Sex and the Single Girl: Cultural Persistence and the Pill*

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Abstract

Historical out-of-wedlock childbearing predicts a quarter of demand for the Pill in Sweden. The positive relationship is robust to the inclusion of economic, demographic, and marriage market controls as well as accounting for unobserved community characteristics. A model of premarital sex where social sanctions and marriage customs play a prominent role illustrates how culture influences nonmarital fertility and contraceptive adoption. The strong influence of historical factors on take-up of the Pill is used to identify how the Pill influenced teenage childbearing. The sharp decline in teenage childbearing following the Pill's introduction is consistent with the model and the empirical results.

JEL Codes: J13, N3, O33, Z10

Keywords: contraception, culture, out-of-wedlock childbearing, teenage fertility, Sweden

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*_Sex and the Single Girl_ was the title of Helen Gurley Brown's 1962 advice book translated into Swedish in 1966 and published under the title _Sexrecept för en ensam flicka_ (Sex recipes for a lonely girl).

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1 Introduction

There are few more compelling examples of technology as liberator than 'the Pill', yet the adoption of this new contraceptive technology was a social phenomenon. The promise of the Pill, a technological innovation which allowed women to assert control over their fertility and their sex lives, stood at odds with centuries of custom and severe social sanction against promiscuity and out-of-wedlock childbearing levied against single women. In the absence of contraceptive technologies to effectively control fertility, facets of culture such as stigma and custom became a more or less effective check on women's fertility, achieved at the price of curtailed sexual freedom and severe punishments against women who deviated from social norms and customs. Women who bore children outside of marriage were social pariahs in 19th century Sweden, a consequence of harsh punishments against promiscuity. While society had changed dramatically by the time the Pill was introduced, there remained a strong influence between the local customs that regulated women's sexuality in the past and the adoption of the Pill.

Demographers have long posited an important role for culture in the spread of contraceptive methods and norms regarding reproduction, yet economic studies of the Pill have largely ignored the social aspects of contraceptive technology adoption.[1] Since Goldin and Katz (2002) several studies have investigated the employment and fertility effects of the Pill using the differential pattern of legal access to contraception for young women across the U.S.[2] The empirical approaches employed in these studies preclude an evaluation of culture's role in contraception demand. This neglect of the social aspects of the Pill's diffusion is surprising given that economists from Malthus to Marshall have long recognized the importance of social forces in fertility control. Marshall argued in his Principles of Economics (1922) that fertility decisions are influenced by cultural forces, emphasizing the role of social constraints such as moral codes and customs:

> "Society exercises pressure on the individuals by religious, moral and legal sanctions, sometimes with the object of quickening, and sometimes with that of retarding, the growth of population....To its [population] influence, often un-

[1] See the Princeton European Fertility Project and related work by Lesthaeghe and Neels (2001), Watkins (1986), and Carlsson (1966).

[2] See Bailey (2006, 2010).

> avowed, sometimes not even closely recognized, we can trace a great part of the rules, customs and ceremonies that have been enjoined in the Eastern and Western world by law-givers, by moralists, and those nameless thinkers, whose far-seeing wisdom has left its impress on national habits."

The first theories of culture focused on the regulation of sexual behavior and reproduction.[3] The historical roots of the habits Marshall describes mirror notions of culture emphasized in Tabellini's (2010) study of the determinants of development among regions in Europe, and the cultures of anti-Semitic violence explored in Voigtlander and Voth (2012). Despite a renewed interest in culture, investigations of its influence on facets of fertility control such as the adoption of modern contraceptive methods are scarce.[4] In taking stock of the recent literature on culture in economics Fernandez (2011) notes the dearth of studies on how contraceptive innovations interact with cultural forces and conjectures that technology and culture jointly influence one another. Recent work by Greenwood, Guner and Fernandez-Villaverde (2012) and Greenwood and Guner (2010) make a persuasive case that sexual mores and courting customs have changed dramatically in the face of contraceptive advances. Quantifying how differences in culture affect the adoption of contraceptive innovations, the other side of this feedback mechanism, is an open question which I aim to address. I use unique data on demand for the Pill and historical illegitimacy behavior to quantify how the social constraints which have shaped fertility patterns since medieval times influence the take-up of modern modes of contraception.

This paper not only extends the scope of empirical studies of cultural persistence to the domain of sexual behavior and contraception but develops a model that makes explicit a role for culture in contraceptive technology adoption. The model is consistent with the data along several dimensions. While it may not be surprising that historical illegitimacy matters for contraceptive demand, it is not clear a priori which way this relationship would go in the aggregate. Mechanisms where contraceptive technology adoption is negatively related with illegitimacy are many. Communities which provide more support to single mothers may experience more non-marital fertility and lower demand for contraception to avoid such outcomes. Contraceptive cultures which diffuse knowledge more effectively may lead to lower

[3] See the extensive literature on culture following Bronislaw Malinowski, in particular his *Sex and Repression in Savage Society* (1931).

[4] See Fernandez and Fogli (2009) for a discussion of the role of culture in contemporary fertility decisions.

unwed birth rates as well as more rapid adoption of new contraceptive technologies. Such mechanisms may be at work, but on their own they cannot account for the strong positive relationship observed in the data. The model of social stigma and demand for premarital sex presented here provides a set of testable predictions which are born out in the data and mirror recent work by Greenwood et al (2012) whom emphasize the role of parents, peers, and religious institutions in shaping sexual mores. The empirical analysis provides insight into how religious institutions interact with community norms to affect decisions regarding sexual activity and contraceptive use while the model emphasizes the peer effects discussed by Greenwood et al (2012).

The data is consistent with social constraints playing an important role in regulating sex and marriage behavior. Historical out-of-wedlock births exhibit substantial variation across locations, which are positively associated with demand for the Pill. Non-marital fertility is highly correlated over time, indicative of persistent differences in social constraints; out-of-wedlock births per 100 births in 1910 have a correlation of 0.76 with measures from fifty years earlier, and 0.55 with measures fifty years later. Though highly correlated, out-of-wedlock birth rates are not constant, but evolve differentially across communities. Some communities have low and stable non-marital fertility over many decades, while other communities have rising non-marital fertility. The relative ranks of communities are stable over time, but they have very different trajectories for how non-marital fertility evolves. This distinctive pattern of long run time variation in unwed birth rates is used to estimate a model in differences, to account for unobserved local characteristics. Places where cultures regarding sex and marriage became more liberal, represented by an increase in the rate of out-of-wedlock birth at the turn of the century, have more rapid take-up of the Pill. The model in differences uses this very different source of variation to identify the effect of culture, yet the conclusions we draw from the data are the same.

While the main objective of the paper is to understand how history influences the demand for modern contraceptives, this strong relationship between historical illegitimacy and take-up of the Pill can also be used to evaluate how Pill use altered the incidence of teenage motherhood. The paradoxical effect of the Pill increasing the incidence of out-of-wedlock childbearing among the young, as emphasized by Akerlof, Yellen, and Katz (1996), cannot

be ruled out by the model but the empirical analysis presented in Section 6 suggests that this was not the dominant effect of the Pill.[5] The data is clear; the Pill reduced the incidence of teenage birth in the decade following its introduction. These results extend the literature on the Pill's role in fertility timing to the case of teenagers, a population emphasized in quantitative studies but overlooked in recent empirical analyses.[6]

The paper proceeds with a review of historical trends, the Swedish institutional setting, and related literature. Next, a model of demand for pre-marital sex is developed and used to analyze the introduction of the Pill. The unique data on Pill use is described in Section 4. The empirical framework and main results are presented in Section 5. Section 6 extends the analysis to estimate the causal effect of the Pill on teenage childbearing and Section 7 concludes.

2 The Historical and Institutional Setting

2.1 Social Sanctions and Courting Customs

Social constraints on individuals' reproductive decisions were particularly strong in 19th and early 20th century Sweden. Evolutionary biologist Bobbi Low (1990) described the setting, "19th century Sweden represents an extreme of societal constraints on people's reproduction: highly monogamous, little remarriage, essentially no divorce, and a low rate of illegitimacy." Societal constraints took many forms; ethnological studies emphasize social sanction against pre-marital sex and courting customs which regulated sexual behavior among the young and

[5] Akerlof et al (1996) emphasize how the Pill and liberalized abortion access altered 'shotgun marriage' customs and reduced the bargaining power of women with preferences against contracepting, inducing some to engage in premarital sex whom otherwise would not, a force leading to increased non-marital fertility. Similarly, Greenwood and Guner (2010) model the direct effect of contraceptive innovations on the courting behavior of the young, modeling how changes in the cost of sex brought about by contraceptive innovations altered the social circles in which the young interacted, and in turn their sexual behavior and the incidence of teenage pregnancy. Yet, Greenwood and Guner (2010) conclude that the Pill contributed very little to the change in sexual behavior among the young.

[6] Bailey (2010) and Ananat and Hungerman (2007) are two papers which discuss the Pill and fertility timing. Kearney and Levine (2011) are a recent exception to the focus in the literature on women aged 18 and older. They examine the role of income inequality in the non-marital childbearing decisions of the young and do not explore the role of technological innovation emphasized here. Gronqvist (2009) also studies how subsidies of the Pill targeted at teenagers reduced the abortion rate and the likelihood of teenage childbearing during a much later time period.

meted out punishment on those who violated local customs.

A woman who engaged in sex outside of marriage was a *hora* (whore) or a *löndahora* (immoral woman). If her sexual encounter resulted in a birth, the child would be referred to as a *horunge* (whore youngster). Unmarried women whom engaged in *lönskaläge* (affairs with unmarried men) or *enkelt hor* (with married men) were subject to punishment under the law.[7]

In addition to legal sanctions, women also faced social and financial penalties levied by the church. "Churching" required unmarried mothers to confess their transgressions in conjunction with ceremonies designed to publicly humiliate them before their children could be baptized. Confession as penance for unlawful intercourse was abolished in 1855 but continued to be practiced into the 20th century in some parts of Sweden. These ceremonies culminated in absolution, but women who confessed illicit sexual behavior would never regain their status and sat apart from the community during church services. The church also imposed fines and work levies on women who conceived children in relationships that did not lead to marriage.

Community sanctions, both social and financial, against women who engaged in pre-marital sex were extensive. The most visible included the wearing of a red cap, called a *horluva* (whore cap), to signify her status when out in public. Folk customs attributed any number of the consequences of poor nutrition among children or livestock to whores. Rickets was commonly believed to be caused by whores, and suspected whores were banned from working near children or livestock.[8] Instead, these women were relegated to heavy field work at reduced wages. Other women were the main monitors of sexual behavior. Married women inspected the breasts of single women, in conjunction with the tending of geese, to find out if they had given birth or were pregnant.[9]

Courting customs also operated as a check on illicit sex and a means for enforcing marriage among the young. Sweden has several distinct courting customs, as discussed by Wikman (1937), but all of these customs carried with them severe penalties for women who had children outside of legitimate marriages. Regions or social groups that were tolerant of pre-

[7] See Chapters 2 and 13 of the Giftermålsbalken and Chapter 17 of the Strafflagen.

[8] Rickets were referred to as *horeskäver*.

[9] Such monitoring had been used to catch child murderers since the Middle Ages.

marital sex within courting rituals were strictly opposed to loose sexual relations. Families played an important role in monitoring courting behavior in the south, while in the north courting was monitored by gangs of young men who punished and excluded individuals who violated *nattfrieri* (night courtship) customs. Customs differed by region according to Frykman (1975); social sanctions were stronger in southern Sweden, while monitoring and enforcement of courting customs was stronger north of the *limes norrlandicus*.[10]

2.2 Fertility Control: Coitus Interruptus and Abortion

The agrarian society that typified Sweden in the 19th century relied heavily on social control as a substitute for contraception. Reduced coition through prolonged abstinence and late marriage was the main means of fertility control, but methods for preventing conception or inducing abortion played a role. Early explanations of divergent fertility patterns in Sweden made little reference to contraception.[11] Although family planning and the spread of neo-Malthusian ideas among intellectual circles was underway in Europe during the 1870's the spread of contraceptive technologies was limited.[12]

Detailed historical analysis of contraceptive practices is scant. The lack of attention paid to contraception in 19th century historical studies may be due to widely held views of family planning as a sign of moral weakness. This view was codified in the anticontraceptive laws of 1910. From 1911 until 1938, it was illegal to provide knowledge of contraceptive techniques or publicly sell contraceptives "intended for immoral use or to prevent the results of sexual intercourse." Knut Wicksell pamphleted and lectured on contraception and was denounced as an "apostle of promiscuity" and jailed for spreading birth control propaganda.

Quantitative evidence from Gotland suggests that interrupted intercourse had been practiced among married couples since the 1700's and throughout the rest of Sweden by the end of the 19th century.[13] Anecdotal and quantitative evidence also leads Frykman (1975) and

[10] *Limes norrlandicus* roughly marks the frontier of medieval society as well as a biological divide between different climate zones with different types of plant growth.

