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Equilibrium Effects of Abortion Restrictions on Cohort Fertility: Why Restricting Abortion Access Can Reduce Human Capital, Social Welfare, and Lifetime Fertility Rates.

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Abstract

The United States Supreme Court's ruling in *Dobbs v. Jackson Women's Health Organization* has made understanding the impact of abortion laws increasingly important and timely. We investigate recent claims by policymakers that abortion restrictions increase birth rates; we also evaluate consequences for human capital and women's welfare. We motivate our theoretical contribution by presenting some simple empirical analysis of cross-country associations. These provide no evidence of a significant association between abortion legality and birth rates. Our main contribution is an applied economic theory model. Contrary to some policy claims, but in line with stylized empirical facts, abortion bans can *lower* equilibrium fertility: An abortion ban might cause women to have more unintended births at young ages, but this could reduce their accumulation of capabilities that would prepare them to have a larger family later. We solve a 2-period version of the model, and simulate it and a 3-period version. Our model shows that the sign of the effect on lifetime fertility depends on whether the increase in fertility due directly to unintended births is outweighed by the effect on subsequent fertility choices. But either way, abortion restrictions are likely to reduce human capital and harm women's welfare.

Keywords: abortion, fertility, human capital, capabilities, *Dobbs*

JEL Codes: I12, I18, I31, J13

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1 Introduction

In 2022, the United States Supreme Court's ruling in *Dobbs v. Jackson Women's Health Organization* held that the US Constitution does not include a right to abortion. This decision overruled previous Supreme Court decisions — most notably *Roe v. Wade* (1973) — which had held that the right to privacy within the 14th Amendment conferred qualified rights to terminate a pregnancy. The *Dobbs* decision led to immediate and subsequent legal restrictions and bans being imposed on abortion in many states.

The Supreme Court's decision also fueled speculation about the effect of abortion laws on fertility choices of women and families. Numerous articles in popular media have assumed that the abortion restrictions imposed in the wake of the *Dobbs* decision will lead to an increase in births; see, for example, Jeltsen (2022) and Kekatos (2022). The intuition behind such an assumption is simple: if women are unable to abort an unintended pregnancy due to a ban or restriction on abortion, they will be required to give birth to those babies that would otherwise not be born. Such an intuitive argument has even caused opponents of abortion access to claim that abortion restrictions could reverse the decline in the U.S. birth rate, such as Matt Schlapp, the chairman of the American Conservative Union (O'Donnell Heffington, 2023), who argues that: "If you say there is a population problem in a country, but you're killing millions of your own people through legalized abortion every year, if that were to be reduced, some of that problem is solved."

The contribution of this paper is to challenge such arguments from one perspective: that of economic theory. Our paper offers a theoretical complement to the existing empirical literature, in which the evidence for a positive effect of abortion restrictions on fertility is ambiguous at best (Foster, 2021). Indeed, countries that have had more restrictive abortion laws, such as Italy and Spain, often have lower fertility rates than countries such as the Netherlands where abortion has long been free and accessible (Levels, Need, Nieuwenhuis, Sluiter, and Ultee, 2012).

In this paper, we first motivate our analysis by presenting some simple stylized facts that further suggest an absence of a positive effect of abortion restrictions on fertility, and perhaps even an effect in the opposite direction: First, in data from 24 developed countries from 2017, the only country where abortion was classified as "highly legally restricted" (South Korea) had the lowest tempo-adjusted total fertility rate. Second, in a larger set of 44 developed countries in 2014, we find no significant association between the average fertility rate and a measure of abortion legality.

Therefore, this paper asks an applied, theoretical question: Why might legal restrictions on abortion not be associated with greater aggregate fertility rates in the long-term? Our intuition is that such laws might increase fertility *in the short-term* if pregnant women cannot get an abortion, but *in the long-term* such restrictions could affect incentives and opportunities related to life choices, relationships, and human capital accumulation, possibly making women less likely to choose to have a larger number of children. This is roughly what happened in Romania in the 20th century, for example, where the birth rate increased sharply when abortion was banned, but the birth rate subsequently fell to its pre-ban levels, even while the ban remained in place (Teitelbaum, 1972).

We then present an applied economic theory model that illustrates this mechanism: we consider a representative woman who lives for T periods, and has opportunities for relationship experiences and accumulation of "capabilities" (some form of human capital) in each period, before choosing their desired number of children in the final period. Being in a sexual relationship in any given period involves a risk of pregnancy. We assume that giving birth involves the loss of capability accumulation for that period, due to the time, effort, and money expended in pregnancy, giving birth, and being the mother of a newborn child. Finally, at the end of the model, the cost of raising children decreases with the woman's stock of accumulated human capital: women with more capabilities are assumed to be more able to raise a larger family.

We solve for the equilibrium of this model in a 2-period version, and perform simulations of this version of the model and of a larger 3-period version. Analysis of *equilibrium* outcomes is important, because women will make different relationship formation, human capital, and (in an extension of our model) contraceptive choices to achieve their life goals in a policy environment where they anticipate legal restrictions on abortion. Our results indicate that it is possible that women will have fewer children on average when abortion is illegal, because they are less likely to have opportunities to accumulate capabilities (due to unintended births), and the lack of capabilities discourages future fertility. For an abortion ban to increase fertility would require that, for a significant number of women, the unintended births caused would take them above the level of fertility that they would otherwise choose, which can happen in a model with 3 or more periods, making the overall predicted effect of abortion restrictions on fertility ambiguous, just like in the empirical literature. We also find that abortion restrictions are likely to reduce relationship formation, out of fear of pregnancy.

Finally, and worthy of emphasis, we find that in all scenarios, women's average wellbeing decreases when abortion is illegal, because of lower human capital accumulation, constrained fertility, and lower partner match quality.

The rest of the paper proceeds as follows. The remainder of the current section presents an overview of the relevant literature on abortion and fertility. Section 2 performs a simple empirical analysis which generates some stylized facts about the cross-country association between abortion laws and fertility. Section 3 then presents our theoretical model and the simulation results, and section 4 concludes the paper. Two appendices in the paper and a supplementary online appendix present some additional algebraic, simulation, and estimation results.

1.1 Literature

A significant amount of empirical work has studied the effects of abortion laws on birth rates. Some of this work has found negative effects of legalized abortion on birth rates (Klerman, 1999; Guldi, 2008; Medoff, 2008; Lahey, 2014), while others have found more nuanced results; in particular, Levine (2004) summarizes a body of empirical evidence which suggests that legalized abortion in the US led to lower birth rates, but that subsequent more moderate restrictions on abortion don't seem to be associated with higher birth rates, perhaps due to adjustment of contraceptive and other behaviours.[1] Several recent papers (Mølland, 2016; González, Jiménez-Martín, Nollenberger, and Castello, 2021) have found that legalized abortion (in Norway and Spain) delayed fertility in the short-run, but with no negative effect on completed fertility, and led to increased educational attainment of young

[1] Kane and Staiger (1996) find a similar empirical result: they claim that past research suggested that banning abortion raised the teen birthrate, but that more recent restrictions are associated with reductions in fertility. Results for Eastern Europe in Levine and Staiger (2004) are also similar.

women.

There are also several papers that suggest ambiguous effects of abortion laws in long-run equilibrium: Kearney and Levine (2015) find a significant drop in the teen birth rate in the US since 1991, most of which cannot be explained by observable factors such as abortion laws, while Teitelbaum (1972) shows that an increase in births following Romania's abortion ban in 1966 lasted only for about 5 years. Levels, Need, Nieuwenhuis, Sluiter, and Ultee (2012) study abortion choices in the Netherlands, and remark that, in the Netherlands, "abortion is legal, safe, easily available, and free of charge. Paradoxically, it is also extremely rare", and it is important to note that the Netherlands' abortion regime coexists with a fertility rate that is higher than southern European countries like Italy and Spain that have had more restrictive abortion policies.

This literature indicates that the effects of abortion laws on fertility are not unambiguous, and that long-run effects could be different from shorter-term impacts. Our contribution will be primarily theoretical, in attempting to present a model that is consistent with such ambiguous effects, though the following section will first add to the existing empirical evidence by examining cross-country associations between abortion laws and fertility. Because of our theoretical focus, our paper is perhaps closest to Forsstrom (2021), who presents and estimates a structural model in which abortion restrictions affect fertility, partnership formation, and human capital accumulation. However, unlike our model, the latter paper predicts an unambiguously positive effect of an abortion ban on birth rates.

Importantly, a new empirical literature on recent birth rates in the US has emerged, in some cases since we presented the first draft of this paper. This empirical literature coheres with and complements our theoretical results—especially the Turnaway Study of Foster (2021) and Dench, Pineda-Torres, and Myers's (2024) investigation of post-*Dobbs* birth rates. We discuss this literature in Section 3.3.

2 Motivating Facts: Data and Simple Empirical Analysis

In this section, we motivate our theoretical results by presenting a simple empirical analysis of the cross-country association between abortion laws and fertility. These descriptive facts are intended to illustrate the range of possible equilibrium outcomes, not as cleanly identified estimates of cause-and-effect.

First, we combine fertility data from the Human Fertility Database with the Guttmacher Institute's classification of countries by the legality of abortion in 2017. A "tempo-adjusted total fertility rate" is available for 24 countries, all of which are economically developed. Of these, only South Korea was classified as "abortion highly legally restricted" rather than "abortion broadly legal"; abortion was subsequently decriminalized in South Korea in 2021. South Korea had the lowest tempo-adjusted TFR of the 24 countries, as can be seen in Figure 58 in supplementary appendix L.[2]

A larger set of 44 developed countries has a total fertility rate available from the UN World Population Prospects for 2014 and a Guttmacher Institute abortion legality classification. There is no difference in average fertility rate by abortion legality, as can be seen in Figure 1 and Table 1, where "restricted" is a binary variable equal to 1 if the country has significant abortion restrictions;[3] whether the sign of the difference is positive or negative depends on whether observations are weighted by the annual number of births of each country. The confidence interval always includes zero and the coefficient is always small in absolute magnitude, ranging from 0.05 of a birth to 0.14 across four regressions with and without weights and with and without controls for GDP per capita.

Taken together, these data suggest a stylized fact that legal restrictions on abortion are not associated with greater equilibrium aggregate fertility rates. In fact, while we know that there are many differences across countries, and many factors that can influence fertility

[2]The Human Fertility Database also has a tempo-adjusted TFR for Taiwan, which is lower than for South Korea, but GDP per capita is not available.

