Tightening abortion to increase fertility

Anna Matysiak
Interdisciplinary Center for Labour Market and Family Dynamics (LabFam)
Faculty of Economic Sciences University of Warsaw

Lucas van der Velde
Interdisciplinary Center for Labour Market and Family Dynamics (LabFam)
Faculty of Economic Sciences University of Warsaw

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Abstract

In 2020, the Polish Constitutional Tribunal declared that abortions on the grounds of fetus anomaly were against the constitution. The ruling effectively outlawed abortions, as over 95% of legal abortions were conducted on this ground. Using vital statistics and a regression discontinuity design, we study how the ruling affected fertility. We find that the change in the legislation resulted in a fall in overall fertility of around 4% of the previous mean. This decline was visible across regions, and it was of a similar magnitude for urban and rural settings. We further show that regions that were initially more opposed to abortion experienced smaller fertility declines. We do find only weak evidence of differential effects based on mother's characteristics.

Introduction

In 2020, Poland became one of the few countries that tightened abortion legislation in the last thirty years. This change resulted from a decision from the Constitutional Tribunal (TK), which ruled that abortions due to foetus anomaly were against the provisions of the constitution. This decision effectively made abortion illegal in the country, as over 95% of legal abortions cited foetus anomaly as a cause for termination.

This research explores how this policy change affected fertility patterns. A priori, banning abortion could increase or reduce fertility. As discussed in Levine (2007), the possibility of an abortion acts as an insurance against downward risk. By closing this mechanism, the decision of the Constitutional Tribunal could induce women to use other contraceptive methods that offer higher protection against pregnancy. Women who might have tried to have a (an additional) child could be discouraged after the change. At the same time, there is empirical evidence running in the opposite direction. (Kulczycki et al. 1996) found that when Romania banned abortion, fertility rates soared. Moreover, allowing legal abortion tends to reduce births, especially among teens (Clarke and Mühlrad 2021, Cabella and Velázquez 2022).

We study the policy change using data on births in Poland since 2018. We employ an interrupted time series analysis that exploits changes in births occurring approximately 38 weeks after the TK ruled on the matter. We find that births decline in the aftermath of the ban. The decline in births exceeded the number of abortions in previous years. More women opted to "terminate" pregnancy by never starting it, than what would have resulted if the option to abort would have been available at a later stage. The decline was stronger among more educated mothers, women who were older at the time of birth, and among those who already had children. This effect suggests that women switched their use of contraceptive methods following the ruling. Besides fertility outcomes, we also show that the policy change resulted in an increase mortality among newborns. The increase in newborn deaths is the other side of the same coin. Among women who are unable to legally interrupt their pregnancies, some of them will give birth to children who are unfit to survive on their own. The increase, however, is lower than abortions in the prior years.

The study is organized as follows. The next section describes the evolution of abortion legislation, with a special focus on the most recent policy change. In section 2 we describe the method and data available to use. Section 3 presents the findings from our research. Finally section 4 concludes.

1 Background

Polish institutional context

Brief history of abortion legislation in Poland Between 1956 and 1993, Poland, like many other countries under Soviet influence, had a very liberal abortion policy that contemplated the possibility of abortion based on social conditions. Effectively, this meant that the procedure was available on demand. Within the first years of transition, the situation changed. First, medical associations took the first steps to limit access to abortions. These restrictions include the introduction of conscientious objections, allowing doctors to refuse performing the procedure. Moreover, additional paperwork was required from pregnant women. In 1993 a new law on reproductive rights and family planning was passed by the parliament. This law stipulated that abortion was permitted only in on three grounds: when the pregnancy resulted from an illegal act (such as rape), when it endangered the mother's health or life, or when there was a severe foetus anomaly. The legislation foresees penalties for people conducting the abortion, as well as people who collaborate with them, for example by providing information. Importantly, women seeking abortion are not punishable.

Both the changes promoted by medical associations and the law on reproductive rights, had an immediate effect on the number of *legal* procedures performed in the country. The number of abortions dropped from over 100 thousand cases in 1988 to less than a thousand in 1994. This decline includes not only a reduction in abortions, but also a switch towards non-registered procedures, with detrimental consequences for health of women.

The 1993 law on reproductive rights was controversial. A left-wing government attempted to reintroduced socio-economic conditions as grounds for abortion, but this legislative change was ruled unconstitutional by the Constitutional Tribunal (TK), setting a precedent for subsequent

changes. More recently, in 2016 two proposals were presented to the Parliament. One promoted liberalizing access to the abortion, while the second attempted to ban it completely. Only the second proposal was sent for proceedings. This decision resulted in a massive social demonstration across the country, the so-called "Black protest." Three days later the Parliament dismissed the proposal.

Blocked the legislative route, a group of Members of Parliament issued a motion for constitutional review, on whether the possibility of having an abortion based on foetus abnormality violated several articles from the Constitution. In October 22nd 2020 the TK declared that indeed abortion due to foetus abnormality was against the Constitution, and should no longer be cited as a reason for terminating a pregnancy. These decision did not immediately banned this reasons, since under Polish law decisions by the TK are not binding. In order to gain legal power, the decision should be published in the Official Bulletin. The responsibility for publication falls within the Executive branch. In principle, it is possible that the decision is never published.

