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Master Thesis

Increased knowledge and parents fertility decisions. The effect of the CUB-test on abortions.

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Abstract

New and more advanced prenatal tests have steadily been introduced in the Swedish maternity care system in the last 30 years. The combined test, CUB, was introduced step wise in Swedish maternal care from 2008 and onward. The CUB test detects children with chromosomal abnormalities prenatally and is offered at no charge for women in treated counties. This thesis investigate the reform using a difference-in-difference approach to determine the effect of the CUB test on the number of late abortions performed. My theoretical framework suggest that the introduction of CUB should increase the number of abortions of children with chromosomal aberrations. As supported by theory I find a positive effect of CUB on late abortions for my main group of interest, women 35-39 years old. These women were the ones most effected by CUB. The positive effect of 0.47 percentage units is statistically significant at the 10% level. It corresponds to a 3.6-7.1% decrease in the number of babies born with chromosomal aberrations.

KEYWORS: Prenatal diagnosis, CUB, chromosomal aberrations, health economics

1 Introduction

The last two decades have offered a fast development of prenatal diagnosis. Ultra sound combined with more advanced tests are now available to most parents in the western world. These tests come with difficult ethical dilemmas. Who should live and who should never be born? How much should the society help parents to optimize their child making decisions by providing subsidized knowledge through the tests? Today, there are many human traits that can be detected prenatally and even more to come in a near future. This fact corroborate the urgency of conducting more research on how the tests effect parents behaviour to enable well-informed policy decisions. It is still unclear how the tests affect parents abortion decisions. One of the first traits possible to detect prenatally was the sex of the child. This possibility is still widely used for sex-selective abortions. Sex-selective abortions have had large consequences for the affected local societies where missing women create demographic problems sometimes unforeseen by the local authorities (Jha et al. (2006); Lin, Liu, and Qian (2014)). New prenatal tests, as the combined test (CUB), goes further and detects children with chromosomal aberrations with a high precision. These children will be born with disabilities but can potentially live satisfying lives. The effect of CUB on the number of abortions of children with chromosomal aberrations is not well investigated. The expected utility of having a disabled child compared to a non-disabled child may not be the same for the parents. The CUB test offers parents more knowledge about their unborn child, for free. This knowledge is used to better determine their expected utility of the child they are carrying. The effect of CUB give answers to how parents respond to the incentive of getting free knowledge of their unborn child and if there actually is an effect on the abortion rate of disabled children.

In this paper I investigate the effect of getting knowledge about the health of an unborn child on parents fertility decisions. I contribute to the research around prenatal tests and the knowledge effect by investigating the effect of getting more knowledge about the fetus prenatally, in the setting of abortions of disabled children. The CUB test is one of the most used prenatal tests in Sweden. I want to investigate the effect of a change in the availability of CUB and how that affect parents propensity to terminate the pregnancy. The CUB test is used as a proxy for knowledge. I look at the effect of being offered CUB on the number of late abortions performed. I compare the share of late abortions (from the 12^{th} week) per pregnant woman in counties that do and do not offer CUB. Late abortions are used since the result from CUB will not be available until week 11-14 of gestation. Thereafter an invasive test will be offered before a final decision about an abortion is made. Abortion decisions due to the result of the CUB test should therefore not be prevalent before week 12. Further, to investigate the economic significance of my results I look at correlations between my results and the number of children born and aborted with chromosomal aberrations.

CUB is a non-invasive test and not associated with a risk of miscarriage. I therefore avoid the risk that acceptance of CUB is based not only on the urge to know more about the baby's health but also comprise an effect of risking a miscarriage (the risk of miscarriage is not associated to the health of the baby in the case of invasive testing). However in the step after CUB parents generally are offered an invasive test before they make an abortion decision. A non-invasive test as CUB has the advantage of being widely offered which increases the external validity of the study. Invasive tests (that were the predominant test types prior to CUB) cover just a small part of the women, generally related to a risk group. The effect of that subgroup of women is possibly heterogeneous and not necessarily applicable to other groups of women. My study will cover a much larger sample of pregnant women which enables me to draw wider conclusions of the knowledge mechanism in the general population of pregnant women compared to previous studies. That leave me with a very policy relevant estimation of a large scale screening program. Previous research has looked at correlations between prenatal tests and abortions of fetuses with chromosomal abnormalities (see for example Boyd et al. (2008); Forrester, Merz, and Yoon (1998); Ekelund et al. (2008) in Section 4) but to my knowledge this paper is the first trying to investigate the causal link between the CUB test and late abortions. The knowledge effect is suitable to be investigated following a non-invasive test with low monetary cost and no risk of miscarriage. The setting makes is plausible that parents choose to accept CUB (or not) based only on their own incentives to get more knowledge about their child's health. The effect has previously been tested mostly in the case of sex-selective abortions. Due to the recent introduction of tests identifying chromosomal aberrations my thesis will be among the first to investigate the knowledge effect in this new setting. In both cases parents are faced with a choice of getting more knowledge about characteristics of the fetus. There are however some important differences between selective abortions based on the sex of the fetus and the health of the fetus. At first, prenatal tests for the purpose of detecting chromosomal abnormalities are often subsidized by the state. Second, a subsidy enables more women to take part of the treatment and also establish that the activity is morally acceptable by the authorities. This implies that an investigation of the effect of CUB on abortions does not just provide the research with more knowledge but is also an important analysis to make in the sake of policy evaluation as well for economic and moral reasons.

