.7
2	59	118	35.1	1.66	0.86	83.1	43.2	0.22	11.0
3	58	174	37.6	2.33	1.29	77.6	43.1	0.36	12.1
4	63	252	38.8	3.11	1.76	77.8	44.0	0.56	13.9
5	76	380	39.8	3.83	2.07	76.6	41.3	0.79	15.8
6	71	426	40.1	4.52	1.90	75.4	31.7	0.93	15.5
7	62	434	40.3	5.16	2.52	73.7	35.9	1.31	18.7
8	50	400	41.8	6.32	3.98	79.0	49.8	0.98	12.3
9	49	441	42.3	6.67	3.10	74.1	34.5	1.61	17.9
10	30	300	41.3	6.93	4.07	69.3	40.7	2.13	21.3
11	14	154	42.5	7.71	4.50	70.1	40.9	2.21	20.1
12	15	180	43.3	7.87	3.87	65.6	32.2	2.67	22.2
13	5	65	44.2	8.00	3.00	61.5	23.1	3.60	27.7
Total	704	3358	39.5*	4.28*	2.24*	74.7	39.1	0.96*	16.7

*average excludes zero parity women.

Table 8. Age at Last Birth of Taiwanese Women remaining in first marriages and continuously under observation from age at marriage (by age 30) to age 46 by births, surviving sons, infant deaths, etc., 1906-1946.

Age at Last Birth	# Women	Age at First Birth	Avg. Child-bearing Years (1)	# of Women Adopting after last birth	% Adopting after last birth	# Adopted Children	Adopted Children/ Woman	%Male of Last Births
15-17	2	17.6	0.0	2	100.0	3	1.50	50.0
18-20	11	19.2	0.6	9	81.8	18	1.64	63.6
21-23	17	20.2	2.2	10	58.8	19	1.12	52.9
24-26	33	20.2	5.5	12	36.4	28	0.85	60.6
27-29	38	22.3	6.3	15	39.5	33	0.87	60.5
30-32	30	21.3	10.5	9	30.0	31	1.03	50.0
33-35	56	21.2	13.3	10	17.9	44	0.79	44.6
36-38	98	21.5	16.2	10	10.2	59	0.60	64.3
39-41	178	21.1	19.4	13	7.3	137	0.77	52.8
42-44	138	21.3	22.0	5	3.6	108	0.78	62.3

45-47	19	21.7	24.3	0	0.0	19	1.00	57.9
48-50	1	25.3	23.3	0	0.0	3	3.00	0.0
Total*	621*	21.2	16.2	95	15.3	502**	0.81*	57.0

*excludes zero parity women **excludes 62 children adopted by zero parity women.
1. "Childbearing years" are the years from the first to the last birth.

Table 9. Surviving Sons of Taiwanese Women remaining in first marriages and continuously under observation from age at marriage (by age 30) to age 46 by number of surviving sons, births, age at last birth, infant loss, etc., 1906-1946.

# Surviving Sons	# Women	Age at First Birth	Age at Last Birth	Avg. Child-bearing Years (1)	# of Women Adopting after last birth	% Adopting after last birth	# Adopted Children	Adopted Children/ Woman	%Male of Last Births
0	51*	22.6	28.2	5.6	26	51.0	63	1.24	29.4
1	116	22.0	33.1	11.1	29	25.0	102	0.88	61.2
2	150	21.3	37.6	16.3	17	11.3	111	0.74	53.3
3	127	21.2	39.7	18.6	14	11.0	102	0.80	54.3
4	92	20.5	40.7	20.2	8	8.7	67	0.73	60.9
5	44	20.2	41.6	21.4	0	0.0	32	0.73	70.5
6	25	19.3	41.2	21.9	0	0.0	17	0.68	80.0
7	13	20.8	43.2	22.3	1	7.7	7	0.54	69.2
8	2	18.5	41.6	23.1	0	0.0	1	0.50	100.0
9	--	--	--	--	--	--	--	--	--
10	1	19.6	42.1	22.4	0	0.0	0	0.00	100.0
Total	621*	21.2	37.4	16.2	95	15.3	502**	0.81	57.0

*excludes 30 zero parity women. **excludes 62 children adopted by zero parity women.
1. "Childbearing years" are the years from the first to the last birth.

