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The Effect of Abortion Liberalization on Sexual Behavior: International Evidence

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The Effect of Abortion Liberalization on Sexual Behavior: International Evidence

Abstract

Most industrialized countries have increased access to abortion over the past 30 years. Economic theory predicts that abortion laws affect sexual behavior since they change the marginal cost of having risky sex. We use gonorrhea incidence as a metric of risky sexual behavior. Using a panel of 41 North American, European and Central Asian countries over the period 1980-2000, we estimate the impact of abortion law reform on risky sex. Compared to the most restrictive legislation that permits abortion only to save the pregnant woman's life or her physical health, more liberal abortion laws are associated with at least thirty additional gonorrhea cases per 100,000 individuals. The marginal effect of laws which make abortion available on request is larger than the effect of laws which allow abortion on socioeconomic and mental health grounds. Our results are robust against a set of alternative sample constructions and model specifications.

JEL Code: I12, I18, J13, K00, K32, Z13.
Keywords: Gonorrhea, pregnancy, sexually transmitted diseases, abortion laws.

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I. INTRODUCTION

Over the past few decades, most industrialized countries have extended the circumstances under which abortion services are legally available. As a result, some 40 percent of the world's population currently resides in countries that permit abortion on request. Another 25 percent has access to abortion on socioeconomic and mental health grounds which are in most cases broadly interpreted (Center for Reproductive Rights 2008).

We examine the relationship between abortion access and sexual behavior for a sample of 41 North American, European and Central Asian countries. This work extends previous studies by Klick and Stratmann (Klick and Stratmann 2003, 2008) who examine the effect of abortion policies in the United States. In contrast to Klick and Stratmann, our panel allows us to consider the effects of a further class of abortion laws, namely abortion access that is conditioned on socioeconomic and/or mental health grounds.

Because internationally comparable data on sexual behavior do not exist, we approximate risky sexual behavior using gonorrhea incidence. This proxy for risky sex is not only attractive because of data-availability; it also adds to our understanding of an important public health issue that has been largely ignored.

According to the World Health Organization (WHO) there are 62 million new cases of Gonorrhea every year (World Health Organization 2001), and, for the United States, lifetime treatment costs for each case are estimated between $60 for men and $303 for women (Chesson et al. 2006). Untreated, gonorrhea can lead to pregnancy complications, infertility, blindness in newborns infected by their mothers, septicaemia, arthritis, endocarditis and meningitis (World Health Organization 2001). Existing public health models of STD incidence ignore the behavioral effect studied here. If, as we hypothesize in this article, improved abortion access leads to higher STD-rates, there are health benefits from the introduction of programs that proactively safeguard against adverse effects of abortion liberalization.

The paper is organized as follows. Section II outlines the theoretical background from which we derive our research question. In Section III we give an introduction to abortion law and summarize the legislation and its reform in the 41 countries in our sample. Following this account, we present our systematization of abortion laws that forms the basis of our empirical analysis. The empirical approach to identify the relationship between abortion and gonorrhea incidence is illustrated in Section IV, and Section V discusses the data used in our estimation. Sections VI and VII present the econometric results and a set of robustness checks while Section VIII concludes.

II. CONCEPTUAL FRAMEWORK

Sexual behavior is commonly regarded to be a product of natural instincts and socialization. Hardy and Zebin (1991), for instance, explain adolescent pregnancies as being determined by biological factors and longstanding family and community characteristics. In this work, incentive-driven, "economic" decisions generate little consideration. This is surprising, as changing environmental factors like laws and norms alter the costs and benefits of certain sexual behaviors. Given these changes, it is unlikely that behavioral patterns are affected only through long-term socialization. Rather, as we hypothesize in this paper, individuals' natural dispositions are likely constrained by rational considerations of costs and benefits. A simple economic model predicts that a change in the cost of risky sex through abortion law reform causes rational individuals to adjust their sexual activities.

In a formal framework, we assume that an individual's utility (U) positively depends on the "consumption" of sex (S), and a composite good (X). We further assume that utility U(S, X) is concave in S. As we investigate the sexual behavior of heterosexual couples[1], the cost of sex (C) includes the risk of unwanted pregnancy that increases with every additional

[1] A "couple" here defines any pair of individuals who engage in heterosexual sexual activities.

sexual encounter. In formal terms, the marginal cost of sex is positive. This framework generates a downward sloping demand curve for sexual activity.[2] Therefore, if the cost (price) of sex drops through some intervention, the frequency and/or riskiness of sex will increase.

$$\frac{\partial U(S,X)}{\partial S} = \frac{\partial C}{\partial S}. \tag{1}$$

The cost associated with unwanted pregnancy (C) goes beyond the financial burden of giving birth and raising a child. For example, pregnancy and motherhood can diminish earnings through their negative impact on educational opportunities and labor market participation (Angrist and Evans 1999). Further, the opportunity to give up a child for adoption does not avoid the physical and financial cost of pregnancy and delivery, and can cause additional cost in the form of emotional hardship.

Induced abortion can reduce the costs of pregnancy and avoid those of motherhood. However, the procedure's legal status is an important determinant of its cost, and therefore a component of the cost of risky sexual behavior. If access to legal and safe abortions is restricted, these costs increase as a result of higher search and pecuniary costs, an increase in health risks[3], and the threat of criminal prosecution for both providers and seekers of illegal abortions. Consequently, our theoretical model predicts more and riskier sexual activities under more liberal abortion regimes.[4] This does not imply that every individual facing a

[2] Similar approaches to sexual behavior that base on costs and benefits are suggested, for instance, by Posner (1992) and Levine (2000). A more elaborate model which generates the same outcome can be found in Levine and Staiger (2002). In their model, the individual makes decisions sequentially. At the last stage, the individual will have an abortion if the abortion costs are lower than the costs of giving birth. Since the abortion option is available, the individual is less likely to use alternate forms of contraception when in engaging in sexual activities.

[3] The World Health Organization estimates that twenty million unsafe and illegal abortions are carried out every year, resulting in 78,000 maternal deaths and hundreds of thousands of disabilities. Today, since most developed countries have liberalized abortion-access, illegal abortion has primarily become a phenomenon of the developing world. See Cook and Dickens (1988), Cook et al. (1999), and Grimes et al. (2006).