[3]Specifically, restricted = 0 if abortion is unrestricted or can be permitted for health reasons *and* on socioeconomic grounds. If we alter the definition of our variable such that restricted = 0 only if abortion is unrestricted, the results are qualitatively the same: the coefficients' magnitudes are similar but the signs are reversed, with small negative values in columns (1) and (2) and larger (but non-significant) positive values in columns (3) and (4).

Figure 1: Correlation Between Fertility, Income, and Abortion Laws

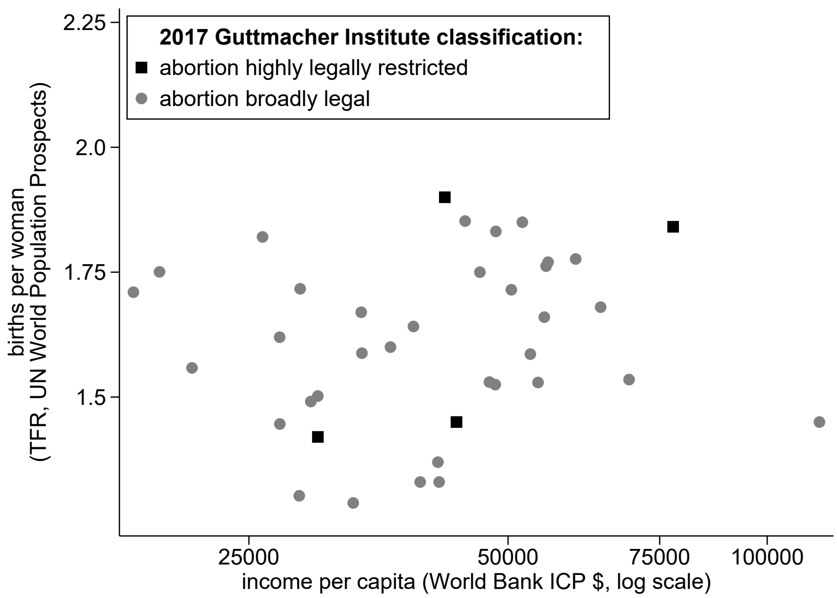


Table 1: Regressions of Fertility on Abortion Laws and Income

	(1)	(2)	(3)	(4)
restricted	0.076	0.050	-0.136	-0.114
	(0.115)	(0.110)	(0.116)	(0.104)
GDP per capita ($000s)		0.002		0.003
		(0.002)		(0.003)
constant	1.577	1.509	1.668	1.517
	(0.027)	(0.068)	(0.052)	(0.175)
weighted by # of births	no	no	yes	yes
N	44	43	44	43

Notes: Robust standard errors are presented in parentheses below each coefficient.

rates, the example of South Korea suggests that legal restrictions on abortion can at least coexist with (if not cause) very low levels of fertility.[4] Our model in the next section will attempt to explain how this stylized fact could come about.

[4]Although South Korea is regarded as relatively socially conservative and paternalistic among developed countries, our data also include Japan, which fares even more poorly than South Korea in the World Economic Forum Global Gender Gap Index (World Economic Forum, 2023), at 125th and 105th respectively. Although this remains highly anecdotal, gender inequality is not a unidimensional scalar, and there are various differences between these two countries, it remains true that Korea's abortion laws were more restrictive than Japan's for a long time, and their fertility rate is lower.

3 Theory Model & Simulations

In this section, we present a theoretical model of a representative woman who lives for T periods and makes relationship and child-bearing choices over time, with consequences for completed fertility and human capital accumulation. The first subsection presents the model, while the second illustrates the model using numerical simulations, and the third discusses our findings and their plausibility.

We emphasize that our contribution is to the applied theoretical economics literature, so we use the tools and language of that literature. This is only one angle from which to consider abortion policy. Access to reproductive healthcare and reproductive freedom and justice more broadly are significant issues with wide implications for policy, ethics, and social science (Hartmann, 1987). No parsimonious model can capture every woman's experience of reproductive policy. Within this broad landscape, because the hypothesis of an effect of abortion bans on birth rates is frequently invoked in policy and political debates, this social scientific aspect of abortion policy merits study with economists' tools—and with other tools, as well. Additionally, we emphasize that our goal is to focus on the capability mechanism in our model; other mechanisms are surely important in the abortion decision and its implications, but modelling a general equilibrium framework of abortion is beyond the scope of the current paper.

3.1 Theory Model

Our model focusses on a representative woman who lives for T periods.[5] By focussing on women and abstracting from men, aside from two parameters that capture the quality of a woman's match with a male partner, our analysis primarily applies to societies where women drive the demand for abortion.[6]

In each of the first $T-1$ periods of the model, the woman has the opportunity for both

[5] Our model is based on a simple set of mechanisms, and as such is not designed for a detailed analysis of heterogeneity; however, in footnote 17 in section 3.2 we discuss the ambiguous effects of introducing greater heterogeneity into our model, in the form of varying parameters that capture the probability of accumulating human capital if a woman does or doesn't give birth in a period.

[6] We abstract from same-sex partnerships and other gender identities to focus on heterosexual women, who represent the majority of unintended pregnancies; we encourage further study on these other important populations.

relationship experiences and accumulation of human capital, though the latter should be understood in a broader sense as "capabilities" rather than purely as formal education. Being in a relationship involves a risk of pregnancy,[7] in which case the woman must decide whether to keep the pregnancy or have an abortion, if the latter is legal; keeping the pregnancy involves the loss of the human capital accumulation opportunity for that period, due to the (monetary and non-monetary) costs of having an unplanned birth.[8] At the end of the period, a woman who is in a relationship decides whether to stay with her current partner, or separate and be randomly matched with a new prospective partner in the next period. In the final period, the woman receives a randomly-drawn partner — unless she chose to remain with her partner from a previous period — and she chooses her final number of children, which must be at least as large as the number of children she already has,[9] and where the cost of children decreases with human capital accumulation: women with more capabilities are assumed to be more able to raise a larger family.[10]

The general T-period specification of the model can become quite complicated, but the fundamental intuition can be conveyed by a shorter form of the model, and so we focus here on a 2-period version of the model. In the following subsection, we will also present a simulation of a 3-period version of the model and discuss how the analysis generalizes as T

[7] In this sense, we use the word "relationship" to mean exposure to the risk of pregnancy rather than a formal commitment. However, in supplementary appendix H, we show that the results are generally similar if there is also a (smaller) risk of pregnancy among single women, which could be due to casual sex or even to rape, though Finer, Frohwirth, Dauphinee, Singh, and Moore (2005) find that only about 1% of abortions in the US are due to rape. We also model contraception in extended results below.

[8] Johansen, Nielsen, and Verner (2020) find that the subsequent education and employment of both women and men are negatively affected by parenthood before age 21 in Denmark, although Kearney and Levine (2012) do not find negative future economic consequences of teen childbirth in the US.

[9] As such, this final period corresponds to a time when the woman is in a settled relationship and could choose to have additional children if she desires.

[10] In supplementary appendix D, we present a simple model of the child production process, which highlights the conditions under which greater capabilities would be associated with a lower cost of having children. In supplementary appendix E, we present the result of our model if human capital accumulation instead lowers fertility preferences; unsurprisingly, by shutting off the main mechanism in our paper, this leads to the conclusion that an abortion ban must raise fertility. This is part of the reason why we focus on general "capabilities" in the paper, and not just formal education: we want to emphasize the varied capabilities that women can accumulate over time which may permit them to achieve their desired fertility, and which may be interrupted by the need to give birth in the presence of an abortion ban. Even in the case of formal education, recent evidence (Doepke, Hannusch, Kindermann, and Tertilt, 2023) suggests that the negative correlation between education and fertility has diminished over time in the US, and the relationship is quite flat for women with at least a high school diploma in a variety of developed countries; Doepke, Hannusch, Kindermann, and Tertilt (2023) also point out that recent evidence suggests an ambiguous causal relationship between education and fertility.

increases. In the 2-period model, the timeline is as follows:

- At the beginning of period 1, the woman meets a prospective male partner and observes q, the observable component of the long-term quality of the match with this partner. She then decides whether to enter a relationship with this prospective partner; if she does so, she will receive utility σ from having a partner in period 1, but faces a probability p of becoming pregnant.[11]

- If the woman becomes pregnant, she must decide whether to have an abortion or not, if that choice legally exists. We assume that an abortion ban actually makes abortion impossible, but we will return in section 3.3 to the possibility that it only increases the difficulty of terminating a pregnancy.

- At the end of the first period, a woman in a relationship will also observe ϵ, the idiosyncratic component of long-term match quality. She must then decide whether to stay with her current partner and receive match quality utility of $q + \epsilon$ in period 2, or end her relationship, in which case she will be matched with a random partner in period 2 whose expected match quality $\mathrm{E}(q + \epsilon)$ is normalized to zero. To be precise, we assume that both q and ϵ follow uniform distributions between -0.5 and 0.5.

- If the woman did not have a child in period 1, she accumulates a unit of human capital c, which provides utility γ in period 2 as well as affecting the cost of raising children.

- Finally, in period 2, the woman chooses her final level of fertility, receiving utility α for each unit of child n,[12] but also paying a convex cost $\frac{n^2}{2(c+1)}$ to raise the children, where the cost depends inversely on the human capital (or "capabilities") c that the woman has accumulated. Obviously, the woman cannot choose a number of children that is less than the number she already has, so $n \geq 1 - c$, since a woman with $c = 0$ is a woman who had a child in period 1.

[11] Contraception and abortion are *substitute goods*, in the microeconomic sense. We assume that p is exogenously fixed, but the results are qualitatively similar if women can choose their value of p subject to a contraceptive cost, as demonstrated in Appendix A.

[12] For simplicity, we allow for non-integer numbers of children in the final fertility choice.