In the days subsequent to the announcement by the TK another series of massive protests took place under the slogans "*Pieklo Kobiet*" (women's hell) and "*Strajk Kobiet*" (Women's strike). This movilization occurred in spite of concerns over Covid-19 and measures taken to restrict the ability of citizens to protest (Krajewska 2021).

Notwithstanding the movilization, the President published the decision in the Official Bulletin in January 27th 2021, three months after the initial ruling. As a result, Poland, followed shortly by some states in the US, became one of the few countries that tightened the abortion laws over the last 30 years despite the global trend toward legalization of abortion (Center of Reproductive Rights) (Krajewska 2021). To understand the reach of the ruling, it suffices to look at abortions in the preceding years. Abortions due to foetal defects constituted already 97% of all legal pregnancy terminations in the years 2017 – 2020.

Fertility in Poland Poland belongs to the lowest-low fertility countries since the early 2000s with a total fertility rate well below 1.4 for most of this period. This low fertility coincides with the relatively high attachment of Poles to Catholic values. The persistence of low fertility has been usually explained by a weak state support for combining paid work and childcare that did not meet the needs of the rapidly growing population of highly educated women (Kotowska et al. 2008, Mishtal 2009). In 2021, 35% of women aged 25-34 had a tertiary degree (Eurostat Statistics Database). Though the use of modern contraception in Poland is moderate (UN, 2022), women were able to control their fertility. This is reflected not only in low total fertility but also in low teenage fertility (Sobotka et al. 2015).

Previous results

Folk wisdom suggests that tightening abortion laws should lead to higher fertility. Romania is probably the most known case, as the country introduced an abortion ban in 1966. This policy change was followed by a sudden increase in the birth rate by a factor of two. As people found ways to get access to illegal methods of birth control and pregnancy termination the birth rates decline (Kulczycki et al. 1996). When the ban was lifted in 1990, the availability of abortion con-

tributed to the decrease in fertility in the subsequent years, though its impacted was mitigated by the availability of modern contraceptives(Mureşan 2008).

More recently, studies focused on how liberalizing abortion affected on fertility. Levine (2007) finds that the legalization of abortion in the US following Roe v Wade was followed by a decline in fertility of more than 4 percentage points. Similarly, Guldi (2008) found that the removal of parental consent requirements for teenagers seeking abortion in the US reduced teenage fertility by around 10% and that this effect was largely driven by a decline in non-marital fertility. A decline in adolescent fertility as a result of abortion legalization was also found in Uruguay by Cabella and Velázquez (2022) and in Mexico DF by Clarke and Mühlrad (2021) though the latter study also found some, much smaller, reduction in fertility in other Mexican states which tightened their own legislation. Back in the US, Ananat et al. (2007) found that legalization of abortion led to a decline in completed fertility, and not only to the shifts in fertility timing.

Previous findings are not conclusive, and indeed a reduction in fertility following restrictions in abortion laws was also observed. Klerman (1999) found that state withdrawal of abortion funding, which took place in the US in the 1980s, led to subsequent declines in fertility, which were stronger among higher-order mothers as well as other groups which were most likely to qualify for the state funding before. Likewise, a small reduction in fertility was found following the strengthening of abortion penalization in several Mexican states between 2007 and 2008 (Clarke and Mühlrad 2021).

Kane and Staiger (1996), Levine (2007) propose a model to reconcile these contradicting findings. They present the fertility decision as a sequential process, in which women first decide on a contraceptive technology, and conditional on pregnancy they choose whether or not to have an abortion. This sequential perspective allows studying how changes in abortion can influence decisions on the use of contraceptive technologies. First, conditional on being pregnant women are less likely to have an abortion, as the the procedure becomes more expensive, for example they would have to travel to a different country where it is legal. By itself, this effect would increase the number of births. However, women anticipate that they will not be able to perform an abortion, and they may turn to using contraception on a larger scale[1]. This shift in the use of contraceptive technologies should be understood in a broad sense. It includes people who decide to postpone (or even forego) having additional children. Such an extreme case could occur when a pregnancy could potentially impose high costs for a woman, e.g. there is a higher risk of foetus defect. For these women, abortion serves as an insurance mechanism. Since the risk of a foetus defect increases with maternal age older women may be more likely to abandon having a (or another) child. Highly educated women may also be more likely to use contraception to lower the pregnancy risk as they face particularly high opportunity costs of giving birth to a disabled child which requires disproportionately high care inputs.

2 Methods and Data

In order to uncover fertility effects of tightening abortion laws we use data on births from the vital statistics. This database includes the day of birth and the place of birth (the region, and whether

[1]See Appendix 4 for a formal analysis of changes in abortion legislation and contraceptive choices.

the birth was in an urban or rural area). This is our main database. In order to remain comparable to previous studies, we aggregates births at the weekly and monthly levels. Besides this general data, the Central Statistic Office also provides aggregate database containing more information on the mothers. These data include age (in ten year intervals), the education level, and the parity of the child. Given the higher sensitivity of these data, they are only distributed at the monthly level.

