# Fertility Control with Imperfect Methods: Strategies of Family Building and the Choice of Technique during the German Fertility Transition, 1885-1915


## Abstract

An extensive body of literature, mostly drawn from the Princeton project on the European fertility transition, is based on the critical assertion that fertility control during the transition was parity-dependent. The indirect evidence for this proposition is flawed. Following up on an argument formulated by Santow (1995) and David and Sanderson (1986), this paper revisits the question of control during the transition by placing it within the framework of dynamic models of fertility under uncertainty. It examines the choice of technique and the strategy for family building during the period of the transition in Germany during the period 1885 to 1915. Available technologies varied in efficiency, cost and disutility, which posed significant tradeoffs for couples. After establishing the relative efficiency of most of the technologies available to couples, the paper examines the decision to use birth control and the choice of birth control strategy. The econometric analysis uses a detailed survey of fertility outcomes, birth control practices and social and economic information that includes much of the period of the transition. The results suggest that the logic of birth control technologies and desired family size created a bifurcated distribution of strategy choices.


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## Introduction

Since the publication of the summary results of the Princeton project in the mid-1980s, most accounts of the fertility transition in Europe that adheres to two core conclusions:

- The control of fertility within marriage was an innovative behavior that diffused rapidly through European populations.
- The couple innovated by placing their actions associated with family-building and reproduction within a framework of a rational calculus.
- Sociology drove the process of diffusion, not adaptations to changes in economic circumstances. The attitudes of peer groups and networks of communication played the central role. The innovative behavior moved at about the same time through all social classes, rather than from a leading social class to followers (Woods, 1987, p. 291).

With the exception of Knodel's analysis of family reconstitutions carried out in several German villages (Knodel, 1988), arguments in favor of these conclusions appeal to the empirical foundation that the Princeton project laid out in the monographs of the 1970s and 1980s. Each of these narratives of the fertility transition in a European country employs panel datasets on infant mortality, Ig (marital fertility adjusted for the age distribution of the population), rates of marriage and rates of out of wedlock births for relatively large geographic units that covered the period of the transition. The overall conclusions elaborated in Coale and Watkins (1986) was the that rapid diffusion of innovative behavior among most couples during a short period of time provides a better description of fertility transition than describing it as a process of the adaptation of successive cohorts to changes in the demand for children. Given this perspective, changes in Ig over time (a ten percent decline) could date to *within a calendar year* the onset of a significant increase in the share of couples controlling marital fertility. Consider the account of the fertility

of transition in Germany (Knodel, 1974). The transition started in the first provinces in 1881 (Berlin and some parts of Baden) and continued to spread throughout the empire; by about 1915, all seventy-one German provinces had gone through the 10 percent decline. The focus on geographic units of observation led to the general conclusion that diffusion across space, rather than through social classes, characterized the fertility transition (Watkins, 1986, p. 441).

As Guinnane, et. al. (1994) and Santow (1995) have noted, two crucial assumptions underlie the mapping from information about fertility rates and the age distribution of the population of married women (for large regional aggregates) to conclusions about contraceptive behavior. First, the regime prior to the fertility transition was one of "natural fertility." Widely differing levels of fertility found in pre-transition populations did not result from conscious efforts to control or influence fertility within marriage (Coale, 1986).[1] Fertility control within marriage was in that sense an innovation in behavior. The second assumption was that the behavioral change that marked the transition took a specific form: couples adopted stopping—birth control initiated after achieving a desired parity—as their family-building strategy. Assuming parity-dependent control eased the task of making the mapping between the data at hand (births and the age distribution of married women) and drawing inferences about the presence of fertility control. The assumption also enabled historians to use the Coale-Trussell indices of M and m to summarize in more detail the contours of the timing of the fertility transition in those cases where more detailed data were available.[2]

[1] The standard Princeton view of what it calls natural fertility ascribes these variations to differences in the biology of conception (fecundability) or the incidence of intra-uterine deaths (miscarriages). Social practices that influence the length of time for breastfeeding and the period of abstinence while the infant is breastfeeding may also play a role. The results in David and Mroz (1989), which analyzes sequences of birth intervals of French couples prior to the transition, are consistent with Santow's perspective that the concept of natural fertility is too restrictive for describing the fertility behavior of couples before the transition.

[2] The Coale-Trussell M is intended to provide an indicator of natural fertility. The measure m is a measure of parity-specific control. It summarizes the extent to which of age-specific fertility rates of a given population deviate from

Guinnane, et. al. (1994) were the first to explore the ability of Ig and M and m to detect changes in marital fertility brought about by an increase in the share of a population adopting family-building strategies that utilized birth control. They report simulations of populations under varying assumptions about the proportion practicing stopping or spacing (parity-independent fertility control), the parity at which control was initiated and the efficiency of the contraceptive methods used (between 85 and 95 percent). They find that Ig is insensitive to the spread of control even within a relatively large minority of the population. The results for m are similar. If a controlling population is replacing parity-independent control with parity-dependent control, random variation in fecundability and fetal or infant deaths all lead to a blurring of the difference between the behavior of the couple—the use of contraceptives and the adoption of a strategy for the timing of births—and observed age-specific marital fertility. These results also point to the importance of the assertion that the adoption of fertility control took place virtually simultaneously within a geographic area, rather than as a process of diffusion from leaders to followers.

David and Sanderson (1986) contribute to the discussion with an argument that the "rudimentary contraceptive practices" that were available during the 19$^{th}$ and early 20$^{th}$ centuries must have also affected the fertility control strategies of couples. Their simulations suggest that middle class U.S. American couples may have reduced coital frequency to achieve an apparent target of two children (David and Sanderson, 1986, Table 7.8 p. 357). Taken together, these papers point introduce two themes that have emerged the research that attempts to assess the validity of the Princeton narrative. The first is the issue of whether fertility control was an

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the Hutterite fertility schedule. The Hutterites were an American religious sect with unusually high fertility. The schedule is derived from age-specific fertility data for the 1920s.

innovation and confronts the core notion of natural fertility. This issue is related to the second question of what type of birth control strategy was actually practiced.

A brief overview of these themes serves as the background for this paper's task: to examine historical evidence on the actual practice of birth control in the context of the German fertility transition prior to World War I. When placed within the framework of a dynamic model of fertility under uncertainty, the contours of the choices available to German couples become apparent. The contraceptive technologies that were then available posed tradeoffs in cost, discomfort and efficiency. An invaluable survey of married German men from the early war years reveals a range of responses to these tradeoffs. The choices of technique and the timing of birth control are most consistent with a perspective that emphasizes the economic rationale for family size, the occupational status of the mother and the availability of advanced birth control methods.

## Natural Fertility, Strategies for Control and Contraceptive Methods

Recent studies have challenged the notion of natural fertility and have examined the feasibility of stopping strategies in the context of the historical period during which the European fertility transition took place. David and Mroz (1989b, pp. 201-202) argue that detecting any kind of spacing behavior in a mixed population of controllers and non-controllers requires considerably more sophisticated empirical techniques than those used in all of the Princeton studies. Subsequent studies support their assertion. The analysis of Mormon genealogies in Anderton and Bean (1985) and reported in more detail in Anderton, et. al. (1990) finds spacing behavior a pre-transition frontier population and argues that the transition to lower fertility was simply the adoption of existing spacing strategies that would achieve smaller family sizes. Van Bavel (2004) and Van Bavel and Kok (2004) found that prior to the fertility transition,

working class couples in Leuven/Louvain, Belgium and in western and central Netherlands apparently spaced births in an effort to limit the proportion of dependent children in the household at any one time. Bengtsson and Dribe (2006) found evidence of spacing behavior as a response to income shocks among landless peasants in pre-transition Sweden.

David and Sanderson (1986), David and Mroz (1989a and 1989b), Szreter (1996) and Santow (1995) focus on the interdependence of fertility control strategies and the availability of efficient methods of contraception. David and Mroz (1989a) argue that the use of inefficient methods may have prompted the spacing of births early in the marriage. Santow followed up on this perspective with an argument that the European fertility transition differed from the transition in developing countries during the 20th century in at least one important way. Europeans achieved their transition by drawing upon an existing repertoire of fertility-controlling techniques (mostly withdrawal) that were already known, but much less efficient than the IUD or sterilization that were preferred during the transitions of 20th century.[3] Using these traditional methods along with a strategy to space births would have been preferred to adopting a strategy of parity-dependent control, which is more logical when highly efficient methods of contraception are available. Santow appeals to literary evidence on the existence of euphemisms for withdrawal found in sources from the eighteenth through the early twentieth centuries to argue for continuity in knowledge and acceptability of this form of control across the transition.[4] Szreter (1996) presents evidence that he argues is consistent with spacing behavior among British couples during the early 20th century. Hionidou (1998) provides some support for Santow's perspective

[3] Watkins (1986, p. 435) had argued, for example, that "although condoms and devices to block the entrance to the uterus were known before the nineteenth century, they do not seem to have been effectively manufactured or widely distributed until well into the twentieth century."

[4] Van de Walle and Muhsam (1995) counter that the euphemisms that have appeared in literary sources referring to withdrawal (particularly, the "sin of Onan") most likely referred to other sexual practices until the transition was already underway. It was also not clear that earlier references to withdrawal would have also implied widespread knowledge of it, because of the inherent riskiness of it in an extramarital context.[4]

in her study of the transition on the Greek island of Mykonos. Although she finds that condoms played an important role in the fertility transition there, she agrees with the general perspective that spacing (and abortion) was practiced by couples before the transition; spacing was the primary approach to timing contraception in the early years after the transition as couples became familiar with methods of birth control. Stopping was more likely to be employed in the final stage of the transition. Jansen (2005) also provides some support for Santow's view for contemporary populations. He notes that about one-quarter of younger zero-parity married women (ages 15-24) in a variety of developing countries across Asia, Africa and Latin America initiate control upon marriage.

More recent research on Britain and the United States suggests a variety of contraceptive practices. Relying upon a survey of contraceptive use taken in 1945, Seccombe (1990) argues that up to 80 percent of marriage cohorts prior to 1920 (well after the transition) used withdrawal. Evidence from American sources for the period at or before World War I from middle or upper middle class couples suggest only about one-fifth used withdrawal; 28 percent used douches and one-third used barrier methods (David and Sanderson, 1986, Table 7.2).