[11] Nils Wohlin (1915) emphasized marital delay and abstinence in his analysis of the extremely low marital fertility rates on Gotland.

[12] Technical contraceptive measures that preceded the Pill were a very recent phenomenon in Sweden according to Frykman (1975).

[13] See Carlsson (1966) and Gaunt (1973).

Santow (1993) to conclude that knowledge about coitus interruptus was widespread by the late 19th century or earlier.[14] These conclusions are supported by the findings of a survey conducted by the Swedish Population Commission undertaken during the early 1930s which found that knowledge of coitus interruptus was widespread, while familiarity with condoms, diaphragms and other methods for limiting fertility were minimal.[15]

The regulation of abortion has a long history in Sweden.[16] The 13th century Västergötland Law forbade any form of induced abortion under threat of severe penalty. The criminal code of 1734 placed abortion on par with infanticide and made it punishable by death. In 1864 and again in 1890 the law was liberalized, and the maximum sentence for abortion was reduced to six years of penal servitude. The law was further liberalized 1921.

Although knowledge of abortifacients was rudimentary, many women attempted to use home remedies to induce abortion.[17] In the last half of the 19th century provincial doctors were required to perform autopsies of suspected suicides and evidence from these autopsies shows that attempted abortion was widespread according to Hedren (1901). From 1851-55 through 1901 an increasing number of suicides were committed by unmarried pregnant women. These suicides increased quickly from 1870 onward, although they showed little systematic variation by region. The majority of women captured in the suicide statistics were in the final stages of pregnancy and their suicides occurred by poison, ninety percent of which occurred due to phosphorous.[18]

[14] Frykman (1975) provides an account, of an exchange between a mother, and her son of around 20 which occurred in 1916. The mother implores her son to be careful while visiting a dance that evening saying "Olle, my dear, I tell you: don't let it drip where it sits unprotected." Her son, recently returned from military service, responds, "Oh no, Mum! I'll push all of it up their arses!" Frykman argues coitus interruptus was known to both the mother's and son's generation.

[15] Although coitus interruptus was well known by 1900, it should be noted that women may have had limited control over its use. Knowledge of the technique does not assure that it was used. The occurrence of out-of-wedlock birth may be seen as reflecting social norms regarding responsibility more than knowledge about the art of interrupted intercourse.

[16] The lack of geographically disaggregated abortion data precludes a study of abortion demand.

[17] Informal measures included phosphorous, arsenic, quicksilver, ergot, saffron and strong laxatives like aloe.

[18] Matches containing phosphorous were banned in 1901 due to their use in abortions, which in many cases were fatal to women.

2.3 The Geography of Swedish Illegitimacy

Social constraints were strong but not uniform. Illegitimacy differed dramatically across Swedish communities at the turn of the century, and had since the first population statistics were collected. These differences formed the basis of a division of Sweden into the distinct demographic regions described by Sundbärg (1910) and depicted in Figure 1.[19]

Before 1850 illegitimacy was highest in the area west of Stockholm and in the most southern parts of Sweden. A single characteristic that defines illegitimacy patterns is difficult to discern; high rates of illegitimacy are seen north and south of the *limes norrlandicus*, along coasts and plains. Mining and industrial regions have relatively high occurrence of unwed birth, but many areas with high levels of illegitimacy were primarily agrarian. Heckscher (1949) argued that urbanization led to the differential pattern of out-of-wedlock fertility, but the detailed maps of illegitimacy during this early period constucted by Frykman (1975) suggest that illegitimacy was independent of population concentration. Frykman (1975) shows how areas with high illegitimacy had population densities no different from central Småland, an area of low illegitimacy.

Increasing out-of-wedlock births during the 19th century have been attributed to many factors. A series of land reforms, begun in the eighteenth century, disrupted rural communities making it difficult to monitor and enforce norms related to sex and marriage among the young. Growing resource extraction industries in the middle of Sweden led to migration of single men to these areas. Women were also more mobile, moving to regions that offered employment in textile industries. A regression of out-of-wedlock births per 100 births in 1910 on indicators for areas where land reform was carried out most extensively, as well as areas where forestry was most prevalent are positive and significant.[20] Historical constraints on community capacity to enforce marriage and pre-marital sex norms appear, in part, to

[19] The figure is from Gustav Sundbärg (1910) *Emigrationsutredningen Bilaga V: Ekonomisk-statistisk beskrifning öfver Sveriges olika landsdelar.* Sundbärg (1910) also included characteristics based on the incidence of suicides, age of marriage, and rates of marital fertility in his analysis.

[20] A regression of out-of-wedlock birth rates in 1910 on fixed effects for communities where the enskifte and lagaskifte land reforms were carried out most "enthusiastically" and "rapidly", according to Helmfrid (1961, p. 127), and a fixed effect for the three counties where the forestry industry employed 7 percent or more of the rural population are positive, highly significant in the case of forestry employment, and significant at the 10 percent level for the land reform measure. This suggests that the forces which constrained the ability of communities to enforce norms of behavior among the young may have led to higher rates of non-marital fertility in the past.

play a role in observed non-marital fertility patterns from the early 20th century.

2.4 Literature Review and the Contemporary Setting

Gustav Sundbärg, the father of Swedish population statistics, argued that community characteristics, persistent across generations, drove the persistent differences in non-marital fertility he documented back through 1750; he coined the phrase "public mood" to refer to these characteristics.[21] The model developed in the next section makes these community characteristics specific in a way that is consistent with the social sanctions and marriage customs emphasized in depictions of 19th century Sweden. Sundbärg's hypothesis and the model developed here are in keeping with Guiso, Sapienza and Zingales' (2006) definition of culture as "those customary beliefs and values that ethnic, religious, and social groups transmit fairly unchanged from generation to generation."

Willis (1999) emphasizes the role of men's and women's absolute and relative incomes as a driving force behind non-marital fertility trends. Social institutions do not play an explicit role in Willis (1999), but the ability of communities to force men to share in the cost of children could raise the "supply price" of unmarried children and diminish the attractiveness of non-marital fatherhood. Akerlof, Yellen and Katz (1996) argue that the introduction of the Pill contributed to the decline of "shotgun marriage" customs and in turn the rise of out-of-wedlock childbearing in the U.S. during recent decades. Greenwood and Guner (2010) analyze how the contraceptive revolution changed the cost of sex and attitudes toward premarital sex among the young. Beyond the contribution of the Pill to the erosion of social norms, Goldin and Katz (2002) argue that increases in women's employment and education can be attributed to innovations such as the Pill. Chiappori and Orrefice (2008) present a theoretical analysis of how the Pill shifted the balance of power between women and men and, according to Orrefice (2007), altered allocations between spouses.

The question I examine, the data I use, and the empirical strategies I employ differ from previous work on culture, fertility and contraception. Norms about sex, marriage, and reproduction are difficult to elicit. Using historical measures of illegitimacy to proxy

[21] See Gustav Sundbärg's *Bevolkerungsstatistik Schwedens 1750-1900* as well as his volume *Emigrationsutredningen Bilaga V: Ekonomisk-statistisk beskrifning öfver Sveriges olika landsdelar.*

for differences in culture is similar to Fernandez and Fogli (2006, 2009), who emphasize culture as a feature of the preference environment. The focus on contraception as a specific channel through which culture influences fertility is unique to this paper.[22] The institutional setting of this paper also differs from studies such as Fernandez (2007) and Blau et al (2008) which analyze the behavior of second generation immigrants using measures of behavior in the parents' home country to proxy for norms. This approach addresses the challenge of separating cultural and institutional influences by looking at immigrants residing in an institutional setting unrelated to the cultural background of their parents. The localities I study face the same legal, educational, medical, and retail drug market institutions.

The homogeneity of institutions in Sweden induced by the extensive regulatory environment is unprecedented. The assumption of uniform institutions is difficult to support in some settings, but in the context of Sweden this assumption is accurate in both the *de jure* and *de facto* sense. The laws regulating the sales of contraceptives do not differ by jurisdiction, and are set by national regulatory bodies. In addition, the medical and retail pharmacy sectors are operated by public entities subject to uniform administration. Pharmacies offer the same assortment of contraceptives, at the same prices, throughout the country. Private insurance is virtually non-existent during this period, so the prices set by the pharmacy monopoly reflect the cost faced by consumers.[23]

Unique sales data from 70 markets constitute the entire universe of oral contraceptive sales in Sweden. The 1970 through 1974 period is the earliest for which data is available following the approval of the Pill for contraceptive use.[24] This period predates changes in abortion access brought about by the Swedish Abortion Act of 1974.[25] Although abortion was illegal, it had become unofficially acceptable to perform abortions in cases of clear medical, social, or humanitarian necessity, as determined by a medical board that reviewed individual petitions for abortion. The Abortion Act granted women access to abortions without the approval of a medical board or two physicians, as required during the period studied here. This

[22] Fernandez and Fogli (2006 and 2009), and other papers on culture transmission such as Bisin and Verdier (2000 and 2001), emphasize the joint influence of culture as transmitted by parents (direct) and the communities in which women reside (oblique). I estimate the composite effect of both forces as proxied for by observed behavior of previous generations of women in a locality.

[23] This period predates the introduction of uniform subsidies on oral contraceptives.

[24] In May of 1964 the Svenska medicinalstyrelsen approved the use of oral contraceptives in Sweden.

[25] Lack of disaggregated abortion data precludes an analysis of culture on abortion demand.

period also predates the revision of the sex education curriculum in 1975.[26,27] In addition to a common curriculum in the schools, all maternal health clinics provided information about contraceptives and supplied diaphragms to women regardless of their marital status since the 1950s. The Riksförbundet för Sexuell Upplysning (RFSU) kept a list of doctors known to provide contraceptives, but by the late 1960s they deemed this unnecessary as doctors were universally willing to provide contraceptive services to women. Swedish law also provided the right to women as young as 15 to receive help with birth control measures without parental knowledge. In 1968, of those couples using some type of preventative method at their most recent intercourse, condoms and coitus interruptus were the most common methods, followed by the Pill.[28]

Sweden's institutional setting is well suited for an analysis of culture's effect on demand for the Pill. The legal, medical, retail pharmacy and educational institutions that played a role in the supply of the Pill and contraceptive information were all subject to uniform rules during the period studied. In this unique environment, where all of the salient institutional features are constant, large differences in sales of oral contraceptives are arguably demand driven.

3 Model

The primitives in the model are different technologies for preventing out-of-wedlock child-bearing. Demographic studies have emphasized how land reforms and differences in customs affected the capacity of communities to monitor and enforce norms of behavior among the young. Differences in the capacity to prevent out-of-wedlock births and norms regarding pre-marital sex can have long lived effects on demand for new contraceptive technologies according to the model developed here.

Out-of-wedlock births per woman in community j is a function of the share of women in locality j that engage in out-of-wedlock sex, n_j, and the probability that a woman engaging

[26] It should also be noted that advertising by pharmaceutical companies to consumers was prohibited.

[27] Since 1970, Swedish law has not distinguished between children born in and out-of-wedlock with regard to paternal inheritance rights, and changes in the marriage code that expanded the scope for civil marriages predate the period studied.

[28] See Lewin (2000).

in pre-marital sex in locality j would incur an out-of-wedlock birth, p_j

$$owb_j = n_j p_j.$$

The share of women that choose to engage in sex outside of marriage will be determined in equilibrium, given the probability p_j. p_j is a function of local constraints on the contracts that can be enforced between couples or the contraceptive technologies available in the community, and is taken as given. Women in community j choose whether to engage in pre-marital sex in order to maximize their utility, which reflects the utility they receive if they do not engage in sex, V, as well as the joy they receive from engaging in non-marital sex, β_i, where this taste parameter varies across women.[29] Women also take into account the costs of out-of-wedlock sex. These costs include both a social sanction, γ_j, as well as the relative cost of an out-of-wedlock birth, C, that happens with probability p_j.[30] The utility of engaging (or not) in pre-marital sex is given by

$$U_{i,j} = \begin{cases} V & \text{abstain} \\ \beta_i - \gamma_j - p_j C & \text{pre-marital sex} \end{cases}$$

Each community will have a critical threshold, β_j^{sex}, where women with larger benefits from pre-marital sex will choose to engage in sex and women whose benefit is less than this threshold will choose to abstain. This threshold value, β_j^{sex}, is increasing in both the social sanction and the expected out-of-wedlock birth cost,

$$\beta_j^{sex} = V + \gamma_j + p_j C.$$

Assume that β_i is distributed according to the cumulative distribution function $\Phi(\cdot)$. The fraction of women engaging in pre-marital sex in each community is

$$n_j = 1 - \Phi(V + \gamma_j + p_j C).$$

[29] For simplicity I assume β_i shares a common distribution across communities and that V is a constant. These assumptions could be relaxed without changing the general conclusions of the model. Persistent heterogeneity across communities in the relative utility derived from abstinence may be another way culture affects both out-of-wedlock birth rates and demand for the Pill.