In order to recover the effect of tightening abortion legislation, we make use of Interrupted Time Series analysis (Bernal et al. 2016, McDowall et al. 2019). This method resembles a Regression Discontinuity Design. Its main assumption is that the circumstances in which women decide whether to get pregnant or not just before and just after the announcement by the Constitutional Tribunal are similar to each other in many aspects apart from the abortion legislation. As a result, any differences in fertility which emerge from comparing the two periods can be attributed to the changes in the abortion legislation. Rodgers et al. (2005) pioneered this approach in fertility research, and Comolli and Vignoli (2021) offers a recent example.

At its core, the Interrupted Time Series analysis consists of two steps. In the first step, one models the time series before the intervention, taking proper care of separating the stationary and the non-stationary components. Then, one would study whether the intervention lead to significant deviations with respect to what would have been observed if the time series continued in its previous path. In our case, modeling the time series involves deseasonalizing the time series. For this purpose, we regress the number of births on monthly fixed effects, and keep the residuals. We add back the mean to ensure that the level of births is the same in the initial period. The deseasonalized series contains a time trend that we recover in the second stage.

Having deseasonalized births, we study the effects of the change in the abortion legislation by fitting models of the form:

$$Y_t^d = \beta_0 + f(t) + \beta_1 \text{After}_t + g(t) \times After + \epsilon_t$$

where Y_t^d is the deseasonalized number of births in Poland in month t and β_1 is the parameter of interest. It shows the decline in births at the time of conception. In principle, $f(t)$ and $g(t)$ can be different, and involve high order polynomials. However, given that the time series is relatively short, our main specifications employ up to second order polynomials. Having deseasonalized the data, $beta_0$ has an interesting interpretation, it is the average number of births in the period before tightening abortion legislation.

In our case, the use of interrupted time series analysis requires addressing three issues. The first issue corresponds to establishing the timing of the treatment. As discussed in Section 1, there are two possible options: when the Constitutional Tribunal announced its decision (October 2020) and when the decision was published in the Official Bulletin (January 2021). We opted for using the first date, as once the Constitutional Tribunal announced its decision, women knew it will be eventually become binding, though the exact date remained unclear.[2]

The second issue corresponds to the timing of conception. Unlike births, where the exact date

[2]There is also some confusion about these dates in official reports. In the reports to the Council of Ministers for the years 2021 and 2022, it was informed that the changes became effective in October 2020, and January 2021 respectively.

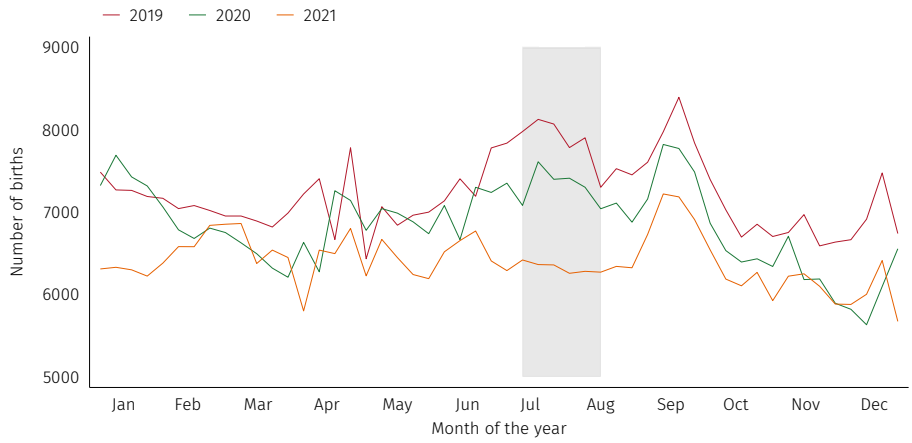
is known, one cannot identify when conception took place. As such some of the births that we ascribe to the treatment group, i.e. those occurring 38 weeks after the initial announcement of the decision, could have been conceived before. Analogously, some births from the control group might be early deliveries from pregnancies conceived after the announcement. Both errors bias our estimates towards zero, independent of whether the new ruling results in fewer or more births.

A final issue corresponds to selecting the time frame for the analysis. While data on births dates back to the early 2010's, we restricted the sample to the years immediately before the reform. The reason is that interrupted time series, like RDD, provides a local estimate. Including observations from earlier periods could increase efficiency at the cost of increasing bias in identifying births close to the cutoff. Moreover, extending the sample before 2016 creates an additional problem. In 2016, the Polish government introduced an unconditional cash transfer program from families with children, which resulted in a short but noticeable increase in births. To avoid confounding the lingering effect of this policy and the change due to the tightening of abortion legislation, we focus on births occurring as of 2018.

3 Results

We begin this section by presenting the raw data. Figure 1, we plot the weekly number of births against time where time is measured in weeks starting in January of the year t. The shaded area represents the first month where births could have been affects by the decision of the TK. The area marks 37 to 41 weeks after the initial decision of the TK.

Figure 1: Evolution of the number of births



Notes: Figure reports the number of birth in each week of the year. Weeks are not adjusted by the number of days. The lines indicate the steps and changes in legislation on abortion. The first vertical line corresponds to 37 weeks after the decision of the Constitutional Tribunal (TK), the second corresponds to 37 weeks after the publication of the decision in the Official Bulletin .