Szreter (1996) offers the only significant departure from these characterizations of birth control during the transition. He argues that in Britain, a culture of abstinence accompanied the widespread adoption of birth control within marriage. He relies upon indirect evidence from the distribution of children ever born for marriages grouped by occupational groups in the 1911 British census. Occupational groups with lower fertility were also more likely to have married late. He concludes that this pattern is consistent with a generalized culture of abstinence that both

limited premarital sex and carried over into marriage as a reduced frequency of intercourse (Szreter, 1996, pp. 387-398).[5]

Two of the Princeton monographs address the question of contraceptive methods, without engaging the broader debate over their relationship with birth control timing strategies. Lesthaeghe (1977) in his study of Belgium argues that the propagation of fertility control took place without significant public discussion, which would have been more likely were controllers using devices available commercially. The widespread use of withdrawal by the more religiously conservative Flemish population as late as the 1960s (32 to 44 percent) suggests that it must have played an even more important role during the time of the fertility transition. Teitelbaum (1984, pp. 196-210) provides a review of the kinds of contraceptives available in Britain at the turn of the century and some of the paths of dissemination on this information, but does not address the question about the kinds of contraceptives in use.

Since the publication of the initial set of monographs, scholars sympathetic to the Princeton view have elaborated on the original account. Van de Walle (1992) argues that prior to the transition the concept of numeracy (and the desired number of children) was well established in European culture, if not widespread throughout the population. Couples who thus accepted the idea of fertility control revealed a latent demand for control rather than responding to a change in demand (see also Cleland, 2001, p. 58). Watkins (1986, p. 435) argues that the methods used early in the transition (withdrawal, abstinence or abortion) all "required sacrifices; ... [t]heir use in marriage bespeaks a considerable degree of determination by one or both spouses."

[5] Szreter argues that abstinence was a long-held cultural practice that resulted in a pattern of relatively late marriage during difficult economic times, and reductions in the age of marriage during times of improved economic conditions. Knodel (1988, pp. 226-229) contrasts the pattern in England with Germany. In England, improved economic conditions appear to have relieved a constraint on premarital sex and increased the proportion of pregnant brides among young brides, even as the age of marriage fell. In Germany, Knodel finds no consistent relationship between the age of marriage and the percent of young brides who were pregnant. Instead, young women who conceived first within marriage were younger than those who bore their first child before marriage. Wittenberg, et. al. (1895) suggest considerable variation in the cultural acceptability of premarital intercourse in Germany.

Danzi and Watkins (1995) and Cleland (2001) characterize the process of the spread of the innovation as one involving changes in group behavior. Although some (social and economic) elites with access to a wider range of communication could be the innovators, the pattern of adoption primarily followed paths of interpersonal communication through social or linguistic groups. Those groups were responsible for reshaping the norms of acceptable behavior within marriage. Some social institutions such as the Catholic church could influence cultural norms or mores to the extent that they could block or slow diffusion (defined by religious adherence) (see Lesthaeghe and Surkin, 1988, p. 13 and Lesthaeghe, 1977, pp. 137-139).[6] This view in its more extreme form rejects individualistic decision-making as an important influence on the early adoption of birth control. Cleland argues that rapid diffusion took place "regardless of the position of groups within the economic structure."

## A Framework for Analysis

Further progress in this debate can benefit from recasting the discussion about patterns of contraceptive use and timing strategies into concrete hypotheses about behavior. The Princeton innovation view suggests conflates two decisions that were central to the transition into one. The first is the decision to actually use some form of contraception in order to limit the number of births or space them. The second decision about the appropriate timing strategy and method for contracepting births receives little attention, except for blanket assertion of a stopping strategy. Dynamic models of fertility offer an alternative approach. From this perspective, the choices involved include the optimal stock of children and efficiency and timing of contraception . These models incorporate three sources of uncertainty in the process of family building that may have

[6] Lesthaeghe (1977, p. 1378) notes that official efforts of the Catholic church were most likely too late to halt fertility decline in Belgium. Although German bishops issued official statements in opposition only in 1914, efforts by organized Catholicism (the Catholic Center Party) to restrict providing information about contraception date to well before 1900. The comments of Catholics from Rhineland and Westphalia in Marcuse (1917) point as well to an association between their religious identity and the decision not to use birth control.

been significant during the period of the European fertility transition: the uncertainty associated with conceiving and bringing a pregnancy to term, the risk of an infant or child death and the uncertainty associated with methods of contraception.[7] The models offer one approach to explaining differences in contraceptive choices and differential responses of couples to unexpected births (for example, twins) or deaths. They also nest some of the key maintained hypotheses of the Princeton view within a wider range of potential outcomes. Although the data available for this study of contraception during the early years of the fertility transition do not allow for estimation of a fully-specified structural dynamic model, they do permit us to examine some of the key hypotheses implied by such models.

Following Arroyo and Zhang (1997), suppose that a couple maximizes lifetime utility (the discounted sum of the utility in each period of family-building). This class of model posits that the risk of a birth ($\Pi^b$) during a period t, the (exogenous) risk of the infant dying during the period ($\Pi^m$) and the efficiency of contraception $u_t$ all influence the probability of an additional child ($\Pi_t$) during period t:

(1) $\Pi_t=(1-u_t)\Pi^b- \Pi^m$

Utility is defined over current births ($C_t$), the existing number of children ($M_t$), time of the mother ($T_t$), the efficiency of contraception ($u_t$), and the numéraire good ($X_t$). Utility is concave in $C_t$, $M_t$ and $X_t$. Higher efficiency of contraception may likely entail greater disutility from the actual practice of contraception because of the inconvenience of efficient methods, health risks or reduced enjoyment.

The simplest version of the model assumes that the hours of leisure of the husband are fixed and the wife allocates her time between market work and leisure. The fixed income of the

[7] Arroyo and Zhang (1996) provides an overview. Newman (1988) offers one of the most detailed analytical treatments of this kind of model and derives a number of hypotheses. Rosenzweig and Schultz (1987), Rosenzweig and Schultz (1989), Guilkey and Jayne (1997) and Carro and Miro (2006) offer empirical applications.

husband and the wage income of the wife are allocated among expenditures on the stock of children and contraception priced at $P_t^M$ and $P_t^u$, respectively, and $X_t$. The solution for each period t yields an optimal sequence of the stock of children and level of efficiency of contraception $\{M_t^*, u_t^*\}$. Figure 1 illustrates the choice of $u_t^*$, which reflects the tradeoff between the expected discounted marginal benefit of avoiding another birth and the marginal cost in foregone utility of undertaking that level of contraception. The marginal cost of contraception is the opportunity cost of foregone consumption goods ($P_t^u$) and the disutility of contraceptive practices. The marginal benefit of contraception is the capitalized value in the next period of avoiding a birth in the current period given parity M. It is constant in u and described by a horizontal line. The sequence $\{u_t^*\}$ over the reproductive life span of the couple can take on a multitude of patterns, but two are relevant for debates about the fertility transition. The first is a spacing strategy, where in the absence of infant deaths, $u^*$ alternates between values greater than zero and zero. At any t greater than or equal to the T that results in $M_T^*$ (conditional upon survival), $u^*$ takes on positive values. A stopping strategy is a sequence of $u^*=0$ until T, when $u^*$ takes on positive values (presumably sufficient to lower the probability of an additional child sufficiently). For the purposes of discussion, define a third strategy as spacing upon marriage. It is a series of $u^* \geq 0$; at marriage, $u^*>0$.

The analytical results for a similar model developed by Newman (1988, pp. 55-56) and the others in the literature summarized by Arroyo and Zhang (1997) identify direct and indirect influences on $\{u_t^*\}$. A drop in the effective price of contraception (condoms become available through mailorder) or the marginal disutility of efficiency (the availability of the pill) reduce the marginal cost and increase efficiency. A fall in the background level of infant mortality or a rise

in fecundability (i.e., a higher $\Pi^b$) increase the marginal benefit of a conception and result in increased efficiency.[8] A lower discounting of future utility also increases efficiency.

As with the standard Becker-type models of fertility, the effects of the husband's income and the wage earned by the wife involve more subtle interactions and less clear-cut predictions, since they work through the choices of X* and M*. Higher income for the husband will shift the marginal cost of control down (as the marginal utility of X falls), but it could also lower the marginal benefit of control through an impact on desired family size. An increase in the female wage likewise lowers the marginal cost of control. Whether there is a corresponding upward shift in the marginal benefit of control depends upon whether the usual substitution effect away from leisure (the wage effect) is reinforced by a price effect (if leisure and children are complementary goods), which would result in a reduced desired stock of children. The introduction of an explicit time cost of raising children for the wife makes it more likely that the marginal benefit of control will rise with an increase in the wage of the wife. Finally, it should be noted that a higher marginal cost of children (say, in urban versus rural areas) would result in greater efficiency.

This class of models directs attention to several issues. The Princeton perspective implies that most couples had an unsatisfied demand for fertility control. Once fertility control was adopted in a geographic area, it would initially be unlikely for the various elements of this kind of economic model, which focuses on individual characteristics, to predict fertility control. In an elaboration of this view, Cleland (2001) argues that changes in the demand for children would have lagged behind the transition *as a response* to the realization that contraception was available. In addition, this kind of model offers scope for couples to choose a range of spacing or stopping strategies or a combination of the two. The Princeton view argues for one particular

[8] Note that the opposite circumstance common to many transitional European populations of high infant mortality and low fecundability could lead to a hoarding of births.

sequence of $u_t^*$ among many. Santow and others argue that a diversity of contraceptive techniques would have led to a broader range of strategies that would have included stopping along with other approaches. During the years prior to fertility decline (and the early years of fertility decline), the preferred strategies for controllers would more likely have been spacing (or initiating control upon marriage). As time went on, the use of stopping strategies would have become more common.

## Contraceptive Choices and Strategies in the German Fertility Transition

Although the Princeton interpretation of the fertility transition posits epochal changes in the behavior of European couples, both in terms of sexual relations and in approaches to family-building, virtually all of the evidence is based on aggregated data on realized births with various adjustments for the age distribution of married women. This paper focuses instead on two dimensions of actual behavior towards contraception: the choice of method and timing of contraception. As noted above, direct evidence on the use of contraceptive methods and strategies is generally available only from many years after the transition. This is not surprising. Choices and strategies were about intimate behavior within marriage that was rarely discussed in polite society. In some countries such as Belgium, the adoption of new behaviors could occur under the radar of public knowledge. Even in Great Britain or the United States, with public trials about the dissemination of information on birth control or active prosecution of those attempting to sell birth control devices, very little direct evidence has been left behind about actual contraceptive behavior or strategies.