Table 10. Parity distribution of Taiwanese Women remaining in first marriages and continuously under observation from age at marriage (by age 30) to age 46 and age at last birth etc., 1906-1946.

# Births	# Women	Age at First Birth	Age at Last Birth	Avg. Child-bearing Years (1)	Avg. Closed Birth Interval	# of Women Adopting after last birth	% Adopting after last birth	# Adopted Child-ren	Adopted Children per Woman	%Male of Last Births
0	30	--	--	0	--	--	--	62	2.07	0.0
1	30	24.1	24.1	0.0	--	19	63.3	35	1.17	56.7
2	32	23.0	28.3	5.4	5.4	12	37.5	33	1.03	62.5
3	35	21.6	29.0	7.3	3.65	13	37.1	38	1.09	51.4
4	48	22.4	33.1	10.7	3.57	14	29.2	47	0.98	66.7
5	47	21.9	35.9	14.0	3.5	8	17.0	35	0.74	48.9
6	73	22.1	37.3	15.2	3.04	10	13.7	51	0.70	52.1
7	61	21.6	39.2	17.6	2.93	4	6.6	32	0.52	50.8
8	90	21.1	40.3	19.2	2.74	5	5.6	70	0.78	65.6
9	68	20.7	41.2	20.5	2.56	7	10.3	40	0.59	64.7
10	61	19.3	42.1	22.8	2.53	1	1.6	47	0.77	42.6
11	36	18.9	42.2	23.3	2.33	0	0.0	36	1.00	72.2
12	23	18.9	42.4	23.4	2.13	1	4.3	19	0.83	47.8
13	10	18.9	42.1	23.2	1.93	0	0.0	8	0.80	50.0
14	5	18.8	44.4	25.6	1.97	1	20.0	11	2.20	60.0
15	1	18.4	44.5	26.1	1.86	0	0.0	0	0.00	0.0
16	1	19.6	42.1	22.4	1.49	0	0.0	0	0.00	100.0
Total*	651	21.2*	37.4*	16.2*	2.71	95	15.3*	564	0.87**	57.0

*average excluding zero parity women. ** average includes zero parity women

1. "Childbearing years" are the years from the first to the last birth.

Table 11. Parity distribution of Dutch Women born before1860 remaining in first marriages and continuously under observation from age at marriage to age 46 and age at last birth etc.

# Births	# Women	Age at First Birth	Age at Last Birth	Avg. Child-bearing Years (1)	Avg. Closed Birth Interval
0	118		--		--
1	34	34.9	34.9	--	--
2	59	32.1	35.1	3	3
3	58	31.2	37.6	6.4	3.2
4	63	30.4	38.8	8.4	2.8
5	76	28.7	39.8	11.1	2.78
6	71	27.9	40.1	12.2	2.44
7	62	26.9	40.3	13.4	2.23
8	50	25.4	41.8	16.4	2.34
9	49	25.5	42.3	16.8	2.1
10	30	25.1	41.3	16.2	1.8
11	14	23.8	42.5	18.7	1.87
12	15	23.9	43.3	19.4	1.76
13	5	22.4	44.2	21.8	1.82
Total*	704	28.5*	39.5*	11.0*	2.33

*average excluding zero parity women. ** average includes zero parity women

1. "Childbearing years" are the years from the first to the last birth.

Table 12. Odds ratios of stopping per parity, completed marriages Taiwan (models per parity).