[30] The cost of an out-of-wedlock birth is both an economic and social outcome. Persistent heterogeneity in this cost across communities, just as with the relative utility derived from abstinence, may be another way culture affects both out-of-wedlock birth rates and demand for the pill. With sufficiently long data on pill demand it may be possible to distinguish between fixed differences in the value of abstaining, V, over different communities and the dynamic evolution of the social sanction term, γ_j, but this is beyond the scope of the current paper.

The social sanction associated with engaging in out-of-wedlock sex is higher if fewer women in your community have sex outside of marriage.[31] If no one engages in pre-marital sex in the community this cost may be large, $\lim_{n_j \to 0} \gamma(n_j) = \infty$, but the more women whom engage in sex outside of wedlock the smaller will be the social sanction of doing the same, $\frac{\partial \gamma_j}{\partial n_j} < 0$.[32]

Changes in the cost of non-marital sex brought about by changes in p_j have an ambiguous effect on the out-of-wedlock birth rate. The direct effect of an increase in p_j is to raise out-of-wedlock births for a given share of the population engaging in out-of-wedlock sex, while the indirect effect works in the opposite direction, reducing the fraction of the population that engages in non-marital sex,

$$\frac{\partial owb_j}{\partial p_j} = \frac{\partial p_j n_j}{\partial p_j} = n_j + p_j \frac{\partial n_j}{\partial p_j}.$$

The total response will be positive when the elasticity of the share having sex with respect to p_j, $\varepsilon_{n,p}$, is less than unity,

$$\varepsilon_{n,p} = \frac{\partial n/n}{\partial p/p} > -1.$$

This mild condition will be maintained in the analysis and for examples calibrated such that both the social sanction and the expected cost of an out-of-wedlock birth have similar weight in the decision problem women face $\frac{\partial owb_j}{\partial p_j}$ is weakly positive.[33]

What happens when the Pill is introduced? The inherited social sanction γ_j, a function of the existing technologies in a community, does not adjust immediately to the introduction of the Pill. In the short run the social sanction is fixed.

The probability of a costly out-of-wedlock birth is p_p when using the Pill, and this comes at cost c_p. Each woman compares abstaining to the utility she would obtain using the technology that is least costly to women in her community. She compares using the existing technology, with associated probability p_j, to the birth control Pill with the probability of out-of-wedlock birth p_p and cost c_p. Women will use the Pill if the net benefit of using the

[31] This is consistent with a conformity norm. If few women have pre-marital sex then there will be more women to punish deviators.

[32] A function that satisfies these conditions is $\gamma_j = \frac{1}{n_j} - 1$. In this case the equilibrium share of the population engaging in pre-marital sex, n_j, is characterized by the following equation $n_j = 1 - \Phi(V + \frac{1}{n_j} - 1 + p_j C)$.

[33] $\Phi(\cdot)$ is assumed to be the Normal cdf and $\gamma(\cdot)$ follows the example in the previous footnote in these computations.

new technology exceeds the cost,

$$c_p < (p_j - p_p)\, C$$

and the value of using the Pill and engaging in out-of-wedlock sex exceeds the value of abstinence,

$$V < \beta_i - \gamma_j - p_p C - c_p.$$

This will lead to another critical threshold in each community, β_j^{Pill}, that will partially determine the choice to adopt the Pill if $\beta_i > \beta_j^{Pill}$, where

$$\beta_j^{Pill} = V + \gamma_j + p_p C + c_p.$$

Demand for the Pill will depend on two conditions:

$$n_j^{Pill} = \underbrace{\left[1 - \Phi\left(V + \gamma_j + p_p C + c_p\right)\right]}_{\text{Social Sanction}} \times \underbrace{1\left[\text{if } c_p < (p_j - p_p)\, C\right]}_{\text{Local Customs}}.$$

The first condition describes demand for the Pill, or the share of women whom would engage in non-marital sex using the Pill as a function of the social sanction, γ_j. If social sanctions are large, few women engage in non-marital sex, and demand for the Pill will be low. The social sanction reflects past behavior, in particular the share of women who engaged in non-marital sex in past periods.[34] The second condition captures the effect of local customs that prevent out-of-wedlock birth. If local customs are ineffective at preventing unwed births, reflected by a large p_j, women will choose to adopt the Pill as a means to prevent costly out-of-wedlock births.

Small sanctions on engaging in pre-marital sex, γ_j, tend to raise the rate of out-of-wedlock birth, all else equal, as do poor customs for preventing out-of-wedlock birth, large p_j. Past out-of-wedlock birth rates proxy for both of these forces.[35] The model illustrates how social forces influence demand for contraceptives. Social sanctions and customs affect demand for the Pill just as they influenced out-of-wedlock birth rates. It is not out-of-wedlock birth rates *per se* that cause increased demand for the Pill, but differences in the social sanction incurred by engaging in non-marital sex, or the ability of local institutions to enforce promises

[34] The economy does not move to a new stationary equilibrium immediately in response to the introduction of pill, but social sanctions will adjust over time to the existence of the pill.

[35] Both forces are important and the possibility of multiple equilibria makes clear that customs alone do not determine illegitimacy behavior as a given custom can be consistent with different degrees of social sanction.

of marriage in the case of pregnancy. The model illustrates how local customs and social sanctions from the past shape demand for modern contraceptives.

4 Data Description

To explain the striking differences in demand for oral contraception in Sweden from 1970-1974 data on current demographic and economic conditions, characteristics of the local marriage market, non-pecuniary costs of obtaining the Pill, as well as demand shocks in the form of venereal disease (VD) prevalence are constructed. In addition to extensive contemporaneous controls, alternative historical factors related to the role of religion and women's education attainment are also included. Table 1 presents summary statistics for the variables used in this analysis.[36]

The main explanatory variable is out-of-wedlock births per 100 births in 1910. The left panel of Figure 2 maps unwed births per 100 births in 1910. The data is compiled from the *Befolkning Statistisk Årsbok* for each year.[37]

The dependent variable is the sale of oral contraceptives per woman aged 16-40 for 70 markets.[38] These data, from the quarterly *Swedish Drug Market* publication, are unique to this paper.[39] Average expenditures per woman was 9.6 SEK per year. This corresponds to approximately 10 days of the most popular variety of the Pill.[40] A year of the Pill would cost less than one percent of the average woman's income at the time. Since different communities face the same supply curve, differences in quantities sold reflect differences in demand.[41] The

[36] The values reported in Table 1 are unweighted averages.

[37] The data reported in the statistical yearbooks comes from population censuses performed every decade, supplemented by data from local church books. Church books contain extensive birth, death, and marriage records in addition to the minutes of the *husförhör* (home interrogations) conducted by local priests. The 1900 census resulted in a discrepancy of only 310 missing individuals in the Church records of a total population of just over 5 million. The dual collection of population statistics, and the high level of agreement between these measures during the period I investigate argues for the reliability of the birth statistics used here.

[38] These 70 markets account for the total universe of oral contraceptive sales in Sweden.

[39] Previous studies have relied on retrospective surveys to determine which types of contraception women had used at different points in time. These surveys are useful in eliciting information on the birth control methods women have used, but they present an incomplete picture of demand for the Pill.

[40] Expenditures per month would correspond roughly to the cost of two movie tickets, or three bottles of wine.

[41] Non pecuniary costs, such as access to pharmacies, may have differed across markets, but I account for this in the empirical specification.

right panel of Figure 2 maps demand for the Pill across markets. Areas of high and low demand are found in the North and South, and in both densely and sparsely populated areas. Urban areas, such as Stockholm and Malmö, are among the highest Pill demand areas, but Gothenburg, the second largest city, is not among the top ten markets.

5 Empirical Specifications and Results

5.1 Fixed Culture: A Model in Levels

Culture as a persistent characteristic is consistent with non-marital fertility patterns in Sweden. The correlation between non-marital fertility across counties from 1860 to 1910 is 0.76, and it is nearly as large for the subsequent fifty year period. An empirical model in levels evaluates whether out-of-wedlock births, a proxy for differences in sanctions and customs, can explain demand for the Pill across markets.

All of the models considered share a common linear specification. $Pill_{jt}$ represents demand for the Pill per fecund female in locality j at time t. X_{jt} contains contemporaneous factors that vary over locality and time. OWB_j captures past out-of-wedlock birth behavior in locality j, an outcome that reflects differences in cultures that have persisted over time. The estimated model is

$$Pill_{jt} = X_{jt}\beta + OWB_j\alpha + \eta_t + \varepsilon_{jt}.$$

The full set of time fixed effects are captured by η_t, and ε_{jt} represents unobservables in community j at time t.[42] The model relates demand for the Pill from 1970 through 1974 to historical out-of-wedlock birth rates.

Out-of-wedlock births are measured at the market level. Most standard errors are clustered by county to allow for arbitrary correlation at the market level, within county, in the unobservables.[43] Clustering at the more disaggregated market level, is appropriate and

[42] We consider specifications with time fixed effects to capture aggregate trends in demand for the pill, but omitting these fixed effects has little impact on the estimated coefficient on culture. Similarly, estimating the model for each year instead of by pooled OLS yields similar estimates with regard to the influences of out-of-wedlock births.

[43] There are 70 markets and 24 counties in Sweden. While some markets and counties correspond one to one, the island of Gotland is one example of this, there are roughly three markets per county, and a maximum of four markets in any one county.

produces somewhat smaller standard errors. A battery of robustness tests are presented in Section 5.2.1 to evaluate the sensitivity of the baseline results.

5.2 Levels of Out-of-Wedlock Birth and Pill Demand Results

Historical out-of-wedlock birth rates are positively correlated with demand for the Pill, as seen in Table 2, and this relationship is robust to whether contemporaneous economic, demographic, epidemiological and supply side controls are included as well as the period in which past out-of-wedlock births are measured. The first specification in Table 2 includes out-of-wedlock births per 100 births from 1860 and year fixed effects. The coefficient on the out-of-wedlock birth rate is 0.20 and highly significant. Including the full set of contemporaneous controls which include employment and income controls for both men and women, age characteristics by marital status, the sex ratio for unmarrieds aged 16-40, the number of pharmacies normalized by the geographic area to control for differences in the non-pecuniary costs of obtaining the Pill, and demand shocks such as the prevalence of venereal disease in a community results in a slightly larger and more highly significant coefficient.[44,45] Columns 3 and 4 presents estimates from models with and without contemporary controls when out-of-wedlock birth rates are measured in 1900. Coefficient estimates are similar in magnitude and significance to the estimates obtained using unwed births measures from 1860. The final two specifications in Table 2 report results for the same two specifications using out-of-wedlock birth rates from 1910. Coefficient estimates are positive and significant at the one percent level and somewhat smaller in magnitude. Although persistent differences in cultures regarding sex, marriage, and contraception are not variable price or income measure, it is still informative to compute the elasticity of Pill demand to out-of-wedlock birth. The elasticity

[44]The fraction of the population that has VD per 1000 of the population aged 15-40 lagged one year captures the prevalence of VD in the locality. VD includes congenital or acquired syphilis, gonorrhea, or cancroid.

[45]In alternative specifications, not reported here, I control for other moments of the income distribution including median income measures and ratios of the 70th to the 30th percentiles of the income distribution for the whole population, the ratio of male to female income, and other source incomes, but the coefficient on unwed births in unchanged. Alternative specifications that take into account migration, using the share of the population that is foreign born, as well as differences local schooling systems, such as the share of high school students enrolled in programs that qualify them to attend university have similar results with respect to the importance of out-of-wedlock birth rates. Similarly accounting for additional characteristics of married women in the locality, such as the share with two or more children, does not affect the coefficient on unwed births.

in the final specification is 0.23, in the middle of the range of similar elasticity estimates using data from other periods.[46]

The results reported in Table 2 are consistent with persistent social constraints affecting contraception decisions. The point estimate in the last specification suggest that a one standard deviation increase in the rate of out-of-wedlock birth would result in an increase of 0.42 standard deviation in demand for the Pill. Regardless of whether minimal or extensive covariates are included, or the time period considered, be it 1860, 1900, or 1910, historical illegitimacy has a strong positive correlation with demand for the Pill when introduced in Sweden.

5.2.1 Robustness Checks

The results presented in Table 2 are robust to alternative assumptions regarding the behavior of residuals, the estimator used, and the measure of unwed birth. Sensitivity analyses using the same model as in column 6 of Table 2, the baseline specification, and alternative measures of out-of-wedlock birth are reported in Table 3 and discussed below. Estimates reported in Table 2 are unweighted, but weighting by the fecund female population in the 1970s results in similar estimates, slightly smaller in magnitude, consistent with social sanctions and marriage customs having a stronger effect in less populous areas.