As a result, the overall utility function is given by:

$$U = \sigma s + \gamma c - \delta a + q + \epsilon + \alpha n - \frac{n^2}{2(c+1)}$$

where $s = \{0, 1\}$ for being with a partner in period 1, $c = \{0, 1\}$ for accumulating human capital in period 1, $a = \{0, 1\}$ for having an abortion in period 1, q is observable partner match quality, ϵ is idiosyncratic match quality, and n is the final number of children. $\delta \geq 0$ represents the disutility the woman may experience from having an abortion.[13]

We can solve this model by backward induction, starting with the woman's final fertility choice in the 2nd period: the optimal choice of fertility that maximizes $\alpha n - \frac{n^2}{2(c+1)}$ would be given by $n = (c+1)\alpha$, but the woman cannot have fewer than $n = 1$ if she gave birth in the first period, so the final fertility choice will be given by $n^* = \max\{1 - c, (c+1)\alpha\}$. Moving backwards to the end of the 1st period, the woman has two potential decisions to make if she is in a relationship. First, after observing ϵ, she must decide whether to stay with her partner or leave; if she leaves, she will draw a partner of random quality in the final period, and we normalize $\mathrm{E}(q+\epsilon) = 0$, so the woman stays with her partner if the current $q+\epsilon \geq 0$.[14] Second, a woman in a relationship becomes pregnant with probability p, and if so, she must choose whether to have an abortion or not, if abortions are legal. She knows that, if she aborts, she will end up with $n = 2\alpha$, whereas she will have $n = \max\{1, \alpha\}$ if she keeps the pregnancy; we assume that $\alpha > 1$, so that an unintended pregnancy is not exactly "unwanted" in terms of overall fertility, though we will consider the alternative scenario later in our simulations. The woman will choose an abortion (if legal) if $U(abort) \geq U(keep)$, where:

$$U(abort) = \sigma + \gamma - \delta + \mathrm{E}(q+\epsilon) + 2\alpha^2 - \frac{4\alpha^2}{4} \geq \sigma + \mathrm{E}(q+\epsilon) + \alpha^2 - \frac{\alpha^2}{2} = U(keep).$$

Therefore, this simplifies to the condition that the woman will prefer to choose an abortion if the disutility from an abortion is low enough: $\delta \leq \gamma + \frac{\alpha^2}{2}$.

Finally, at the start of the 1st period, the woman observes the q of her prospective partner and decides whether to enter a relationship. Her utility from staying single is:

$$U(single) = \gamma + \alpha^2.$$

[13] We do not allow for discounting, but an extension of our model to a discount factor below 1 in supplementary appendix F shows that the results are very similar in that case.

[14] In supplementary appendix G, we allow for the possibility that being a single mother could reduce the probability of meeting a potential partner; in the two-period model, this has no effect on our results, but it makes an abortion ban even more likely to reduce fertility if $T = 3$.

Her utility from a relationship depends on q and on abortion laws and decisions. Given q and the outside relationship option of 0 after observing ϵ, we have $\mathrm{E}(\max\{0, q+\epsilon\}|q) = 0.5q+0.25$. Expected utility is the same whether abortion is legal or not for a woman who wouldn't have an abortion anyway, which we have seen is the case if $\delta > \gamma + \frac{\alpha^2}{2}$. The important distinction is between the expected utility for a woman who would and (legally) could have an abortion and the utility for a woman who wouldn't or (legally) couldn't:

$$U(rel|q, abort) = \sigma + \gamma - \delta p + 0.5q + 0.25 + \alpha^2$$

$$U(rel|q, keep) = \sigma + \gamma(1-p) + 0.5q + 0.25 + \alpha^2 \left(1 - \frac{p}{2}\right)$$

where rel is short for "relationship".

So, a woman who wouldn't or couldn't abort enters a relationship if $U(rel|q, keep) \geq U(single)$:

$$\sigma + \gamma(1-p) + 0.5q + 0.25 + \alpha^2 \left(1 - \frac{p}{2}\right) \geq \gamma + \alpha^2$$

which gives us $p \leq \frac{\sigma+0.5q+0.25}{\gamma+\frac{\alpha^2}{2}}$. Meanwhile, a woman who would and could abort enters a relationship if $U(rel|q, abort) \geq U(single)$:

$$\sigma + \gamma - \delta p + 0.5q + 0.25 + \alpha^2 \geq \gamma + \alpha^2$$

which gives us $p \leq \frac{\sigma+0.5q+0.25}{\delta}$. Given that $\delta \leq \gamma + \frac{\alpha^2}{2}$ for a woman who would choose an abortion if possible, banning abortion would mean that p would have to be lower to enter a relationship for such women, discouraging relationship formation. This result is easy to understand: if being in a relationship presents some risk of pregnancy, and if abortion is illegal, this represents a cost of relationships which would reduce relationship formation.[15]

This version of the model, with $T = 2$ and $\alpha > 1$, produces a stark result: banning abortion must reduce average fertility. When abortion is illegal, women have two choices in the first period: stay single, or enter a relationship but accept that this may lead to an unintended pregnancy. If abortion was legal, some women would choose to enter a relationship but plan to have an abortion if necessary, and our assumptions are such that the level

[15] In supplementary appendix H, we also consider an extension of the model to a case in which there is a risk of pregnancy outside of a relationship; the results are broadly similar to those from the baseline model, with a stronger tendency towards reduced fertility after an abortion ban with $T = 2$ and more ambiguous effects with $T = 3$.

of fertility of 2α for such women is the same as if they were single in period 1, but higher than the fertility α of women who give birth in period 1.[16] Therefore, banning abortion means that more women will have unintended births in period 1, which will lower the total number of children born to those women from 2α to α. It is also clear that abortion restrictions decrease women's average utility, because of lower human capital accumulation, lower overall fertility, and lower match quality as women take fewer draws from the distribution of potential partners.

In a version of the model with a smaller value of α, or a longer time horizon, the effect on fertility would be ambiguous: banning abortion would reduce subsequent fertility choices by lowering human capital, but would cause women to have more babies faster, with uncertain overall effects. Basically, banning abortion would cause some women to have children before they intended; for some, this will lower their ability to have children later, while for others it will directly cause them to have more children than intended. The overall effect would depend on the parameter values – or, in a model with heterogeneous types, on their distribution in the population – and so we will explore the possibilities numerically in the next subsection of the paper. Appendix A also shows that results are similar in a version of the model with endogenous p.

An additional possible effect of abortion restrictions that is not present in our main model is that women may be less likely to try to become pregnant, if doing so runs the risk of complications that would normally require medical procedures that are similar to abortion for health reasons. Some evidence on the US post-*Dobbs* suggests that this may be a quantitatively important consideration; see, for example, Simmons-Duffin (2022). We do not include this mechanism in our main model in order to focus on the capability-accumulation mechanism, but it would have a theoretically unambiguous effect: in so far as banning abortion discourages women who want more children from attempting to become pregnant, it will lower equilibrium birth rates. Supplementary appendix I presents an extension to this case, and unsurprisingly, the main impact is to significantly lower fertility in the presence of

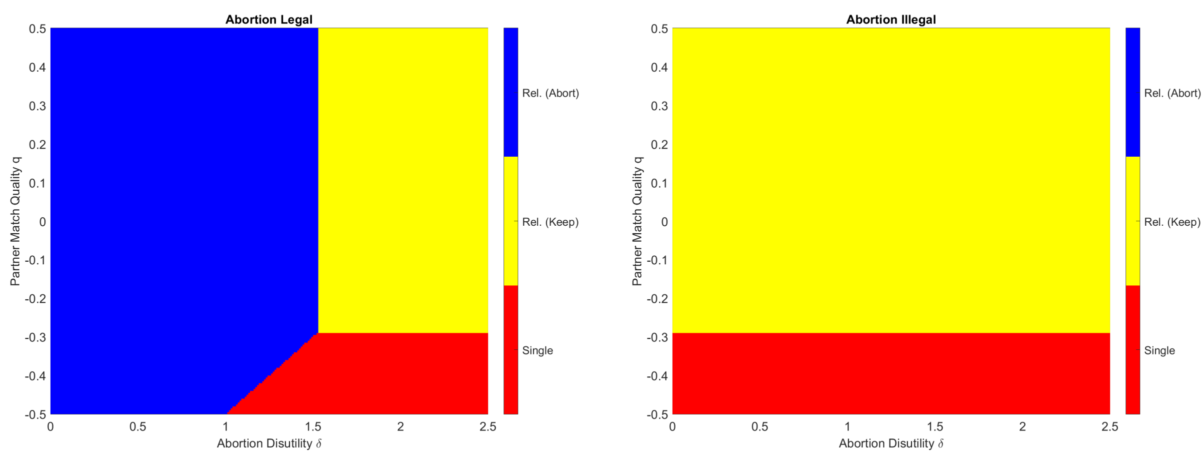
[16] In appendix A, we also model the possibility that women may use different contraceptive methods to lower their probability of pregnancy if abortion is banned, with similar overall results to the baseline model. Another possibility is that meeting a partner who is a better match could directly affect the number of children that a woman would prefer to have; we rule this out, but it could further increase the negative effect of abortion restrictions on fertility if women in better matches have more children.

an abortion ban; in our simulations, the effect of an abortion ban is always negative even with $T = 3$.

3.2 Numerical Simulations

We begin by simulating the model from the previous subsection in the case with $\alpha > 1$. Specifically, we assume $\gamma = 0.8$, $\sigma = 0.2$, $\alpha = 1.2$, and $p = 0.2$, and we present results for a range of values of δ between 0 and 2.5, as well as the range of values of q between -0.5 and 0.5 for the quality of the initial match. Figures 2, 3, and 4 present the results; Figure 2 shows that banning abortion would raise the fraction of women who are single in the first period (where "Rel." refers to entering a relationship), while also obviously causing women in relationships who would have had an abortion to give birth instead. Figure 3, meanwhile, shows the unambiguous prediction of our 2-period model with respect to fertility: the number of children weakly decreases due to an abortion ban, because the ban may cause some women to have unintended births which will reduce their final preferred fertility. Figure 4 shows that all women whose first-period choices are affected by the abortion ban will experience lower expected utility as a result.