[4] It is also possible to generate this prediction with a simple model of condom use. If we assume that individuals use condoms to prevent conception and contracting STDs but that condoms are costly, abortion availability lowers the contraceptive benefits of condoms without changing their STD prevention capacity. This implies that once abortion becomes more widely available, individuals will be less likely to use condoms. Consequently, a ceteris paribus increase in STD incidence is predicted.

liberal abortion legislature will show riskier sexual behavior. For those who reject abortion regardless of its legal status, policy changes might be irrelevant.[5] However, for our prediction to hold, it suffices if at least some individuals adapt their sexual behavior to a change in abortion-access.

III. Review of Abortion Laws

In the second half of the 20th century, many countries have extended circumstances under which abortions are legally performed.[6] At the same time, there is a large variety of abortion legislation across countries. Adding to this diversity, similar written law does not necessarily coincide with equal abortion access because enforcement of the legislation can depend heavily on its interpretation through government, the judicial branch, and the medical profession.

De jure abortion legislation is typically grouped into five categories (See, for example, Rahman et al. 1998). Starting with the most restrictive category, these are: abortion prohibited altogether or allowed only to save the woman's life; permitted to preserve her physical health; permitted to preserve her mental health; permitted for socioeconomic reasons; and permitted on request.

We now present a brief account of abortion legislation and reform in our sample countries.[7]

Our sample contains twelve former Soviet states. Since the end of the Soviet Union, none of these states has made substantial changes to the Soviet law of 1955 that permitted

[5] However, even for those individuals, the cost of rejecting sexual intercourse increases when abortion becomes widely accessible (Akerlof et al. 1996). These individuals may thus increase their sexual activities because of the higher cost of rejecting potential sexual partners and not because of the reduced risk of unplanned motherhood.
[6] Investigating abortion policies worldwide, Cook and Dickens (1978, 1988), Cook et al. (1999) and Boland and Katzive (2008) identify 118 policy-changes towards liberalization for 1967-2007. During the same period, more restrictive policies were implemented only 13 times.
[7] Where not otherwise indicated, the following account draws from the United Nation's *2002 International Review of Abortion Policies*. See United Nations (2002).

abortion on request. The situation is similar for the four former Yugoslavian countries for which data is available. After Yugoslavia's dissolution in the 1990s, Croatia, Macedonia, Serbia and Slovenia continued the right to abortion on request.

Six Central and Southeastern European countries in the sample changed their abortion laws during, or shortly before transition from communism, with five of them adopting abortion on request: In the 1980s, Albania only permitted abortion in cases of a serious threat to the woman's life or her physical health.[8] This policy was abandoned immediately after the socialist government was removed in 1991 when abortion became available on request. From the 1960s, in Romania, abortion was legal only for medical reasons and narrowly defined socioeconomic reasons.[9] After ousting the Ceausescu regime in 1990, the new government declared abortion legal on request. In socialist Bulgaria, Hungary and, until 1986, Czechoslovakia, abortion was accessible on a number of socioeconomic grounds, including being unmarried.[10] Following Czechoslovakia (1986), Bulgaria (1990) and Hungary (1992) fully liberalized abortion soon after the end of communist rule.

Poland is the only former socialist country that has continued to restrict abortion access. In fact, the democratically elected Polish governments have taken a tougher stance on abortion than their communist antecessors under whose rule abortion was legal in cases of unspecified "difficult living conditions". In 1993, all socioeconomic grounds were eliminated from the law, so that abortion remained legal only to preserve the woman's mental health. The socioeconomic grounds were briefly reinstated in 1997, but shortly after, a pro-life coalition regained the parliamentary majority and reestablished the restrictive 1993 law.

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[8] The restrictive policy had severe impacts on maternal health. Despite the governmental efforts to raise fertility, an estimated fifty percent of pregnancies ended in mostly self-induced abortion. As a consequence of the unsafe and unsanitary conditions of illegal abortions, maternal mortality ranked highest in Europe second only to Romania. The number of premature births was also abnormally high.

[9] Abortion on socioeconomic grounds required abortion seeking women to already have five children under their care or to be older than 45 years of age.

[10] For married women, the socioeconomic criteria included a minimum number of existing children, age (typically 40 or over), a serious sickness of the husband, disintegration of the family, and difficult economic conditions.

Like the Central and Southeastern European countries, Western Europe and North America have experienced a trend towards more liberal abortion laws during the 1980-2000 period. With the United States, Denmark, Sweden, Norway, Austria, Italy[11], and The Netherlands[12], seven countries made abortion accessible on request throughout the entire sample period. Four additional countries have substantially altered their legal approach to abortion. Of these, Canada and Germany have changed their laws to permit abortion on request. Before abortion became available on demand in 1988, Canadian law permitted it only to preserve the woman's health, including mental grounds. Since a request for abortion required a three member hospital committee's approval, interpretation of the law and thus abortion access varied substantially between the Canadian provinces and healthcare institutions. Because of the committees' extensive discretionary powers, the Canadian Supreme Court declared the existing law unconstitutional in 1988. Since then, abortion access has been unrestricted. The Western part of Germany operated under a law that allowed abortion on socioeconomic grounds since 1975.[13] This legislation contrasted with that of the German Democratic Republic where abortion was available on request. After unification, the separate legislations co-existed for almost three years until a Federal Constitutional Court ruling in 1993 made abortion available on request in the entire country.[14]

Up to the mid-1980s, when Portugal and Spain added physical and mental health provisions to their abortion laws, these two countries only permitted abortion to save the

[11] The Italian law of 1978 does not explicitly allow abortion on request. However, the law leaves it to the woman herself to determine if continuation of the pregnancy would endanger her mental health, taking into account her state of health and living conditions. In practice, abortion access is limited by the possibility of conscientious objection for medical personnel. In the more conservative Southern parts of Italy, up to ninety percent of physicians opt out of performing abortions. See Cook et al. (1999) and Rahman et al. (1998).

[12] Prior to the 1981 reform which fully liberalized abortion, Dutch legislation did not permit abortion unless the woman's life was at risk, although the law was not strictly implemented. However, since for the Netherlands data on gonorrhea incidence is only available from 1982 onwards, we are not able to consider the 1981 reform in our analysis.