Prenatal diagnosis, as well as health care over all is generally highly subsided in Sweden. Health care is decentralized and the 21 counties independently decides what prenatal diagnosis they want to subsidize. Due to high monetary costs and political prioritization, some counties have decided not to offer CUB for free. There are also large differences in how fast counties implemented CUB and to which women (see Table 1 in Section 2 for more details). In my empirical setting I use the fact that the CUB test was implemented gradually in Sweden. This enables me to investigate the effect of CUB on abortions causally. Some counties started to offer the CUB test to all pregnant patients and some provided it to all patients that were at least 35 years old at the expected date of delivery. The third group of counties have not yet started to offer CUB to women outside the risk groups. I have abortion data on all 21 counties in Sweden aggregated by age in four cohorts. I match this data with corresponding data on the number of pregnant women from the Swedish Pregnancy Register. I propose a difference-in-difference strategy to exploit the variation caused by the fact that different counties adopted the CUB test at different times. The assumption necessary for a causal interpretation is that the pretreatment trends in the number of abortions of children between countries are parallel. With other word must the timing of implementation and choice of age group be exogenous in relation to both trends and temporary chocks in the number of late abortions. Patterns found in the data will be analysed according to the theoretical framework and discussed in Section 8. I will also calculate the estimated number of missing children due to invasive testing. This indicates how large the effect is in terms of children born and provide a prediction to policy makers how CUB affect changes in the birthrate of children with chromosomal aberrations.

My main finding is that CUB has a positive effect on the number of late abortions for my main group of interest, women 35-39 years old. This cohort constitutes the group of women that were affected most by CUB. The estimate suggest that the number of late abortions increase with 26% or 6.5-13 late abortions per year (the mean number of late abortions during a year in the untreated counties was was 34.3 in 2004-2012). This correspond to a 3.6-7.1% decrease in the number of babies born with chromosomal aberrations if the untreated counties had introduced CUB. For women 30-34 years old I find negative effects of CUB. This estimate should be interpreted with caution since it is sensitive to some of my robustness checks. The effect should be smaller for this group since less fetuses will have a chromosome abnormality in this group of women compared to women 35-39 years old. These women are also less effected by CUB during the treatment period.

The remainder of the paper is structured as follows: Section 2 presents a background and the institutional setting. In Section 3 I discuss a simple theoretical framework based on an economic analysis of fertility choice. Section 4 introduce previous literature around prenatal diagnosis and selective abortions. My data and descriptive statistics are presented in Section 5 and I discuss my main methodology and research design in Section 6. Results are presented in Section 7. In section 8 I discuss my results and Section 9 concludes the paper.

2 Background and Institutional Context

In Sweden, health care services are decentralized and provided by the counties. Swedish health legislation advocates good health and health care on equal terms for the whole population (SFS 2018:1997). Despite this, there are major differences between counties in what prenatal tests they offer. All counties have to offer pregnant women 6-10 visits to a maternity care center during the pregnancy. Visits are optional and free of charge. Almost all pregnant women choose to use the service (Swedish Association of Local Authorities and Regions, 2019). What prenatal test that are accessible to a woman at the maternity care center depend therefore mainly on where she lives. Based on their own budget and political leadership, each of the 21 counties independently decides what prenatal diagnosis they want to offer. All pregnant women are however offered an ultrasound screening between week 16-20 of the gestation.

Ultrasound screening has been a routine procedure, where all pregnant women are offered the treatment, since the 1970's in Sweden. Ultrasound can detect visible defects (sometimes caused by chromosomal aberrations) but must be complemented with other methods to detect most fetuses with chromosomal abnormalities. The last 30 years many new tests have been developed. Many of them are invasive and only offered to a subset of women, generally belonging to a risk group. Prenatal tests developed during this time period were designed to discover fetuses with birth defects. Many of the invasive tests specifically aim to discover fetuses with chromosomal abnormalities in an early stage of the pregnancy. The most common chromosomal aberrations found prenatally are trisomy 21 (Down syndrome), 18 (Edward syndrome) and 13 (Patau syndrome). All three conditions lead to more or less severe intellectual disabilities often combined with health problems. The Combined Ultrasound and Biochemistry test (CUB test) was one of the first non-invasive test methods that could identify a chromosomal abnormality with high precision at a relatively low cost and with nor risk of miscarriage. This new opportunity provided a growing number of women with early prenatal screening. Today the CUB test is the most commonly offered test in addition to the ultrasound. Before the introduction of CUB, only women matching a certain criteria[1] were offered prenatal tests. These tests were invasive[2] and are still the only test offered in some counties[3].

CUB is typically performed in week 11-14 of the gestation and the result is presented to the parents as a probability that the child has a chromosomal aberration. The probability is calculated based on four indicators: The age of the patient, a blood test, an ultra sound screening and a nuchal translucency of the fetus which is determined by a scan of the fluid at the back of the fetus' neck. A CUB test is expected to find about 80% av all screened children with Down syndrome for a 5% positive false rate (Wald and Hackshaw, 1997). Women with a probability of having a child with chromosomal abnormality exceeding

[1] They were above a certain age threshold (normally 35 years), they had had a child with a chromosomal abnormality during a previous pregnancy or had a family history of a specific genetic disorder.

[2] Such as an amniocentesis or a Chorionic Villus Sampling (CVS).

[3] From 2019 Norrbottens län is the only county that still only offers an invasive test.