Figure 2: First-Period Choices



These two-period results are quite stark, particularly the finding that an abortion ban must reduce fertility. In additional results that are available upon request, we can show that changing σ, γ, or p moves the location of the critical values at which first-period choices change, but otherwise doesn't fundamentally change the results. Changing α, however, can

Figure 3: Expected Fertility

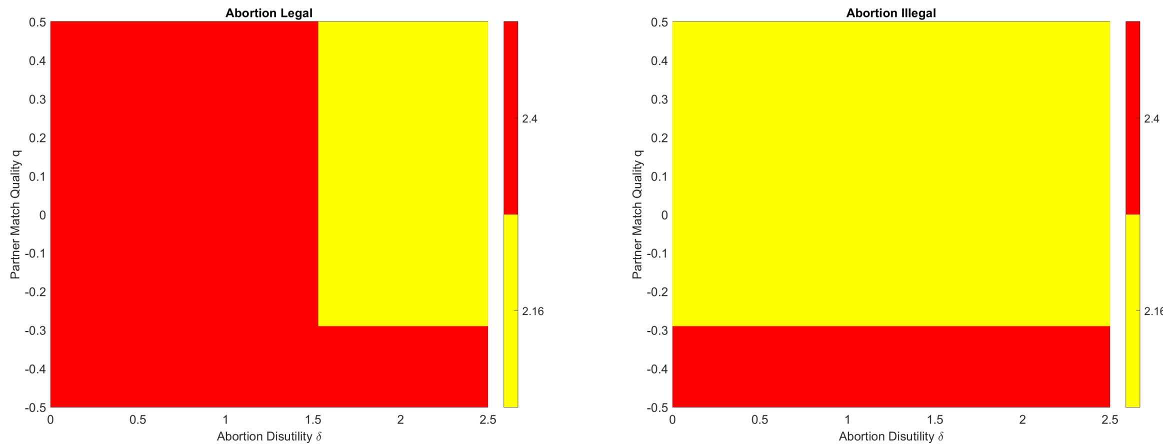
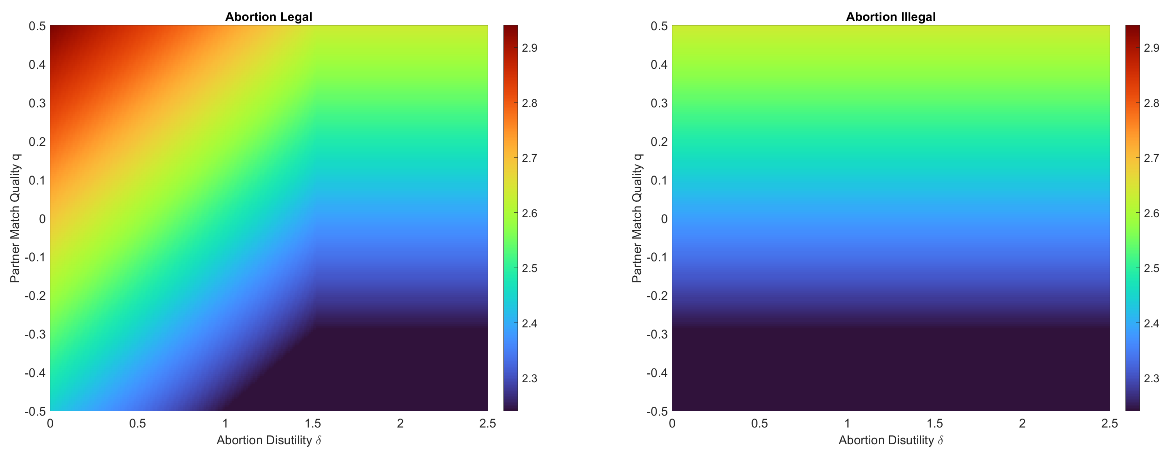


Figure 4: Expected Utility



alter the results in a more fundamental way: if $\alpha < 1$, then having an unintended child in the first period produces a fertility level that is higher than desired — but it is still a lower fertility level than would be desired by a woman who did not have a child in the first period, and thus weakly lower than the level of fertility in the absence of an abortion ban, unless $\alpha < 0.5$. In the latter case (in which fertility preferences are very low), having an unintended first-period birth causes a woman to have more children (one) than she ever would deliberately choose to have. Figures 5, 6, and 7 present this case, which is broadly similar to the first set of results except that average fertility increases very slightly following an abortion ban.

But here is our point: *Life in the real world is not two-period.* This case highlights that,

Figure 5: First-Period Choices ($\alpha = 0.49$)

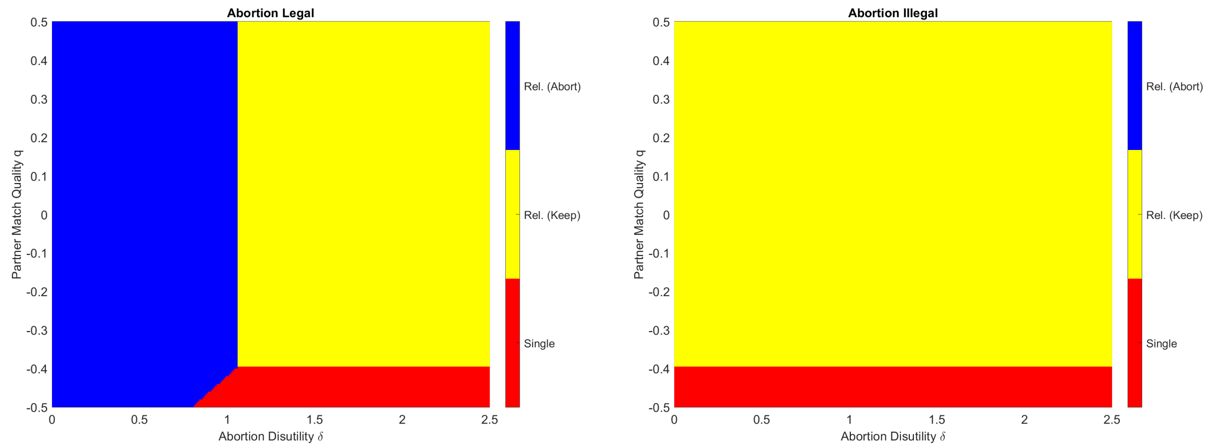
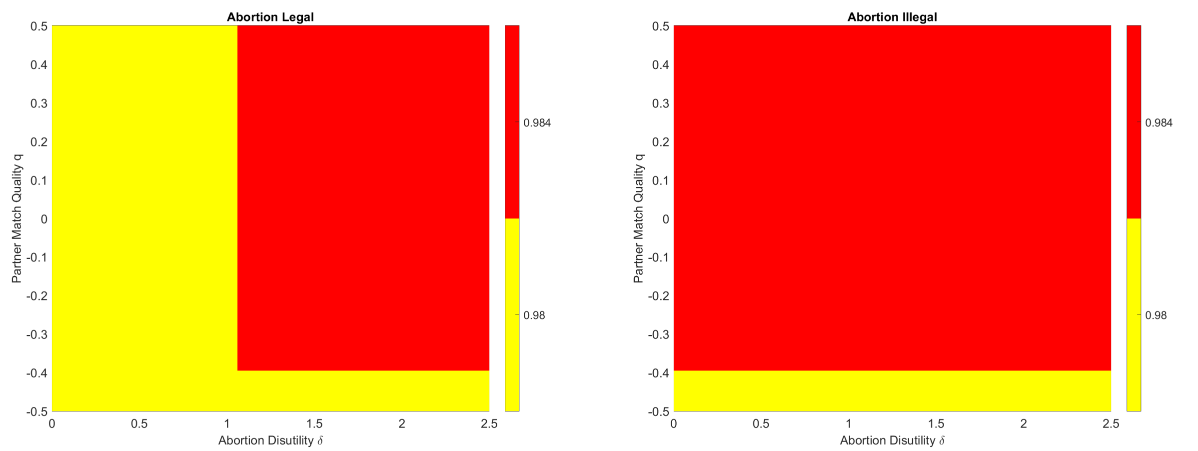
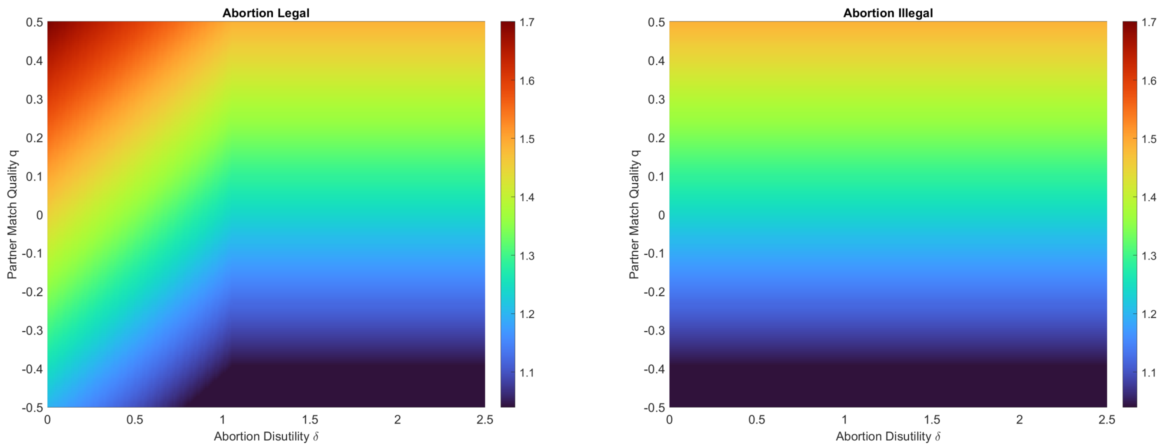


Figure 6: Expected Fertility ($\alpha = 0.49$)



for an abortion ban to raise fertility, it must be that any unintended births caused by the abortion ban raise total fertility, rather than decreasing it through effects on subsequent fertility choices. This is easier to achieve in a model with more than 2 periods, since it would offer more than one opportunity to accumulate unintended births. However, such a multi-period model can become quite complex, because at the end of each period in which a woman is in a new relationship, she could choose to stay with her current partner, which would imply that she will be in a relationship (with that partner) in all future periods. As a result, we do not focus on an algebraic analysis of such a longer model, although appendix B presents the algebraic solution of a 3-period version of the model. Instead, we solve numerically for the equilibrium in a 3-period version of the model, with the same parameters as before except

Figure 7: Expected Utility ($\alpha = 0.49$)



that $\alpha = 0.7$; in the context of a 3-period model, the maximum possible fertility level would be 3α for a woman who does not have a child in periods 1 or 2 and thus accumulates 2 units of human capital. However, having unintended children in the first two periods could lead to a higher level of fertility for some women than would occur if they could have at least one abortion.

Figures 8, 9, and 10 present the numerical results from this 3-period scenario: Figure 8 presents the first-period choice, which looks qualitatively similar to Figures 2 and 5 except that the cutoff between staying single and entering a relationship takes a somewhat different form. Figure 9 presents the expected number of children, and is a bit harder to interpret because of the range of colours presented, but it is clear that banning abortion lowers fertility for women with low δ, who would have had abortions as needed and ended with high fertility, but now must face the risk of unintended births which will reduce capability accumulation and thus subsequent fertility. However, a range of women with high first-period q and moderate δ see their expected fertility increase when abortion is banned: if they gave birth in period 1, they would have had an abortion in the second period if necessary, but now cannot, and so they have some chance of having a second unintended child, which raises their fertility beyond what they would choose with a single unintended child. This mechanism could generate a positive effect of abortion restrictions on fertility, depending on the distribution of parameter values in the population, particularly α: a lower value of α would raise the probability of an abortion ban raising average fertility. Finally, Figure 10 shows that average utility weakly declines as before in the presence of an abortion ban, since the latter is a restriction on the options that a woman can consider.