A few elements stand out from Figure 1. First, one can observe a downward trend in the number of births, as lines from most recent years tend to be lower than lines from earlier years. Second, there is evidence of strong seasonality, as births spike in three different periods: July, September

and late December/early January. Third, within these seasonal patterns, we can observe that births in 2021 behaved differently. The first spike, corresponding to the month of July, is not visible in the most recent data. For this month, we observe fewer births than what we would have expected following the pattern from previous years. At the same time, July is the month when first children conceived after the announcement of the Constitutional Tribunal should be born. The decline in the number of births appears to be short-lived, however. By September, differences between 2021 and 2020 began to shrink, and by the second week of November, the number of births in two years appeared indistinguishable. Notice, however, that November and December 2020 constitute a problematic reference point, as births in these months would have been conceived at the beginning of the pandemic.

The effect of abortion tightening

We use two functional forms for $f(t)$ and $g(t)$. In the first specification, we include a time trend and its square, both for the period before and after the regression. We estimate our models for the entire country as well as separately for urban and rural areas. Our estimates are presented in Table 1 where we show the estimates from the first specification in columns (1)-(3) .

Table 1: Decision of the Constitutional Tribunal and births

	All births	City	Rural
After=1	-246.3*	-147.5*	-98.78*
	(134.9)	(81.24)	(58.91)
Weeks since	-12.98***	-6.891***	-6.094***
	(2.750)	(1.661)	(1.192)
Weeks since ^{2}	-0.0429**	-0.0187*	-0.0242***
	(0.0188)	(0.0113)	(0.00840)
Weeks since $\times$ After=1	23.13***	12.19***	10.94***
	(6.482)	(3.804)	(2.952)
Weeks since^2 $\times$ After=1	-0.192***	-0.115***	-0.0778**
	(0.0739)	(0.0423)	(0.0347)
Constant	6295.9***	3702.2***	2593.8***
	(86.87)	(53.42)	(35.93)
N	208	208	208
R^2	0.766	0.772	0.719

Notes: Table presents results of linear regressions where the dependent variable is the weekly number of births. The first three columns present a specification where we control for time using a quadratic term, whereas in the remaining columns we include flexible specifications. Heteroskedasticity consistent standard errors in parentheses. ***, ** and * denote significance at $p < 0.01$, $p < 0.05$, and $p < 0.1$, respectively.

The first column shows that the decision of the Constitutional Tribunal resulted in an immediate fall of almost 250 births, or roughly 4% of the average number of births during a week in the sample ($246/6295.9 = 0.0391$). The interactions with time show that this fall did not last. By the end of the twentieth week, the number of births returned to the same trend as in the previous years. The next two columns show that the effect was similar in magnitude in urban and rural areas, around 4% in both cases ($147/3702 = 0.039$, $98.78/2593.8 = 0.038$). The second part of Table 1 includes additional specifications where we allow a more flexible time pattern for the effects. As in the first part, we observe that the effects are concentrated around the first month and a half,

while they tend to disappear, as signalized by the lack of significance of the Constitutional Tribunal variable.

Overall, our findings suggest that the announcement of the Constitutional Tribunal was indeed followed by a decline in the number of births. This decline was transitory and a reversal to the trend was observed within the period of 2 months (5-7 weeks) after the announcement. While the number of births by the end of 2021 increased, this increase was not stronger than what one usually observes in November and December. It thus seems that the births which were not conceived in the first months after the announcement of the Constitutional Tribunal did not increase in the next period. At the same time, we see that the depressing fertility effect of the stricter abortion law was transitory and affected largely fertility decisions of women who planned to have children shortly after the new ruling, but did not have an effect on women who were making their fertility decisions early in 2021.

One potential explanation on why the effect of the tightening of the abortion law on fertility is short lived could be related to the salience of the topic. In the aftermath of the decision, protests multiplied throughout the country gaining local and international news coverage. Such coverage could have affected the perceived risk of a pregnancy, leading to a transitory downfall in births. As time passed, the decision of the Constitutional Tribunal lost relevance. The interpretation is consistent with the effects of news concerning economic risk explored by Comolli and Vignoli (2021). This interpretation is supported with evidence from Google Trends: the search for abortion in Poland was seven times as high during the initial decision, when compared to the week of its publication. A similar trend is uncovered for the topic "Women's Hell" (Piekło kobiet), a slogan that was popularized during the protests ensuing the decision of the Constitutional Tribunal. Other popular tag, "Strajk kobiet" (women's strike) exhibits the same time pattern.