1/250 [4] are offered an invasive test. There are two types of invasive test offered: Chorionic Villus Sampling (CVS) and amniocentesis. For the CVS placenta cells, derived from the same fertilized egg as the fetus, are analyzed. When performing an amniocentesis a needle is inserted into to the abdomen of the women. In the uterus the fetus is surrounded by amniotic liquid. During the procedure a small amount of amniotic fluid is removed from the sac surrounding the fetus. The fluid contains genetic information about the fetus that is analyzed. Both a CVS and an amniocentesis is connected with an increased risk of miscarriage. About 1% of the invasive tests are expected to cause a miscarriage of the baby (Gajdos, Garrouste, and Geoffard, 2016)[5]. Amniocentesis is the most frequently used invasive test in Sweden. The reason is that the result from CUB generally is available between week 11-14. The parents will then have to decide whether to do an invasive test and make an appointment. The CVS procedure typically is performed in week 12 and the amniocentesis in week 15-18 and consequently offered to a larger share of the parents.

In January 2008, before any national guidelines around CUB were put in place, the first counties started to offer the CUB test to all pregnant patients at no cost for the patient (Bieniaszewski Sandberg, 2009). Eight years after the first large scale implementation of the CUB test the Swedish National Board of Health and Welfare (2016) concluded that the number of children born with chromosome aberrations had slightly decreased. They assessed that the real decrease of children born with chromosomal aberrations probably was larger than the size of the observed decrease. This is because Swedish women have become older when having children during the time period. Since the risk of having a child with chromosomal aberrations increase with the age of the mother, more children are expected to be born with chromosomal aberrations when the mothers get older. The report finds patterns of an increasing number of aborted fetuses with chromosomal aberrations since 1999 but cannot connect the decrease to prenatal testing. The descriptive evidence also suggests that there are considerable regional differences between the abortion rate of fetuses with chromosomal abnormalities[6]. To investigate the cause of the pattern in descriptive data I use the variation in implementation of the CUB test. The timing of implementation is summarized in Table 1. In the first year of treatment (2008) all women in the county of Stockholm and Örebro were treated. In Uppsala, Gotland, Skåne, Gävleborg and Västernorrland women aged above a certain threshold were treated and the 14 other counties remained untreated. In 2012 (my last year of data) eight out of 21 counties had implemented CUB for all women, eight counties offered women aged above a certain age threshold and five counties did not offer CUB at all. Most counties implemented CUB within 10 years from the first introduction, however in 2019 Norrbotten county had still not implemented CUB. The CUB test is offered at no cost for the patient[7] in treated counties. A pregnant woman is regarded as treated by the program if she was a registered resident of the

[4] The cutoff differ between different counties and sometimes lies at 1/200.

[5] There are studies that argue that the risk is somewhat smaller, see Wulff et al. (2016).

[6] In 2013 was about 75% of fetuses with detected chromosome aberrations in Stockholm-Gotland and the South West regions aborted but only about 60% in the Northern regions.

[7] The only exceptions are in Uppsala where patients have to pay a fee of around 300 SEK and for women younger than 35 in Värmland that have to pay a smaller fee from 2014. In Värmland women <35 is still coded as treated after 2014 following Friis (2013)

county the year of implementation. Counties that implemented the treatment later than the first month in the year are coded as partly treated. For example is the county of Östergötland coded as 8/12 treated in 2009 and fully treated in 2010. Thus, 8/12 of the pregnant women in the county were expected to be treated[8]. Typically patients could get access to the test in another county when paying out of their own pockets, generally at a cost between 1500-4000 SEK not including travel costs. These women will not be coded as a treated as the parameter of interest is whether the woman was offered CUB for free, not if she actually performed the procedure. The difference in implementation is connected to the political prioritization of different counties in combination with the relatively high cost of the tests. At the time of implementation counties had to employ enough midwifes that were specially educated to perform CUB. The in-job training for midwifes is one explanation why some counties implemented CUB faster than others. Even if counties aimed to implement CUB in about the same time, delays in the training could create differences in the date of implementation. The implementation is spread geographically, geographical factors are therefore not likely to be the main driver of the pace of implementation. There might however be other confounding factors that correlates with when a county implemented CUB and the number of late abortions. I explain what assumptions that must be made to interpret the effect causally in Section 6. These assumptions are then tested in Section 7.2 to confirm that the adaption of CUB was not endogenous.

[8]The partly treatment is used as a proxy for the real treatment. Due to lack of data am I not able to take account for differences in nativity over a year

Table 1: Regional implementation of CUB by month, year and age group

County	Date of introduction All women are offered CUB	Date of introduction Some women are offered CUB	Age threshold	No women are offered CUB
01 Stockholms län	Jan 2008			
03 Uppsala län	Jan 2016	Jan 2008-Jan 2016*	>35	
04 Södermanlands län	Jan 2015			
05 Östergötlands län	Apr 2009			
06 Jönköpings län	Jan 2009			
07 Kronobergs län	Jan 2012			
08 Kalmar län	Jan 2012			
09 Gotlands län		2008**	>35	
10 Blekinge län		Jan 2013- Jan2015	>35	-Jan 2013, from Jan 2015
12 Skåne län	Mar 2018	Jul 2008- Mar 2018	>33	
13 Hallands län	Jan 2017			
14 Västra Götalands län		Jan 2009	>35	
17 Värmlands län	Mar 2010**			
18 Örebro län	Nov 2008			
19 Västmanlands län		Jan 2017	>35	
20 Dalarnas län	Nov 2017	Jan 2011- Nov 2017	>35	
21 Gävleborgs län		Jan 2008	>35	
22 Västernorrlands län	Jan 2012	Jul 2008- Jan 2012	>35	
23 Jämtlands län		Oct 2009	>35	
24 Västerbottens län		Oct 2009	>35	
25 Norrbottens län				No introduction

Note: *Women <35 was offered CUB at cost price in Uppsala 2010-2016.