Figure 8: First-Period Choices ($T = 3$)

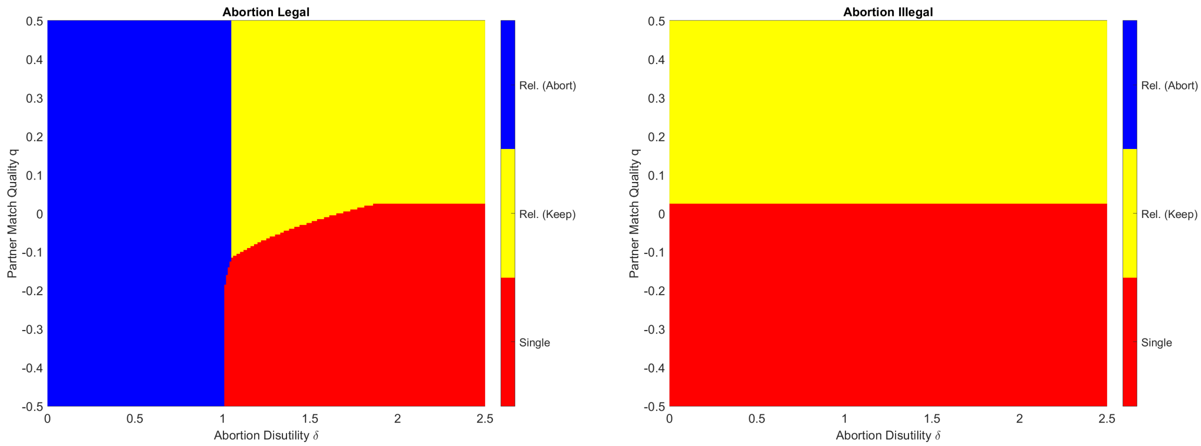
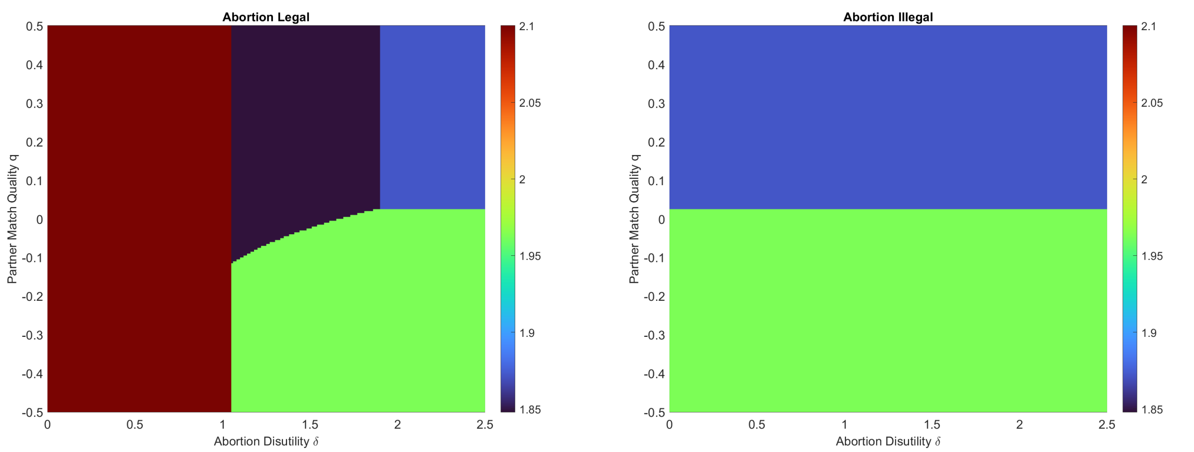
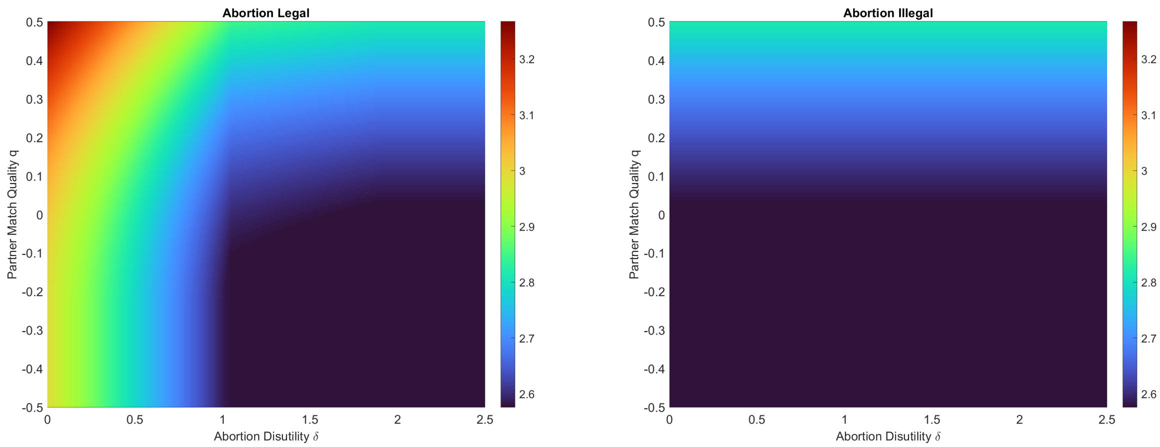


Figure 9: Expected Fertility ($T = 3$)



If the number of periods T increased beyond 3, the analysis would become increasingly complicated, but the basic result would remain: it is possible for an abortion ban to lower overall average fertility, because it would lead to unintended births that would reduce capability accumulation and thus reduce desired total fertility. On the other hand, it is also possible for the effect of an abortion ban on total fertility to be positive, if the unintended births raise total fertility high enough on their own, and the probability of such an outcome will tend to increase with T, holding parameter values fixed. The overall effect is thus am-

Figure 10: Expected Utility ($T = 3$)



biguous, much like the existing empirical literature.[17] We have also considered the variation in outcomes by α and γ in supplementary appendix J: averaging across δ and first-period q, the effect of an abortion ban on fertility is fairly uniformly negative for the values we consider, even for $T = 3$.

3.3 Discussion and Enrichments of Our Model: Complementary Recent Empirical Literature

Our model indicates that abortion restrictions could actually lead to lower fertility in the long-run, as initial increases in child-bearing as women are denied abortions could be offset by the effects of unintended childbearing which may reduce women's opportunities to accumulate the capabilities needed to make a larger family desirable. While this mechanism is new in the theoretical literature to our knowledge, it is consistent with recent empirical findings.

Before *Dobbs*, Lenharo (2021) and Lowrey (2022) described research based on the Turnaway Study (which compared the outcomes of women who had or were denied an abortion due to being just before or after a gestational limit). This study found that being denied an

[17] As mentioned in footnote 5, we have also investigated the effect on our results of introducing parameters h_0 and h_1, where h_0 is the probability of accumulating a unit of human capital if one has a child in a period (normally 0 in our model), and h_1 is the probability of accumulating human capital if one doesn't have a child (normally 1). The effects of such a modification are ambiguous, and seem to depend more on the gap between h_1 and h_0 than on the value of each: when the gap between them shrinks, the probability of an abortion ban raising fertility increases, but the amount by which fertility changes tends to be smaller.

abortion is associated with worse outcomes on multiple dimensions than among women who were able to have an abortion, including poverty and unemployment, which is consistent with our story about unintended births affecting the accumulation of capabilities. An important recent paper on the same subject is Miller, Wherry, and Foster (2023), who find sustained increases in financial distress after being denied an abortion.

Meanwhile, empirical research on the same Turnaway Study indicates that abortion restrictions may not lead to long-term increases in fertility: being denied an abortion reduces the probability of subsequent intended pregnancies (Upadhyay, Aztlan-James, Rocca, and Foster, 2019), with no effect on unintended pregnancies (Aztlan, Foster, and Upadhyay, 2018). As explained by Dr. Diana Greene Foster in González-Ramírez (2023), "When people are unable to access an abortion, they are less likely to have wanted pregnancies later under better circumstances".[18] This plausible explanation is consistent with the mechanism and results of our model, and is also consistent with the empirical evidence presented in section 2, where we showed that abortion restrictions are not associated with higher fertility, and may even be associated with lower fertility (in the particular case of South Korea). Additionally, although it is difficult to directly measure "capabilities" (as opposed to formal education), some research (Fahlén, 2013) has indicated that reductions in various dimensions of capabilities are associated with a reduction in childbearing intentions.

It is important to note that, in order to explain the lack of a clear positive effect of abortion restrictions on fertility, we need some dynamic mechanism like the capability-accumulation mechanism in our model. It is clear that, if abortion restrictions don't lead to increases in fertility, some aspect of women's behaviour must have changed; but most behavioural modifications would not be capable of generating an ambiguous effect of abortion laws on fertility. For example, women may become less likely to enter relationships (a factor which is present in our model), or more likely to use highly-effective contraception (which we consider in an extension in appendix A), but both of these effects would only dampen the increase in fertility that an abortion ban would generate, by allowing women to reduce (but

[18] Dr. Foster goes on to give detail that is thoroughly consistent with our model: "The net effect of not being able to get an abortion is that people will have babies at a time when they don't have the financial resources, social support, strong relationships, life circumstances — and then be less likely to have wanted pregnancies later, either because they have all the children they can care for or because the better circumstances are less likely to emerge following the strain of raising a child that they were not prepared for."

not eliminate) the probability of unintended births. We need a force that accumulates over time, such that unintended births at early ages could lead to a reduction in fertility in later periods, and such a force would necessarily look very much like our capability-accumulation process.[19]

Of course, one important simplification in our model is that we assume that an abortion ban will stop all abortions. In practice, this is not true. Many women travel to other states, or even other countries, where abortion may still be legal (Myers, 2024). Many women choose an abortion despite legal restrictions, including through the use of medication abortion if they have access (Aiken, Starling, Scott, and Gomperts, 2022).[20] In such a reality, it may be more appropriate to think of an abortion ban as increasing δ, the cost of an abortion. If we consider the left panels of Figures 8 through 10, for any point in the figure representing a woman with a particular combination of values of δ and q, an abortion ban would then amount to a shift to the right, and in supplementary appendix K we formally analyze this situation.