The German experience offers an opportunity gain a better understanding of these issues. Germany encompassed a wide geographic variation in measured fertility decline over a period of 30 years (Knodel, 1974). The decline in fertility, or the *Geburtenrückgang*, prompted an intense

public debate as observers noted that the rival to the east, Russia, continued to experience high fertility. The debate, and the efforts to understand it, took place in a society that prior to 1914 offered a forum for discussions of sexuality and sexual behavior that was as open as in any other European country. The country's twenty year-old experiment in near-universal health insurance provided working class women with access to the medical community through a network of clinics and hospitals that was perhaps unequalled in any other European country. As a result, a cadre of physicians (some of whom were Social Democrats) with significant experience with working class women and their health problems emerged; several used their access to patients and the records of health insurance funds, *Polikliniken* (practices with multiple doctors) or maternity or women's hospitals to conduct empirical investigations of the decline. Their medical associations had a statutory role in the governance of health institutions, and they could also be called upon in the case of government enquiries.

A companion paper draws upon the contemporary and archival evidence developed by the debate over to Geburtenrückgang to document the range of birth control methods available to couples during the period of the fertility transition, the paths by which information and birth control devices were made available to the public, the strategies of contraception in use and the pattern of diffusion.[9] For most of the nineteenth century, women had access to post-coital douches and sponges or tampons. Men had access to caecal condoms (manufactured of animal membrane) and withdrawal. By the late nineteenth century, diaphragms and cervical caps had become available for women and rubber condoms were available for men. The early twentieth century saw the expansion of methods available to women. Various kinds of spermicidal suppositories (of uncertain effectiveness), equipment for douching and primitive intra-uterine

[9] See Brown (2009) for a detailed discussion and references from archival materials and contemporary sources.

and intra-cervical devices to block sperm were introduced. Appendix Table 1 provides a list of these methods.

In journal publications and handbooks for married women and health contemporary physicians offered an assessment of the efficiency of each of these methods and their relative disutility. Archival records provide information on costs. Figure 2 provides a rough summary of this assessment ca. 1910. Withdrawal was convenient and inexpensive, but many physicians were convinced of the deleterious effects of withdrawal on the physical and mental health of the husband. It was also viewed as inefficient. Condoms, particularly rubber condoms, deadened sensation, but were agreed to be highly effective. The equally efficient caecal condoms (made from animal membranes) were significantly thinner than rubber condoms, but much more expensive. Douches were safe and relatively inefficient; for households with perhaps one water tap and limited privacy, they were also inconvenient. For a price, women could purchase devices that simplified the process. Physicians ranked barrier methods for women such as the cervical cap or diaphragm above douching in efficiency; the diaphragm was least convenient. Cervical caps remained in place for a month, but required a visit with a midwife or doctor for reinsertion. At the same time, they were more expensive. Finally, the early intra-uterine and intra-cervical devices were expensive and relatively efficient. One device, a stem diaphragm (for example, the Sterilett), which was inserted for longer periods of time than a cervical cap, also exposed women to risks of infection or worse.

The range of costs presented in Figure 2 offer a rough estimate of the minimum annual price of contraceptive devices using price lists provided by mail order houses. At an average daily wage of a low- to moderately-skilled worker in Berlin of 3-4 Marks per day, the more efficient methods could cost from ten to 15 days of labor. Local drug stores and rubber-goods

stores offered these items in urban areas; rural residents were more likely to rely upon door-to-door peddlers. These alternative sources most had some mark-up over mail-order prices, which could range up to 100 percent.[10] Although couples could purchase contraceptive devices anonymously in urban areas at a wide variety of outlets, the comments of rural pastors in the mid-1890s documented in Wittenberg, et. al. (1895) suggest that relatively anonymous access for those living in rural communities could have been difficult.

Evidence from three surveys conducted ca. 1910 suggests that German couples made use of a variety of the methods then available. The summary results are presented in Table 1. All three surveys suggest that a majority of the population by ca. 1910 was controlling fertility. The survey from the predominantly Catholic Bavarian city of Würzburg and surrounding rural communities shows the dominance of withdrawal. The surveys of Berlin and all of Germany (which included one-half of couples resident in Berlin) show greater diversity. Less than one-half of couples relied exclusively on withdrawal. Table 2 summarizes two surveys conducted by the German physician Max Marcuse (Marcuse, 1913 and 1917), which offer some additional information on the timing of contraception. It appears that initiating control at marriage (usually, but not always at zero parity) was relatively common among Berlin women. Starting control at marriage was unusual among the earliest marriage cohort among the soldiers in Marcuse's 1915 survey. Most of this first cohort married at a time when the transition (as identified by the Princeton method) was just taking place in their province of residence. For all other cohorts, a significant minority initiated birth control at marriage.

[10] See HSTAD Regierung Düsseldorf 38984 Medizinalverwaltung, "Geburtenrückgang 1914 bis 1914 (Bd. 6) [Kahnakte]", price quoted for the "Alphaspritze" sold by a peddlar is 15 Marks. It retailed for 7.5 Marks from the mailorder house Gutbier.

The diversity in contraceptive use and timing strategies evident in these surveys suggests an opportunity to test central Princeton assertions about behavior during the fertility transition. Fortunately, the Marcuse (1913 and 1917) published the responses to his two surveys. Marcuse was a Berlin physician whose practice before the war included large numbers of working class women. His 1912 survey of 100 of his female patients included questions about their history of spontaneous and induced abortions and their usage of birth control along with basic demographic data. During the war, he administered a comprehensive survey at a military hospital in Stuttgart to 293 married patients from around Germany who were seeing him because of concerns about venereal disease. The survey included questions on the number of conceptions, abortions and child deaths of each of the soldier's marriages. It also recorded information on the religion and the social background of the patient and his wife (or wives). Finally, the published notes of each interview included a discussion on the use of contraceptive methods, including the method(s) types used and the timing of use.[11]

The survey responses allow investigation of two empirical questions. The first question is whether the pattern of control was significantly influenced by the timing of the fertility transition. The Princeton view argues that the timing of the transition in a particular geographic area should be the strongest influence on the decision to control fertility, rather than the tradeoffs associated with the desired number of children, the opportunity cost of the wife's time and other considerations. The second question is more closely related to the relationship between the choice of the method of contraception and the timing strategy adopted (to stop, space, or start at marriage). Extending the logic of the basic model of fertility control suggests that a choice of inefficient control could have been consistent with a strategy that extended the period during

[11] Both surveys are found in Marcuse (1917). From internal information in the wartime survey, it appears to have been conducted in 1915 or 1916. See Neuman (1978) and Linse (1972), who also draw upon these surveys.

which the couple practiced contraception. The model further predicts that contraceptive use would be higher among employed females, women living in a low infant mortality environment and potentially among households with a higher income. Before it is possible to examine these hypotheses, a better understanding of the efficiency of birth control methods at the turn of the century is required.

## Estimating the Efficiency of Contraceptive Strategies

Were German couples at the turn of the twentieth century as efficient in their use of contraception as couples were a century later? Contemporary observers did not think so. Early on, Hasse (1885) noted that the use of withdrawal was only infrequently observed among the "less educated classes;" instead, "more indolence is observed." The practice "always presumes a higher intelligence and control of the will or the instincts," which was presumably lacking among this group. Writing twenty years later, Fürbringer (1904, pp. 236-237) and Forel (1907, pp. 458-459) also stressed the unreliability of withdrawal in comparison with condoms. Both Forel and Fürbringer were skeptical about the efficiency of any of the methods used by women, including douches, sponges or tampons, or diaphragms.[12] The Marcuse survey data offer an opportunity to estimate the efficiency in use of the contraceptive methods available to couples in Germany shortly before World War I. For about 156 couples, the fertility and contraceptive histories are sufficiently detailed to identify periods without contraceptive use and periods when contraceptives of various kinds were used (by both husband and wife).[13] For about 30 of these couples, we observe both a period at risk of pregnancy without contraception, and then a period

[12] Forel was a physician and one of Switerzland's earliest sexologists. Fürbringer was a Professor in Berlin.
[13] The sample used excluded the second marriage of the soldiers being interviewed. The periods of contraceptive use are most often referenced by the age of the wife or the age of the children. In a few cases, the period at risk remaining after the first child was born was estimated by subtracting 1.3 years from the period at risk discussed in the original source. 1.3 years is the average interval for a first birth after marriage found in Knodel (1988).

involving contraception. Another 46 allow observation of the pattern of fertility for couples not using contraception.

The specification of the relationship between the probability of conception and the use of alternative forms of contraception takes account of the potential endogeneity of the choice of contraception and the limitations of the Marcuse data. It follows the insight of Rosenzweig and Schultz (1989) in their study of the impact of schooling on the effectiveness with which a couple used contraceptives. They noted that the choice of a contraceptive method could be correlated with other characteristics of the couple and thus can not be treated as strictly endogenous. That suggests an instrumental variables strategy as an alternative specification to one that treats the contraceptive choice as exogenous. Although not precise, the Marcuse data provide information on the length of time (in years) during which a particular method was used and the number of conceptions that took place over that interval. These are sufficient data to allow use of a count data model, such as the Poisson or Negative Binomial model, to test for the impact of the use of particular method on the probability of birth. Winkelmann (2008) summarizes the advantages of these two count models compared with other specifications. Both rule out negative predicted values, and a Poisson model can be readily related to a model of birth intervals. Guinnane and Moehling (2006) apply a count model to fertility data of residents of Dublin after the turn of the century.

Here, the model chosen initially follows a Poisson specification:

(2) $P(X=n)=\exp(-\lambda)* \lambda^n/n!$

Here, X is the count of conceptions over a given interval and $\lambda=\exp(f(\mathbf{X}\beta, \mathbf{W}\gamma))$. $\lambda$ can be interpreted as the annual probability of conception and 1-est.$\lambda$ is the predicted *efficiency* of a method. Typically the function $f(\cdot)$ follows a linear specification. In this case, the vector **X**

includes the most parsimonious specification of influences on the wife's fecundability and risk of conceiving: her age at the beginning of the interval over which she was at risk of conceiving and a dummy variable that equals one if the interval included World War I.[14] The elements of the vector **W** take on the value of one for different choices of contraceptives and the estimated vector of coefficients $\boldsymbol{\gamma_i}$ provides information on the impact of the contraceptive method on the probability of a birth. Finally, consistent with a Poisson or negative binomial specification, the logarithm of the duration of the period at risk is included in the regression. Since the choices of contraception may well be endogenous, the results reported for the estimation also include estimates that use instrumental variable methods.