Alternative Measures of Out-of-Wedlock Birth Rates All specifications in Table 2 measured out-of-wedlock births per 100 births, but alternative per woman measures yield similar results. The coefficient reported in the first column of the top panel of Table 3 corresponds with the baseline specification, while column 3 is identical to the baseline, but the measure of unwed birth is computed per 1000 women instead of per 100 births. The coefficient is positive and significant regardless of which measure is used, and the elasticity is similar to the per birth measure.

The model posited that unwed births had a social component, but illegitimacy may also be driven by economic factors or local marriage market conditions. A two-step estimation

[46] The coefficient estimate in specification 2, using unwed birth measures from 1860, corresponds with an elasticity estimate of 0.20, and the coefficient from specification 4 implies an elasticity of 0.25, using illegitimacy measures from 1900.

procedure is used to address this. I regress out-of-wedlock birth rates on the sex ratio, women's wage rate in levels as well as relative to men's wages, and the urbanization rate, all measured in 1910. These are the factors emphasized in Hecksher (1949) and Willis (1999). The residual from this regression is used to measure the cultural component of unwed births. The approach partials out the components of out-of-wedlock births driven by factors one may argue are unrelated to culture. Results from the second stage regression are reported in columns 2 and 4 of Table 3 for unwed births per 100 births and per 1000 females.[47] The point estimate for the per birth measure are similar to the results reported in Table 2. Although differences in economic and marriage market conditions influenced illegitimacy rates in 1910, these factors do not drive the strong relationship between illegitimacy at the turn of the century and subsequent demand for the Pill.

The Between Estimator The same four specifications are estimated using the between estimator in the bottom panel of Table 3, in effect regressing averages by market. The coefficients on out-of-wedlock birth rates are unchanged and remain highly significant when using the between estimator for all four specifications. The coefficient estimates on the per birth measures in column 1 and 2 range from 0.16 to 0.18 using the between estimator or pooled OLS. Coefficient estimates on unwed birth per woman range from 0.33 to 0.35. The relationship between past illegitimacy and demand for the Pill is robust to alternative estimators.

Measurement Error According to Myrdal (1968) high non-marital fertility rates in Sweden were due to more accurate birth statistics.[48] Yet birth statistics may overstate illegitimacy if many illegitimate births are the product of stable partnerships that ultimately lead to marriage. The tradition of long engagements in Sweden, with betrothals announced years in advance of marriage, may have led to births being classified as illegitimate which, from

[47] Results from the first stage suggest that urbanization has a positive and highly significant effect on out-of-wedlock births, regardless of how they are measured, while the sex ratio is a significant determinant of out-of-wedlock birth per women.

[48] Only if illegitimate births included children born from extramarital relations could the statistics understate illegitimacy according to Myrdal (1968).

the perspective of the model, may have been quite different.[49] Until 1900 the number of illegitimate births that occurred to engaged women were also reported in the birth statistics.[50] Estimating the baseline model using a measure of the illegitimate births per 100 births in 1900 which excludes births to engaged women yields a slightly larger and still highly significant coefficient estimate of 0.26 (0.06). Accounting for measurement error related to the timing of marriage for engaged couples does not alter the strong positive relationship between past illegitmacy and demand for the Pill.

The discrepancy between church book and the census records was largest in Stockholm. Omitting Stockholm from the estimation of the baseline model results in a slightly smaller though still highly significant coefficient on out-of-wedlock birth of 0.16 (0.04). Stockholm does not drive the positive relationship found in the data.

Placebo Tests One may be concerned that it is not marriage customs, nor norms about pre-marital sex that drive differences in demand for the Pill, but persistent differences in the use of medicine, contraceptive or otherwise. A series of placebo tests are run to address this, replacing demand for the Pill in the baseline specification with measures of demand per adult for a variety of drugs such as antibiotics, nonprescription analgesics, cough medicine, and multivitamins. These drugs are chosen because their use is also largely demand driven. Regardless of how unwed births are measured, coefficient estimates are not significantly different from zero, and demand for these medicines shows no consistent relationship with non-marital fertility in 1910. For the case of vitamins demand is positively related to non-marital fertility, while for antibiotics, aspirin, and cough medicine demand is negatively correlated with past unwed birth rates, although none of these point estimates are significantly different from

[49] An alternative definition of illegitimate births including all children conceived outside of wedlock is not well aligned with the model, nor can it be calculated for the broad group of communities considered here. According to Linner (1967) 35 percent of all brides in Sweden are pregnant on their wedding day, which is similar to Myrdal (1968) who estimated that 34 percent of marriages in 1916 resulted in births in less than eight months, and that from 1931-35 25 percent of all children born to women under the age of 30 took place within eight months after the marriage.

[50] In 1900, 9 percent of illegitimate births were to women engaged to be married. In rural areas these births accounted for 10 percent of illegitimate births, 7 percent in cities and villages. In Stockholm births to engaged women accounted for only 4 percent of illegitimate births compared to 6.6 percent in Gothenburg and 12 percent in Malmö.

zero.[51] These results suggest that the importance of historical illegitimacy on drug demand is specific to the Pill.

Contemporary Illegitimacy and Alternative Functional Forms The nature of non-marital fertility changed significantly with the spread of cohabitation as an alternative to marriage in the later half of the 20th century. Out-of-wedlock births per 100 births in 1910 and 1961 have a correlation coefficient of 0.55, yet the nature of the births which underly these measures may be quite different. As discussed with regard to the historical literature review, out-of-wedlock births at the turn of the century and before carried a strong social penalty. Births to unmarried women in 1860 which were not legitimated by marriage were generally synonymous with single mothers, not cohabitating couples in informal marriages.[52] As attitudes toward cohabitation changed out-of-wedlock birth became more common and no longer reflected community norms regarding single motherhood as they once had. The changing social context of marriage may have changed the relationship between observed non-marital fertility behavior and social norms regarding promiscuity. The common occurrence of cohabitating households with children and the social acceptance of cohabitation as an alternative to marriage make recent measures of non-marital fertility less reflective of norms regarding promiscuity than measures from the turn of the century. In this regard, comparisons on non-marital fertility from recent time periods where births to cohabitating couples account for a significant share of non-marital births introduces a potential source of measurement error which may bias estimates with regard to the effect of social norms on demand for the Pill.

Under different assumptions with regard to the nature of this measurement error we can mitigate this potential source of bias by comparing alternative functional forms for the empirical specification. In the case that cohabitation is proportional to the degree of single

[51] With regard to vitamin demand per adult, the mean demand is 3.7 SEK and the coefficient estimate on unwed births is 0.01 with a standard error of 0.05. Demand per adult for antibiotics is 15 SEK on average and the coefficient on unwed births is -0.12 with a standard error of 0.13. Analgesics such as aspirin which do not require a prescription face a demand of 2 SEK per adult on average across the 70 markets, and the coefficient of unwed births in the demand equation is -0.01, with a standard error of 0.02.

[52] Cohabitation was uncommon at the turn of the century, and generally regarded as inferior as reflected by the derogatory reference to such arrangements as "Polish marriages." I thank Torben Traenas for this insight.

motherhood in a community, for example where observed nonmarital fertility consists of an underlying population of single mothers plus a proportional amount of cohabitating mothers, where this proportion is constant across communities, an empirical specification where non-marital fertility enters in logs could account for this type of proportional measurement error. The proportional measurement error case may be the most reasonable, in the sense that it would suggest that cohabitation, in absolute terms, would be more common in communities with relatively liberal norms regarding pre-marital sex while relatively rare in communities with more conservative attitudes, versus estimating a model in levels which would only be unbiased if the effect of cohabitation on non-marital births was uniform (in levels) across communities. Replacing the measure of nonmarital fertility with a measure from 1961 in the baseline specification yields a positive yet smaller coefficient estimate 0.12 (0.06), significant at the 10 percent level.[53] Estimating a similar model where non-marital fertility enters in logs yields a positive and more highly significant coefficient estimate 1.54 (0.73), implying an elasticity of demand for the Pill to contemporary illegitimacy of 0.16.[54] Although recent measures of single motherhood are likely prone to significant measurement error due to the growing prevalence of cohabitation there is general support for the strong positive relationship found using measures from earlier periods.[55]

5.2.2 Alternative Historical Factors

Illegitimacy remains an important determinant of demand for the Pill even after controlling for historical religious environment, education attainment, and development. Presence of Pentecostals and the share of the community opposed to prohibition significantly influence future demand for the Pill. Yet, accounting for these factors does not affect the quantitative importance of past illegitimacy, as seen in Table 4.

[53] The model of Pill demand with extensive controls and a measure of unwed births per 100 births in 1961 yields a coefficient estimate of 0.11 and a clustered standard error estimate of 0.06.

[54] Care is taken to select a period that strictly predates the legalization of the Pill, but results are similar when using later data.

[55] Instrumental variables would be another means for addressing the measurement error issue. One may argue that historical illegitimacy rates could be a valid instrument. Using unwed births from 1910 to instrument for non-marital fertility in 1961 yields a coefficient estimate on unwed births in 1961 of 0.30 (0.08), twice as large as the estimate in the OLS regression.

Wages, Sex Ratios and Urbanization in 1910 Differences in out-of-wedlock birth rates may reflect differences in women's economic opportunities, as argued by Willis (1999) and Heckscher (1949). These differences may have a persistent component that could influence demand for the Pill. Including the urban to rural population ratio, the ratio of women to men, and women's wages in levels and relative to men, all from 1910, addresses this concern. The first column of Table 4 reports these results. While female wages have a negative and significant relationship with subsequent demand for the Pill the coefficient on out-of-wedlock birth is not significantly different from the baseline estimate. This exercise differs from the two-step approach in Table 3 since historical measures are not restricted to work through past illegitimacy.

Historical Marriage Patterns Reducing the occurrence of coition outside of marriage was one way for communities to prevent the occurrence of costly out-of-wedlock births. Inducing young couples to marry early, either in cases of premarital pregnancy or as a general norm of behavior was a means to achieve this. According to the model, early marriage norms embodied in low values of p_j can act as substitutes for contraception in preventing non-marital births. If these norms persisted we should also see a relationship between historical age of first marriage patterns and demand for the Pill. Where courting customs that promote early marriage are strongest we would expect demand for the Pill to be lower. In communities with weaker norms for early marriage the demand for the Pill should be greater.[56] This intuition is confirmed in column 2 of Table 4. In communities where women married youngest an increase in the average age of first marriage, hence weaker marriage norms, the greater is demand for the Pill six decades later. The negative coefficient on age of first marriage in late marriage communities could be interpreted as consistent with Malthusian restraint being highly persistent. Communities which effectively promote late marriage as a means of reducing fertility may continue to promote prolonged abstinence even in the face of modern contraceptive methods, hence leading to reduced demand for the Pill. While historical marriage patterns are important determinants of demand for the Pill, accounting for age at marriage does not alter our conclusions regarding the importance of past illegitimacy.

[56] Delayed marriage also played an important role for reducing coition and in turn fertility in 19th century Sweden.

Women's Education Norms regarding education may influence women's demand for the Pill. The share of women with a high school degree in 1930 is used as a proxy for local norms about female human capital investment. Column 3 evaluates how women's past education attainment affects Pill demand. High school attainment in 1930 reflects the education environment faced by the mothers of the fecund females studied. The women whose high school attainment is measured are no longer fecund and do not affect demand for the Pill directly, but the culture that shaped their education decisions may continue to influence future generations of women. The coefficient on high school attainment is positive, but not significant. Although education norms may be an important factor in women's demand for the Pill, accounting for such factors does not change conclusions about the importance of past out-of-wedlock birth rates.[57]

Religion The vast majority of Swedes are members of the Church of Sweden (Svenska Kyrkan), but several other Protestant denominations have been prevalent in certain communities.[58] Including the share of population that was a member of a Pentecostal Church in 1930 quantifies how religious composition affects demand for the Pill. The coefficient estimate on the Pentecostal share is negative and significant at the tenth of a percent level suggesting that the more prevalent Pentecostals the lower is demand for the Pill, though the coefficient on the out-of-wedlock birth rate is little changed.[59]

The important role of religious institutions is consistent with the hypothesis that culture matters for shaping contraceptive demand. Guiso, Sapienza and Zingales (2006) and others have emphasized the role of religion in transmitting cultural norms, and the results are consistent with religious institutions playing an important role in regulating demand for

[57] I also account for local differences in women's literacy in these same communities. The literacy (småskolan) education corresponds to less than an elementary education. Alternative specifications that include measures of women's literacy rates have similar results where the coefficient on literacy is positive but not significant, and the coefficient on unwed births is unchanged.

[58] In 1930 the largest religious minority in Sweden was the Swedish Mission Church, which claimed 2.4 percent of the population as members. The next largest religious minorities were the Baptists and Pentecostals with 1.3 and 0.7 percent of the population respectively. It should be noted that some members of dissenting religions were also members of the Church of Sweden.