[13] The socioeconomic grounds stipulated that a legal abortion may be obtained if the woman is in a state of "intolerable distress", as determined by a physician other than the one performing the abortion. In reality however, there was substantial regional variance in abortion access. In the North, abortions on socioeconomic grounds were relatively easy to obtain, while access was more restricted in the Southern states.

[14] De jure, abortions continue to be illegal but are free from prosecution if the woman states that she is in a "situation of distress and conflict".

woman's life. Under Irish law, abortion is illegal under all circumstances except to save the woman's life, giving the country one of today's most restrictive abortion laws.[15] The abortion law of Cyprus allows a woman to end her pregnancy if it would cause her or any child she may already have physical, mental or psychological harm. Moreover, although not codified, socioeconomic grounds are also accepted. The situation in Cyprus is comparable to those in Israel and Luxembourg[16] where current legislation also permits abortion only on mental health grounds, but is interpreted so as to also include social reasons.

Until 2003, Swiss law permitted abortion only in cases of a serious threat to the woman's life or her physical or mental health. However, legal practice varied between the cantons: while in many cantons, abortion was virtually available on request, in others, abortion access was highly restrictive. In Finland, the socioeconomic grounds for legal abortion comprise any situation in which delivery and care of the child would place a strain on the woman. Iceland's law also includes socioeconomic provisions which are however somewhat more restrictive.[17] Finally, Great Britain requires abortion-seeking women to bring forward a socioeconomic justification. In general, the law is interpreted rather liberally.[18]

To summarize the above, there is a great deal of variation in abortion laws and their interpretations. In our approach, we measure abortion access with a three category variable

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[15] An estimated 4,000 Irish women travel to England each year to obtain abortions. Information on abortion opportunities abroad could be legally disseminated by Irish family planning associations and other groups until a 1990 Supreme Court ruling banned such activities.

[16] The Luxembourg law provides a conscientious objection clause that allows medical personnel to opt out of performing abortions on ethical grounds. Because most health facilities are run by religious orders refusing to perform abortions, abortion seeking women are often referred to abortion services abroad.

[17] The Swiss law stipulates that a woman can obtain an abortion for several reasons: if she has given birth to several children at frequent intervals and only a short time has elapsed since the previous birth; if she lives in difficult family circumstances owing to the presence of many young children or to the serious ill health of other persons in the household; or, if the woman cannot look after a child satisfactorily because of her youth or lack of maturity.

[18] For an abortion to be legal other than to save the pregnant woman's life the British law requires two physicians to conclude that the pregnancy has not exceeded 24 weeks and that continuance of the pregnancy would endanger the woman's, or her existing children's physical or mental health, taking into account socioeconomic factors.
Because of the rather liberal character of British abortion law, "abortion tourism" to Britain was a common phenomenon until abortion laws were also liberalized in most of Continental Europe, and is still taking place from Ireland today. In 1973, the annual number of non-residents seeking legal abortion in Britain peaked at an estimated 53,600.

which is based on written law.[19] The first category incorporates the most restrictive legislation that permits abortion only when the woman's life or her physical health is at serious risk. These policies make it virtually impossible to obtain abortions at will. The second category comprises laws that make abortion available for mental health and socioeconomic reasons. We use this generic category because of the substantial variation within the mental health and socioeconomic provisions: as shown in our above account of international abortion laws, the reading of mental health is in most cases rather liberal, so that mental health grounds often implicitly include socioeconomic reasons. The third category covers all laws that permit abortion on request. For each country in our sample, Table 1 reports the coding of abortion legislation and the periods for which gonorrhea incidence data is available. Figure 1 shows how the abortion law categories have changed over time for our sampled and documents the trend towards more liberal abortion legislation in the sample.

IV. EMPIRICAL STRATEGY

The aim of this paper is to investigate whether a change in the cost of sexual activity leads to changes in sexual behavior. Given a lack of data on sexual activities (see, for instance, Fenton et al. 2001 and Hewett et al. 2008), we exploit the fact that certain infectious diseases are primarily transmitted through sexual intercourse. With gonorrhea incidence we use the frequency of a prominent STD to proxy risky sexual activities. For a number of reasons, gonorrhea is attractive as a measure of sexual activities. It is one of the most frequent

[19] The following categorization is based on the aforementioned five categories of the written abortion law. In addition to belonging to one of these categories, abortion laws also typically contain further provisions: Different third party authorization requirements involving physicians or committees of physicians, social workers, parents, or spouses in the abortion decision. Some laws make counseling and waiting periods mandatory. Financial support for the procedure also varies by country and by the reason for which abortion is obtained. While the cost of therapeutic abortions is commonly fully covered, abortions on request often are paid for privately. Moreover, direct charges for abortions are not the only way in which income can affect abortion access. Additional costs typically accrue when health facilities that perform abortions are remote. This occurs not only in countries with few abortion facilities, but also if conscientious objection clauses are permitted and invoked by a large part of physician in an area, like in Southern Italy or Luxembourg. Also, in federal systems that regulate abortion at the state level, access can vary geographically.

STDs[20] and time-series data are available for a large set of countries. Further, its latency period is short, minimizing the lag between infection and diagnosis and because it is easily cured, gonorrhea has simpler dynamics than other STDs (Klick and Stratmann 2003, 2008). Finally, in contrast to syphilis, gonorrhea is not primarily transmitted among homosexual individuals.[21]

With an unbalanced panel of 41 countries and 21 years from 1980 to 2000 we estimate the following regression equation

$$GONRATE_{it} = \beta A_{it} + \gamma X_{it} + \lambda_i + \nu_t + \varepsilon_{it} \tag{2}$$

The independent variable $GONRATE_{it}$ is the number of newly diagnosed gonorrhea cases per 100,000 individuals per year t and country i, and ε_{it} represents an idiosyncratic error term. We estimate these models with weighted least squares using a country's population as a weight.

A_{it} is the three-category abortion variable described above. In an alternative specification, A_{it} is an indicator variable that equals 1 if abortion is legal on request or for socioeconomic or mental health grounds and 0 if abortion is only legal to save the pregnant woman's life or her physical health. Since we use in all specifications as our reference point the most restrictive regimes that only permit abortion to save the woman's life or physical health, our theory predicts a positive coefficient β.