Table 3 reports two groups of specifications. The second and third columns show the results of estimating a base level Poisson regression for couples not practicing birth control during some or all of their reproductive careers. Column two includes couples who never practiced birth control and column three includes couples with significant periods of time without birth control. The pseudo $R^2$ estimated for both groups using the method discussed by Cameron and Trivedi (1998, p. 154) shows that the Poisson model can explain a large share of the variation in births, even with a parsimonious specification. $\chi^2$ tests for the Poisson model failed to reject that specification at all conventional levels of significance. When the datasets include couples practicing birth control, the Poisson regression explains a bit less of the variation than does the negative binomial model. This may result from the presence of some overdispersion, which implies that the standard error of the model is larger than the expected value, or the estimated $\lambda$.

[14] Alternative specifications for influences on fecundability included information on the difference in age between the husband and wife, the age of the husband and the number of children in the family of the husband or wife. None of these were variables were statistically significant.

For all couples, the risk of pregnancy falls with the logarithm of marital duration. The results suggest two alternative rankings of the efficiency of contraceptive methods, which hinge upon whether or not the choice of method is exogenous (see the summary in Table 4). Both rank the condom as the most effective method and the douche as the least effective method. If the choice of contraception is assumed to be exogenous (or not correlated with other unmeasured characteristics of the couple), the next most efficient methods are the diaphragm, cervical cap or IUD. These are followed by withdrawal, with an estimated risk of pregnancy of 30 percent. When the estimation controls for the potential endogeneity implied by a dynamic model of fertility under uncertainty, the relative efficiency of withdrawal rises to a ten percent annual risk of conception, about as efficient as a diaphragm, cervical cap or IUD. Accounting for the choice of method may also require a closer look at whether or not the couple employed a stopping strategy.

Table 4 compares the results with estimates of efficiency from a meta-analysis of studies of the United States (Trussell, 2004) and surveys of couples in nineteen developing countries that were funded by the USAID (Cleland and Ali, 2004). Both surveys record the risk of conception during the first year of use. The data for the United States distinguish further between perfect use (consistent use and without error) and regular use, which could include cases where use is only infrequent or may have been discontinued. The relative rankings from the analysis of the Marcuse data fall within the range of the results from contemporary data.

## Estimating Models of Contraceptive Choice

The simple model of contraceptive choice provides a framework for examining two features of contraceptive use that figure prominently in the debate over the fertility transition.

The first decision to examine is whether or not the couple used contraception to control fertility, or in terms of the model,

(3) $u^*_t \neq 0$ for any t

The second is to examine the determinants of the observed $\{u^*_t\}$ for those couples choosing to use contraception during some period of their marital life. That analysis will focus on the initial time path of control chosen at marriage and the method chosen at the onset of control. Consider first the choice of whether or not to ever control contraception.

The data in the Marcuse survey provides information on whether or not a couple would *ever* use contraception (up to the time of the survey), so the relationship to be estimated will be the probit model

(4) $P(z^*=1)$ for $u^*_t>0$ for some t and 0 otherwise, where

(5) $z^*=f(M^*, \mathbf{X}\beta, \varepsilon)$.

$M^*$ is the desired number of children, and it in turn is a function of other influences:

(6) $M^*=g(\mathbf{W}\gamma, \xi)$

The vector **X** includes characteristics of the couple that would influence the access to information about birth control information or contraceptives (residence in Berlin or a large city), religious affiliation (Catholicism discouraged birth control) and a Princeton timing variable that relates the couple's decision-making to the presence or absence of the fertility transition in the couple's region of residence. The timing variable measures the elapsed amount of time between the Princeton date in the couple;s province of residence and the year in which the couple was either married (for those not controlling fertility) or initiated birth control (for those couples who used birth control). Knodel (1974, p. 62) provides estimates of the Princeton date. The Princeton

dates in the Marcuse sample ranged between 1881 (Berlin) and 1910 (eastern Prussia).[15] The Princeton narrative hypothesizes that the timing of the transition should lead to a discontinuous—and significant—change in the willingness of couples to use birth control. A strong version of this hypothesis is that the diffusion of the idea of birth control had a much more significant impact on the use of contraception than did changes in the desired family size. The specification adopted here for capturing the Princeton date effect includes three dummy variables for different periods during which the couple decided to control fertility. This specification allows for a non-linear relationship between the elapsed time after the Princeton date and the probability of using birth control.

The desired family size ($M^*$) is determined by the vector **W** of family and locational characteristics. Marcuse's interviews usually included some comments on the desired number of children. For example, number 228 noted that the couple (married in 1912) "had right away (at marriage) agreed on one or two." For couples further along in their child-bearing years, the question was very often if "more children were desired." (See number 141.) A majority of men never desiring to practice birth control replied with a comment such as "more children desired" (number 81). For a minority of non-controllers, comments such as the current number of surviving children was "enough" allowed identification of the desired number of children.

The influences on the number of desired children include a proxy for the cost of the child: the place of residence (residents of villages would have a lower cost; residents of large cities and Berlin would experience a higher cost). In addition, if the husband listed an occupation for the mother, the opportunity cost of a child rises, which should lower the desired number of children. Women marrying at later ages often expressed the desire to limit the number of children (or not

[15] In many cases, the geographic areas given by Marcuse (Rhineland) included several of Knodel's provinces. For these cases, the weighted average of dates was used. In a few cases, the spread of dates was so wide as to make an average meaningless. These cases were excluded from analysis.

bear any at all) because of the well-known risks of child-bearing. The model of birth control choice also implies that a higher rate of infant mortality in the province where the couple resided should increase the incentive to hoard births and the number of desired children.[16] Whether or not the husband is Catholic allows us to measure the impact of the pro-natalist views of the Catholic church. Finally, most women in the Marcuse sample were migrants from other parts of Germany, some of which were still experiencing high fertility. The $I_g$ in the wife's province of birth at her age 15 should reflect attitudes about acceptable family size that could be carried into marriage.

Four dummy variables capture the economic standing of the husband. The variable Middle and Upper Salaried takes on a value of one if the husband was employed as a middle-level salaried employee (in a bank, for example) or as a member of the liberal professions. The variable Small Business takes on a value of one if the husband was either a master craftsman (and typically owned his own shop) or a small businessman. Lesthaeghe and Wilson (1986) argue that small businesses (family farms, independent craftsmen) would have favored larger family sizes, since children could help in the fields or in the shop.[17]The variable Lower Salaried takes on the value of one for husbands employed as lower-level salaried employees as post office workers, office messengers, or tram drivers. The literature is replete with references to the difficulties faced by lower-level salaried officials with large families, since the salary schedule did not provide much scope for increases. Finally, the variable for a working class husband takes on a value of one for employment either as skilled labor (craftsman) or unskilled or semi-skilled labor (workers, factory workers, etc.). The reference category in the regression is agricultural

[16] For the most part, the infant mortality variable distinguishes between urban and rural infant mortality in the province where the couple resided. The variable is measured as of the date of marriage of the couple.
[17] See Lesthaeghe and Wilson (1986, Table 6.3). Small business owners would likely fit into category B, a group that they argued would be less resistant to reducing family size for economic reasons.

laborers or farmers. Table 5 provides the complete definition of each variable, its sample average and its standard deviation.

If couples decided both on whether or not to use contraception and the desired number of children, then $M^*$ could potentially be correlated with the error term ε. For that reason, estimation of eq. (4) uses probit with instrumental variables as well as ordinary probit. The use of instruments allows a test of hypothesis that the desired number of children is exogenous. The Wald test statistic for the hypothesis is distributed $\chi^2$ with one degree of freedom.

A quick look at Table 6, which reports the full result of the estimation of the decision to use birth control, suggests that taking account of the endogeneity of the desired family size about doubles its importance for the decision on whether or not to practice birth control.[18] One way to interpret the impact of this variable is to compare the actual family size of the couple's parents with its desired family sizes. For the estimating sample, the difference in the medians is about four children (from six children for these couples, most of whom were born in rural areas, to two children). The difference in family size over one generation would increase the probability of using contraception by 0.5.

Catholicism of the husband reduced the likelihood of practicing birth control, but the effect is measured with substantial error. A comparison of the IV probit results with the ordinary probit results suggests that adherence to the Catholic religion exerted its influence indirectly through the desired family size (where the coefficient is positive).

The coefficients on the timing variable dummies suggest that the Princeton interpretation broadly construed has some validity, but limited quantitative importance. The results imply that a ten percent decline in fertility (as measured by $I_g$) was correlated (after a lag of a few years) with

[18] The results of the Wald test, presented towards the bottom of Table 6, suggest that the hypothesis of exogeneity can be rejected at a five percent level of significance.

an appreciable change in the willingness to practice of birth control over and above the influence of the desired family size. The coefficients on the "Princeton date" variables are jointly non-zero at any reasonable level of significance, as is the coefficient for couples making their strategy decision within fifteen years of the date. For the first quarter century after the dating of the transition, the coefficients imply that couples were about nine or ten percent more likely to use contraception. After a quarter century, the importance of timing almost doubles, which may reflect the fact that most of the couples in this category were resident in Berlin.

The other influence that matters is where the couple lived. Residents of Berlin were a bit less likely to control fertility (once we have controlled for other influences); residents of other large cities were about nine percent more likely to use contraceptives. Berlin was home to most of the couples making a decision about contraception more than 25 years after the Princeton date, so the full impact for Berlin is much closer to about 0.16. Note that the large city effect is about equivalent to the Princeton timing effect.

The third column of Table 6 provides evidence on the main influences on the desired family size. Marital fertility in the wife's home province has the strongest impact. A one standard deviation change in $I_g$ (0.13 X 1.573) accounts for about fifteen percent of the standard deviation in the desired family size (1.33 children). A Catholic husband also raised the expected family size. Residence in a village would increase desired family size by about one child. Residence in Berlin would also increase predicted desired family size by about one child; the coefficient for more than 25 years since the Princeton date, which applies almost exclusively to Berliners, means that the net effect for Berlin is about zero.

The coefficients on the occupational variables proxying the middle and upper income groups were all negative. The only coefficient that was significantly non-zero was the coefficient

for lower-salaried workers, which implies a reduction in desired family size of one child. Surprisingly, owners of small businesses also desired small families; the Lesthaeghe and Wilson hypothesis that family-run enterprises prompted a higher demand for children can be rejected at a ten percent level of significance.