[59] Pentecostals were the only group among the three largest dissenting denominations that had a significant marginal effect, though all three had little impact on the unwed birth coefficient. Alternative specifications that take into account the share of the local population that are members of significantly smaller denominations, such as the Catholic Church, do not change our conclusions regarding the importance of local norms as proxied for by out-of-wedlock birth behavior in 1910.

contraception. Cursory analysis does not suggest that there are strong complementarities between the prevalence of certain religious denominations and the community norms captured by historical unwed birth rates. Including an interaction term for the prevalence of Pentecostals and the unwed birth rate does not alter the results, and the interaction term is not significant.[60]

Prohibition In order to capture differences in religious culture when over 95 percent of the population was part of the Church of Sweden an alternative proxy is constructed based on the results of the alcohol ban referendum of 1922. The temperance movement in Sweden was closely aligned with the Church. Less support for the ban corresponds with less religious communities.[61] Individuals may have had little choice with regard to their membership in the Church of Sweden, but the share of the population that supported the alcohol ban provides a measure of those sharing similar views to those espoused by the Church.

Opposition to prohibition has a significant positive effect on Pill demand, as seen in the fifth column of Table 4. This is consistent with more religious communities, which supported prohibition, having more conservative attitudes regarding sex. These attitudes are persistent, and in turn reduce demand for contraception. The out-of-wedlock birth rate coefficient remains highly significant and similar to the baseline estimate. This complements and validates the main results, highlighting the importance of religion in transmitting cultural norms.

The last column of Table 4 evaluates to what extent the Church, and the norms it espoused, complement community customs that reduced the occurrence of out-of-wedlock fertility. An interaction term, increasing in both the proportion of births outside of wedlock in 1910 as well as the share of the population that opposed prohibition, is added in the last column. The coefficient on unwed birth in 1910 increases slightly in both magnitude and significance, as does the coefficient on prohibition opposition, relative to the results reported in column 5. The coefficient on the interaction term is positive and significant, suggesting that a strong Church presence complemented community customs in influencing demand for con-

[60] The interaction term is constructed by demeaning both membership in the Pentecostal Church and the share of births outside of marriage, ordering both variables so that larger values indicate more liberal attitudes toward premarital sex, and computing the product.

[61] Many civic organizations and unions also supported prohibition. In this regard prohibition does not only proxy for religion but civic ties more generally.

traception. This means that communities with high/low unwed birth rates and weak/strong presence of the Church also had disproportionally greater/lesser demand for the Pill. Quantitative models of preference formation with regard to sexual behavior such as Greenwood et al (2012) have emphasized how the decisions of the Church and parents to instill norms of behavior in the young interact, the results in column 4 provide empirical evidence on this complementary relationship.

5.2.3 Heterogeneous Effects

Is the effect of culture uniform across communities, or is the strong relationship between past illegitimacy and demand for the Pill driven by behavior among a certain subset of communities? Table 5 traces out the differential impact of culture on contraceptive decisions across communities with different characteristics by interacting out-of-wedlock birth rates with community indicators. A positive and significant relationship between past illegitimacy and demand for the Pill is found in all communities, although the relationship is significantly stronger in communities with strong religious institutions and a low degree of mobility with regard to residents place of birth. Strong ties and strong local institutions make for a highly persistent effect of culture on demand for the Pill.

Turning to the results in Table 5 in detail, the first column reports coefficients on non-marital fertility in 1910 for communities with high and low levels of unwed birth in 1910. Both coefficients are large, positive, and highly significant. The effect of past illegitimacy is not significantly different across these two types of communities. The second specification quantifies Frykman's (1975) hypothesis that marriage customs were more important north of the *limes norrlandicus*, while stigma was more prevalent to the south. While the forces for regulating out-of-wedlock fertility may differ their influence on demand for the pill is similar according to the result reported in column 2. The third specification compares communities where more or less of the residents were born within the county.[62] While the impact on Pill demand is positive and significant in both types of communities, the marginal effect is significantly larger in communities where outsiders are a smaller fraction of the population. The next two columns look at two types of migration discussed in the demographic liter-

[62] According to county level computations from the 1910 census.

ature, namely areas where forestry was a sizable share of the work force and migration to cities. Non-marital fertility patterns from the past are significant determinants of Pill demand regardless of the degree of urbanization or the prevalence of the forestry industry. The final specification considers communities with relatively stronger/weaker religious or civic institutions, as measured by prohibition support in the 1922 referendum discussed before. Communities where a majority of voters supported prohibition, indicating a stronger presence of the Church or civic groups organized to ban the sale of alcohol, have a significantly stronger relationship between past non-marital fertility and demand for the Pill. This result lends strong support to models of norm transmission such as Greenwood et al (2012) whom emphasize the role social institutions such as the church and civic groups in promoting norms of behavior which stigmatize premarital sex. Communities with strong social institutions which promote conservative norms of behavior have a much stronger relationship between past illegitimacy and demand for the Pill. This suggests that social institutions play an important role in maintaining and transmitting norms of behavior with regard to premarital sex and echoes the findings in the analysis of historical factors where strong religious institutions are found to be complementary to local norms that stigmatize premarital sex in reducing demand for the Pill.

5.3 Evolving Culture: A Model in Differences

Relaxing the assumption that culture is constant, an empirical model is developed that links long run changes in the non-marital fertility rate to growth in demand for the Pill. Slowly evolving culture is consistent with Guiso, Sapienza and Zingales (2006). Studies of the transmission of trust and other cultural traits, as in Algan and Cahuc (2010), have emphasized how these traits change over decades.

Levels and changes in unwed birth behavior at the turn of the century are closely related. The rise in illegitimacy during the first decades of the last century was not uniform. Communities with low illegitimacy rates in 1900 also have low rates of illegitimacy in later years. A regression of the change in the out-of-wedlock birth rate from 1900-1910 on the illegitimacy rate in 1900 yields a positive and significant coefficient; a community with a 10 point higher rate of unwed birth would experience an increase in the illegitimacy rate of roughly

one point more over the decade.[63] This fanning out of unwed birth rates over time can be seen in Figure 3, which presents county level data from 1860-1910. Illegitimacy evolved in a nonlinear fashion, increasing rapidly in communities with high illegitimacy, and remaining constant where illegitimacy was initially low.

Differential patterns of illegitimacy growth motivate the estimation of a model in differences. Do communities that became more liberal with regard to their tolerance of pre-marital sex at the turn of the century continue on this trajectory, and in turn do women in these communities find it more advantageous to adopt the Pill? Estimating a model in differences identifies the effect of culture from changes in unwed birth rates. This approach addresses concerns that omitted fixed characteristics, unrelated to culture, may drive past out-of-wedlock birth and subsequent demand for the Pill. Studying variation across time within communities uses a very different source of variation than the model in levels. Even after differencing out the fixed component of unwed birth behavior, which may be driven in large part by culture, changes in unwed birth rates are still significant determinants of growth in demand for the Pill.

Consider an extended version of the model in levels that includes a market level fixed characteristic, μ_j,

$$Pill_{jt} = X_{jt}\beta + OWB_{jk}\alpha + \eta_t + \mu_j + \varepsilon_{jt}.$$

These fixed characteristics could include constant differences in the public mood, as discussed by Sundbärg (1910), or other characteristics that may be fixed over time and possibly correlated with initial levels of non-marital fertility. I could explicitly control for the regional differences discussed by Sundbärg by including fixed effects for the three regions he outlined. Doing so results in larger and more highly significant coefficient estimates on non-marital fertility.[64] Identifying α from within region variation in unwed birth rates and Pill demand suggests local variation in culture within demographic regions is important.

A more flexible approach differences out the fixed effect for each market and estimates a model in differences. The model estimated is

$$\Delta Pill_{jt} = \Delta X_{jt}\beta + \Delta OWB_{jk}\alpha + \Delta\eta_t + \Delta\varepsilon_{jt},$$

[63] Results are similar when comparing changes from 1900 to 1940.

[64] In the baseline specification, including fixed effects that correspond to Sundbärg's three demographic regions results in an estimated α of 0.20 (0.08).

where Δ is the time difference operator. The effect of culture is identified off of changes in the unwed birth rate, in this case changes in OWB_{jk} over periods k from 1860 to 1910 or 1900 to 1910, unaffected by the fixed characteristic μ_j. Changes in Pill use are equivalent to terminal period levels since the initial period is zero both 10 and 50 years earlier.[65] Using longer horizon differences to identify how changes in culture affect the take-up of the Pill uses variation that is fundamentally different from the model in levels. The long horizons over which differences are calculated is critical, as year to year differences would be dominated by measurement error or short run variations unrelated to the slow moving evolution of culture represented in Figure 3.

5.4 Changes in Out-of-Wedlock Birth and Pill Demand Results

Models in differences yield estimates that are similar to those obtained from the model in levels; changes in out-of-wedlock birth are positive and significant, regardless of whether the between or pooled OLS estimator is used, as seen in Table 6. Controlling for other historical trends, such as changes in total birth rates, local marriage market conditions, and urbanization from 1900 to 1910 improves model fit but does not alter the positive and significant coefficient estimate on changes in non-marital fertility. Results are positive and significant for both fifty year and ten year differences. This supports the conclusion that omitted fixed characteristics cannot explain the positive relationship between past illegitimacy and demand for the Pill. The strong positive effect of non-marital fertility on Pill demand is robust to whether the empirical model is estimated in levels or differences.[66]

Increases in unwed birth rates, indicating a liberalization of sanctions and customs during the 19th century has a positive and significant effect on Pill demand. Differential growth in out-of-wedlock birth rates explains six percent of the variation in Pill take-up. Taken together with the results in levels, this makes a persuasive case that social constraints matter for contraceptive decisions.

[65] The results reported in Table 5 exclude the 1964-1974 difference since Pill sales from the last half of 1964 are not observed, although including it does not change the result.

[66] An alternative approach to addressing the omitted community characteristic problem is instrumental variables. In a previous version of this paper I used butter prices to instrument for out-of-wedlock birth rates following Schultz (1985). The approach yielded the same positive and significant relationship between out-of-wedlock birth and Pill use.

6 Estimating the Pill's Impact on Teen Births

Models of non-marital fertility such as Akerlof et al (1996) and Greenwood and Guner (2010) emphasize how improvements in contraceptive technology or access to abortion may increase out-of-wedlock childbearing by inducing more women to participate in nonmarital sex. A similar mechanism exists in our model. More women engage in premarital sex when the Pill is introduced than would otherwise, $n_j^{Pill} > n_j$. Without saying more about the shape of the stigma function or the distribution of tastes for premarital sex the model is ambiguous about the impact of the Pill on non-marital fertility. Yet, under additional assumptions such as bounding $\varepsilon_{n,p} > -1$, it can be shown that the Pill would reduce nonmarital fertility.

In order to provide evidence on this relationship and inform the behavioral assumptions that underlie the model an empirical analysis of the causal effect of the Pill on teenage fertility is presented. The model is well suited to capture the behavior of teenagers, whose fertility occurs largely outside of marriage. Teenage mothers accounted for a sizable share of non-marital fertility in Sweden during the early 1960s. Before the Pill was legalized 5 to 25 percent of all births occurred outside of marriage, but for teenagers the rates were many times greater, ranging from 36 to 81 percent across communities. In this section we analyze how the Pill influenced the fertility decisions of teenage women.[67]

In the case of teenage births the aggregate data presents a striking set of facts. From 1964 to 1970 the average fertility rate for women aged 15-19 dropped by more than a quarter, as seen in Figure 4, while in some communities the teenage fertility rate was halved in six years. This drop in fertility was not uniform as the fertility decline among these young and overwhelmingly single women was largest in communities where Pill use was greatest, as illustrated in Figure 5. While the aggregate data is consistent with the Pill leading to a decline in teenage fertility the instrumental variables estimates presented here will provide evidence on whether this correlation is causal.

[67] Significant data limitations with regard the availability of population and birth statistics prior to 1968 limit the scope of the marriage and fertility behavior that can be compared before and after the introduction of the Pill.