**The exact month has not been found.

***Women <35 in Värmland were no longer offered CUB at free from 2014.

Sources: Bieniaszewski Sandberg (2009); Ingvoldstad, Öhman, and Lindgren (2014); Pettersson (2018); Friis (2013); Petersson et al. (2016).

3 Theoretical Background

This section presents a theoretical framework that help us understand parents optimal fertility decisions given the uncertainty in outcome. I base my simple theoretical framework on Becker (1960) and use it to be able to draw theoretical predictions about parents fertility decisions. The framework analyzes parents fertility decisions when they are offered more knowledge about the outcome in two different settings. First, when utility is the only parameter that varies between parents. Second, monetary cost is the only parameter that may differ between children and parents.

In a seminal work Becker (1960) argues that the theory of the demand for consumer durables is a useful framework in analyzing the demand for children. He claims that children can be thought of as a consumption good that gives satisfaction similar to other durable goods such as housing or cars. Becker (1960) identifies five determinants of a family's demand for children: taste for children[9], family income, knowledge of the "child type"[10], uncertainty of what type (disabled or non-disabled) the fetus is, and monetary cost. Children are thought of as a normal good where an increase in income increases the demand for children. If $U_{child} > U_{nochild}$ the family will have another child, otherwise not. The utility function is however restricted by a budget constraint. Parents will maximize their number of children and consumption given the budget constraint. The total cost of children and other consumption goods must be smaller or equal to the life time income of the parents[11]. Child production has a built in uncertainty due to the fact that children are produced at home and not purchased at the market. The uncertainty in production is transferred into a corresponding uncertainty in consumption. The number of children born with disabilities every year is known at the population level. But before prenatal tests are introduced, uncertainty of the health outcome of the unborn child exist at the family level. From here on uncertainty of the type of child (disabled or non-disabled) and knowledge about the type, is treated as one parameter. When knowledge increase the average uncertainty of the future utility decreases and vice versa. Lastly the net cost of a child[12] depend partly on its future ability to work. Based on previously described theory of Becker's I first develop a framework when I keep all monetary costs constant. The only parameter that differs between parents is then their expected utility of having a disabled versus a non-disabled child. The framework then catches how a change in knowledge (CUB) affects parents fertility decisions (whether to keep or abort a disabled child) based on changes in expected utility.

[9]Defined as the family's expected utility from having a child.

[10]I will use a framework where a child can be either disabled or non-disabled.

[11]The budget constraint can be written as: $C + (N + D)k \leqslant Y$ Where $k=$ *fixed cost of producing and rearing a child to adulthood*, $Y=$ *parent's life time income.*

[12]Computed as the present value of expected outlays plus the imputed value of the parents' services, minus the present value of the expected money return plus the imputed value of the child's services.

3.1 The framework using constant monetary costs

The pecuniary cost associated with having a disabled child might be larger than for a healthy child[13]. For my first predictions however, I assume that loss of income due to having a disabled child is fully reimbursed by the society. In a welfare state as Sweden extra costs are likely to be reimbursed by the state.[14]. Therefore all these extra costs are assumed to be fully reimbursed by transfer payments. This assumption is a simplification of reality but help us understand the mechanism when parents get more knowledge about their fetuses. Given this assumption, utility is the only parameter that differ between parents. The utility received from a child depend on the taste. Parents may have a difference in taste for children with and without a disability. I assume that parents taste for disabled and non-disabled children stay constant over time. Parents whose taste for a disabled child differ from a non-disabled child will benefit from getting more knowledge (accept prenatal tests) about the child. The decision if the family should accept prenatal diagnosis or not will, in my simplified framework, depend on the difference between the expected utility of having a child with and without a disability given the family's predetermined taste parameter. It will also depend on the cost (in form of dis-utility) to accept prenatal tests. With the introduction of the CUB test, this cost decreased. The test induce low monetary costs of testing combined with no risk of miscarriage. It also lower the probability that especially older mothers (above the age of 35) have to undergo an invasive test[15].

Suppose that a family receives utility equal to U_n for a child with no disability and U_d for a child with a disability. Parents decide on fertility sequentially. First, they have to make the decision whether to have a child or not. Second, they choose whether to accept more knowledge (CUB) or not based on their taste parameter. Third, parents found to have a high risk of carrying a disabled child are offered an invasive test. Fourth, they decide whether they want to terminate the pregnancy or not. In the first step the expected utility from a child equals $EU = PU_n + (1 - P)U_d$ where P is the probability of having a child with no disability. The family will have a child whenever the expected utility from having a child is greater than the expected utility from consuming other goods, given the limits of parents budget constraint. The actual utility is either U_n, or U_d, which differs from EU as long as $U_n \neq U_d$. In the second step, rational and forward-looking parents will only accept CUB if their expected utility of giving birth to a disabled child is smaller than the expected utility of accepting prenatal tests (both CUB and then an invasive test) and perform an abortion of such a child. If not, the family will not accept the CUB test. In the third step, the CUB test reduces the uncertainty, P, of what utility the family will receive from the unborn child. This in turn increases the knowledge of the actual utility of the fetus. For families

[13]There might also be other costs associated with a disabled child. Costs associated with a disabled child on top of monetary costs are the cost of the social stigma of being disabled. Abortions might be associated with a cost and the costs due to the attitudes toward abortion and children with chromosomal abnormalities between the staff at the hospital. These types of cost are implicitly incorporated into the taste parameter.