So how does enriching our model, in this way, to include medication abortion or abortion-related travel change our results? Interestingly, the results of our analysis in supplementary appendix K imply that, while the effects of an abortion ban are still ambiguous, there could be an interesting heterogeneity of effects with $T = 3$. Women who start with low δ might be interpreted as women who are richer, or less religious, or located in regions with easier access to abortion; one way or another, these are women for whom abortion is relatively low-cost

[19]One possible extension that is beyond the scope of our current paper could feature two-sided matching of women with men who may have different preferences, such as fertility preferences, rather than just modelling men as a match quality term in the way that we do. This would substantially increase the complexity of our model, but the same basic force is present, and the new mechanisms introduced would be likely to go in the same direction. To see this, imagine that women match with men from a distribution of fertility preferences, and as a result some women are influenced into having an abortion through negotiation with their partner: if women's average fertility and abortion preferences were such that an abortion ban would normally lower fertility in our model, then in a model with two-sided matching, there could be some women who would get an abortion due to their partner's preferences, but those partners' preferences would be for *higher* fertility if abortion permits higher fertility. In that case, an abortion ban would prevent such abortions, and cause some such women not to enter a relationship with such a partner, or to leave such a partner, potentially allowing them to later match with someone who has a lower fertility preference; all of these mechanisms would lead to fewer children in expectation. The opposite argument applies if an abortion ban would normally raise fertility in our model.

[20]As noted in supplementary appendix K, the latter point is an important reality about abortion in the US today: even among abortions that take place in abortion facilities, the Guttmacher Institute estimates that the majority are now carried out using medication abortion (Jones, Nash, Cross, Philbin, and Kirstein, 2022).

in both a monetary and psychological sense, and such women would be more likely to react to an abortion ban by lowering their fertility (due to reduced capability accumulation). On the other hand, women with high δ, who might be poorer, or more religious, or located in the American south where access to abortions is more difficult, would be more likely to have too many children due to an abortion ban and thus increase their overall fertility; for them, the abortion ban might make abortion so prohibitively costly that, unlike the low-δ women, they could not have an abortion even if they have already had one unintended birth and have a greater incentive to seek an abortion the second time.

In other words, once we incorporate this realistic feature of post-*Dobbs* abortion access in the US, we find the further result that banning abortion increases inequality, in this way, and has larger effects on already-more-disadvantaged women. These predictions are specific to the interpretation of an abortion ban as an increase in abortion difficulty δ, and it would be worth examining, in future research, to what extent these predictions are supported by fertility data in the years to come.

4 Conclusion

This paper considers the consequences of abortion restrictions for fertility, starting from the fact that, while many voices in reproductive politics assume that such restrictions would lead to an increase in births, the existing evidence is quite ambiguous. We add to the ambiguity of this evidence by motivating our investigation with a new stylized fact from descriptive cross-country analysis: abortion restrictions are not associated with greater aggregate equilibrium fertility rates.

We then present a model of the choices of women over relationships and their consequences for human capital accumulation. We show that it is possible for an abortion ban to lead to a reduction in equilibrium fertility, because it will lead to an increase in unintended births which will reduce the opportunities of women to acquire the capabilities needed to raise a larger family. In other words, an abortion ban may lead to increased fertility at young ages, but possibly lower completed fertility as women who have unintended births face negative effects on their subsequent life circumstances and thus choose to have fewer children in the end. The overall effect of these two forces is ultimately ambiguous, much like the existing empirical literature. Other mechanisms that we explore in extensions to our model – such as the health risk of abortion bans acting as an incentive to avoid pregnancy even among women who want more children, and the rise of self-managed abortion with medication – would unambiguously reduce equilibrium birth rates. And, to emphasize again, in all scenarios of all models, banning abortion reduces women's wellbeing and human capital accumulation.

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A Results from Model with Endogenous p

The baseline model assumes that p, the probability of becoming pregnant if a woman is in a relationship, is exogenously fixed. Of course, in practice, a woman and her partner could adopt different methods of contraception to modify this probability, and so in this appendix, we allow women in a relationship to choose $p \in (0, 1]$ subject to a cost function $k(p) = \theta p^{-\phi}$. This cost decreases with p, as more costly and effective contraception methods produce a lower probability of pregnancy; and the functional form chosen ensures that all women will choose $p > 0$.

In the 2-period version of the model, this modification has no effect on the decision to have an abortion, nor on any of the choices that take place afterwards (conditional on the value of c). However, it introduces an additional decision in between the first-period relationship decision and the abortion decision: any woman who is in a relationship must choose her value of p. If the woman would (and could) have an abortion, her expected utility is as follows:

$$U(p|q, abort) = \sigma + \gamma - \delta p + 0.5q + 0.25 + \alpha^2 - \theta p^{-\phi}$$

$$U(p|q, keep) = \sigma + \gamma(1 - p) + 0.5q + 0.25 + \alpha^2 \left(1 - \frac{p}{2}\right) - \theta p^{-\phi}$$

and therefore the utility-maximizing choices of p are given by:

$$\frac{\partial U(p|q, abort)}{\partial p} = -\delta + \theta\phi p^{-\phi-1} = 0 \rightarrow p(abort) = \left(\frac{\theta\phi}{\delta}\right)^{\frac{1}{\phi+1}}$$

$$\frac{\partial U(p|q, keep)}{\partial p} = -\gamma - \frac{\alpha^2}{2} + \theta\phi p^{-\phi-1} = 0 \rightarrow p(keep) = \left(\frac{\theta\phi}{\gamma + \frac{\alpha^2}{2}}\right)^{\frac{1}{\phi+1}}.$$

Strictly speaking, these are the values of p chosen as long as they are smaller than 1; for certain values of the parameters, particularly low values of δ, a woman might want to choose a very large value of p, but of course we impose a maximum value of $p = 1$.

Since we know that $\delta \leq \gamma + \frac{\alpha^2}{2}$ for women who would choose to have an abortion, it follows that, given γ and α, women who would choose to have an abortion will choose a higher value of p, because becoming pregnant is less costly to them. This further implies that banning abortion will tend to lower p for those women: becoming pregnant would be more costly in that case, and it is worth taking further measures to avoid such an outcome. However, since women with $\delta > \gamma + \frac{\alpha^2}{2}$ are unaffected by an abortion ban, this increase in contraceptive measures among women who can no longer get an abortion can only reduce the increase in unintended births caused by an abortion ban; it cannot eliminate it entirely, and so the overall effect of an abortion ban on fertility will continue to be negative.

The choice to enter a relationship or not is also different now: the utility from being single is unchanged at $\gamma + \alpha^2$, but the expected utility from entering a relationship is now given by:

$$U(rel|q, abort) = \sigma + \gamma - \delta p(abort) + 0.5q + 0.25 + \alpha^2 - \theta p(abort)^{-\phi}$$

$$U(rel|q, keep) = \sigma + \gamma(1 - p(keep)) + 0.5q + 0.25 + \alpha^2 \left(1 - \frac{p(keep)}{2}\right) - \theta p(keep)^{-\phi}.$$

Therefore, a woman who wouldn't or couldn't abort enters a relationship if $U(rel|q, keep) \geq U(single)$:

$$\left(\gamma + \frac{\alpha^2}{2}\right) p(keep) + \theta p(keep)^{-\phi} \leq \sigma + 0.5q + 0.25$$

and a woman who would and could abort enters a relationship if $U(rel|q, abort) \geq U(single)$:

$$\delta p(abort) + \theta p(abort)^{-\phi} \leq \sigma + 0.5q + 0.25.$$

The terms on the left-hand sides of these inequalities can be expressed as follows:

$$\left(\gamma + \frac{\alpha^2}{2}\right) p(keep) + \theta p(keep)^{-\phi} = \frac{\phi + 1}{\phi} \left[\left(\gamma + \frac{\alpha^2}{2}\right)^{\phi} \theta\phi\right]^{\frac{1}{\phi+1}}$$

$$\delta p(abort) + \theta p(abort)^{-\phi} = \frac{\phi + 1}{\phi} \left[\delta^{\phi}\theta\phi\right]^{\frac{1}{\phi+1}}$$

and so we can see that the left-hand side of the inequality is weakly larger when abortion is illegal: banning abortions reduces the probability of women entering relationships, because women who would have had an abortion can no longer do so, and they must face both a chance of becoming pregnant and the higher contraceptive cost that they will choose.

It remains true in this version of the model that banning abortion must reduce average fertility: women who would give birth in period 1 even in the absence of an abortion ban will be unaffected, and some women who would have had an abortion in period 1 will now give birth, even if they reduce p and the probability of entering a relationship to partially compensate, leading to more unintended births in period 1 and a reduction in human capital accumulation, which decreases final fertility.

As in Figures 2, 3, and 4, we can simulate this version of the model, using $\theta = 0.05$ and $\phi = 1$, and otherwise using the same parameters as before, except that we raise σ to 0.4 to compensate for the contraceptive cost which lowers the attractiveness of relationships. Figures 11, 12, and 13 present the results, which are generally very similar to those from the baseline model. We have also examined how the results change when θ take a higher value of 0.08, reflecting a higher contraceptive cost, and unsurprisingly this raises the probability that women will stay single; but our results – available upon request – show that the effect of an abortion ban remains very similar.