The vector X_{it} contains control variables and γ is the corresponding vector of coefficients. The controls include two macroeconomic measures to capture a country's level of societal development. Namely, we include gross domestic product (GDP) per capita in 2005 US-Dollars and the annual change in a consumer price index (CPI) measured by three indicator variables: between 5 and 25, between 25 and 100, and more than 100 percent. The omitted reference category is a change of less than 5 percent. Theory does not provide clear

[20] Global incidence is only higher for Trichomoniasis and Chlamydia (Gerbase et al. 1998).
[21] For the United States, the share of gonorrhea cases that are contracted through homosexual intercourse is estimated to be 20 percent, while for syphilis, it is three times as large (Center for Disease Control 2006).

guidance for the signs of coefficients on income and inflation. On the one hand, poverty and economic volatility may coincide with a shortage in contraceptive supply and worse healthcare in general, leading to high gonorrhea incidence (Jones et al. 2002). On the other hand, if sexual activity is a normal good wealthier societies may show higher STD rates.

The vector X_{it} also includes the percent share of the population aged 15-24. Since this is the age group with the highest likelihood of contracting gonorrhea (Lowndes and Fenton 2004b) we expect a positive coefficient on this variable. Further, we incorporate urbanization and population density to account for the role of remoteness and agglomeration in the development of legal norms and the transmission of STDs (Dehne et al. 2002). Finally, as previous work by Dee (2008) has found that the right to same-sex-marriage can lead to changes in STD incidence, we also include an indicator variable that equals 1 if a country grants such rights and 0 otherwise.

Our regression controls for common period effects in gonorrhea incidence through ν_t. The country fixed effects λ_i absorb time-invariant country characteristics like cultural and religious norms that may affect both abortion legislation and the frequency of gonorrhea. The country effect is also useful because it allows us to control for the country difference in gonorrhea surveillance systems that we discuss in the appendix. In some specifications we include country specific time trends in gonorrhea incidence that are not captured by the year indicators and our other controls.

In models that include the country trends, we identify the abortion effect through the discrete change in abortion legislation and the change in gonorrhea incidence across all countries right around the time of legal reforms. By contrast, in models without such trends, identification is provided by the change in gonorrhea incidence for countries that changed their abortion law over the sampled period.

V. DATA

We obtained gonorrhea incidence data[22] for Europe and Central Asia from WHO's European Health for All Database (World Health Organization 2009). The WHO collects data from national sources. For the United States and Canada, we obtained incidence data directly from their national STD surveillance agencies (Center for Disease Control 1994, 1998, 2002, and Public Health Agency of Canada 2008).

Because there are no internationally binding guidelines for the collection of gonorrhea data, the accuracy and detail of reported incidence rates vary between countries and across time. Countries differ in their capacity to identify individuals who have contracted gonorrhea. Further, even though we only consider countries which mandate physicians to report gonorrhea cases to the national surveillance agency, physician reporting rates differ across countries (See Lowndes and Fenton 2004a, Panchaud et al. 2000, Dehne et al. 2002, Van Duynhoven 1999). We describe the variation in data collection methods and data quality in further detail in the appendix. As discussed in the previous section, the inclusion of country fixed effects and country-specific time trends in our model enables us to control for some of these differences.

We obtained the GDP per capita and CPI time-series online from the United States Department of Agriculture's Economic Research Service (United States Department of Agriculture 2009). To obtain estimates of the total population, the share of the population aged between 15 and 24, the degree of urbanization and population density, we used the United Nation's World Population Prospect (United Nations 2007). Because these data are available only in five year intervals, linear interpolation was used to fill the data gaps. Data on same-sex-marriage laws was acquired from Dee (2008) and other online sources.

Table 2 presents summary statistics for the variables in our empirical models.

[22] For the robustness checks in Section VII, we also acquired data on syphilis, malaria, and tuberculosis.

VII. ECONOMETRIC RESULTS

Table 3 presents the results of our econometric analysis. Columns 1, 3, and 4 of Table 3 report coefficient estimates for models that measure abortion access with an indicator variable that equals 1 if abortions are legal on request or on socioeconomic or mental health grounds, and 0 if abortions are legal only to save the woman's physical health or life. Columns 2, 5, and 6 present results for models that include two separate indicator variables for laws that permit abortions on request and for laws that permit it on socioeconomic or mental health grounds. Because in all specifications our reference category are laws that allow abortion only to save the woman's life or to preserve her physical health, the reported coefficients measure the impact of improved access to abortion relative to the most restrictive legislation.

Columns 1 and 2 of Table 3 show regression results with no covariates other than the abortion variables, no year and country effects and no trends.
The specifications presented in columns 3-6 include country and year effects and the full set of control variables. In addition, the specifications shown in columns 4 and 6 include country trends.[23]

Below each coefficient estimate, we report two standard errors. The first row below each coefficient shows Huber-White robust standard errors in parenthesis. In the second row below each coefficient and in brackets is the standard error adjusted for clustering at the country level. The latter standard error allows for serial correlation in the error term (Bertrand et al. 2004). It also helps account for dependence arising from the potentially different methods of collecting the STD data across countries.

The results in columns 1 and 2 of Table 3 show that more liberal legislation is associated with higher gonorrhea incidence. Column 1 indicates that laws which permit

[23] We also estimated specifications with country and year effects with and without country trends which did not include any further control variables. The results were qualitatively similar to those presented in columns 3-6 of Table 3 and are and available from the authors on request.

abortion on request or on socioeconomic or mental health grounds are associated with 82 more gonorrhea infections per 100,000 individuals. Disaggregating this effect in column 2 shows that the previous result is primarily driven by the differences in gonorrhea incidence between laws which make abortion available on request and laws that permit abortion only to save the woman's physical health or life. The point estimate on abortion on request show that this legislation is associated with 107 additional gonorrhea infections per 100,000 individuals. In contrast, the difference between abortion legal on socioeconomic and mental health and abortions legal to save the mother's life or her physical health is 10 infections per 100,000 individuals, and this difference is not statistically significant.