[14]This is reasonable to believe due Swedish legislation and the extra monetary aid available to parents having disabled children (Vårdguiden, 2019).

[15]This is since CUB is a non-invasive test and only women that receive a high probability of having a disabled fetus will be offered an invasive test. This is compared to all women above 35 (for most counties) before the introduction of CUB.

that get a high probability of having a disabled child an invasive test is offered. At this point families will accept the test since their CUB decision in step two was based on their expected utility of going through the whole test procedure against their expected utility of having a disabled child. In the fourth step, my framework predicts that children will be aborted if it is found to have a disability, otherwise not.

Lets assume that parents value non-disabled children higher than disabled children: $U_n > U_d$. Also assume that parents have concave utility functions[16]. This implies that a given investment in child bearing give a lower expected utility than the actual utility of having a non-disabled child. The opposite relation holds true for having a child with a disability that would give a lower utility than the expected one. In this situation prenatal diagnostics could provide parents with knowledge that enable them to better predict the utility of a certain child. Using this reasoning I arrive to the following predictions: When knowledge is offered to more parents, more parents are expected to accept the offer as long as some parents have a difference in taste between having a child with and without impairments. A larger share of families correctly estimates their expected utility of the child they are expecting when the uncertainty is reduced. A larger share of children with disabilities are expected to be detected at an antenatal stage. From that follows that more children with chromosomal aberrations will be aborted.

3.2 The framework using constant utility

I will now briefly discuss a second way to investigate my framework. Now I assume that all parents value disabled and non-disabled children the same, $U_n = U_d$. However the monetary cost might differ between rearing a disabled and a non-disabled child. Parents should then accept the offer of CUB when their expected income is smaller than the expected cost of having a disabled child but larger than the expected cost of a non-disabled child. Richer parents will not perform any test but just keep their fetuses. Poorer parents would abort directly since they would not afford any type of baby. It is also possible that the difference in cost between having a disabled child and a non-disabled child might differ for parents in different part of the country. For example, parents living in sparsely populated parts of the country might have to travel far for both specialised health care and special schools. What types of parents that constitutes the group accepting CUB group cannot be distinguished in the scope of this paper due to lack of individual level data. Therefore will this hypothesis not be tested in this thesis. Lastly there might be a mix of monetary and taste based factors that drives the demand for prenatal testing. In this case it is harder to disentangle the effects. A few general conclusions could still be drawn. An implementation of the CUB test should increase the amount of parents accepting the test as long as there are differences in tastes and/or costs of having a disabled and a non-disabled child. This should lead to an increase in selective abortions. My model can however not predict which group of women that are more likely to perform the test. This is determined by whether the cost or utility change is in play. The effort to disentangle that effect is left to further research. The general predictions from this Section will be used to analyze my results from Section 7.

[16] Let's assume that the utility function depend on three factors: $U(C, N, D)$ *C=the utility from consumption of all goods other than children, N=the number of children with no disability, D=the number of children with a disability.*

4 Previous Literature

This section present previous empirical literature of the knowledge effect on abortions. I first describe the effects of knowledge on sex-selective abortions. Thereafter I describe my contribution and present evidence around the introduction of prenatal diagnosis and the effect on abortions. Lastly I present papers that identifies determinants of the demand for selective abortion.

Ultrasound screening was introduced in the Western maternal care program in the 1960's. At first the procedure was only meant to be used for medical purposes. But the new possibility of receiving more knowledge about an unborn child have had many both predicted and unforeseen effects. Screening was quickly made a standard procedure used to determine both anomalies and the child's sex. The effect of receiving more knowledge about your unborn child on the abortion rate has been thoroughly studied in the setting of sex selective abortion (Jha et al. (2006); Lin, Liu, and Qian (2014)). The new technology enables parents to determine the fetal sex before the child is born. Since the 1980s diagnostic ultrasound screening is widely used in parts of Asia where parents expect boys to give a predominantly higher utility than girls. This have had large effects on the boys to girls ratio[17]. Chen, H. Li, and Meng (2013) estimated that the increased access to ultrasound can explain 40-50% of the sex imbalance in China. Access to screening has also been found to affect the abortion rate in India (Bhalotra and Cochrane, 2010). About 0.48 million Indian girls were estimated to be aborted 1995-2015 due to diagnostic screening. The effects on abortions of girls depend both on the access to screening but also on the boy preference of parents in a certain community. The effect of having access to prenatal screening can therefore differ both between and within countries. This suggest that the taste for a certain child characteristic is of great importance for the size of the effect of screening on abortions.

Prenatal tests that specifically detect chromosomal aberrations have been introduced more recently than the ultra sound screening. Previous studies that claim to have causal interpretations of prenatal tests detecting chromosomal aberrations, have focused on the effect of invasive tests (Garrouste, Le, and Maurin (2011); Shurtz, Brzezinski, and Frumkin (2016)). Both studies looked at the effect of how subsidized amniocentesis affect parents choice to perform an invasive test. Garrouste, Le, and Maurin found that parents are highly sensitive to monetary incentives when it come amniocentesis decision. My setting enables an investigation of the knowledge effect of a non-invasive test on abortions. I contribute to the research around prenatal tests and the knowledge effect by investigating the knowledge factor in the setting of abortions of disabled children. I study the effect of getting more knowledge of your fetus on the probability of abortion. My estimates capture the effect of knowledge for a large share of the population of pregnant women compared to previous studies. That leave me with a very economically interesting estimate of the size of the effect of having more knowledge about your unborn child on the abortion rate. This effect has previously been tested in slightly different settings. In an Israeli study