If we extend the model to $T = 3$, the potential for ambiguous effects of an abortion ban exist as before, and the model is even more complicated than before, necessitating a repeat of the numerical

Figure 11: First-Period Choices (Endogenous p)

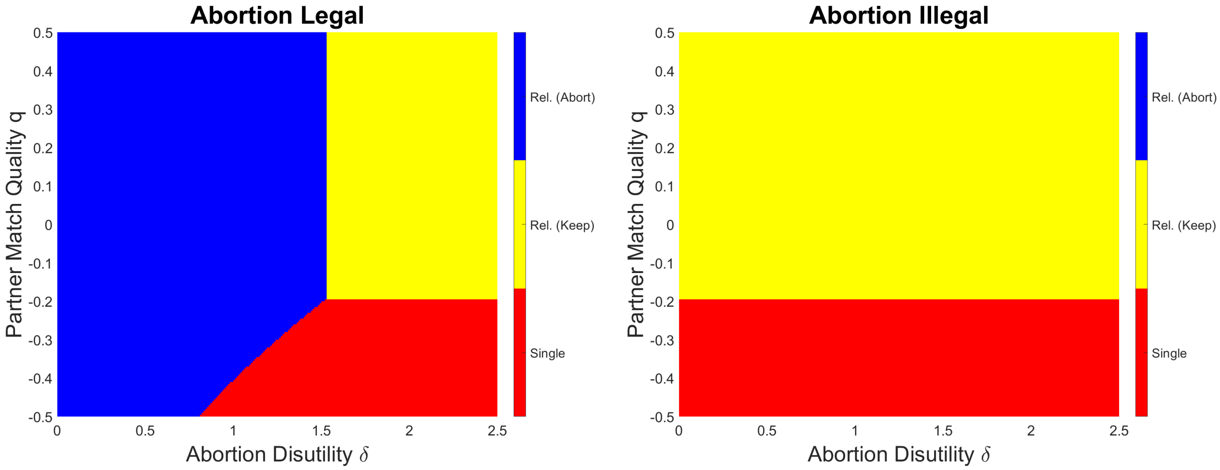
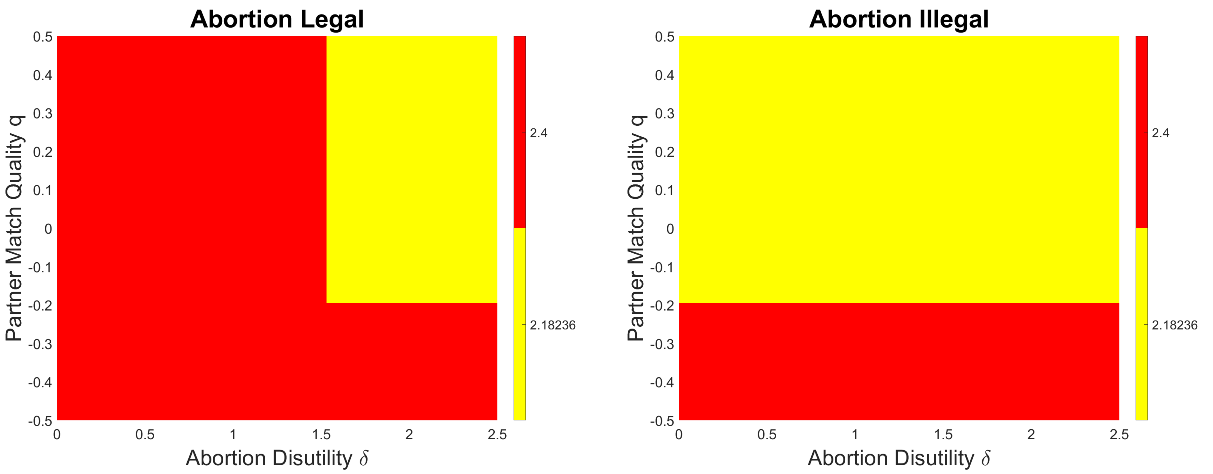


Figure 12: Expected Fertility (Endogenous p)



analysis from section 3.2. Figures 14, 15, and 16 present the results, which are again very similar to those from the baseline model, with only slightly different shapes and locations of critical values. The overall effect of an abortion ban on fertility remains ambiguous, because women with low δ may have unintended births which reduce capability accumulation and thus total fertility, while women with moderate δ could have enough unintended births if abortion is banned that their average fertility increases above the level that would have prevailed in the absence of a ban. These results are also very similar if we consider a higher value of θ, as in the case of $T = 2$ above. Allowing women to adjust their contraceptive behaviour and thus modify their probability of pregnancy does not change the fundamental result of the model, as it can only moderate the increase in unintended births that an abortion ban will cause.

Figure 13: Expected Utility (Endogenous p)

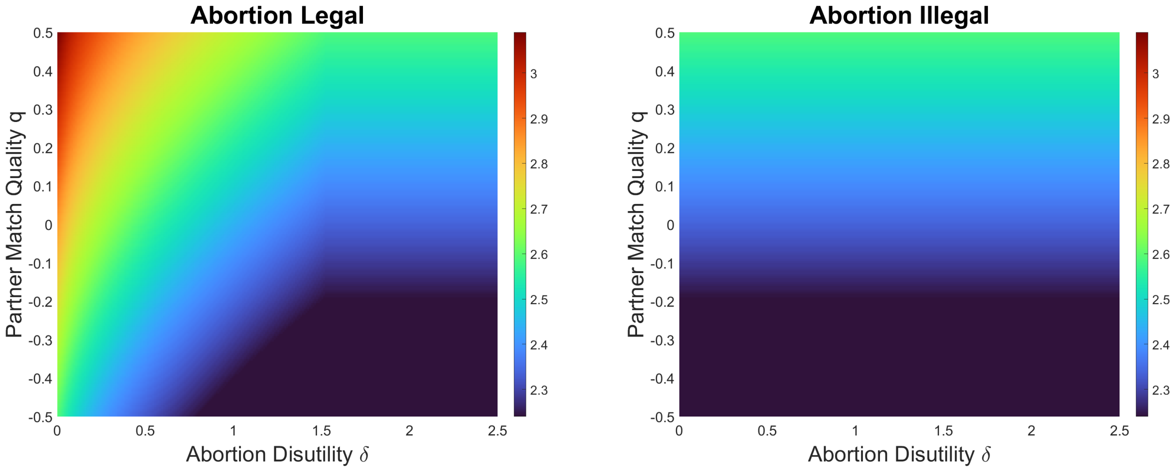
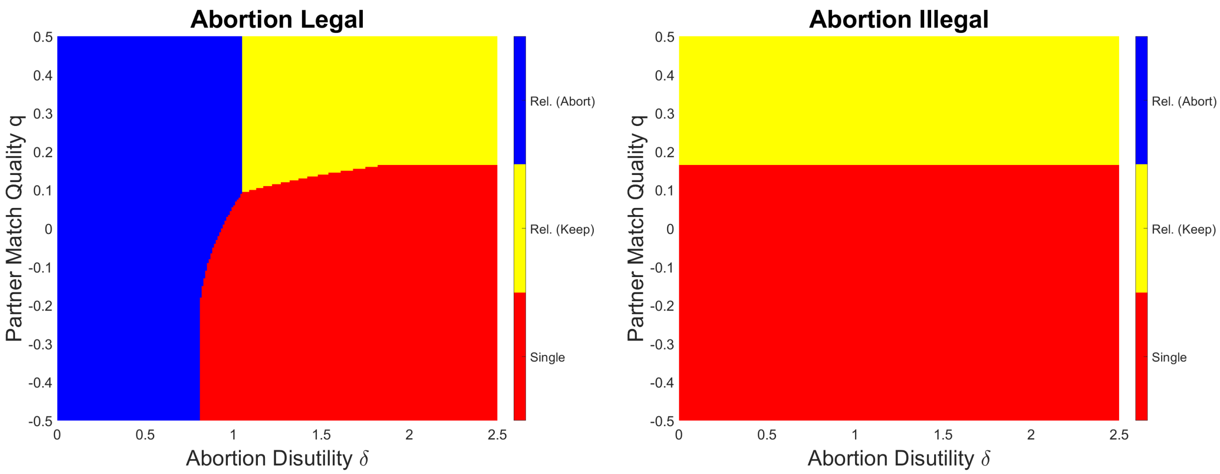


Figure 14: First-Period Choices (Endogenous p & $T = 3$)



B Algebra from 3-Period Version of Model

When extending the duration of the model from 2 periods to 3, the basic structure of the model is similar, but there are more cases to consider. The overall utility function can still be written as:

$$U = \sigma s + \gamma c - \delta a + q + \epsilon + \alpha n - \frac{n^2}{2(c+1)}$$

but now the possible values of some variables have changed: $s = \{0, 1, 2\}$ for being with partners in periods 1 and/or 2, $c = \{0, 1, 2\}$ for total accumulated human capital, and $a = \{0, 1, 2\}$ for the total number of abortions. q and ϵ continue to denote match quality with the woman's final partner, and n is still the final number of children.

The final fertility choice in period 3 is still the value of n that maximizes $\alpha n - \frac{n^2}{2(c+1)}$ subject to the minimum given by the number of children already born, which means $n^* = \max\{2-c, (c+1)\alpha\}$. We assume that $\alpha \in (0.5, 1)$, so that a woman who had 2 unintended births in the first 2 periods will have $n^* = 2$, whereas women with 1 unintended birth will choose $n^* = \max\{1, 2\alpha\} = 2\alpha$.

Figure 15: Expected Fertility (Endogenous p & $T = 3$)

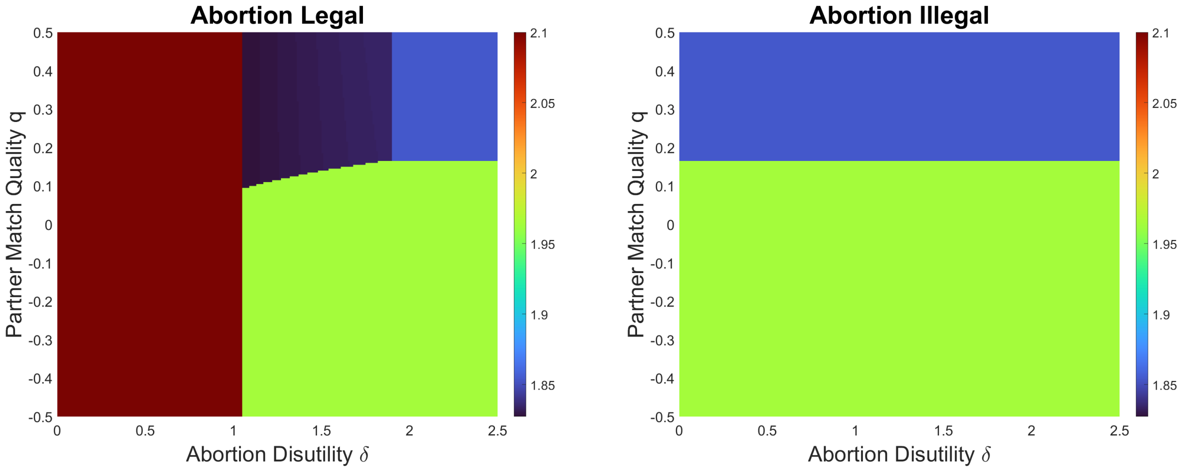
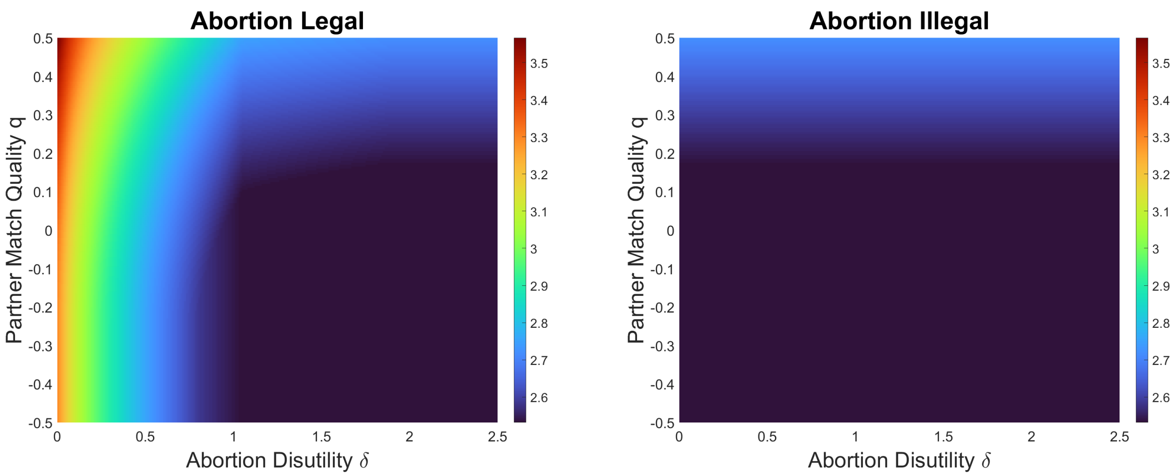