Birth order	Age at marriage	Duration of marriage	Interval with previous child	Less than 2 sons surviving and no daughters	Less than 2 sons surviving, At least 1 daughter	Ar least 2 sons surviving but no daughters	Ar least 2 sons surviving and at least 1 daughter	Child dies within a year	Model chi-square	R^2	N
3	0.99	1.02***	1.02	1.70	0.87	0.76	1.00	1.15	28.66	0.17	428
4	1.22****	1.02****	1.02	3.71	1.26	1.87	1.00	1.25	43.45	0.24	400
5	1.26****	1.03****	1.02**	-	1.24	0.27	1.00	0.71	64.49	0.32	367
6	1.20***	1.03****	1.03*	-	0.29	0.64**	1.00	0.78	73.12	0.35	326
7	1.31****	1.03****	1.06***	-	0.76	1.43	1.00	1.03	77.08	0.41	276
8	1.41****	1.04****	1.03*	-	0.47	1.02	1.00	0.59	84.81	0.44	231
9	1.79****	1.04****	1.02	-	1.61	1.45	1.00	0.25**	75.51	0.50	166
10	1.70****	1.06***	1.01	-	1.10	-	1.00	1.04	65.46	0.61	107

R^2 is Nagelkerke's R Square. * significance level p<.10; ** significance level p<.05; *** significance level p<.01; **** significance level p<.001

Table 13. Odds ratios of stopping per parity, completed marriages The Netherlands, women born before 1860 (models per parity)

Birth order	Age at marriage	Duration of marriage	Interval with previous child	Less than 2 sons surviving and no daughters	Less than 2 sons surviving, At least 1 daughter	At least 2 sons surviving but no daughters	Ar least 2 sons surviving and at least 1 daughter	Child dies within a year	Model chi-square	R^2	N
3	1.36****	1.05****	1.00	0.21	0.58	0.45	1.00	0.47	120.03	0.41	508
4	1.40****	1.04****	1.01	1,34	0.72	1.24	1.00	0.32**	121.44	0.43	448
5	1.46****	1.05****	1.02*	-	0.50*	0.95	1.00	0.62	155.91	0.53	385
6	1.52****	1.04****	1.03**	-	1.03	0.23**	1.00	1.23	121.58	0.49	309
7	1.47****	1.03****	1.01	-	1.21	0.72	1.00	1.43	63.42	0.34	237
8	1.68****	1.08****	1.01	-	0.16**	2.45	1.00	1.86	95.07	0.60	174
9	1.73****	1.05****	1.02	-	1.20	0.86	1.00	2.00	65.23	0.55	124
10	1.57****	1.03***	1.02	-	2.59	1.7	1.00	1.04	22.92	0.36	75

R^2 is Nagelkerke's R Square. * significance level p<.10; ** significance level p<.05; *** significance level p<.01; **** significance level p<.001

Table 14. Age at Last Birth by Age at Birth of First Surviving Son and Age at First Birth: Taiwanese Women remaining in first marriages and continuously under observation from age at marriage to age 46 by Age at First Birth, Who had their First Surviving Son before age 30 and their Last Birth after age 30, 1906-1946.

Age at Birth of First Surviving Son	# Women	Age at Marriage	Age at First Birth	Age at Last Birth	Avg. Child-bearing Years	Births/ Woman	Surviving Sons/ Woman
First Birth 15-19							
15-19	87	16.78	18.27	39.70	21.43	8.82	3.71
20-24	72	16.91	18.46	39.66	21.21	9.21	3.44
25-29	33	17.06	18.41	39.63	21.22	9.45	2.91
Total	192	16.88	18.36	39.67	21.31	9.07	3.47
First Birth 20-24							
20-24	142	19.62	21.65	40.03	18.38	7.75	3.43
25-29	56	20.11	22.19	39.51	17.31	7.11	2.79
Total	198	19.76	21.80	39.88	18.08	7.57	3.25

Table 15 Summary measures of Taiwanese and Dutch Fertility

	Taiwanese	Dutch
Age at Marriage	19.2	26
Age at First Birth	21.2	28.5
Reproductive Span (years)	16.2	11.0
Age at Last Birth	37.4	39.5
Avg. Closed Birth Interval (years)	2.71	2.33
Mean Completed Parity	6.98	5.73

Table 16. Proportions of married women not fertile after stated age.

Age	Taiwan	Europe (1)	Liaoning (2)
20	4	1	4
25	8	6	13
30	12	16	29
35	20	27	51
40	50	56	74
45	95	97	93

Europe: based on Leridon, *Human Fertility*, 101-102.
Liaoning: calculated from Table 5.5 of Lee and Campbell, *Fate and Fortune*, 93.