[17]The introduction of the technology caused a boys to girls ratio as high as 140 to 100 in certain Chinese regions. This can be compared to regions with no difference in preference between boys and girls where the natural birthrate is about 105 boys on 100 girls.

no statistically significant effect of being offered free invasive prenatal diagnosis on abortions was found (Shurtz, Brzezinski, and Frumkin, 2016). That held true both for the rate of pregnancy terminations and the number of children born with Down syndrome. This could be an effect of both the taste of children with chromosomal aberrations but also capture an aversion against the invasive tests. Since my study investigate a noninvasive test I will be able to estimate the screening effect disentangled from the risk of invasive tests. It is however fair to say that there is a consensus in the literature around the existence of a correlation between prenatal diagnosis and the number of children born with chromosomal aberrations (Boyd et al. (2008); Gottvall (2016); Forrester, Merz, and Yoon (1998); Ekelund et al. (2008)). Boyd et al. compared EU countries with and without a screening program for structural malformations and chromosome anomalies, and found that more pregnancies were terminated due to birth defects in screening program countries[18]. In a descriptive study using Swedish data, Gottvall (2016) found a steady birth rate of children with chromosomal aberrations for almost two decades but with a sharp decline in 2015 and 2016. In combination with a trend of aging mothers the results suggest that the number of aborted children with chromosome aberrations has increased. This is in line with Ekelund et al. (2008) that found a 50% decrease in the number on infants with Down syndrome in Denmark after the introduction of prenatal screening in 2005. They could not determine the causal effect of the decrease but claimed that the reform caused part of the decline. The number of missing babies was based on a calculation where Danish population data was used to calculate the expected number of live-born children with Down syndrome. That prediction was then compared to the real number of children born with Down syndrome. The same pattern has also been found outside Europe. Forrester, Merz, and Yoon (1998) found that prenatal diagnosis and elective terminations of pregnancies decreased the prevalence of children born with chromosomal abnormalities in Hawaii. There are however studies with conflicting evidence where a decreasing trend in abortions of disabled children has been found. Jacobs et al. (2016) suggest that a change toward more non-invasive screening decrease the number of abortions of all types of aneuploidy (an aneuploidy is the prevalence of either one more or less chromosome in a chromosome pair). This conclusion was drawn looking at population data in Scotland. The result is not interpreted causally. The authors try to argue that the result is driven by societal changes with a wider acceptance of diversity. Natoli et al. (2012) reviewed literature using US data from 1995-2011 and found a decreasing rate of terminations of Down syndrome pregnancies toward the end of the time period. The summary termination rate determined in the paper may not be applicable to the entire US population of pregnant women. These conflicting results may be due to several factors. There might be heterogeneous effects underlying results pointing in different directions. Changing societal attitudes might drive the result but do not catch the causal effect of introducing a test. Due to their methodologies, these studies cannot distinguish the effect of the introduction of a prenatal test from other societal changes.

Before turning to my theoretical background I will present literature trying to further explain the mechanisms around the choice of selective abortions. The first mechanism is the difference in expected cost when having a child with and without impairments. Asch (1999) identifies a lack of adequate

[18] Out of the detected children with both Down syndrome and neural tube defects 88% of the pregnancies were terminated.

social arrangements and economic aid as driving forces of an increased demand for selective abortion. That motivates the decision rather than the impossibility that many of the children diagnosed with chromosomal abnormalities could have satisfying lives. Gadjos et al. (2016) showed that French government authorities put more monetary value to prevention of having children born with Down syndrome than parents themselves. They used a simple model to examine the utility of the child born with Down syndrome to parents and policymakers. The conclusion was that policymakers gave much less value to these children than parents when forming their reimbursement models. However, people that answered their survey were on average expecting to get less value from having a child with Down syndrome than having a miscarriage. The second mechanism as pointed out by Shakespeare (1998) was that demand also could be affected by the social cost of impairment. A more including society would therefore lower the social cost of having a disabled child. The net social effect depends on the cultural context. Li, Chandrasekharan, and Allyse (2017) concluded that broader cultural influences could induce cost of both abortions and having disabled children. They suggested that abortion was a greater stigma in the USA than in China but having a disabled child was a larger stigma in China than in the USA. Lastly the uptake of the treatment might depend on the characteristics of the household. Several studies attempt to identify heterogeneity within the group of mothers. Peterson et al. (2016) found that the uptake of CUB was higher for employed Swedish women than unemployed. Women born in Sweden were more likely than women born abroad to accept CUB. Women accepting CUB were also on average older and had a statistically significant lower BMI. A study from Iceland found that women were more likely to accept prenatal diagnosis when they were more educated and if they had gotten more information about the procedure. Families with congenital anomalies in the family history were also more likely to accept CUB (Stefansdottir et al., 2010). Siffel et al. (2004) found that black women were less likely to terminate a pregnancy where the child was found to have Down syndrome than white women in the USA. Due to heterogeneity, I will control for socioeconomic factors to increase precision and control for potential heterogeneous effects when presenting my results in Section 7. I will however not be able to distinguish the effect of CUB for different groups of mothers based on socioeconomic characteristics. This is left for further research.

5 Description of the data

In this section I present the data used and explain characteristics and decisions leading to the final data set. That follows by descriptive statistics where I present characteristics of the data. I want to study the effect of a non-invasive prenatal test on pregnant women. For this I have gathered data on abortions, the number of pregnant women and an indicator for when CUB was introduced in every county and age cohort.