In columns 3 and 5 of Table 3 we add the full set of controls and country and year fixed effects. The results show a positive effect of easier abortion access on gonorrhea incidence. For specification 3 we find an increase of 46 new infections in comparison to laws that permit abortion only to preserve the woman's life or health. The coefficient estimates for the alternative specification in column 5 suggests that the incidence of gonorrhea increases by 70 if abortion is available on request and by 47 if abortion is legal on socioeconomic or mental health grounds.

The results are qualitatively similar when we include country trends in specifications 4 and 6, although the point estimates in these specifications are smaller. In column 4 we find that easier access to abortions leads to 33 additional cases of gonorrhea. Column 6 shows that compared to column 5, the rather large difference between abortion available on request and abortion available on socioeconomic or mental health grounds is getting smaller. In comparison to laws that permit abortions to save the woman's physical health or life, abortion on request leads to an increase of 37 gonorrhea cases, while abortion legal on socioeconomic or mental health grounds leads to 32 additional cases.

VII. ROBUSTNESS CHECKS

One concern regarding the identification of our estimated effect is if the introduction of new abortion laws coincides with a change in the accuracy of gonorrhea surveillance. There is no strong reason to suspect this for the Western countries in the sample. However, in Eastern Europe, the political and socioeconomic upheaval of transition weakened disease surveillance (Panchaud et al. 2000, Dehne et al. 2002). At the same time, a number of Central and Southeastern European countries in our sample reformed their abortion law. Because these countries liberalized abortion policies and because worse monitoring led to lower reported gonorrhea incidence, we may bias our estimate of the effect of abortion law liberalization on gonorrhea incidence. Therefore, similar to Dee (2008), we present estimates of the effect of different abortion laws on gonorrhea incidence for three subsamples (Table 4). Table 4, row 1 repeats the results of the full sample estimation we presented in columns 5 and 6 of Table 3. Table 4, row 2 shows the coefficient estimates from a sample which excludes all former socialist countries. All coefficients show the predicted sign and are larger for laws that permit abortion on request than for laws that permit abortion on socioeconomic or mental health grounds. Only in the specification that includes country trends are the abortion law point estimates larger than for the full sample estimation presented in row 1.

Table 4, row 3, shows coefficient estimates for a subsample that omits observations from former socialist countries before 1992. Again, the coefficient signs are consistent with our predictions, and as before, the coefficient on laws that permit abortion on request is larger than the coefficient for laws that abortion on socioeconomic or mental health grounds.

In addition all coefficients in row 3 are larger than those in row 1, supporting that there was a simultaneous weakening of gonorrhea surveillance and liberalization of abortion law in the former socialist countries.

As a further robustness check, we estimated the effect of abortion laws using only observations from the nine countries which adopted a new law during the sample period. The

results are presented in Table 4, row 4. Since our analysis is based on nine countries, we do not report standard errors with clustering at the country level. The coefficient estimates are statistically significant, show the predicted sign, and, for the specification that includes country trends are of similar magnitude as those estimated for the full sample in row 1.

To examine whether we are simply picking up the effects of unobserved changes in health attitudes and policies, in Table 5, we present estimates for the effect of abortion law on the incidence of syphilis in row 2, tuberculosis in row 3 and malaria in row 4. Table 5, row 1 repeats the coefficient estimates for gonorrhea which are also shown in columns 5 and 6 of Table 3. Because syphilis is primarily a homosexual disease we predict a small, if any, abortion law effect on syphilis incidence. Tuberculosis and malaria are not sexually transmitted. Thus, a positive and statistically significant effect of abortion laws on tuberculosis and malaria would suggest that our prior conclusions about gonorrhea incidence are at least in part an artifact of omitted variables bias.

The results presented in Table 5 are consistent with our predictions. We find no systematic evidence with respect to these other diseases.

VIII. CONCLUSION

The aim of this paper is to investigate whether decisions on sexual activity are driven by considerations of costs and benefits, and not merely a product of instincts and long-term socialization. To test this hypothesis, our empirical approach relates abortion laws of different restrictiveness to gonorrhea incidence which is our proxy for risky sexual behavior. In our econometric analysis we use data from 41 countries for the 1980-2000 period.

Consistent with our theoretical prediction and consistent with the results of Klick and Stratmann (2003, 2008), we find that compared to legislation that only permits abortion to save the woman's life or her physical health, less restrictive abortion policies lead to

significantly higher gonorrhea incidence. In addition, the marginal effect of laws which make abortion available on request is generally larger than the effect of more restrictive laws which permit abortion on socioeconomic and mental health grounds.

The basic result that increased abortion access is associated with an increase in risky sex has now been demonstrated in three separate samples covering different periods, counties, and types of laws. Our results suggest that human disease spread models can be improved by including a behavioral component to generate more reliable results. Further, the finding that more liberal abortion laws lead to an increase in risky sex may help practitioners to quantify and safeguard against possible public health repercussions of abortion liberalization.

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APPENDIX: GONORRHEA SURVEILLANCE ACROSS COUNTRIES

The most common method to collect data on the frequency of gonorrhea is to mandate physicians or laboratories to report new cases to a central surveillance agency. Other surveillance systems, like those of Belgium and France obtain incidence data from voluntary sentinel studies in which participation is however often low or varies substantially over time (Lowndes and Fenton 2004a, Panchaud et al. 2000).[24] We therefore limit our sample to countries where incidence data is obtained through mandatory case reporting.

Nevertheless, even in the limited sample certain comparability issues remain. Despite case reporting being mandatory in all sample countries, the share of diagnosed gonorrhea cases physicians actually report to surveillance agencies differ substantially between countries (Lowndes and Fenton 2004a). For Canada, the United Kingdom, Ireland, the Scandinavian and the former socialist countries, the reporting rates are estimated to be 70 percent or higher, whereas they are 50 to 70 percent for the United States and Switzerland. For Germany, Austria, the Netherlands, Spain, Portugal, and Italy[25], underreporting is most severe with at least every second diagnosed case not being registered in the official statistics. These differences are often ascribed to the setup of healthcare systems. If private providers and general practitioners play an important role, reporting tends to be lower than in public healthcare systems with specialized STD care institutions. Further, not all countries require laboratory confirmation of diagnosed cases before they are registered in the official gonorrhea statistics (Lowndes and Fenton 2004a and Panchaud et al. 2000).