Figure 16: Expected Utility (Endogenous p & $T = 3$)



We can then move backwards to period 2, and obviously any woman who is in a relationship in period 2 will stay with her current partner if the current $q + \epsilon \geq 0$. The abortion choice for a pregnant woman in period 2 is more complicated now, because the incentives depend on whether the woman gave birth in period 1. If the woman already has a child (which we denote as $n_1 = 1$), then she knows that she will have $n = 2$ if she gives birth again, and $n = 2\alpha$ if she gets an abortion; then her total utility from each choice going forward (omitting values from the first period) is given by:

$$U_2(abort|n_1 = 1) = \sigma + \gamma - \delta + \mathrm{E}(q + \epsilon) + \alpha^2$$

$$U_2(keep|n_1 = 1) = \sigma + \mathrm{E}(q + \epsilon) + 2(\alpha - 1).$$

Therefore, a pregnant woman who already had a child in the first period will have an abortion (if legal) if and only if $\delta \leq \gamma + \alpha^2 + 2(1 - \alpha)$. If the woman did not have a child in the first period (or $n_1 = 0$), then she will have $n = 2\alpha$ if she gives birth in period 2 and $n = 3\alpha$ if not, so her total utilities going forward are:

$$U_2(abort|n_1 = 0) = \sigma + \gamma - \delta + \mathrm{E}(q + \epsilon) + \frac{3\alpha^2}{2}$$

$$U_2(keep|n_1 = 0) = \sigma + \mathrm{E}(q + \epsilon) + \alpha^2$$

and therefore she will have an abortion (if legal) if and only if $\delta \leq \gamma + \frac{\alpha^2}{2}$, as in the baseline 2-period model. As a result, given parameter values, a woman is more likely to choose an abortion in the second period if she had a child in the first period, because the cost of another unintended birth in terms of lost human capital is greater.

At the start of the second period, for a woman who did not stay in a relationship in the first period, we can solve for expected utilities from staying single and from entering a relationship, where the utility again depends on whether the woman already has a child. Specifically, and again omitting utility already experienced in the first period, we have:

$$U_2(single|n_1 = 1) = \gamma + \alpha^2$$

$$U_2(single|n_1 = 0) = \gamma + \frac{3\alpha^2}{2}$$

$$U_2(rel|q, n_1 = 1, abort) = \sigma + \gamma - p\delta + (0.5q + 0.25) + \alpha^2$$

$$U_2(rel|q, n_1 = 0, abort) = \sigma + \gamma - p\delta + (0.5q + 0.25) + \frac{3\alpha^2}{2}$$

$$U_2(rel|q, n_1 = 1, keep) = \sigma + (1 - p)\gamma + (0.5q + 0.25) + (1 - p)\alpha^2 + 2p(\alpha - 1)$$

$$U_2(rel|q, n_1 = 0, keep) = \sigma + (1 - p)\gamma + (0.5q + 0.25) + \frac{(3 - p)\alpha^2}{2}.$$

Therefore, the critical value of p below which a woman who wouldn't (or couldn't) have an abortion will enter a relationship is given by $p \leq \frac{\sigma+0.5q+0.25}{\gamma+\alpha^2+2(1-\alpha)}$ if she already has a child, and $p \leq \frac{\sigma+0.5q+0.25}{\gamma+\frac{\alpha^2}{2}}$ if she doesn't have a child. For a woman who would and could have an abortion, the critical condition to enter a relationship is $p \leq \frac{\sigma+0.5q+0.25}{\delta}$ regardless of her prior number of children.

When the analysis moves backwards to period 1, it becomes increasingly complicated, because decisions depend on the distribution of outcomes following the possible values of q in period 2 if the woman enters period 2 without a partner. At the end of period 1, we can write the expected future utility (still omitting all values from the first period) from staying with a partner or leaving:

$$U_1(stay|q + \epsilon, n_1 = 1, abort) = \sigma + \gamma - p\delta + q + \epsilon + \alpha^2$$

$$U_1(stay|q + \epsilon, n_1 = 0, abort) = \sigma + \gamma - p\delta + q + \epsilon + \frac{3\alpha^2}{2}$$

$$U_1(stay|q + \epsilon, n_1 = 1, keep) = \sigma + (1 - p)\gamma - \delta + q + \epsilon + (1 - p)\alpha^2 + 2p(\alpha - 1)$$

$$U_1(stay|q + \epsilon, n_1 = 0, keep) = \sigma + (1 - p)\gamma - \delta + q + \epsilon + \frac{(3 - p)\alpha^2}{2}$$

$$\begin{aligned} U_1(leave|n_1 = 1, abort) = &\Pr(q \geq \hat{q}(abort))\mathrm{E}(U_2(rel|q \geq \hat{q}(abort), n_1 = 1, abort)) \\ &+ (1 - \Pr(q \geq \hat{q}(abort)))U_2(single|n_1 = 1) \end{aligned}$$

$$\begin{aligned} U_1(leave|n_1 = 0, abort) = &\Pr(q \geq \hat{q}(abort))\mathrm{E}(U_2(rel|q \geq \hat{q}(abort), n_1 = 0, abort)) \\ &+ (1 - \Pr(q \geq \hat{q}(abort)))U_2(single|n_1 = 0) \end{aligned}$$

$$U_1(leave|n_1 = 1, keep) = \Pr(q \geq \hat{q}(n_1 = 1, keep))\mathrm{E}(U_2(rel|q \geq \hat{q}(n_1 = 1, keep), n_1 = 1, keep)) + (1 - \Pr(q \geq \hat{q}(n_1 = 1, keep)))U_2(single|n_1 = 1)$$

$$U_1(leave|n_1 = 0, keep) = \Pr(q \geq \hat{q}(n_1 = 0, keep))\mathrm{E}(U_2(rel|q \geq \hat{q}(n_1 = 0, keep), n_1 = 0, keep)) + (1 - \Pr(q \geq \hat{q}(n_1 = 0, keep)))U_2(single|n_1 = 0)$$

where the various values of $\hat{q}$ are the critical values of q to enter a second-period relationship, which can be calculated by rearranging the critical values of p above. A comparison of the expected utilities from staying or leaving for a given value of n_1 and the choice of an abortion or not (if necessary) in the second period identifies the choice that a given woman will make, but there is no simple algebraic way to express this choice.

Similarly, a pregnant woman's choice of having an abortion or not in the first period depends on future expected outcomes:

$$U_1(abort|q, abort(t = 2)) = \sigma + \gamma - \delta + \mathrm{E}(\max\{U_1(stay|q + \epsilon, n_1 = 0, abort), U_1(leave|n_1 = 0, abort)\})$$

$$U_1(abort|q, keep(t = 2)) = \sigma + \gamma - \delta + \mathrm{E}(\max\{U_1(stay|q + \epsilon, n_1 = 0, keep), U_1(leave|n_1 = 0, keep)\})$$

$$U_1(keep|q, abort(t = 2)) = \sigma + \mathrm{E}(\max\{U_1(stay|q + \epsilon, n_1 = 1, abort), U_1(leave|n_1 = 1, abort)\})$$

$$U_1(keep|q, keep(t = 2)) = \sigma + \mathrm{E}(\max\{U_1(stay|q + \epsilon, n_1 = 1, keep), U_1(leave|n_1 = 1, keep)\})$$

and a comparison of the expected utility from having an abortion or not in the first period – given the choice that the woman would make in the second period and her current value of q – identifies the choice that she will make. Finally, the choice of entering a relationship in the first period is as follows:

$$U_1(single|abort(t = 2)) = \gamma + \Pr(q \geq \hat{q}(abort))\mathrm{E}(U_2(rel|q \geq \hat{q}(abort), n_1 = 0, abort)) + (1 - \Pr(q \geq \hat{q}(abort)))U_2(single|n_1 = 0)$$

$$U_1(single|keep(t = 2)) = \gamma + \Pr(q \geq \hat{q}(n_1 = 0, keep))\mathrm{E}(U_2(rel|q \geq \hat{q}(n_1 = 0, keep), n_1 = 0, keep)) + (1 - \Pr(q \geq \hat{q}(n_1 = 0, keep)))U_2(single|n_1 = 0)$$

$$U_1(rel|q, abort, abort(t = 2)) = pU_1(abort|q, abort(t = 2)) + (1 - p)(\sigma + \gamma + \mathrm{E}(\max\{U_1(stay|q + \epsilon, n_1 = 0, abort), U_1(leave|n_1 = 0, abort)\}))$$

$$U_1(rel|q, abort, keep(t = 2)) = pU_1(abort|q, keep(t = 2)) + (1 - p)(\sigma + \gamma + \mathrm{E}(\max\{U_1(stay|q + \epsilon, n_1 = 0, keep), U_1(leave|n_1 = 0, keep)\}))$$

$$U_1(rel|q, keep, abort(t = 2)) = pU_1(keep|q, abort(t = 2)) + (1 - p)(\sigma + \gamma + \mathrm{E}(\max\{U_1(stay|q + \epsilon, n_1 = 0, abort), U_1(leave|n_1 = 0, abort)\}))$$

$$U_1(rel|q, keep, keep(t = 2)) = pU_1(keep|q, keep(t = 2)) + (1 - p)(\sigma + \gamma + \mathrm{E}(\max\{U_1(stay|q + \epsilon, n_1 = 0, keep), U_1(leave|n_1 = 0, keep)\}))$$

and any woman can evaluate whether they would (and could) have an abortion if necessary in the first and/or second period, and make their first-period relationship choice accordingly.