The dependent variable in my my final data set is the number of abortions per pregnant woman in a certain county, year and age cohort. To create this variable I used data on abortions and the number of pregnant women. I collected my two types of abortion data from the Swedish National Board of

Health and Welfare (Swedish National Board of Health and Welfare, 2019). The first abortion variable I collected data on late abortions that covers all abortions (no matter the reason) made in week 12 and later[19]. Late abortions will be used for my main regression analysis since this category of abortions is the one expected to be affected by the introduction of CUB. The second abortion variable contains aggregated data on all abortions regardless of the week and reason. This variable is collected to test my claim that CUB should have an effect on late abortions but not affect the main share of abortions. The abortion data is collected for the years 2000-2012 per county and for four age cohorts: women 25-29 years old, 30-34, 35-39 and 40-44. The national data collection of abortion data stopped in 2013. Abortion data from 2014 and onward are only available aggregated at the national level. This restricts my last year of the sample to be 2012.

My sample contains data on all pregnant women who were listed at a maternity care center affiliated with the Swedish Pregnancy Register during the years of 2010-2014 [20]. Pregnancy data is presented as the number of women pregnant per age cohort (<30 year, 30-34 year, 35-39 year and 40+), county and year. The data is aggregated into four age cohorts where I do not know the age of the youngest woman is in my <30 year age cohort and the age of the oldest woman is in my 40+ age cohort. This circumstance makes it difficult to match this data with data from other data sources since the age limits probably are not constant over time. This is the main reason for why I only use the 30-34 and 35-39 age cohorts in my regression analysis in Section 7. On top of the pregnant women data, the register collects information on the number of CUB tests performed. This variable catches all women that accepted CUB both in countries that had introduced CUB and not. This variable is collected per county, for the same age cohorts as the pregnancy data and for the same years, 2010-2014. This data is used to investigate the claim that the offer of CUB affect the uptake rate of CUB. The Swedish Pregnancy Register started to collect data in 2010 and their coverage of maternity clinics increased from 71% of all pregnant women in 2010 to 91% in 2013. Essentially all Swedish women enlist while pregnant which indicates that the Swedish Pregnancy Register also covered 91% of all pregnant women in 2013 (Swedish Association of Local Authorities and Regions, 2019). The coverage varied between counties. Three counties had particularly bad coverage during the first year (2010): Uppsala, Södermanland and Dalarna. This lead to an underestimation of the pregnant population of women. However, as long as the women missing is not correlated with the counties' decision to implementing CUB will the lack of coverage not bias my estimates. This claim is plausible since CUB was implemented based on political and monetary reasons at the county level and should not be correlated with maternity clinics choices to register at the Pregnancy Register. Even though individual women can reject to participate in the register, this does not create a problem as long as the decision is uncorrelated to a counties decision to implement CUB.

I want to combine my abortion data with the number of pregnant women to create my dependent

[19] A legal abortion can be freely made until week 18 in Sweden. After week 18 must the woman get an approval from the National Board of Health and Welfare to perform the procedure.

[20] Source: Petersson, Kerstin; Doctor of Medical Science, president of the Swedish Pregnancy Register. 2019. Email April 4th.

variable. Since my pregnancy data does not cover most of the years of interest I have used two different strategies to calculate the number of pregnant women. First, I used the data from the Pregnancy Register and imputed data for the years 2000-2009. I calculated the mean probability of a woman being pregnant per county and age cohort over the years 2011-2014 [21]. To do this I compared the mean number of pregnant women to the mean population of women per age cohort, county and year. Population data was gathered from Statistics Sweden (2019) for the number of women per county, in the age cohorts 25-29, 30-34, 35-39 and 40-44 for the years 2000-2014. The calculated mean probability was then multiplied with the population of women in each age group, county for the years 2000-2009 to create my proxy of pregnant women. Second, I used data on the number of babies born per county in the years 2000-2012 for three age cohorts, <30, 30-34 and 35+ (Statistics Sweden, 2019). This number was adjusted to exclude the double count of multiple births[22]. To generate my dependent variable I added to the number of late abortions to the number of children born per county, year and age cohorts 25-29, 30-34, 35-39 and 40-44. There are however some women giving birth when being older than 44 but their share of the total amount of babies is marginal. Only late abortions (performed after week 12) are used since women having an early abortion are unlikely to ever register at a maternity clinic (and being offered CUB). For both my pregnant women variables, the dependent variable is created by dividing the number of late abortions with my number of pregnant women. My main analysis use the induced number of pregnant women as the dependent variable see Section 7. The sum of babies born and late abortions is used as a sensitivity analysis and the regression results is found in Appendix C. The years 2004-2012 is used for my main analysis and 2000-2003 is added for my robustness checks.

The interruption in the data collection of abortions in 2013 leaves me with a sample containing the years 2000-2012 for my dependent variable (late abortions per pregnant woman). I therefore use treatment data, the implementation of CUB for the same years. My treatment data is generated as a dummy and summarized in Table 1 in Section 2. For my regression analysis only two of my age cohorts are used. I will analyze the two age cohorts separately. First, I exclusively look at women 30-34 years old, where CUB=1 if this age cohort is treated in a county a certain year, zero otherwise. Second, I look at women 35-39 years old where CUB=1 if this age cohort is treated and zero otherwise. Lastly, I have included a set of control variables. I gathered the gross regional product (GRP) per capita from Statistics Sweden (2019). I also have data on the share of low educated women per age cohort and county and the share of women born abroad both collected from Statistics Sweden Statistics Sweden (2019). At last, I have data on the employment rate since this could potentially change over time and within a county (Statistics Sweden, 2019).