Moreover, countries vary in their capacity to identify gonorrhea cases in the first place. The difference between the number of infections and the number of diagnosed cases has several causes. In poorer and sparsely populated areas, the remoteness of healthcare

[24] For Belgium, the sentinel system covers up to 40% of laboratories but does not include the Brussels metropolitan region that represents some 10 percent of the population. For France, it is estimated that only 5 percent of laboratories that test for gonorrhea participate in the studies. See Panchaud et al. (2000)

[25] For Italy, Greco et al. (1990) estimate that gonorrhea-cases are 5-150 times less likely to be reported in comparison to other European and North American countries. According to Lowndes and Fenton (2004a) the situation has somewhat improved in the 1990s, but reporting rates remain low.

facilities reduces diagnosis rates as people often resort to self-medication (Dehne et al. 2002). Self medication is also more frequent in societies that stigmatize STDs.[26] Other factors are partner notification requirements in case of a diagnosed infection and the extent of screening programs.[27]

[26] For Italy, Dal Conte et al. (2001) report that while only 3303 gonorrhea cases where officially registered in 1981, 127,000 units of gonorrhea medication where sold during the same year.

[27] Most countries subject only certain high-risk groups like sex workers to routine screenings. More universal screening may lead to much higher reported incidence because gonorrhea can in many cases remain asymptomatic. See Van Duynhoven (1999).

Screening and partner notification are more comprehensive in the newly independent states and Scandinavia. In Canada, the United Kingdom, and the United States partner notification is recommended but non-mandatory. Belgium, France, West Germany, the Netherlands and Switzerland, do not have partner-notification policies.

Table 1: Abortion Legislation in 41 Countries and Sampled Periods

COUNTRY	SAMPLE PERIOD	ABORTION LAW CATEGORY	ABORTION LAW
FORMER SOVIET STATES			
Armenia	1980-87, 1990-99	Request	Based on 1955 (23 Nov) Edict of the Soviet Union
Azerbaijan	1980-2000	Request	Based on 1955 (23 Nov) Edict of the Soviet Union
Belarus	1980-2000	Request	Based on 1955 (23 Nov) Edict of the Soviet Union
Estonia	1980-2000	Request	Based on 1955 (23 Nov) Edict of the Soviet Union
Georgia	1980-2000	Request	Based on 1955 (23 Nov) Edict of the Soviet Union
Kyrgyzstan	1980-2000	Request	Based on 1955 (23 Nov) Edict of the Soviet Union
Latvia	1980-2000	Request	Based on 1955 (23 Nov) Edict of the Soviet Union
Lithuania	1980-2000	Request	Based on 1955 (23 Nov) Edict of the Soviet Union
Moldova	1980-2000	Request	Based on 1955 (23 Nov) Edict of the Soviet Union
Russia	1980-2000	Request	Based on 1955 (23 Nov) Edict of the Soviet Union
Tajikistan	1980-2000	Request	Based on 1955 (23 Nov) Edict of the Soviet Union
Uzbekistan	1980-2000	Request	Based on 1955 (23 Nov) Edict of the Soviet Union
FORMER YUGOSLAVIAN STATES			
Croatia	1980-2000	Request	1978 (21 Apr) Law no. 1252-1978
Serbia	1980-2000	Request	1977 (30 Jun) Act on Termination of Pregnancy.
Slovenia	1980-2000	Request	1977 (20 Apr) Law on Right to a Free Decision regarding Birth
Macedonia	1980-2000	Request	1969 (26 Apr) Decree on Pregnancy Termination
OTHER FORMER SOCIALIST COUNTRIES			
Albania	1980-1990	Life/Physical	1977 (15 Jun) Criminal Code, sect. 95
	1991-2000	Request	1991 (29 Apr) Law no. 7491, art. 16/1995 (7 Dec) Law no. 8045
Bulgaria	1985, 1988-89	Mental/Socioec.	1973 (Apr) Decree no. 0-27 of Ministry of Public Health, amend.: 1974
	1990-2000	Request	1990 (2 Feb) Decree no. 2 of Ministry of Health and Social Welfare
Czech Republic	1980-1986	Mental/Socioec.	1973 (16 May) Decree no. 69-71
	1987-2000	Request	1986 (Oct 20) Law no. 73
Hungary	1980-1992	Mental/Socioec.	1973 Resolution no. 1040 of Council of Ministers; 1973 ordinance no. 4 Minister of Health; 1986 (23 July) Ordinance 3
	1993-2000	Request	1992 (17 Dec) Law no. 79 on Protection of the Life of the Fetus
Poland	1980-2000	Mental/Socioec.	1956 (27 Apr) Law no. 61, 1990 (30 Apr) Ordinance of Ministry of Health and Social Welfare; 1993 (7 Jan) Law on Termination of Pregnancy, repealed in 1996, re-enacted in 1997
Romania	1980-1989	Mental/Socioec.	1966 (29 Sep) Council of State Decree no. 770, last amended in 1985
	1990-2000	Request	1989 (26 Dec) repeal of former law; 1996 (5 Nov) Law no. 140
WESTERN EUROPE AND ISRAEL			
Austria	1980-2000	Request	1974 (23 Jan) Federal Law
Cyprus	1984-2000	Mental/Socioec.	1974 Criminal Code, sec. 167-169 & 169A, amend.: 1986 Law no. 186
Denmark	1980-2000	Request	1973 (13 June) Law no. 350, amend.: 1995 (14 June) Law no. 389
Finland	1980-2000	Mental/Socioec.	1978 (14 July) Law no. 564; 1985 (12 July) law no. 572
(W.) Germany	1980-89, 1991-92	Mental/Socioec.	1976 (18 May) penal code sect. 218
	1993-2000	Request	1993 (28 May) Const. Court decision, new law in effect 1995 (1 Oct)
Iceland	1980-2000	Mental/Socioec.	1975 (27 May) Law no. 25
Ireland	1989-2000	Life/Physical	1861 Constitution, Offences against the Person Act
Israel	1980-2000	Mental/Socioec.	1979 (16 Dec) Amendment of 1977 (31 Jan) Penal Law
Italy	1980-2000	Request	1978 (22 May) Law no. 194
Luxembourg	1980-2000	Mental/Socioec.	1978 (15 Nov) Penal Code, title VII, chapter I, art. 348-353
Netherlands	1982-2000	Request	1981 (1 May) Law on Termination of Pregnancy
Norway	1980-2000	Request	1978 (16 Jun) Law no. 66, Sec. 1-14
Portugal	1980-1983	Life/Physical	1886 (16 Sep) Criminal Code, sect. 385
	1984-2000	Mental/Socioec.	1984 (11 May) Law no. 6, sect. 139-141
Spain	1982-1985	Life/Physical	1800s
	1986-2000	Mental/Socioec.	1985 (5 July) Organic Law No. 9
Sweden	1980-2000	Request	1974 (14 June) Abortion Law (no. 595), amended 1995 (18 May)
Switzerland	1980-2000	Mental/Socioec.	1937 (21 Dec) Penal Code, art. 118-120 (last amended 1942)
UK*	1980-2000	Mental/Socioec.	1967 Abortion Act, amended 1990
NORTH AMERICA			
US	1980-2000	Request	Nationwide: 1973 Supr. Court decisions (Roe v. Wade; Doe v. Bolton)
Canada	1980-1987	Mental/Socioec.	1969 Criminal Code, sec. 251
	1988-2000	Request	1988 Const. Court decision (R v .Morgentaler)