6.1 An Empirical Model of the Pill and Teen Motherhood

We postulate a model where teenage childbearing in community j in year t is a function of Pill use, $Pill_{j,t}$, regional time trends, δ_r, common non-linear year effects, γ_t, and a persistent market level characteristics, η_j

$$TeenMom_{j,t} = \rho Pill_{j,t} + \delta_r * t + \gamma_t + \eta_j + \varepsilon_{j,t}.$$

Regions may have different demographic trends which may influence the development of teen birth rates over time. We account for such factors by including trends for each of Sundbärg's demographic regions. Year effects capture year to year changes in teenage motherhood that are common across all markets, such as changes in education policies which are set at the national level, while community fixed effects capture persistent factors that may drive differences in teen parenthood across communities, a prime example being social stigma against premarital sex. This model implies the following estimation equation in differences, where the fact that Pill use is zero in all communities prior to its legalization is used to simplify the estimation equation,

$$TeenMom_{j,t+1} - TeenMom_{j,t} = \rho Pill_{j,t+1} + \delta_r + \gamma_{t+1} - \gamma_t + \varepsilon_{j,t+1} - \varepsilon_{j,t}.$$

OLS and instrumental variables (IV) methods are used to estimate the coefficients of the model using a panel of differences in teenage birth rates and Pill use. Past illegitimacy and marriage patterns from the turn of the century and before are used to instrument for the diffusion of the Pill within a market. The identifying assumption behind this choice of instruments is that *changes* in teen motherhood during the late 1960s are not affected by the *level* of illegitimacy from a century before except through the take-up of the Pill.[68]

The instrumental variables strategy builds on the empirical analysis in Section 5 where illegitimacy and marriage behavior from a century or half century earlier were shown to be important determinants of Pill use. By using historical differences that are arguably not endogenous outcomes of current economic or marriage market conditions we can isolate a

[68] Although data does not exist to generate a time series of teenage births back through 1860, evidence from the 1960s makes clear that the time series patterns of teenage births are highly non-linear displaying a positive upward trend until 1965 followed by a steep decline through 1969 and a moderate decline in the early 1970s. A cursory examination of the data does not suggest that trends in teenage births are particularly stable over the period of study.

part of Pill use that is predetermined by historical factors. The strong relationship between past illegitimacy and Pill use provides a channel through which exogenous differences in Pill demand can be identified. The empirical model in differences allows us to account for the direct effect that persistent differences in stigma against pre-marital sex may have on teenage fertility across communities, which provides some plausibility to the exclusion restriction.

6.2 Empirical Results on the Pill and Teen Motherhood

Both OLS and IV estimates point to a significant negative relationship between Pill use and the teenage birth rate, as seen in Table 7. The dependent variable in all of the specifications reported in Table 7 is the percent change in the teenage birth rate over a nine year period that includes the introduction of the Pill. The terminal period of each time difference coincides with observations on Pill use from the early 1970s, the period for which Pill use data exists. The first column of Table 7 presents results estimated by OLS where standard errors are clustered at the market level. The coefficient estimate on Pill use is negative and highly significant, $\widehat{\rho}^{OLS} = -0.024$ (0.009). The estimated coefficient implies that most of the 25 percent reduction teenage births during the late 1960s could be explained by the diffusion of the Pill.[69]

The IV estimates are reported in columns 2 through 5 of Table 7. The IV results suggest that the strong negative relationship between Pill use and teenage births is causal. Columns 2 through 4 present IV estimates when Pill use is instrumented for with historical measures of illegitimacy from different time periods, while column 5 includes age of first marriage as an additional instrument. Regardless of the illegitimacy measure used the first-stage results are strong and the coefficient estimates on Pill use are of similar magnitude and highly significant.[70] Adding age of first marriage as an instrument does not alter the estimates. The overidentification test does not reject the null hypothesis that historical illegitimacy and marriage pattern instruments are uncorrelated with the residuals from the estimation equation as the exclusion restriction requires.[71]

[69] This computation exploits the fact that the average Pill use was almost 10 SEK per woman on average.

[70] The F-statistics from the first stage regressions range from 20 to 67, all well above the conventional threshold value of 10.

[71] The Hansen J-statistic for the overidentification test of all instruments is 0.903 with a P-value of 0.342.

The results suggest that the sharp reduction in teen births following the Pill's introduction was causal. The magnitude of the effect was large; for every krona increase in women's average Pill consumption the teen birth rate declined by more than two percentage points. The negative relationship between the Pill's diffusion and teenage fertility rates in Sweden stands in contrast to studies of teenage sexual behavior in the U.S. such as Greenwood and Guner (2010) whom note that relatively few teenagers used the Pill and in turn conclude that the Pill's impact on premarital sexual activity was negligible. The limited influence of the Pill on the young contrasts the age profile discussed in Skjeldestad (1994) whom shows how Pill use is heavily skewed toward the young in Scandinavia. Whether these cross country differences is Pill use are due to policy or preferences remains to be seen, but the introduction of the Pill in Sweden presents an alternative set of policy implications regarding the importance of technolgical advances in contraception on the fertilty decisions of young women.

7 Conclusion

Culture does not run riot. Oral contraception afforded women increased sexual freedom at reduced personal cost, yet the adoption of this new technology mirrored centuries old differences in pre-marital sexual behavior. Social sanctions against pre-marital sex, borne largely by single women, and the resulting pattern of out-of-wedlock childbearing, a persistent feature of Swedish population statistics, predict a quarter of the Pill's take-up following its introduction.[72] The model demonstrates how the same social forces which led to higher illegitimacy rates more than a century ago can also lead to increased demand for the Pill. The empirical analysis provides evidence that the large positive relationship is robust to accounting for alternative contemporary and historical factors as well as taking into account unobserved community characteristics. The model's prediction that the Pill should reduce illegitimacy is supported in the data on teenage births. While previous studies of U.S. data have concluded that the Pill had little effect on the sexual behavior of teenagers, in Sweden,

[72] A fixed effects regression of pill demand is used to compute the permanent component of pill demand for each market. The fixed effects from this regression are then regressed on past illegitimacy rates to determine what share of the variation in the fixed component can be explained.

where women as young as 15 could could obtain the Pill without parental approval, the effect on teenage fertility was marked. The diffusion of the Pill can account for most of the 25 percent drop in teen births following the Pill's legalization. These results provide evidence that the Pill and the policies that regulated it had consequences for the fertility of teenagers.

Theory has emphasized the interaction of culture and technology in many settings, but nowhere is this interaction more important than in the domain of contraception and fertility control. This paper is the first to empirically estimate the impact of culture on the adoption of new contraceptive technologies and demonstrate the quantitative importance of history in driving demand for modern contraceptives such as the Pill. Many topics remain for future work to address, such as whether the introduction of the Pill led to a convergence in the norms that govern the sexual choices of women, as well as a better understanding of the determinants of the persistent difference in non-marital fertility observed in the historical data, a topic of debate among 19th and early 20th century statisticians and economists. To what extent persistent illegitimacy differences reflect broader difference in gender roles and hence may be related to agricultural technologies as discussed by Boserup (1970) and Alesina et al (2011) or medical technologies as discussed in Albanesi and Olivetti (2009) remains to be seen. The divergence of behavior across Swedish communities documented here begs for better evidence on these points as the uniform characterization of Sweden in Alesina et al (2011) based on observations from a small nomadic population obscures the rich sources of within country variation explored in this paper. Explanations such as the role of inheritance patterns and family types discussed in Todd (1990) have parallels in Wohlin's (1915) study of regional illegitimacy patterns. However, the data as presented by Duranton et al (2009) is incomplete and to some extent at odds with the inheritance patterns discussed in Agren (2009).

There are clearly many more avenues to explore in understanding the technological, institutional, and cultural determinants of fertility control, but the empirical results presented here point to the importance of accounting for cultural factors when analyzing contraception and fertility through the inclusion of relevant historical variables. I have shown how out-of-wedlock birth, a behavior influenced by social forces, varies systematically across communities and is persistent over time. Culture may work through many channels: differences in

what Sundbärg (1910) called "public mood", the capacity of communities to enforce promises of marriage in the case of pregnancy, norms, beliefs, and other features of preferences. My findings are consistent with all of these interpretations, and together make a convincing case that culture matters for contraception demand.

References

[1] Agren, M. (2009), *Domestic Secrets: Women and Property in Sweden, 1600-1857.* Chapel Hill: University of North Carolina Press.

[2] Akerlof, G., J. Yellen, and M. Katz (1996), "An Analysis of Out-of-Wedlock Childbearing in the United States." *The Quarterly Journal of Economics*, 111(2): 277-317.

[3] Albanesi, S. and C. Olivetti (2009), "Gender Roles and Medical Progress." NBER Working Paper 14873.

[4] Alesina, A., P. Giuliano, and N. Nunn (2011), "On the Origins of Gender Roles: Women and the Plough." Harvard University Working Paper.

[5] Algan, Y., and P. Cahuc (2010), "Inherited Trust and Growth." *American Economic Review*, 100(5):2060-2092.

[6] Ananat, E. adn D. Hungerman (2007), "The Power of the Pill for the Next Generation." NBER Working Paper 13402.

[7] Bagge, G., E. Lundberg, and I. Svennilson (1935) *Wages, cost of living and national income in Sweden 1860-1930. Vol. 2*, London: King.

[8] Bailey, Martha J. (2006) "More Power to the Pill: The Impact of Contraceptive Freedom on Women's Life Cycle Labor Supply." *The Quarterly Journal of Economics*, 121(1):289–320.

[9] Bailey, Martha J. (2010), ""Momma's Got the Pill": How Anthony Comstock and Griswold v. Connecticut Shaped US Childbearing." *American Economic Review*, 100(1): 98–129.

[10] Bisin, Alberto, and Thierry Verdier (2000), ""Beyond The Melting Pot": Cultural Transmission, Marriage, And The Evolution Of Ethnic And Religious Traits," *The Quarterly Journal of Economics*, 115(3), pages 955-988.

[11] Bisin, Alberto, and Thierry Verdier (2001), "The Economics of Cultural Transmission and the Dynamics of Preferences," *Journal of Economic Theory*, 97(2), pages 298-319.

[12] Blau, Francine (1992), "The Fertility of Immigrant Women: Evidence from High-Fertility Source Countries " in Boras and Freeman, *Immigration and the Work Force: Economic Consequences for the United States and Source Areas*. Chicago: UCP.

[13] Blau, Francine, Lawrence M. Kahn, Albert Yung-Hsu Liu, Kerry L. Papps (2008), "The Transmission of Women's Fertility, Human Capital and Work Orientation Across Immigrant Generations" NBER Working Paper 14388.

[14] Bongaarts, J. and S. Watkins (1996), "Social Interactions and Contemporary Fertility Transitions." *Population and Development Review*, 22(4):639-682.

[15] Boserup, E. (1970), *Woman's Role in Economic Development*. London: George Allen and Unwin Ltd.

[16] Carlsson, G. (1966) "The Decline of Fertility: Innovation or Adjustment Process" *Population Studies*, 20(2): 149-74.

[17] Chiappori, P. A., and S. Oreffice (2008), "Birth Control and Female Empowerment: An Equilibrium Analysis." *Journal of Political Economy*, 116(1):113-140.

[18] Easterlin, R. and E. Crimmins (1985), *The Fertility Revolution A Supply-Demand Analysis*. Chicago:UCP.

[19] Eversley, D.E.C. (1959) *Social theories of fertility and the Malthusian debate*. Oxford: OUP.

[20] Duranton, G., A. Rodriguez-Pose, and R. Sandall (2009) "Family Types and the Persistence of Regional Disparities in Europe." *Economic Geography*, 85(1):23-47.

[21] Fernandez, R. (2007) "Women, Work and Culture," *Journal of the European Economic Association*, Vol. 5, No. 2-3: 305–332.

[22] Fernandez, R. (2011) "Does Culture Matter?" in *Handbook of Social Economics*, Jess Benhabib, Alberto Bisin, Matt Jackson, eds., North-Holland.

[23] Fernandez, R. and A. Fogli (2006), "Fertility: The Role of Culture and Family Experience." *Journal of the European Economic Association*, 4(2-3): 552-561.

[24] Fernandez, R. and A. Fogli (2009), "Culture: An Empirical Investigation of Beliefs, Work, and Fertility." *American Economic Journal: Macroeconomics*, 1(1): 146-77.

[25] Fernandez-Villaverde, J., J. Greenwood and N. Guner (2010), "From Shame to Game in One Hundred Years: An Economic Model of the Rise in Premarital Sex and its De-Stigmatization." NBER Working Paper 15677.

[26] Frykman, J. (1975) "Sexual Intercourse and Social Norms: A Study of Illegitimate Births in Sweden 1831-1933." *Ethnologia Scandinavica*, 1975: 110-150.

[27] Frykman, J. (1977) *Horan i Bonde Samhället*. LiborLäromedel, Lund.

[28] Gaunt, D. (1973), "Family Planning and the Preindustrial Society: Some Swedish Evidence." in *Aristocrats, Farmers, Proletarians: Essays in Swedish Demographic History*, Studia Historica Upsaliensia XLVII, Almqvist and Wiksell Informationsindustrie, Uppsala, 1973.

[29] Goldin, C. and L. Katz (2002), "The Power of the Pill: Oral Contraceptives and Women's Career and Marriage Decisions."*Journal of Political Economy*,110(4):730-770.

[30] Greenwood, J. and N. Guner (2010), "Social Change: The Sexual Revolution" *International Economic Review*, 51(4):893–923.

[31] Grönqvist, Hans (2009), "Putting teenagers on the Pill: the consequences of subsidized contraception." Institute for Labor Market Policy Evaluation Working Paper No. 2009:8.