Regional differences

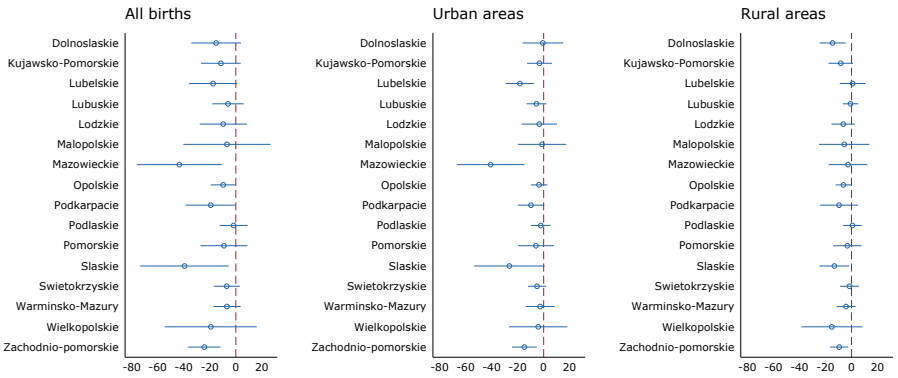
This section explores whether births reacted different across region using weekly data. An initial indicator that regions reacted differently to changes in the legislation is provided in Figure 2. This figure portrays coefficients obtained from estimating the same regressions as in Table 1, but separately for each region. For the sake of space, we plot only β coefficient for the after period, and not the estimates for the time trends. The coefficients plot in Figure 2 shows substantial heterogeneity, which partly reflects population sizes. The effects are larger in Mazowieckie, where Warsaw is located, followed closely by Slaskie. Importantly, when we consider all births, all point estimates are negative, suggesting a generalized decline in births following the decision of the Constitutional Tribunal. Splitting the results by urban and rural areas produces overall lower estimates, as one would expect, and quite often not statistically different from zero.

We provide a second exploration of heterogeneity across regions in Table 2. In these table we estimate the following equation:

$$Y^d_{r,t} = \beta_0 + f(t) + \beta_1 \text{After}_t + \beta_2 \text{After}_t \times \text{Cultural}_r + g(t) \times After + \epsilon_{i,t}$$

where $Y^d_{i,t}$ are deseasonalized births in region r in time t. This variable also accounts for differ-

Figure 2: Regional heterogeneity



Notes: Figure reports coefficients showing the change in births following the tightening of abortion legislation and 90% confidence intervals built using heteroskedasticity robust standard errors.

ences in levels across regions in the period before the tightening of abortion legislation. $f(t)$ and $g(t)$ measure time trends, for parsimony we assume common trends across different regions. The coefficient β_1 represents the causal effect of changes in legislation, whereas β_2 shows how this effect is moderated by region specific cultural factors. Concretely we consider three different measures: the share of people under forty years old who identify themselves as religious, the share of people under forty years old who state that an abortion is not justified under any condition,[3] and the average number of abortions performed in the region before the policy change.

Table 2: Decision of the Constitutional Tribunal and births by groups

	(1)	(2)	(3)	(4)	(5)
After=1	-17.65***	-26.22***	-33.44***	-17.65***	-17.65***
After=1 × Religion is important		11.90			
After=1 × Abortion never accept.			46.57***		
After=1 × Search for Pieklo kobiet				-12.02***	
After=1 × N. abortions before					-22.87***
Constant	394.2***	394.2***	394.2***	394.2***	394.2***
N	3328	3328	3328	3328	3328
R^2	0.432	0.433	0.440	0.455	0.513

Notes: Table presents results of linear regressions where the dependent variable is the number of births. Heteroskedasticity consistent standard errors in parentheses. ***, ** and * denote significance at $p < 0.01$, $p < 0.05$, and $p < 0.1$, respectively.

The results align with previous expectations. In regions where people are more religious, or more opposed to abortion the decline in fertility is lower (the interaction is positive). By contrast, that performed a higher number of abortions before the change in legislation the decline in abortion is stronger. To grasp the magnitude, an increase in the share of young people opposing abortion is associated with an increase of around five births ($10 * 0.4657$). These results resemble those obtained by (Cabella and Velázquez 2022)

[3]These variables were taken from the European Values Study of 2017.

Did the ruling affect mothers differently?

Theoretical discussions and the empirical results discussed earlier suggest that women should react differently based on their individual circumstances. Women with a higher (perceived) risk of conceiving a foetus with an anomaly should react more strongly to changes in the legislation. Alternatively, women with very strong religious views, who would not have an abortion in either scenario, should not alter their fertility choices as a result of changes in legislation.[4] In this section, we explore some possible sources of heterogeneity.

We focus our analysis on three relevant characteristics age at birth, educational status and parity of the child. Our database contains the number of children born within each category in a given month. Typically data are available as of 2018, however data by parity are only available as of 2019. In order to keep the estimates comparable, our preferred sample starts in 2019 and ends in 2022. In total, the sample counts with observations from 48 periods.

The estimated coefficients are displayed in Table 3. We present the results in several groups. First, and to allow comparisons with Table 1, we show the coefficients obtained for the entire population. Then, the next three columns show the coefficients when births are split by parity: first, second and third or more (as births of subsequent children are uncommon). Subsequently, we show the coefficients when births are split by mothers' age. Again, we grouped these births in three categories: women age 25 or younger, women aged between 26 to and 34 and women aged 35 or older. Finally, we show the coefficients when we split births by education of the mothers. The corresponding three levels are primary or lower, secondary and tertiary (Bachelor or higher).

In the upper panel, we observe that the effect tends to be negative and of a size comparable to the regressions using weekly data ($1250/27893 \sim 0.04$). However, the standard errors are large and we lack power to identify any effect. The only exception corresponds to first births. These births are the most numerous, and also the group where the effect of changes in abortion legislation was stronger. We observe a fall in births close to 0.065, around 50% more than in the overall population. In the remaining groups, our regression is not precise enough to capture the decline in births following change in the law. [5].