*Excluding Northern Ireland
Source: United Nations (2002)

Table 2: Summary Statistics

VARIABLE	DESCRIPTION	MEAN	SD	SOURCE
DISEASE				
Gonorrhea Incidence	Gonorrhea cases per 100,000 population	54.91873	66.42079	US: CDC
Syphilis Incidence	Syphilis cases per 100,000 population	14.45713	32.26543	
Malaria Incidence	Malaria cases per 100,000 population	4.052344	28.88053	Canada: PHAC
Tuberculosis Incidence	Tuberculosis cases per 100,000 population	32.45031	24.39277	Others: WHO
ABORTION LAW				
Request/Socioec./Mental	=1 if abortion legal to preserve the woman's mental health, for socioeconomic reasons, and on request; =0 if abortion legal only to preserve the woman's physical health or life.	.969988	.1707228	
Mental/Socioec.	=1 if abortion legal to preserve the woman's mental health or on socioeconomic grounds; =0 otherwise	.3037215	.4601401	UN
Request	=1 if abortion legal on request; =0 otherwise	.6662665	.4718291	
Life/Physical	=1 if abortion legal to save the woman's life or preserve her physical health; =0 otherwise	.030012	.1707228	
CONTROL VARIABLES				
GDP per Capita	Real per capita GDP in 2005 US-Dollars	15447.45	14900.77	USDA
CPI≥100%	=1 if annual inflation higher than 100 percent; =0 otherwise	.0852341	.2793975	
25%≤CPI<100%	=1 if annual inflation between 25 and 100 percent; =0 otherwise	.0828331	.2757954	USDA
5%≤CPI<25%	=1 if annual inflation between 5 and 25 percent; =0 otherwise	.2821128	.4502984	
CPI<5%	=1 if annual inflation lower than 5 percent; =0 otherwise	.5498199	.4978107	
Population	Total population (linearly interpolated)	22687.35	46449.95	UN
Population 15-24	Percentage of population aged 15-24 (linearly interpolated)	15.71966	2.411938	UN
Urbanization	Percentage of population living in urban agglomerations (linearly interpolated)	64.79254	15.56156	UN
Population Density	Population per square kilometer (linearly interpolated)	97.45202	81.45567	UN
Same Sex Marriage	=1 if same sex marriage legal; =0 otherwise	.039489	.1948684	Dee (2008), online sources

CDC: Center for Disease Control
PHAC: Public Health Agency of Canada
WHO: World Health Organization
UN: United Nations
USDA: United States Department of Agriculture

Table 3: Panel Estimation Relating Abortion Access to Gonorrhea Incidence

	(1)	(2)	(3)	(4)	(5)	(6)
Request / Socioec. / Mental	82.32709 (15.93888)*** [48.10612]*		46.23 (13.72)*** [21.36]**	32.79 (15.17)** [8.166]***	.	.
Request	.	107.3509 (18.19131)*** [52.49267]**	.	.	70.42 (17.77)*** [47.27]	37.11 (17.70)** [18.15]**
Socioec. / Mental	.	10.50184 (10.74317) [20.76016]	.	.	46.99 (13.89)*** [21.78]**	32.43 (15.17)** [8.865]***
GDP per Capita	.	.	-0.0129 (0.00189)** [0.00531]**	0.00697 (0.00271)** [0.00409]*	-0.0122 (0.00176)*** [0.00447]***	0.00702 (0.00271)*** [0.00412]*
5% ≤ Infl. < 25%	.	.	-9.737 (7.149) [9.846]	1.734 (4.443) [2.811]	-10.89 (7.390) [9.839]	1.598 (4.530) [2.913]
25% ≤ Infl. < 100%	.	.	-5.332 (9.510) [12.81]	15.09 (6.650)** [4.271]***	-6.258 (9.488) [12.86]	15.01 (6.659)** [4.144]***
100% ≤ Infl.	.	.	45.84 (14.74)*** [24.69]*	59.40 (11.74)*** [22.44]**	44.76 (14.78)*** [25.19]*	59.26 (11.82)*** [22.55]**
Population 15-24	.	.	5.457 (2.246)** [4.155]	5.499 (1.765)*** [2.441]**	6.092 (2.273)*** [3.918]	5.595 (1.840)*** [2.454]**
Urbanization	.	.	6.640 (1.959)*** [6.222]	1.117 (2.776) [4.261]	6.929 (2.044)*** [6.586]	1.173 (2.802) [4.176]
Population Density	.	.	-0.573 (0.747) [2.216]	-4.986 (1.389)*** [2.806]*	-1.550 (0.727)** [1.820]	-5.026 (1.382)*** [2.781]*
Same Sex Marriage	.	.	42.01 (14.76)*** [43.93]	10.90 (9.685) [18.11]	45.38 (14.98)*** [44.88]	10.91 (9.722) [18.18]
Country Effects	N	N	Y	Y	Y	Y
Time Effects	N	N	Y	Y	Y	Y
Country Trend	N	N	N	Y	N	Y
R2	0.973	0.854	0.922	0.981	0.922	0.981

Robust standard errors are presented in parenthesis and standard errors with clustering at the country level in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The dependent variable is the number of individuals per 100,000 who are diagnosed with gonorrhea in year t in country i. Columns 1, 3 and 4 show estimation results for models that use the indicator abortion variable that equals 1 if abortion is legal on request or on socioeconomic or mental health grounds and 0 if abortion is only legal to save the woman's life or to preserve her physical health. Columns 2, 5 and 6 show estimation results for models that use indicator variables derived from the three category abortion law categorization; the omitted reference category is abortion legal to save the mother's life or to preserve her physical health. Each regression is estimated with population weights; n=883.