[32] Guinnane, T., C. Moehling, and C. O'Grada (2006) "The Fertility of the Irish in the Unibed States" Explorations in Economic History, 43(3): 465-485.

[33] Guiso, L., P. Sapienza and L. Zingales (2006), "Does Culture Affect Economic Outcomes?" *Journal of Economic Perspectives*, 20(2):23-48.

[34] Heckman, J.J. and J.R. Walker (1990) "The Relationship Between Wages and Income and the Timing and Spacing of Births: Evidence from Swedish Longitudinal Data" *Econometrica*, 58(6):1411-1441.

[35] Heckscher, Eli (1949), *Sveriges Ekonomiska Historia Från Gustav Vasa: Andra Delen Det Moderna Sveriges Grundlägning Fösta Halvbandet.* Albert Bonniers, Stockholm.

[36] Hedren, Gunnar (1901) "*Om fosterfördrivning från rättsmedicinsk synpunkt.*" Karolinska Institute Dissertation, Stockholm.

[37] Helmfrid, S. (1961) "The Storskifte, Enskifte adn Laga skifte in Sweden - General Features" Geografiska Annaler, 43(1): 114-44.

[38] Lesthaeghe, R. and K. Neels (2001), "From the First to the Second Demographic Transition: An interpretation of the spatial continuity of demographic innovation in France, Belgium and Switzerland.", *European Journal of Population* 18: 325-360.

[39] Lewin, Bo (2000) *Sex in Sweden : on the Swedish sexual life 1996.* Stockholm : National Institute of Public Health.

[40] Liljeström, Rita (1974) *A Study of Abortion in Sweden: A Contribution to the United Nations World Population Conference.* Royal Ministry of Foreign Affairs. Stockholm: Norstedt.

[41] Linner, Birgitta (1967), *Sex and Society in Sweden.* New York: Pantheon Books.

[42] Läkemedelstatistik, A.B. "Swedish Drug Market: Statistical Survey of Registered Pharmaceutical Specialties in Sweden." Stockholm. 1970(I)-1974(IV).

[43] Low, Bobbi (2000) *Why sex matters: a Darwinian look at human behavior.* Princeton University Press.

[44] Malthus, T.R. (1807) *An Essay on the Principle of Population, Volume I.* Fourth Edition, J. Johnson, London.

[45] Malthus, T.R. (1809) *An Essay on the Principle of Population, Volume II.* First American Edition, R. Weightman, Washington City.

[46] Marshall, A. (1922) *Principles of Economics: An Introductory Volume.* Macmillan, London.

[47] McLaren, Angus (1992) *A History of Contraception: From Antiquity to the Present Day.* Wiley Blackwell.

[48] Myrdal, Alva (1968) *Nation and Family.* Boston: MIT Press.

[49] Oreffice, S. (2007) "Did the legalization of abortion increase women's household bargaining power? Evidence from labor supply." *Review of Economics of the Household.*

[50] Santow, Gigi (1993) "Coitus Interruptus in the Twentieth Century." *Population and Development Review*, 19(4):767-792.

[51] Schultz, T. Paul (1985) "Changing World Prices, Women's Wages, and the Fertility Transition: Sweden, 1860-1910." Journal of Political Economy, 93(6): 1126-1154.

[52] Skjeldestad, F. (1994) "Choice of contraceptive modality by women in Norway" *Acta Obstetricia Gynecologica Scandinavia*, 1994 Jan 73(1): 48-52.

[53] Sklar, June (1977), "Marriage and Nonmarital Fertility: A Comparison of Ireland and Sweden." *Population and Development Review*, 3(4): 359-375.

[54] Socialstyrelsen (1972), "Allmän Hälso- och Sjukvård." 1969-1974 editions, Sveriges Officiella Statistik (SOS), Stockholm.

[55] Statistics Central Byrån (1864) "Befolkning Statistisk Årsbok 1860." SOS, Stockholm.

[56] Statistics Central Byrån (1904) "Befolkning Statistisk Årsbok 1900." SOS, Stockholm.

[57] Statistics Central Byrån (1914) "Befolkning Statistisk Årsbok 1910." SOS, Stockholm.

[58] Statistiska Central Byrån (1945) "Statistisk Årsbok 1945." SOS, Stockholm.

[59] Statistiska Central Byrån (1962) "Statistisk Årsbok 1962." SOS, Stockholm.

[60] Statistiska Central Byrån (1970) "Statistisk Årsbok 1970." SOS, Stockholm.

[61] Statistiska Central Byrån (1975) "Statistisk Årsbok 1975." SOS, Stockholm.

[62] Sundbärg, Gustav (1907), *Bevölkerungsstatistik Schwedens 1750-1900.* Reprinted in Urval 3, Statistika Central Byrån.

[63] Sundbärg, Gustav (1910), *Emigrationsutredningen Bilaga V: Ekonomisk-statistisk beskrifning öfver Sveriges olika landsdelar.* Royal Publisher, P. A. Norstedt and Sons, Stockholm.

[64] Sundin, Jan and Erik Söderlund (1979), *Time, space and man : essays on microdemography : reports from the symposium Time, space and man in Umeå, Sweden, June 1977*, Stockholm: Almqvist & Wiksell.

[65] Tabellini, G. (2010) "Culture and Institutions: Economic Development in the Regions of Europe" Journal of the European Economic Association, 8(4):677-716.

[66] Voigtlander, N. and J. Voth (2012) "Persecution Perpetuated: The Medieval Origins of Anti-Semitic Violence in Nazi Germany" forthcoming *The Quarterly Journal of Economics.*

[67] Watkins, S. (1986), "Regional Patterns of Nuptiality in Western Europe, 1870-1960." in *The Decline of Fertility in Europe.* Coale and Watkins (eds) Princeton University Press, Princeton.

[68] Wikman, K. (1937) *Die Einleitung Der Ehe: Eine Vergleichend Ethno-Soziologische Untersuchung Über Die Vorstufe Der Ehe In Den Schwedischen Volkstums.* Das Institut Für Nordische Ethnologie An Der Åbo Akademie, Åbo.

[69] Willis, Robert J. (1999) "A Theory of Out-of-Wedlock Childbearing." *Journal of Political Economy*, vol. 107(S6):S33-S64.

[70] Wohlin, N. (1915), *Den äktenskapliga fruktsamhetens tillbakagång på Gotland.* Stockholm.

Table 1: Summary Statistics

	Mean	Std. Dev.	Min	Max
Pill Demand	9.61	1.70	3.64	14.86
1910 Historical Factors				
Out-of-Wedlock Births (per 100 Births)	12.34	4.01	6.11	27.90
Out-of-Wedlock Births (per 1000 Women)	6.02	2.01	2.81	12.94
Urban to Rural Ratio (x100)	24.97	31.68	0	183
Female to Male Sex Ratio (x100)	103	3.68	95	114
Female to Male Wage Ratio (x100)	60.1	4.08	50	69
Woman's Wage (Öre per Day)	161.5	19.9	125	225
Other Historical Factors				
Out-of-Wedlock Births 1860	7.98	3.08	3.98	26.33
Out-of-Wedlock Births 1900	10.13	3.18	5.29	24.64
Women's HS Attainment 1930	0.35	0.23	0.16	1.35
Pentecostal Church Percent 1930	0.76	0.38	0.17	2.02
Prohibition Opposition in 1922	0.44	0.19	0.18	0.81
1970-1974 Contemporaneous Factors				
Women's LFP Rate	0.64	0.05	0.53	0.79
Working Women's Mean Labor Income	214.9	63.18	122.7	357.2
Men's Mean Labor Income	256.4	38.1	170.4	384.6
Male Income Inequality (70:30)	2.66	0.72	1.63	9.90
Agriculture Income	4.2	2.4	0.3	14.5
Value of Forestry	0.7	0.4	0.0	1.7
Population Density	5.2	11.8	0.1	83.4
Single Women's Mean Age	21.7	0.47	20.8	23.4
Married Women's Mean Age	31.1	0.52	29.9	32.7
Unmarried Male to Female Sex Ratio (x100)	91	17	60	125
Share of Women Single	0.55	0.08	0.36	0.66
Pharmacy Density	3.16	3.66	0.19	19.9
Venereal Disease	0.05	0.09	0.01	0.92

Note: Pill demand, out-of-wedlock births, sex ratios, urban share, and age are measured by market, other variables are measured at the county level. Pill demand is per woman 16-40 in current SEK. The male to female wage ratio is based on agricultural day rates from Bagge et al (1935). HS attainment is the share of women over 15 with a high school degree in 1930. Pentecostal is the percent of the population classified as members in 1930. Prohibition opposition is the share of votes cast against the 1922 ban on alcohol. Mean incomes are for those aged 16-64 in 100s SEK. Women's income is for working women. Population density variables are per square km and pop16-40. The sex ratio is the ratio of women to men16-40. Pharmacy density is per 1000 square kilometers. VD is cases per 1000 of the population aged 16-40.

Table 2: Pill Demand and Out-of-Wedlock Birth in the 19th and 20th Century

	1860 OWB		1900 OWB		1910 OWB	
	(1)	(2)	(3)	(4)	(5)	(6)
Out-of-Wedlock Birth (OWB)	0.20**	0.24***	0.25***	0.24***	0.11***	0.18***
	(0.08)	(0.08)	(0.08)	(0.06)	(0.03)	(0.05)
Share of Women Working		10.03		6.68		5.86
		(6.05)		(5.94)		(6.31)
Mean Income of Working Women		0.01		0.02		0.01
		(0.02)		(0.02)		(0.02)
Mean Male Earnings		-0.04***		-0.04**		-0.04**
		(0.01)		(0.01)		(0.01)
70/30 Male Income Ratio		-0.34		-0.27		-0.34*
		(0.20)		(0.17)		(0.19)
Mean Farm Income		0.06		0.05		0.07
		(0.13)		(0.13)		(0.14)
Forestry Value		0.35		0.50		0.30
		(0.50)		(0.47)		(0.49)
Population Density		0.15**		0.12*		0.11
		(0.06)		(0.06)		(0.06)
Pop Density Squared		-0.25***		-0.20***		-0.17**
		(0.07)		(0.06)		(0.06)
Mean Age of Single Women		1.17**		0.90**		0.85*
		(0.44)		(0.38)		(0.45)
Mean Age of Married Women		-0.31		-0.48		-0.60
		(0.58)		(0.45)		(0.42)
Sex Ratio of Unmarried, 16-40		-0.01		0.01		0.01
		(0.03)		(0.03)		(0.03)
Share of Women Married		4.06		-0.01		-0.06
		(5.84)		(6.00)		(5.82)
Pharmacy Density		0.13		0.14		0.13
		(0.11)		(0.11)		(0.10)
Lagged VD Cases		-0.11		0.76		0.94
		(1.66)		(2.04)		(1.81)
Constant	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.21	0.52	0.31	0.56	0.27	0.55
N	350	350	350	350	350	350

Note: Pill demand per woman 16-40 is the dependent variable. Standard errors, clustered by county, are reported in brackets. Out-of-wedlock births are measured per 100 births. Incomes are computed for those aged 16-64. Population density variables are per square kilometer for those aged 16-40 and the square is divided by 100. Age and share variables are computed for women 16-40. Sex ratio is 100 times the ratio of unmarried women to men aged 16-40. Pharmacy density is per 1000 square kilometers. Venereal disease is per 1000 aged 16-40.