Table 7 presents the predicted probability of practicing contraception for four couples chosen to span some of the significant social and economic differences in Germany prior to World War I. At one extreme is a Catholic farm laborer in Silesia, a region of large estates and a stagnating rural economy where ties to the church and traditional customs remained strong. This was one of the last regions to experience fertility decline. The second couple is a factory worker and his employed wife in an industrial city of the Rhineland, part of the west German heartland of industrial development. He is also Catholic, and likely to be a migrant from a high-fertility region of eastern Germany. The lower-level salaried Protestant salaried worker living in Berlin faces a high cost of housing, but enjoys ready access to all forms of contraception. The Protestant upper- and middle-level salaried worker living in middle-sized city such as Brandenburg would belong roughly to the $85^{th}$ to $90^{th}$ percentiles of the income distribution. Of the two main influences on whether or not a couple would choose to practice contraception, the desired family size was most important. Even at a desired family size of 4 children, the Catholic agricultural laborer in Silesia would have a low probability of practicing contraception. A modest change to only one or two children increased the probability substantially. By contrast, a substantial change in the timing of the transition in the couple's region of residence had a much smaller impact on the likelihood of using contraception. It had virtually no impact on desired family size.

Fertility Transition, Method and Timing

The data from the Marcuse survey can address the second issue at the heart of the debate over the causes of the fertility transition: the choice of method and the timing of fertility control. As noted above, the Princeton narrative does not confront the issue of whether reliance upon imperfect methods may have influenced the choice of when to initiate control. Instead, it relies on the assertion that the stopping strategy *was* also the innovation that initiated the European fertility transition.

The data available in the Marcuse survey do not permit estimation of a structural model. One way to incorporate the information we do have about the couples and the environment in which they initiated birth control is to focus on the most parsimonious specification of the sequence of u*. The specification examines two dimensions of the sequence: the timing of when to initiate control and the couple's initial choice of method. The timing decision partitions the sample of controlling couples into those who chose a stopping strategy (s*=1) and those who did not. [19] The method ($u^*_o$) can be characterized by either the estimated efficiency (1-est. $\lambda$) or whether or not a couple used traditional methods. The discussions of the individual cases in the survey suggest that in practice, the choice of methods (efficiency) remained relatively stable over the duration of the marriage, even in the face of failures. Of the couples choosing a particular method, only about one-tenth subsequently chose another method over the span of time covered by the surveys.

The theoretical model suggests the following relationship between s* and $u^*_o$ and other variables:

(3) $s^*=f(u^*_o, M^*$,income, age of the wife, the wife's employment)

[19] Only about five percent of the couples in the survey for whom the required information is available practiced a spacing strategy that set u* at zero at marriage.

The theory of contraceptive choice suggests that $u^*_o$ should depend upon income, the age of the wife, and the wife's employment. In addition, access to information about contraception, the availability of contraception and attitudes towards contraception will play an independent role in the choice of contraceptive method (and the efficiency of contraception). The specifications for the influences on s* include two alternatives for $u^*_o$. The first specification uses 1-est. $\lambda$ as a continuous measure of efficiency, where the estimated $\lambda$ is the predicted parameter for each couple of the negative binomial fertility functions presented in Table 4. The efficiency will depend upon one of four chosen techniques and the age of the wife. The sample was thus restricted to couples employing condoms, withdrawal along with other techniques such as sponges, various forms of diaphragms or IUDs and douches. Those couples not included either lacked information on some of the independent variables (particularly the infant mortality rate at the onset of control) or employed techniques (primarily sponges, but also suppositories) for which it was not possible to estimate the efficiency of control. The estimation was restricted to couples married prior to 1914 and used maximum likelihood methods.

An alternative specification of $u^*_o$ summarizes the methods chosen by the couple as traditional (use of withdrawal or douching or a combination of the two) and non-traditional, which includes use of the condom and the range of barrier methods or the IUD. The discussion in the literature suggests that efficiency was complementary to stopping behavior. High efficiency methods should be associated with a stopping strategy and traditional methods should be positively associated with starting contraception at marriage.

Desired family size should be positively associated with use of the stopping strategy. The literature offers few suggestions over how the indicators for occupation would affect the choice. Women marrying at an older age would have a shortened period in which to bear children, and

would be more likely to adopt a stopping strategy. From the comments in the Marcuse survey, we would expect that an occupation for the wife would increase the likelihood of a strategy to initiate contraception at marriage (or negatively affect stopping). This may be more likely to be true if occupational choices available to women who re-entered the labor market after a period of giving birth and caring for children were limited.

The previous discussion of the choice to use contraception suggests the additional variables that should influence the desired level of efficiency. Those in middle and upper incomes would be more likely to be willing to pay for more efficient—and more costly—methods of control. We would expect older women to try to assert more control over when they gave birth, which would imply a positive coefficient for the age of the wife. Residents of villages should face a higher price for purchasing more efficient methods and would thus be less likely to choose them. Residents of large cities and Berlin would be more likely to choose efficient methods because of the ease of access (and the greater availability of information). Finally, an important hypothesis suggests that the use of efficient methods should be more likely as the fertility transition proceeded. To ensure convergence of the maximum likelihood estimation, the specification of the Princeton dating variable assumed a simple linear relationship between the time since the Princeton date and the dependent variable.

The specification of the desired number of children function was similar to that used in the estimation of the contraception model. Achieving convergence with the maximum likelihood estimation of the model required dropping $I_g$ of the wife's home region.

Tables 8a and 8b report the results of estimation, include the test of the hypothesis that the contraceptive and timing strategies and desired number of children were jointly. Asymptotic t-statistics are in parentheses. The test of exogeneity of the level of efficiency and the desired

number of children is rejected at better than a one percent level of significance using both specifications of the contraceptive technique. The likelihood-ratio tests reject the hypothesis that the variables in column three are jointly zero at all conventional levels of significance for both specifications.

Consider first the results using the preferred efficiency specification in Table 8a. Stopping behavior was strongly associated with the use of less efficient strategies of contraception. Or stated in another way, couples who chose to begin contraception at marriage also chose the most efficient methods. In addition, the desired family size was positively associated with use of stopping strategies. The strongest impacts were exerted by the age of the wife (positive) and if the wife had an occupation (negative). A woman beginning to practice contraception at age 30 was 15 percent more likely to be practicing stopping behavior than a woman beginning at age 25. If the husband noted an occupation for the wife in the survey, the probability of stopping was reduced by 22 percent. Occupational differences of the husband did not exert a notable influence.

Determinants of the level of efficiency of the birth control strategy largely followed expectations. Women who were older at the time of commencing the use of contraception (or their husbands) were more likely to adopt more efficient techniques. This implies an indirect positive link between efficiency and stopping. Couples choosing stopping behavior would also be more likely to choose their method at a later age. For example, assuming that after three births a family decided to stop, the wife would be at least five years older than the wife choosing contraception right at marriage. The impact on efficiency would be modest (an increase of about .04, or 5 percent at the sample average if 0.79). The increase in efficiency would decrease the

probability of stopping, but that would be more than offset by the direct positive correlation of the wife's age with stopping.

The other important influences on efficiency are residence in Berlin and years since the onset of fertility decline. Part of the estimated impact may be the correlation of the Princeton date variable with the dummy variable for Berlin, but the general trend holds up using the alternative specification in Table 9b. The lesson is clear. The later adapters were also more likely to use less efficient methods. The exception would be in Berlin, where the average efficiency was 0.17 (or twenty percent) above the sample average. The other influences, particularly occupation, do not have much impact on the predicted efficiency. The most notable influences on the desired family size are the wife's age at the time of initiating contraception and the lower middle to upper class occupational dummies.

The results for the interaction of traditional strategies and the decision to stop are less clear-cut. Although the statistical tests clearly reject the hypothesis that family size and choice of contraceptive technique are exogenous to the choice of stopping, the coefficients on either endogenous variable are not significant. The strongest result that emerges is the continued importance of the wife's employment for the likelihood that the couple will or will not use stopping. A couple with a wife with an occupation will be 23 percent less likely to adopt a stopping strategy than will a couple where the wife does not have a listed occupation. Those most well-off (the middle salaried workers, the liberal professions and the highest-income men) were much less likely to use traditional methods than other groups. Residents of Berlin were also much less likely to use traditional methods.

The overall results of the statistical estimation are summarized in Table 9, which shows the predicted birth control strategies for the four couples. The final four columns of Table 9

provide the predicted desired family size, the predicted efficiency, and the predicted probabilities that the couple would use a stopping strategy. The most striking result is that stopping behavior would have most likely been found among two social groups living at the extremes of German social and economic life. The desire for larger family sizes, even for those couples practicing contraception, would have prompted rural agricultural laborers to be relatively likely to use some form of stopping. These couples were more likely to use traditional methods, but the relative efficiency of withdrawal would have made stopping reasonably effective. A high income Protestant couple living in a small city such as Brandenburg lived at a considerable social and economic distance from Catholic farm laborers in Silesia. This couple desired relatively small families, but was able to access efficient methods of contraception; it had the highest probability of using stopping. All other couples, including the proletariat and the lower reaches of the middle class of urban and small-town Germany, would be likely to initiate contraception at marriage. The more heavily the constraints of limited growth in income and high costs of children weighed on a couple such as a lower-level salaried worker living in Berlin, the more the couple would initiate birth control upon marriage.

## Conclusion

This study has examined a question on which the proponents of the Princeton view of the European fertility transition have offered clear hypotheses, but limited evidence: what birth control methods and timing strategies did couples use in the first years of the fertility transition? The unique circumstances of Germany's fertility transition make it an ideal testing ground for examining this question. As late as 1900, Germany encompassed some of the highest- and lowest-fertility regions of Europe. Its transition took place under intense public scrutiny, particularly as the geo-political implications of the decline in fertility became apparent to leading

academics and government leaders. The experiment with universal health insurance had the added benefit of bringing millions of members of the working class in contact with the medical community through visits to clinics and hospitals. Some physicians used the opportunities provided by their work with working class patients to question them about the most intimate details of their lives. The results were remarkable surveys unmatched in any other country that had so recently experienced the onset of fertility decline.