Table 4: Estimates of the Effect of Abortion Laws on Gonorrhea-Incidence by Alternative Sample Constructions

	Without Country Trends		With Country Trends		Sample Size
	Request	Socioec./Mental	Request	Socioec./Mental	
(1) Full Sample	70.41798 (17.77065)*** [47.27474]	46.99326 (13.88598)*** [21.77599]**	37.10799 (17.69919)*** [18.14525]**	32.43084 (15.17463)** [8.864602]***	833
(2) Only Western countries	68.17129 (25.48491)*** [72.88968]	14.28038 (18.60257) [38.77754]	57.04757 (19.53646)*** [23.85854]**	37.67491 (15.38662)** [9.854424]***	381
(3) Excluding Obs. from former socialist countries before '92	77.19773 (25.54327)** [72.69795]	34.51146 (19.96245)* [38.34891]	50.6881 (19.99465)** [21.3501]**	38.9389 (15.69759)** [9.33283]***	578
(4) Only countries that reformed abortion law 1980-2000	52.40767 (12.99026)***	54.35264 (11.36588)***	41.81123 (11.7827)***	33.14881 (11.39021)***	176

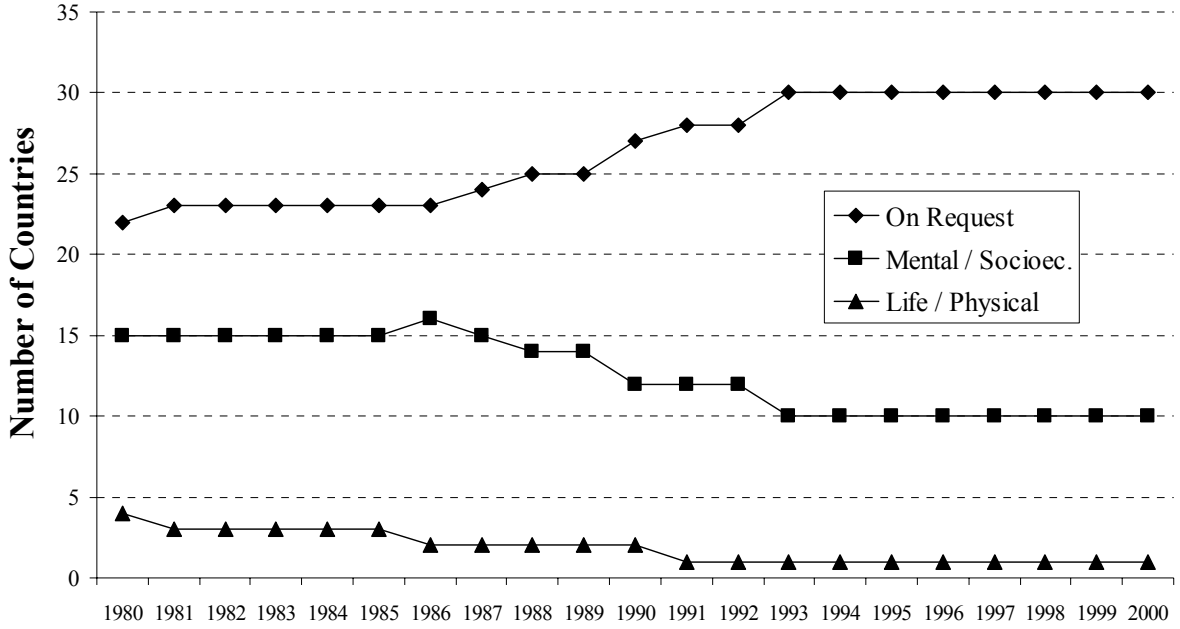
Robust standard errors are presented in parenthesis and standard errors with clustering at the country level in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
We do not present clustered standard errors in row 4 because of the limited number of countries in the sample.
The dependent variable is the number of individuals per 100,000 who are diagnosed with gonorrhea in year t in country i. The Full Sample estimates presented in the first row of this table correspond to those presented in columns 5 and 6 of Table 3. Each regression is estimated with population weights.

Table 5: Estimates of the Effect of Abortion Laws on the Incidence of Different Infectious Diseases

	Without Country Trends		With Country Trends		Sample Size
	Request	Socioec./Mental	Request	Socioec./Mental	
(1) Gonorrhea	70.41798 (17.77065)*** [47.27474]	46.99326 (13.88598)*** [21.77599]**	37.10799 (17.69919)*** [18.14525]**	32.43084 (15.17463)** [8.864602]***	833
(2) Syphilis	-10.23356 (9.939602) [24.31381]	8.239978 (5.831033) [10.14329]	-29.0629 (12.51614)** [14.7206]*	-22.87311 (9.81443)** [10.33511]**	777
(3) Malaria	-1.3796 (1.179852) [2.11096]	-1.00513 (.9951384) [1.735589]	1.23406 (.7325093)* [1.242148]	1.123304 (.6027402)** [1.236559]	789
(4) Tuberculosis	5.79003 (3.848057) [10.17125]	6.053134 (3.326122)* [6.642437]	2.900203 (4.485397) [3.786059]	2.307471 (4.313555) [2.789017]	815

Robust standard errors are presented in parenthesis and standard errors with clustering at the country level in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
The dependent variable is the number of individuals per 100,000 who are diagnosed with gonorrhea, syphilis, malaria, or tuberculosis, respectively, in year t in country i. The Full Sample estimates presented in the first row of this table correspond to those presented in columns 5 and 6 of Table 3. Each regression is estimated with population weights.

Figure 1: Development of Abortion Legislation in 41 Countries, 1980-2000



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