[4] See Fratczak and Sikorska (2009) for an analysis of support of liberal abortion policies in Poland.

[5] Given the low number of observations, the thresholds for rejecting the null hypothesis are higher than in the previous regressions.

Table 3: Decision of the Constitutional Tribunal and births by groups

	Everyone	By parity			By mother's age			By mother's education		
		1st	2nd	3rd +	15-25	25-35	35-50	Primary	Secondary	Tertiary
Months since	-129.2***	-31.41***	-66.59***	-31.37***	-40.51***	-81.64***	-6.933	-15.74***	-84.13***	-94.28***
	(17.66)	(6.489)	(7.846)	(4.871)	(2.027)	(11.54)	(4.934)	(1.291)	(7.806)	(13.24)
After=1	-1250.2	-816.8**	-397.1	-52.17	-103.9	-817.5	-338.4	-1.303	-555.0	-232.7
	(918.3)	(356.3)	(369.6)	(232.2)	(116.9)	(596.4)	(226.4)	(39.72)	(394.3)	(507.2)
Months since× After =1	25.43	-12.99	16.21	21.99	14.87	18.16	-8.661	7.288**	52.40	7.191
	(75.81)	(30.82)	(29.95)	(18.27)	(9.453)	(48.84)	(19.14)	(2.848)	(33.16)	(41.48)
Constant	27893.8***	12552.4***	9523.3***	5914.0***	3655.2***	18407.7***	5936.7***	1384.5***	10644.2***	13595.9***
	(360.3)	(132.9)	(157.3)	(98.23)	(41.44)	(234.1)	(99.86)	(26.11)	(148.3)	(258.0)
Observations	48	48	48	48	48	48	48	48	48	48

Notes: Table presents results of linear regressions where the dependent variable is the number of births. Heteroskedasticity consistent standard errors in parentheses. ***, ** and * denote significance at $p < 0.01$, $p < 0.05$, and $p < 0.1$, respectively.

Interesting patterns emerge in the lower panel. First, estimates on After and its interaction with the time trend are mostly not statistically significant, even if large. This lack of significance is paired with large declines immediately after the decision. Taken together, these patterns support the conclusions from the previous section: there was a decline in births, but it was short lived.

Second, point estimates serve to evaluate the relative impact in each population group. In all cases, point estimates show a decline in the range of 8% to 14% of the average number of births before changes in legislation. The largest estimates correspond to women aged 35 to 50 years old. This is consistent with our previous expectations, as these women faced a higher risk of congenital disorders. On the opposite side, births to mothers younger than 20 years old were barely affected by the policy change. The observed effect is smaller in absolute (number of births) and in relative terms. The least affected group corresponds to mothers with only primary education, whose births fell by around 2%. Possible explanations range from the lower opportunity cost of having additional children, a greater adherence to religious values, or difficulties in access to pregnancy termination already in the initial period, i.e. costs of prenatal tests.

Events after the decision

In September 2021, eight months after the change in the policy, there was a second relevant event. Izabela, a 30 year-old woman who was 22 weeks pregnant died in the hospital of Pszczyna. Her dead resulted from a septic shock that followed the break of amniotic water. The fetous had been diagnosed with malformation, and would have been eligible for abortion before the change in the legislation. The case gain visibility, as the family claims that doctors could have saved her life, but they were reluctant to act as it would have resulted in the death of the foetus. The news about the death of Izabela became public on November first 2021, when the lawyer of the family disseminated it on social media. A new series of protests took place.

The death of Izabela, and the publication in social media served as a reminder of how change in legislation can have dire consequences for women's health. To some extent, it materialized the fears of the protesters who took the streets following the decision of the Constitutional Tribunal.

In this section we explore whether this second event had a noticeable impact on fertility. Notice that identifying this effect poses an additional challenge, as the case gain publicity almost exactly one year after the decision of the Constitutional Tribunal was published. In consequence, our estimates will be based on comparisons to the years *before* the decision of the Constitutional Tribunal.

Our strategy is the same as in the previous subsection. As before, we first deseasonalize births using months from before the decision of the Constitutional Tribunal, and we add the mean to the residuals to maintain the same levels. We then regress deseasonalized births on a time trend, and we split the after variable into two parts. One corresponding the period between the decision of the Constitutional Tribunal and the death of Izabela, and a second that starts with the death and finishes at the end of our sample. In total, we estimate three different time trends. One for the period before the decision of the Constitutional Tribunal, one for the period in between the decision and the death of Izabela, and one for the period after her death. Our estimation equation looks as follows:

$$births_t^d = \beta_0 + f(t) + \tau\, after_{TK} + after_{TK} \times g(t) + \tau_D after_D + after_D \times h(t) + \epsilon_t$$

For the sake of conciseness, Table 4 reports only the estimated treatment effects, $\hat{\tau}_{TK}$ and $\hat{\tau}_D$, which represent the decision of the Constitutional Tribunal and the Death of Izabela. The two events had similar implications for fertility, as in both cases fertility appears to have declined. Consistent with our previous estimates, the decision of the Constitutional Tribunal produces coefficients similar to those presented in Table 1: between 5% to 6% of the average births in the period before the intervention. The effect of the Death of Izabela is considerably larger, almost twice as large. However, the estimates also show how volatile the effects are to how time trends are specified. If one includes a quadratic term, as in all previous estimates, the coefficients (and the standard errors) change abruptly. Similar changes are not observed in the effects of the decision of the Constitutional Tribunal.