* p<.1, ** p<.05, *** p<.01

Table 3: Pill Demand and Alternative Out-of-Wedlock Birth Measures

Panel 1: Pooled OLS Estimator

	Per Birth		Per Woman	
	(1)	(2)	(3)	(4)
Out-of-Wedlock Births 1910	0.18***	0.17***	0.39***	0.35***
	(0.05)	(0.04)	(0.12)	(0.08)
All Baseline Controls	Yes	Yes	Yes	Yes
Clusters	24	24	24	24
R-squared	0.55	0.53	0.65	0.54
N	350	350	350	350

Panel 2: Between Estimator

	Per Birth		Per Woman	
	(1)	(2)	(3)	(4)
Out-of-Wedlock Births 1910	0.18***	0.16***	0.33***	0.34***
	(0.05)	(0.05)	(0.11)	(0.11)
All Baseline Controls	Yes	Yes	Yes	Yes
Groups	70	70	70	70
R-squared	0.62	0.59	0.60	0.60
N	350	350	350	350

Note: Pill demand per woman 16-40 is the dependent variable. Unwed births are measured per 100 births in (1), and per 1000 women in (3). The dependent variable in (2) is the residual from a regression of unwed births per 100 births on urbanization rates, sex ratios, the ratio of women's to men's wages, and women's wage level. Unwed births per woman in (4) is defined by the same 2-step procedure. * $p<0.1$, ** $p<0.05$, *** $p<0.01$

Table 4: Pill Demand and Out-of-Wedlock Births: Alternative Historical Factors

	(1)	(2)	(3)	(4)	(5)	(6)
Out-of-Wedlock Births 1910	0.15***	0.14***	0.17***	0.17***	0.16***	0.17***
	(0.04)	(0.05)	(0.05)	(0.04)	(0.04)	(0.03)
			Historical Controls			
Urban to Rural Ratio 1910	-0.44					
	(0.51)					
Female:Male Pop. Ratio 1910	0.11					
	(0.07)					
Female:Male Wage Ratio 1910	3.26					
	(3.50)					
Female Wage 1910	-0.02**					
	(0.01)					
Youngest AFM 1910		1.01***				
		(0.34)				
Oldest AFM 1910		-1.35**				
		(0.49)				
Women's HS Education 1930			0.06			
			(0.11)			
Pentecostal Share 1930				-0.13***		
				(0.04)		
Prohibition Opposition 1922					5.16***	7.38***
					(0.91)	(0.80)
Prohib X OWB						0.50***
						(0.16)
All Baseline Controls	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.59	0.59	0.55	0.59	0.63	0.75
Clusters	24	24	24	24	24	24
N	350	350	350	350	350	350

Note: Pill demand is the dependent variable. All specifications include the full set of contemporaneous controls. Out-of-wedlock birth measured per 100 births. 1910 wages are agricultural wages from Bagge(1935). AFM is an abbreviation for age of first marriage. Pentecostal is the share of the population that is a member of a Pentecostal Church. Prohibition opposition are voters opposed to the 1922 alcohol sales ban. Women's HS refers to the share of women with a HS education. Col 5 is weighted by the16-40 female population. * $p<0.05$, ** $p<0.01$, *** $p<0.001$

Table 5: Pill Demand to Out-of-Wedlock Birth: Heterogeneous Responses

	(1)	(2)	(3)	(4)	(5)	(6)
High OWB in 1910	0.20***					
	(0.06)					
Low OWB in 1910	0.22**					
	(0.10)					
OWB in 1910x N. limes norrlandicus		0.18***				
		(0.04)				
OWB in 1910x S. limes norrlandicus		0.18***				
		(0.04)				
OWB in 1910 x Low Local Born Share			0.16***			
			(0.03)			
OWB in 1910 x High Local Born Share			0.23***			
			(0.04)			
OWB in 1910 x High Forest Employment				0.17***		
				(0.03)		
OWB in 1910 x Low Forest Employment				0.19***		
				(0.04)		
OWB in 1910 x High Urban Share					0.18***	
					(0.04)	
OWB in 1910 x Low Urban Share					0.18***	
					(0.04)	
OWB in 1910 x High Prohibition Support						0.26***
						(0.05)
OWB in 1910 x Low Prohibition Support						0.18***
						(0.03)
All Baseline Controls	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.55	0.55	0.57	0.55	0.55	0.58
N	350	350	350	350	350	350

Note: Pill demand per woman 16-40 is the dependent variable. Standard errors, clustered by county, in brackets. OWB is measured per 100 births in 1910. High OWB refers to above average OWB. Above median inmigration in 1910 defines high migration and high forestry includes communities in counties with at least 7 pct of the population employed in forestry in 1910. High urban share refers to above average population share living in urban areas, while high prohibition support denotes communities where at least half of voters supported prohibition. * $p<0.10$, ** $p<0.05$, *** $p<0.01$

Table 6: Pill Demand and Out-of-Wedlock Births: A Model in Differences

	Between Estimator			Pooled OLS		
	1860-1910	1900-1910	1900-1910	1860-1910	1900-1910	1900-1910
	(1)	(2)	(3)	(4)	(5)	(6)
Δ Out-of-Wedlock Births	0.17***	0.31**	0.34***	0.17**	0.31**	0.34***
	(0.07)	(0.12)	(0.11)	(0.07)	(0.13)	(0.12)
Δ Sex Ratio			0.01			0.01
			(0.03)			(0.06)
Δ Urbanization Rate			1.51			1.51
			(2.08)			(1.73)
Δ Birth Rate			2.30***			2.30***
			(0.55)			(0.56)
R-Squared	0.16	0.17	0.34	0.09	0.08	0.28
N	350	280	280	350	280	280

Note: Pill demand per woman aged 16-40 is the dependent variable. Levels and changes in pill demand are identical since demand is zero prior to 1964. Since the pill was approved for use during 1964, and sales for 1964 are not observed we omit the 1974-1964 difference in the specifications where changes are computed over the ten year interval 1900-1910. Changes in unwed births are measured per 100 births, and birth rates are defined as 100 times the number of births divided by the population of women. Market level data for sex ratios, urbanization, and birth rates per woman are not yet available in the earliest period. Pooled OLS specifications are clustered at the market level. All estimates are unweighted.
* p<.1, ** p<.05, *** p<.01

Table 7: Percent Change in Teen Births and Pill Use

	OLS	IV 1860 OWB	IV 1900 OWB	IV 1910 OWB	IV 1860 OWB, 1910 AFM
	(1)	(2)	(3)	(4)	(5)
Pill Use	-0.02***	-0.17***	-0.11**	-0.12**	-0.12**
	(0.01)	(0.06)	(0.05)	(0.05)	(0.06)
Region Fixed Effects	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
N	350	350	350	350	350

Note: The dependent variable is the percent change in births per woman aged 15-19 by market over a nine year period that includes the introduction of the Pill, where the terminal period of each time difference coincides with a Pill use observation. Pill use appears in levels in since initial values of Pill use are zero. In columns 2-4 Pill Use is instrumented for by out-of-wedlock birth rates in 1860, 1900, and 1910, respectively. In column 5 out-of-wedlock births in 1860 and age of first marriage in 1910 are the instruments. Region fixed effects follow the definitions in Sundbärg (1910). Standard errors clustered at the market level are reported in brackets.
* p<.1, ** p<.05, *** p<.01

Figure 1: Gustav Sundbärg's Map of Sweden's Three Demographic Areas (1910)

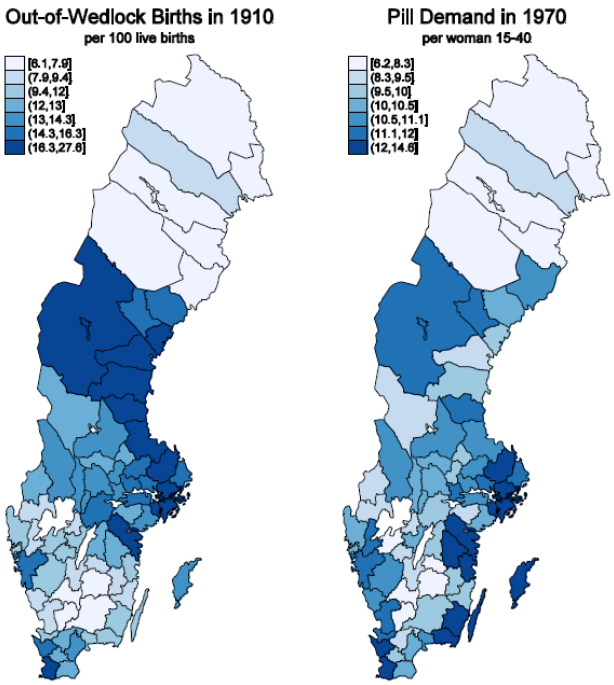

Figure 2: Maps of Out-of-Wedlock Birth and Demand for the Pill by Market

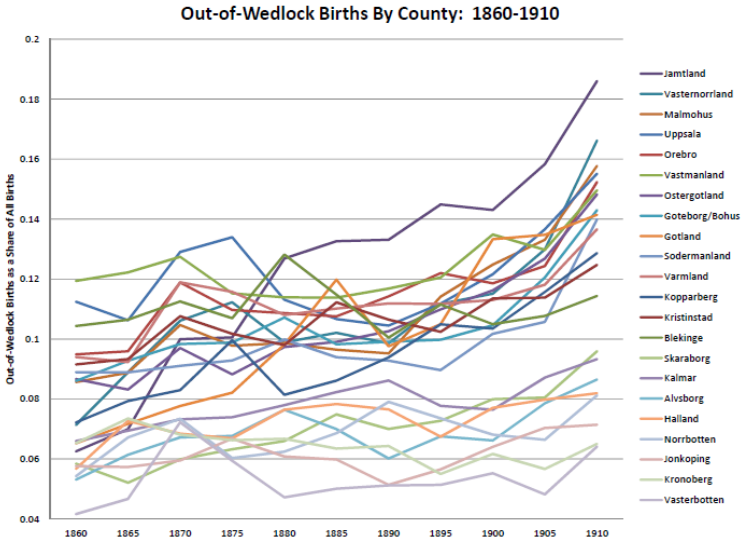

Figure 3: Out-of-Wedlock Births by County: 1860-1910

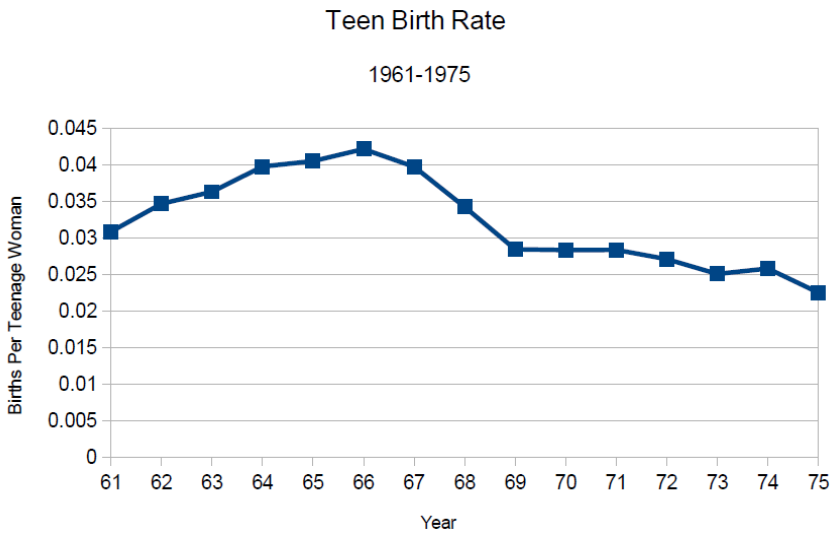

Figure 4: Teen Birth Rate: 1961-1975

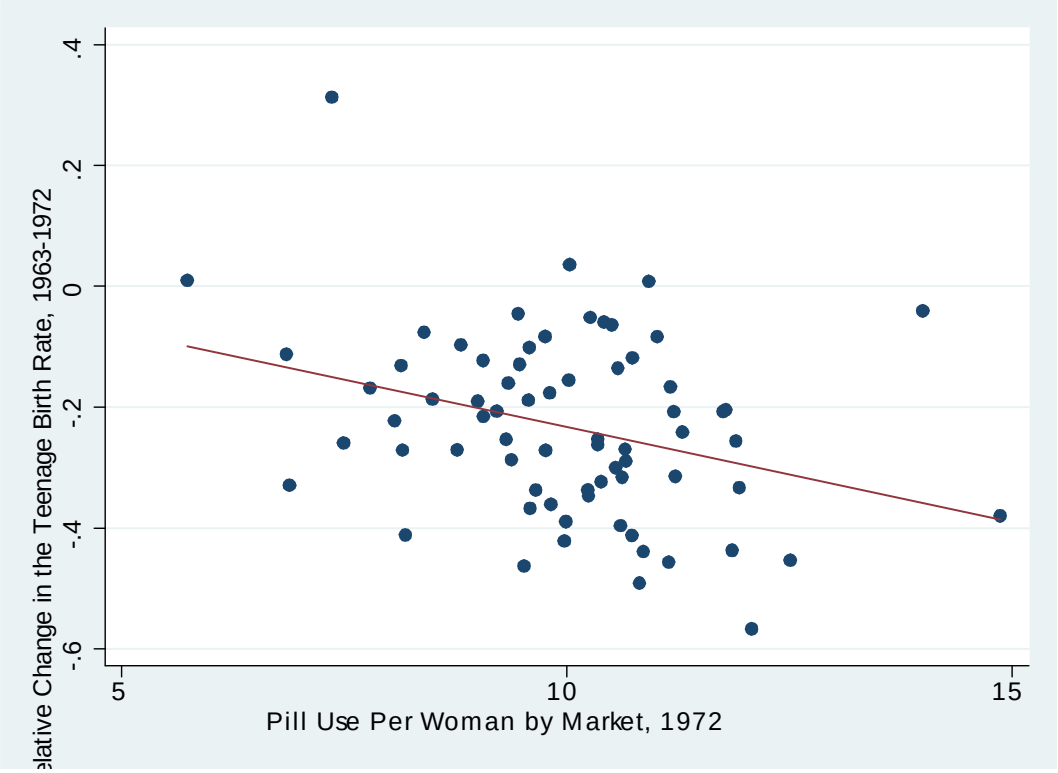

Figure 5: Change in Teenage Birth Rate and Pill Use By Market