Three important results stand out. First, couples in Germany had access to a wide variety of techniques and strategies for fertility control. Second, those choosing to control fertility responded most strongly to changes in desired family size. A geographic area going through the first stage of noticeable fertility decline also registered an increase in the likelihood of contraception; however, the impact of the desired family size overwhelmed this diffusion effect. Finally, a large share of couples marrying before World War I chose to begin contraception at marriage rather than waiting until after achieving a targeted family size. These couples would have included the lower middle and lower reaches of urban society, which would be the groups most sensitive to expanded employment opportunities for women and rising costs of raising children in urban areas.

One implication of the widespread rejection of stopping by groups that composed the large majority of urban populations is that even if a substantial minority of these groups began to initiate contraception, measures of age-specific fertility such as Ig or M and m would be unlikely to detect the change in *contraceptive behavior*. Only a closer look at patterns of birth intervals and their correlates including the socio-economic circumstances identified here can help clarify the outline of the fertility transition in urban and small-town Germany.

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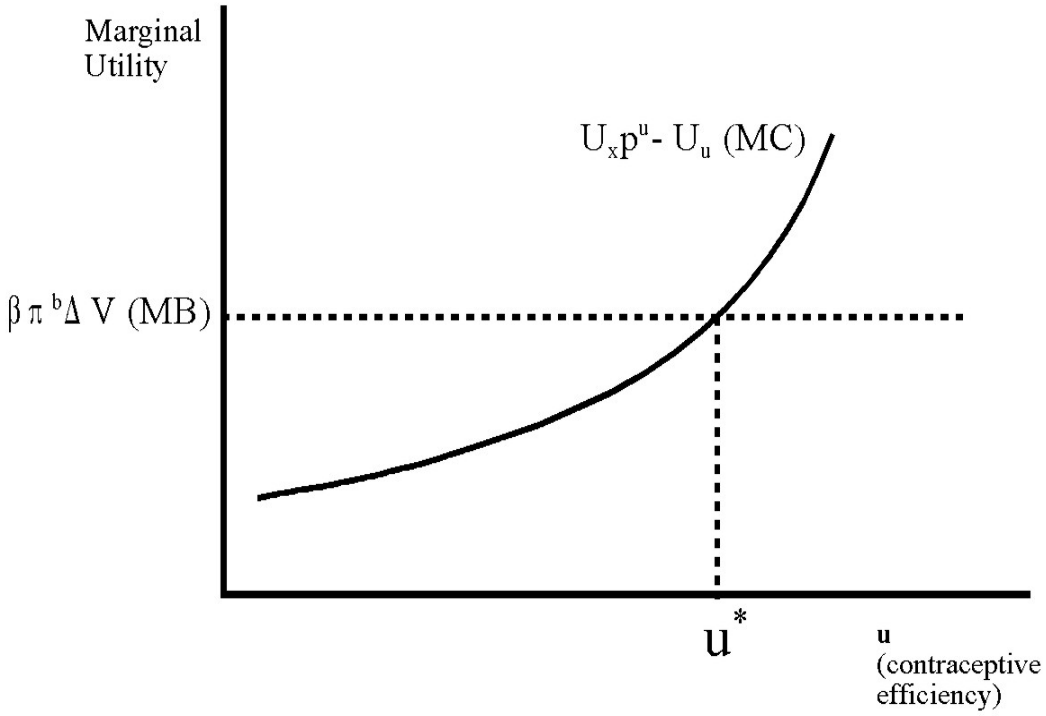
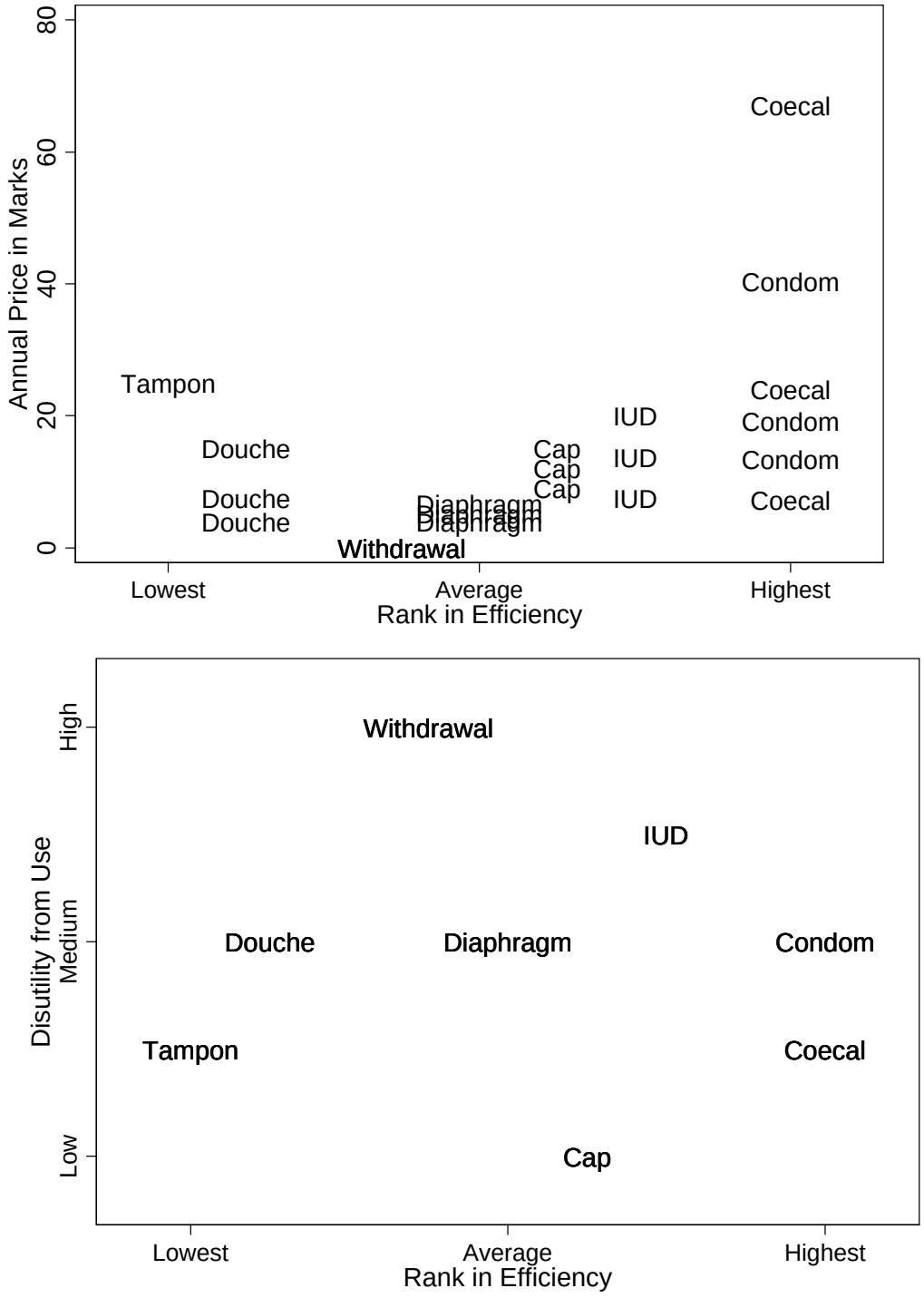
Fig. 1: The Choice of Contraceptive Efficiency




*Source*: Arroyo and Zhang (1997, Fig. 1.
*Notes*: MB refers to the marginal benefit of choosing another unit of contraceptive efficiency to prevent the next birth. MC refers to the marginal cost (in goods and utility loss) of choosing another unit of contraceptive efficiency to prevent the next birth.

Fig. 2: Efficiency, Cost and Disutility of Contraceptive Techniques in Germany ca. 1910




*Source*: Appendix Table 1.
*Notes*: For a discussion of the procedure for estimating the cost of contraceptives, please see the text.

Table 1: The Practice of Contraception among German Married Couples: 1912-1915

| Type of Contraceptive Used | Berlin 1912 (N=81) | Würzburg 1914 (N=468) | Germany 1915 (N=295) |
|---|---|---|---|
| Percent practicing birth control | 66.7 | | 71.4-78.6 |
| Of which: | | | |
| Withdrawal | 36.5 | 83.9 | 41.3 |
| Withdrawal with other method | 3.8 | 11.0 | 17.5 |
| Condom | 23.1 | 3.2 | 20.4 |
| Douche | 36.5 | 1.3 | 8.5 |
| Diaphragm, Cervical Cap or IUD (*Sterilett*) | 13.5 | 0.3 | 10.3 |
| Rhythm | 0 | 0.3 | 0.9 |
| Other | 3.8 | 0.0 | 1.3 |
| Percent inducing abortion as the only form of birth control | 8.6 | NA | 1.4-5 |
| Percent neither practicing contraception nor inducing abortion | 24.7 | | 20-23.6 |

*Source*: Polano (1916) for Würzburg and Marcuse (1917) for Berlin and Germany.
*Notes*: The percent not practicing contraception for Germany in 1915 includes all those who would never practice contraception and those who reported on planning to use contraception only sometime in the future. Data for Würzburg include only married couples.
The percent

Table 2: Strategies of Fertility Control in Germany Shortly after the Transition

| Marriage Cohort | N | Percent Following the Indicated Strategy: Control at Marriage | Spacing | Stopping | Percent Not Practicing Contraception | Percent Married within ten years of the Princeton Date |
|---|---|---|---|---|---|---|
| Marcuse Survey of German Soldiers (ca. 1915) | | | | | | |
| 1896-1900 | 18 | 5.6 | 5.6 | 38.9 | 50.0 | 72.2 |
| 1901-1905 | 36 | 25.0 | 5.6 | 44.4 | 25.0 | 33.3 |
| 1906-1908 | 41 | 22.0 | 2.4 | 39.0 | 36.6 | 17.1 |
| 1909-1911 | 55 | 32.7 | 3.6 | 41.8 | 21.8 | 14.5 |
| 1912-1913 | 70 | 47.0 | 5.7 | 35.7 | 12.5 | 7.0 |
| Of which, only Locations outside of Berlin | | | | | | |
| 1896-1900 | 13 | 7.7 | 7.7 | 38.5 | 46.2 | 100.0 |
| 1901-1905 | 23 | 26.1 | 4.3 | 39.1 | 30.4 | 52.1 |
| 1906-1908 | 27 | 14.8 | 3.7 | 33.3 | 48.1 | 26.0 |
| 1909-1911 | 34 | 29.4 | 5.9 | 35.3 | 29.4 | 23.5 |
| 1912-1913 | 59 | 40.0 | 5.0 | 42.5 | 12.5 | 12.1 |
| Marcuse survey of Berlin Women (1912) | | | | | | |
| 1880-1889 | 5 | 40.0 | | 40.0 | 20.0 | |
| 1890-1895 | 4 | 75.0 | | 0.0 | 25.0 | |
| 1896-1900 | 8 | 25.0 | | 25.0 | 50.0 | |
| 1901-1905 | 23 | 13.0 | | 47.8 | 34.8 | |
| 1906-1908 | 16 | 56.3 | | 25.0 | 18.8 | |
| 1909-1912 | 25 | 36.0 | | 24.0 | 40.0 | |

*Source:* Marcuse (1917) for Berlin and Germany.
*Notes*: Married within ten years of the Princeton date refers to the percent of respondents who were married within ten years of the date of the onset of fertility decline as measured by the Princeton methodology. The date is for the province of residence of the respondent and is taken from Knodel (1974, Table 2.12, p. 62).