Table 4: Decision of the Constitutional Tribunal and Death of Izabela

	All births	Urban	Rural
Panel 1: Linear trend			
After TK=1	-297.0***	-160.0**	-137.0***
	(108.4)	(64.39)	(48.32)
After Death=1	-643.3**	-347.2**	-296.1*
	(269.0)	(169.2)	(158.2)
R^2	0.768	0.775	0.717
Panel 2: Quadratic trend			
After TK=1	-327.7**	-188.9**	-138.8**
	(139.8)	(86.30)	(60.00)
After Death=1	-361.7	-1314.7	953.0
	(3595.3)	(2189.2)	(1938.6)
R^2	0.777	0.782	0.732
N	208	208	208

Notes: Table presents results of linear regressions where the dependent variable is the (deseasonalized) number of births. Heteroskedasticity consistent standard errors in parentheses. ***, ** and * denote significance at $p < 0.01$, $p < 0.05$, and $p < 0.1$, respectively.

Even if one considers the model in Panel 1 to be the correct one, the decline in births following the death of Izabela should be taken with a grain of salt. The interrupted time series method was designed to study the effects at the discontinuity, when abortion legislation was tightened, and not events that took place a year after. The extrapolation for this second year could be problematic if the time patterns are not well captured by the model. An example of such concern would be different cohort sizes, which are arguably identical across weeks, but can differ across years.

4 Conclusions

This article studied the consequences of tightening abortion legislation in Poland. Our estimates show that following the decision of the TK, the number of births declined substantially, and that this decline was observed across the country. In both urban and rural areas, births decline by

around 4 percent of the average births in the previous period. As one would expect from simple models, the decline in fertility was more pronounced in regions were people had a more positive attitude towards abortion, as these women experienced a larger change in the value of a child. By contrast, in regions where women were less likely to have an abortion to begin with, the effects were more muted. Perhaps surprisingly, we found stronger effects among women without children.

These results stand against part of the literature that suggest that abortion legalization leads to a decline in births. We theorize that this difference arises reflects couples' (women's) adjustment of their contraceptive choices in response to changes in institutional incentives. The 4% decline is large, taking into account that just 0,03% of pregnancies ended in an abortion. One possibility is that this difference reflects risk aversion among women, which forego pregnancies instead of risking an instance of fetous malformation. The second case is that the salience of the topic, e.g. due to the social unrest, lead to an overestimation of the probability of needing (receiving) an abortion. Digging deeper requires access to better data.

A limitation of our study, and others working on similar topics, is the inability to observe illegal abortions. Thorough the article, we assume that the availability remains unchanged, but this might not be the case. After the decision of the Constitutional Tribunal, women had additional incentives to explore abortion options beyond those provided by health care facilities. If women learned about these alternative channels, the long term effects would be smaller than the short run effects presented in this paper.

Our study does not take a normative stance on the issue of abortion, and our findings are not informative of how a good policy on abortion should look like. We do not explore (cannot explore) the suffering of women forced to carry a foetus incapable to survive on its own. Nor do we study health issues resulting from recurring to underground termination procedures. Our study only shows the effects on fertility, which, we reiterate, should not be a primary goal when legislating reproductive rights.

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Appendix: A model of fertility and abortion

In this section, we propose a simple modification of the model proposed in Levine (2007). In this model, the decision to abort is intrinsically linked to the decision on which contraceptive technology to use. Contraceptive technologies differ on two accounts: their protection against pregnancy and their relative costs. These costs might be monetary, psychological, physiological, or even the discomfort of using a particular technology. We denote the costs experienced by individual i from using technology t as $C_{t,i}$. The protection against pregnancy is given by one minus the probability that a given interaction results in a pregnancy. We denote the later probability ρ_t, and treat it as a technology specific, i.e. method offers the same protection to all individuals.

Conditional on being pregnant, which occurs with probability ρ_t, women can decide on whether they will have a child or whether they will interrupt the pregnancy with an abortion. Each decision brings certain utility to the woman. In the case of abortion, we denote this utility by $V_{A,i}$ and note that this value could be negative, i.e. abortion is a cost. This value is person specific. It reflects institutional constraints, such as access to safe abortion, expected health costs, and individual motivations. A person with a strong negative views on abortion could have values of $V_{A,i} \sim -\infty$.

On the other hand, we denote the utility of giving birth as $V_{B,i}$, and assume that this value is drawn from a random normal distribution with parameters μ_i and σ_i. The value of a birth is unknown before pregnancy. $V_{B,i}$ includes elements related to the health of the foetus and to the social condition of the would be mother, such as whether the partner / family are supportive. During the first months of pregnancy, this information is revealed. A woman decides to follow through with the pregnancy if $V_{B,i} > V_{A,i}$. This inequality highlights the insurance element of abortion. Abortion protects women against the worse realizations of $V_{B,i}$.