Table 3: Explaining the Efficiency of Birth Control Methods

| | Count Models without Endogeneity | | | | Instrumental Variable | |
|---|---|---|---|---|---|---|
| Independent Variables | Poisson: Never Controlling | Poisson: No Control | Poisson | Negative Binomial | Poisson | Negative Binomial |
| Log of the Period at risk | 0.731 | 0.712 | 0.683 | 0.718 | 0.745 | 0.727 |
| | (6.208) | (14.750) | (12.161) | (11.465) | (8.105) | (8.467) |
| Wife's Age | 0.007 | 0.015 | -0.033 | -0.044 | -0.014 | -0.019 |
| | (0.294) | (0.990) | (-1.724) | (-2.324) | (-0.541) | (-0.761) |
| Wartime | -0.125 | -0.123 | -0.113 | -0.153 | -0.012 | -0.071 |
| | (-0.686) | (-1.206) | (-0.975) | (-1.254) | (-0.062) | (-0.372) |
| Withdrawal | | | -1.015 | -1.005 | -2.130 | -2.098 |
| | | | (-4.651) | (-4.851) | (-3.507) | (-3.437) |
| Condom | | | -2.071 | -2.101 | -3.253 | -3.527 |
| | | | (-3.546) | (-3.904) | (-4.990) | (-5.382) |
| Douching and douching with other | | | -0.740 | -0.750 | -1.104 | -1.154 |
| | | | (-1.661) | (-1.759) | (-1.729) | (-2.101) |
| Diaphragm, Cervical Cap, or IUD | | | -2.000 | -1.990 | -1.882 | -1.928 |
| | | | (-2.636) | (-2.706) | (-1.372) | (-1.402) |
| Constant | -0.093 | -0.276 | 0.840 | 1.053 | 0.784 | 0.978 |
| | (-0.143) | (-0.749) | (1.839) | (2.363) | (1.395) | (1.757) |
| log(α) | | | | -1.870 | | |
| | | | | (-4.267) | | |
| Pseudo $R^2$ | 0.43 | 0.82 | 0.56 | 0.59 | | |
| N | 46 | 122 | 227 | 227 | 225 | 225 |

*Source*: Results of count model regressions. Standard errors are clustered on the couple.
*Notes*: Asymptotic t-statistics in parentheses

Table 5: The Efficiency of Contraceptive Methods

| Type of Method | Germany before 1915 | | United States | | Developing Countries (ORC) |
|---|---|---|---|---|---|
| | Average Use (Choice is Exogenous) | Average Use (Choice is endogenous) | Typical Use | Perfect Use | Average |
| No method | 85 | 82 | 85 | 85 | |
| Withdrawal | 30 | 10 | 27 | 4 | 20.9 |
| Douche | 39 | 26 | 29 | 18 | |
| Condom | 10 | 2 | 15 | 2 | 10.3 |
| Sponge | | | 16 | 9 | |
| Diaphragm | 11 | 12 | 16 | 6 | |
| IUD | | | 0.8 | 0.6 | 1.7 |

*Source*: United States (Trussell, 2004, Table 1); ORC for 20 low- and middle-income countries (Cleland and Ali, 2004, Table 1). For Germany, the failure rates are from the results of Poisson and Negative Binomial Regression reported in Table 4.
*Notes*: The risk of conception for "no method" for Germany is the predicted average risk of conception from the respective models.

Table 5: Description of Variables used in the Statistical Analysis

| Variable | Comments | Mean | Standard Deviation |
|---|---|---|---|
| Desired Family Size | Described in comments to Marcuse. | 1.58 | 1.33 |
| Efficiency | Annual probability of avoiding conception (1-est. $\lambda$) | 0.77 | 0.15 |
| Catholic | Husband Catholic | 0.10 | 0.31 |
| Decision within 5-15 years of Princeton date | Decision to contracept (or get married, for couples not choosing to control fertility). | 0.34 | 0.47 |
| Decision within 16-25 years of Princeton date | | 0.16 | 0.37 |
| Decision more than 25 years after Princeton date | Date refers to the when the couple decided with respect to the Princeton date for the onset of the transition in the couple's province of residence. | 0.41 | 0.49 |
| Decision period | Years elapsed since the onset of fertility decline according to the Princeton Project. | 21.04 | 9.86 |
| Wife has an occupation | Wife has an occupation listed, | 0.68 | 0.47 |
| Resident in Berlin | | 0.41 | 0.49 |
| Resident in City > 100,000 | | 0.15 | 0.36 |
| Resident in village | | 0.15 | 0.36 |
| Wife's Age at Marriage | | 22.82 | 3.68 |
| Infant mortality | Share of infants not surviving their first year. | 0.20 | 0.02 |
| Ig in Wife's Province of birth | Ig is the Princeton index of marital fertility. It is measured at or about the wife's 15$^{th}$ birthday and takes account of rural versus urban fertility rates where possible. | 0.43 | 0.13 |
| Middle and Upper Salaried | Includes all *Beamte*, upper-level professionals and the liberal professions. | 0.21 | 0.41 |
| Small Business | Master craftsmen and small business owners | 0.10 | 0.31 |
| Lower Salaried | Salaried workers (*untere Beamte*) such as tram drivers, postal workers, messengers | | |
| Skilled or unskilled | Skilled craftsmen or unskilled workers (*Arbeiter*) | | |

Table 6: Determinants of the decision to practice birth control ($u^*_t \neq 0$)

| Independent Variables | Practice Birth Control (IV Probit) | | Family Size ($M^*_T$) | Practice Birth Control (Probit) | |
|---|---|---|---|---|---|
| | Coefficient | dy/dx | Coefficient | Coefficient | dy/dx |
| Desired Family Size* | -0.817 | -0.11 | | -0.419 | -0.03 |
| | (-5.410) | (-1.53) | | (-3.086) | (-2.09) |
| Husband Catholic | -0.438 | -0.08 | 0.594 | -0.878 | -0.12 |
| | (-0.918) | (-0.88) | (1.767) | (-1.901) | (-1.29) |
| 5-15 Years elapsed | 1.106 | 0.09 | 0.287 | 0.842 | 0.04 |
| since date | (1.985) | (1.53) | (0.652) | (1.344) | (1.60) |
| 16-25 Years elapsed | 0.807 | 0.10 | -0.221 | 0.889 | 0.06 |
| since date | (1.541) | (1.55) | (-0.544) | (1.554) | (1.48) |
| More than 25 Years elapsed | 1.375 | 0.17 | -0.949 | 2.106 | 0.17 |
| since date | (1.536) | (2.05) | (-1.955) | (2.361) | (1.97) |
| Resident in Greater Berlin | -0.068 | -0.010 | 0.961 | -0.200 | -0.02 |
| | (-0.134) | (0.13) | (2.757) | (-0.336) | (0.32) |
| Resident in City > | 1.198 | 0.09 | 0.391 | 1.541 | 0.06 |
| 100,000 | (1.462) | (1.89) | (1.188) | (1.760) | (2.02) |
| Resident in village | | | 0.907 | | |
| | | | (2.377) | | |
| Wife's Age at Marriage | | | -0.034 | | |
| | | | (-1.265) | | |
| Wife has an Occupation | | | -0.212 | | |
| | | | (-0.973) | | |
| Infant mortality | | | 0.027 | | |
| | | | (0.006) | | |
| Ig in Wife's Province | | | 1.573 | | |
| of birth | | | (2.250) | | |
| Middle and Upper | | | -0.527 | | |
| Salaried | | | (-1.00) | | |
| Small Business | | | -0.884 | | |
| | | | (-1.582) | | |
| Lower Salaried | | | -1.217 | | |
| | | | (-2.24) | | |
| Unskilled and Skilled | | | -0.99 | | |
| | | | (0.652) | | |
| Constant | 1.657 | | 1.89 | 1.044 | |
| | (3.534) | | (1.54) | (1.87) | |
| N | 144 | | 144 | 145 | |
| $\chi^2(1)$ Test of Exogeneity | 3.82 | | | NA | |
| $\chi^2(7)$ Test of IV probit | 49.5 | | | | |
| Percent correctly classified | 84.1 | | | 91.0 | |
| Pseudo $R^2$ | NA | | | 0.32 | |

*Source*: Results of maximum likelihood estimation of instrumental variables probit and probit.
*Notes*: Asymptotic *t*-statistics are in parentheses. The dependent variable is the probability that the couple will practice birth control at some point during its married life. It has a sample average of 0.89. The endogenous variable is the desired family size. Its sample average is 1.58.

Table 7: Predicted Probabilities of Using Contraception for Different Couples

| Occupation | Religion | Wife's Age at Marriage | Parents' Family Size | Desired Family Size | Probability of Contracepting |
|---|---|---|---|---|---|
| Agricultural Worker in a Silesian village. Wife employed. Transition underway for 9 years. | Catholic | 22.7 | 6.5-9 | 4.1 | 0.15 |
| Factory Worker in large industrial city in the Rhineland. Wife employed. Transition underway for 14 years. | Catholic | 19.3 | 5.5 | 2.3 | 0.49 |
| Lower-level Salaried worker in Berlin Wife employed. Transition underway for 30 years. | Protestant | 21 | 5 | 0.7 | 0.98 |
| Middle- or Upper Salaried worker in a middle-size city or small town in Brandenburg. Wife not employed. Transition underway for 18 years. | Protestant | 23 | 6 | 1.6 | 0.80 |

*Source*: Results of estimation presented in Table 6.