With these elements, the probability that a women gives birth conditional on having used contraceptive technology t is given by:

$$P(birth|method = t) = \rho_t \times P(V_{B,i} > V_{A,i})$$

This equation shows that changes in abortion legislation have a direct effect in fertility. More stringent legislation raises the cost of abortion, which drives $V_{A,i}$ down, which in turn raises $P(V_{B,i} > V_{A,i})$. As a result fertility would be expected to increase. This effect was observed in Romania. By the same token, liberalizing abortion (and providing adequate facilities) would increase the value of abortion and lead to a decline in fertility.

These results are conditional on the lack of behavioral changes. If women think strategically, changes in $V_{A,i}$ might lead to changes in the contraceptive technology used. The overall effect on fertility would depend on whether women switch to technologies with higher or lower values of ρ_t. The unconditional probability of given birth is defined as

$$P(birth) = \sum_t \rho_t \times P(V_{B,i} > V_{A,i}) \times P(T = t)$$

In order to understand whether women would switch technologies, we provide more structure to the model. First, we define the expected value of pregnancy.

$$EV(pregnant_i) = P(V_{B,i} < V_{A,i})V_{A,i} + P(V_{B,i} > V_{A,i})E(V_{B,i}|V_{B,i} > V_{A,i})$$

given our assumption that $V_{B,i}$ is normally distributed, this expectation is defined as:

$$EV(pregnant_i) = \Phi(\alpha_i)V_{A,i} + (1 - \Phi(\alpha_i))\big(\mu_i + \sigma_i \frac{\phi(\alpha_i)}{1 - \Phi(\alpha_i)}\big)$$

where $\alpha_i = (V_{A,i} - \mu_i)/\sigma_i$. We normalize the value of not being pregnant to zero.

The second element consists of the decision to use a particular technology. We follow a random utility approach, where the utility of using technology t is given by:

$$U_{t,i} = C_{t,i} + (1 - \rho_t)0 + \rho_t EV(pregnant_i) + \epsilon_{i,t}$$

We follow the usual assumption that $\epsilon_{i,t}$ follows a type I extreme value distribution, which allows defining the probability of choosing method t as:

$$\pi_{i,t} = \frac{exp(C_{t,i} + \rho_t EV(pregnant_i)}{\sum_s exp(C_{s,i} + \rho_s EV(pregnant_i))}$$

Then the odds of choosing method t over method r are given by

$$\frac{\pi_{i,t}}{\pi_{i,r}} = exp((C_{t,i} - C_{r,i}) + (\rho_t - \rho_r)EV(pregnant_i))$$

To uncover the effect of changes in legislation, we compute the derivative with respect to $V_{A,i}$.

$$\frac{\partial(\pi_{i,t}/\pi_{i,r})}{\partial V_{A,i}} = \underbrace{exp((C_{t,i} - C_{r,i}) + (\rho_t - \rho_r)EV(pregnant_i))}_{>0} * (\rho_t - \rho_r) * \underbrace{(\Phi(\alpha_i))}_{>0}$$

The derivative of this odds with respect to $V_{A,i}$ is positive as long as $(\rho_t - \rho_r) > 0$. In other words, it is positive if method t offers a higher probability of becoming pregnant than method r. Tightening abortion legislation amounts to a fall in $V_{A,i}$, which reduces the relative probability of using a method with a higher ρ_t value. The second derivative is also positive, which means that the more one decreases the value of abortion the faster the transition to other methods would be.

We can also compare women with different values of μ_i. The derivative is similar, and given by

$$\frac{\partial(\pi_{i,t}/\pi_{i,r})}{\partial \mu_i} = \underbrace{exp((C_{t,i} - C_{r,i}) + (\rho_t - \rho_r)EV(pregnant_i))}_{>0} * (\rho_t - \rho_r) * \underbrace{(1 - \Phi(\alpha_i))}_{>0}$$

, which is positive if $\rho_t > \rho_r$. Higher values of expected value of birth are linked with the use of technologies that produce a higher probability of pregnancy. The second derivative is also positive, which indicates a increase in the relative ratio as the expected value of giving birth increases. The reverse is also true. A negative shock to μ_i would lead to an increase in the use of contraceptive technologies associated with more protection against pregnancy. Notice that the effects parallel those observed for $V_{A,i}$.

We can study heterogeneity in changes in probabilities linked to changes in abortion costs.

First, it is easy to evaluate the role of relative costs. If method t in infinitely more costly than method r, then the derivative converges to zero. Such situation would arise if, for example, a given technology is not available in the country, or if people have a strong preference for a given method. Second, one would like to study how the derivative changes with μ_i (the expected value of birth absent the option of abortion). This cross-derivative is more difficult to sign. Whether the cross-derivative is positive depends on the size of the difference in ρ_t, on the normalized subjective cost of abortion (α) and the dispersion parameter (σ).

Appendix: Additional tables and figures

Table 5: Abortions by age of the pregnant women

	All births	City	Rural
RD_Estimate	-462.7*	-263.8*	-198.9*
	(240.9)	(142.2)	(105.3)
Observations	260	260	260

Notes: Table presents estimates of tightening abortion legislation on weekly births using the approach developed by (Calonico et al. 2017). $*$ indicates p-values lower than 0.1.