Table 8a: Determinants of the timing and efficiency of birth control

| Independent | Stopping Strategy | | Efficiency* | Desired Family Size* ($M^*_T$) |
|---|---|---|---|---|
| Variables | Coefficients | dy/dx | Coefficients | Coefficients |
| Efficiency* | -3.963 | -1.57 | | |
| | (2.502) | (2.51) | | |
| Desired Family Size* | 0.473 | 0.180 | | |
| | ( 1.867) | (1.86) | | |
| Middle and Upper Salaried | 0.465 | 0.18 | 0.036 | -0.802 |
| | (0.216) | (1.27) | (0.908) | (-2.662) |
| Small Business | -0.363 | -0.143 | -0.030 | -0.723 |
| | (-0.806) | (-0.83) | (-0.598) | (-2.021) |
| Lower Salaried | -0.282 | -0.112 | -0.050 | -0.829 |
| | (-0.786) | (-0.80) | (-1.234) | (-2.628) |
| Wife's Age | 0.088 | 0.034 | 0.008 | 0.057 |
| | (2.566) | (2.58) | (2.203) | (2.060) |
| Wife has an Occupation | -0.562 | -0.219 | -0.008 | -0.342 |
| | (-1.956) | (-2.04) | (-0.270) | (-1.474) |
| Resident in village | | | 0.011 | 0.749 |
| | | | (0.248) | (2.004) |
| Husband Catholic | | | -0.002 | 0.369 |
| | | | (-0.051) | (1.058) |
| Resident in City > 100,000 | | | -0.013 | 0.791 |
| | | | (-0.287) | (2.180) |
| Resident in Greater Berlin | | | 0.168 | 0.427 |
| | | | (3.574) | (1.182) |
| Years elapsed since | | | -0.006 | -0.021 |
| onset of fertility decline | | | (-2.876) | (-1.161) |
| Infant mortality | | | 0.430 | 9.069 |
| | | | (0.652) | (1.734) |
| Constant | -0.723 | | 0.567 | -1.177 |
| | (-0.477) | | (3.175) | (-0.822) |
| N | 104 | | 104 | 104 |
| $\chi^2(1)$ Test of Exogeneity | 13.8 | | | |
| $\chi^2(7)$ Test of IV probit | 57.4 | | | |
| Percent correctly predicted | 68.2 | | | |

*Source*: Results of maximum likelihood estimation of instrumental variables probit.
*Notes*: Asymptotic *t*-statistics are in parentheses. The dependent variable is the probability that the couple will commence birth control upon marriage. The endogenous variables are the efficiency of contraception and the desired family size.

Table 8b: Determinants of the timing and method of birth control

| Independent variables | Stopping Strategy | | Use Traditional Methods* | Desired Family Size* ($M^*_T$) |
|---|---|---|---|---|
| | Coefficients | dy/dx | Coefficients | Coefficients |
| Traditional methods* | 0.324 | 0.129 | | |
| | (0.559) | (0.56) | | |
| Desired Family Size* | 0.092 | 0.036 | | |
| | (0.200) | (0.20) | | |
| Middle Upper Salaried | -0.065 | -0.025 | -0.271 | -0.743 |
| | (-0.145) | (-0.24) | (-2.729) | (-2.655) |
| Small Business | -0.451 | -0.177 | 0.105 | -0.674 |
| | (-1.072) | (-1.11) | (0.823) | (-1.923) |
| Lower Salaried | -0.417 | -0.164 | 0.041 | -0.774 |
| | (-0.954) | (-0.98) | (0.317) | (-1.999) |
| Wife's Age | 0.100 | 0.040 | -0.010 | 0.042 |
| | (2.879) | (2.88) | (-1.153) | (1.664) |
| Wife has an Occupation | -0.596 | -0.234 | -0.099 | -0.243 |
| | (-1.867) | (-1.87) | (-1.201) | (-1.060) |
| Resident in a village | | | 0.124 | 0.407 |
| | | | (1.041) | (0.804) |
| Resident in City > 100,000 | | | -0.006 | 0.466 |
| | | | (-0.047) | (1.309) |
| Resident in Greater Berlin | | | -0.550 | 0.407 |
| | | | (-4.348) | (0.804) |
| Husband Catholic | | | 0.181 | 0.582 |
| | | | (1.595) | (1.899) |
| Years elapsed since | | | 0.010 | -0.029 |
| onset of fertility decline | | | (1.716) | (-1.841) |
| Infant mortality | | | -0.075 | 8.700 |
| | | | (-0.047) | (2.091) |
| Constant | 2.158 | | 1.073 | -0.669 |
| | (2.081) | | (2.633) | (-0.591) |
| N | 119 | | 119 | 119 |
| $\chi^2(1)$ Test of Exogeneity | 11.15 | | | |
| $\chi^2(7)$ Test of IV probit | 19.4 | | | |
| Percent correctly predicted | 62.1 | | | |

*Source*; Results of maximum likelihood estimation of instrumental variables probit.
*Notes*: Asymptotic *t*-statistics are in parentheses. The dependent variable is the probability that the couple will commence birth control upon marriage. The endogenous variables are the efficiency of contraception and the desired family size.

Table 10: Predicted Contraception Strategies for Different Couples: The Probability of Stopping

| Occupation | Religion | Wife's Age at Marriage | Desired Family Size | Efficiency | Probability of Stopping (Efficiency: Table 8a) | Probability of Stopping (Traditional methods: Table 8b) |
|---|---|---|---|---|---|---|
| Agricultural Worker in a Silesian village. Wife employed. Transition underway for 9 years. | Catholic | 22.7 | 2.8 | 0.80 | 0.67 | 0.62 |
| Factory Worker in large industrial city in the Rhineland. Wife employed. Transition underway for 14 years. | Catholic | 19.3 | 1.1 | 0.69 | 0.42 | 0.34 |
| Lower-level Salaried worker in Berlin Wife employed. Transition underway for 30 years. | Protestant | 21 | 0.4 | 0.77 | 0.21 | 0.39 |
| Middle- or Upper Salaried worker in a middle-size city or small town in Brandenburg. Wife not employed. Transition underway for 18 years. | Protestant | 23 | 1.0 | 0.77 | 0.72 | 0.65 |

*Source*: Results of estimation.
*Notes* The estimated probability of stopping for the occupational/geographic group is in the final two columns of the table.

Appendix Table 1: Contemporary assessments of Methods of Birth Control in Germany ca. 1910

| Method | Efficiency | Costs to Utility |
|---|---|---|
| **Women** ["All these methods are uncertain" and "not yet perfected" (Forel (1907, p. 458)] | | |
| Douching (*Irrigator*, *Mutterspritze*, *Ladies friend*) | Forel (1907, p. 458) not a certain method. Fürbringer (1904, p. 137) less reliable than withdrawal. | Douching easiest when running water and a basin readily available. Easiest for those well-off (May, 1916, p. 61). Use special devices to obviate need for a basin (Woycke, 1988., p. 15). Also serves a hygienic function so useable among Catholics (Woycke, 1988, p.15). |
| Tampons (*Schwämmmchen*, but also moss) | Kisch (1904, p. 415) "completely uncertain method." Forel (1907, p. 458) "quite uncertain"... "not dependable" | Could have some affect on enjoyment if large enough to be effective (Woycke, 1988, p. 13) |
| Small rubber balls with spermicide (*Venus-Apparat, Schlauchspritze*) | Braun and Winterberg (1907, pp, 500-501) very effective, but also subject to risk if rubber ball moves. May (1916, p. 61) more effective than usual douching. | Required significant preparation and coordination (Kisch, 1904, p. 417). |
| Diaphragms (*Occlusiv-Pessar*, *Mensiga-Pessar*) | Forel (1907, p. 458) just a bit less insecure than tampons. Can become dislodged. Kisch (1904, p. 416) "rational", "generally serves the goal." Fürbringer (1904, p. 238) less effective than argued by many gynecologists. Braun and Winterberg (1907, p. 498) suggest using other forms of contraception. Martius (1918, p. 80) argues they are better than other methods except for the condom. Best when used in consultation with the doctor for proper fit. | Inconvenient. Insert each time prior to coitus (Kisch, 1904, p. 416). Can cause inflammation (Fürbringer, 1904, p. 238). Correct insertion difficult, maybe should be by doctor or midwife (Braun and Winterberg, 1907, pp. 498-499). |
| Cervical Caps (*Gummischutzkappe*) | Woycke (1988, p. 41) more certain and more convenient than diaphragm. | Need to be re-inserted once a month by a professional after menses (.(Woycke, 1988, p. 41). |
| Intra-Uterine (Cervical) Devices (*Sterilett, Obturator*, *Stempessar*) | Woycke (1988, p. 42) very effective. Braun and Winterberg (1907, p. 500) "hinders conception with absolute security." | Only inserted once by a doctor (Braun and Winterberg, 1907, pp. 499-500), but should not be left in too long. Caused irritation or even perforation of the uterus (Kisch, 1904, p. 417). Strong concerns about health risks |

| Method | Efficiency | Costs to Utility |
|---|---|---|
| | | (Woycke, 1988, p. 43). |
| **Men** | | |
| Withdrawal (*Coitus Interruptus*) | Has risk of failure; requires skill). "Not reliable enough to be recommended as the best in all cases (Fürbringer, p. 237). Method fails "quite often." "neither harmless nor reliable enough to justify its being recommended as the best in all cases." Placzek (1918, p. 73). Woycke (1988, p. 12) writes of a 60 to 80 percent failure rate. | Very convenient method. Catalogue of problems for husband and wife, including reduced enjoyment for both, various emotional problems (including depression or nervous disease( Forel, 1907; Baum, 1892, pp. 43-44)); Fürbringer (1904, p. 235) is more sanguine; Hasse (1885) is very critical. |
| Rubber Condom (*Kondom*, *Präservativ*) (Thickness: 0.03-0.1 mm) | Braun and Winterberg, (1907, p. 498) has a risk of failure. Don't give it complete trust. Fürbringer (1904, p. 138) cites many authors who find it the best among alternatives; relatively the "most perfect." | Reduces sensation; can be inconvenient . Steady use can lead to impotence (Braun and Winterberg, 1907, p. 498). Can be re-used several times. |
| Caecal Condom (*Fischblase*) (Thickness: 0.008-0.04 mm.) | Ferdy (1908) recommends it. Forel (1907, p. 461) agues that there is virtually no loss of sensation. Also very effective. | Limited impact on sensation. Reusable with proper care. |