Table 2: Summary statistics for women 30-39 years old in all counties for the years 2004-2012

Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**National mean***
Population	28872.679	36748.889	1497	159265	601186
Total ab.	518.738	731.276	32	3450	11010.111
Late ab.	34.775	50.977	2	243	746.444
Late ab./pregnant	0.014	0.005	0.003	0.037	0.015
Accepting CUB	275.754	1051.711	0	8850	5730.333
Accepting CUB/preg.	0.084	0.176	0	0.809	0.118
Total preg.	2414.012	3323.108	99	15198	50338.583
Share low educ.	0.531	0.061	0.377	0.661	0.499
Employed (%)	74.999	2.354	68.553	80.321	74.628
Share born abroad	0.163	0.054	0.06	0.325	0.208
GRP/capita	317.027	52.497	242	549	356.667

*National mean is the mean for a variable over the years 2000-2012 for the whole country.

5.1 Descriptive statistics

In Table 2, I present summary statistics from my data set. The table presents descriptive statistics for women aged 34-39 from all of Sweden's 21 counties for the years 2000-2012. The average population in the average county is 28 873 women aged 30-39. The smallest consist of 1497 women and the largest consist of 159 265. The average number of abortions[23] in a county is 518 procedures. The mean number of late abortions was 35 or 0.014 per pregnant woman. In other words, about 1.4% of all women registered at a maternity clinic ended their pregnancy in a late abortion. My data contain the uptake of CUB for three years (2010-2012). The uptake is defined as the percentage of all pregnant women who took the test. The uptake varied between 0 and 81% which indicates that there is a variation in the access to CUB. The introduction of CUB seem to have an effect in some counties for women 30-39 years old. The mean uptake between 2010-2012 was 8.4%. The mean is calculated for all pregnant women 30-39 years old between 2010-2012 where some were not offered CUB at all. On average 8.4 out of 100 women accepted CUB but there are large differences both between counties and between women in different ages. To investigate the uptake of my treatment (how many of the pregnant women in each county that accepted CUB) I plot the frequency of the percentage of pregnant women accepting CUB for all counties. Figure 1 shows the result for women 30-34 years old during 2010-2012. In almost 40% of the counties between 0-10% of the women were not having a CUB test. This indicated that a large part of my sample of

[21] 2010 was left out of the calculation due to low coverage of pregnant women during that year which would generate a misleading probability.

[22] The number was adjusted to 97% of the original number of children born due to the share of multiple birth in 2014.

[23] The data set includes all abortions not exclusively abortions of fetuses with chromosomal aberrations.

women 30-34 stays untreated during the study period. In less than 10% of the counties were the uptake of 60% or more. This pattern does however change in Figure 2 were i plot women 35-39 years old for all counties 2010-2012. The interpretation of the uptake of CUB is discussed more in Section 7.

Figure 1: 20 Swedish counties (excluding Skåne) 2010-2014 and the frequency of the percentage of pregnant women 30-34 years old accepting CUB.

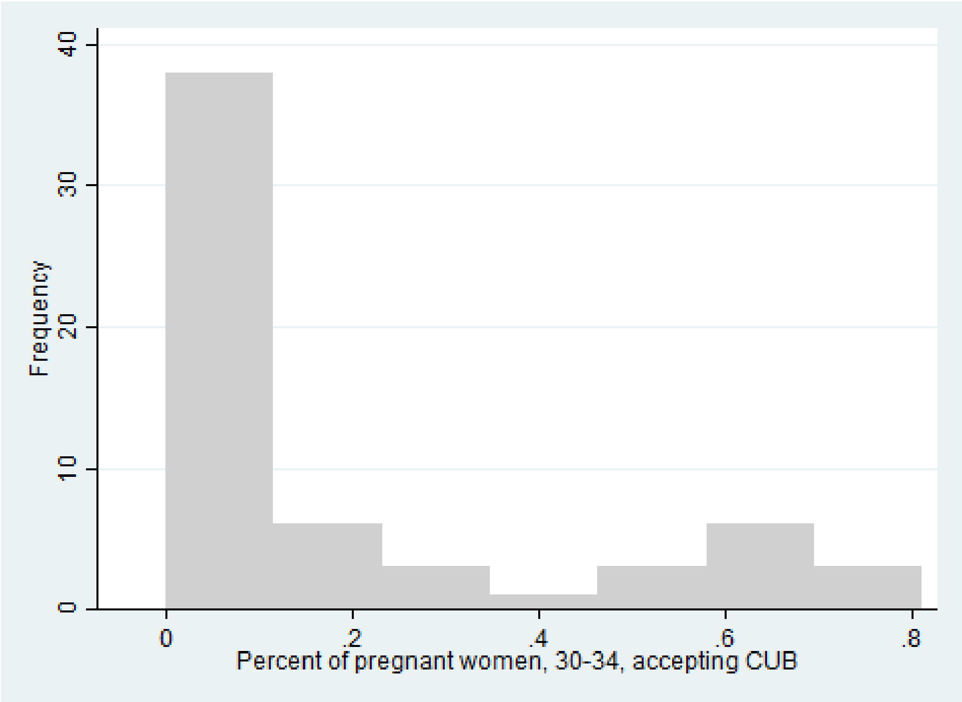
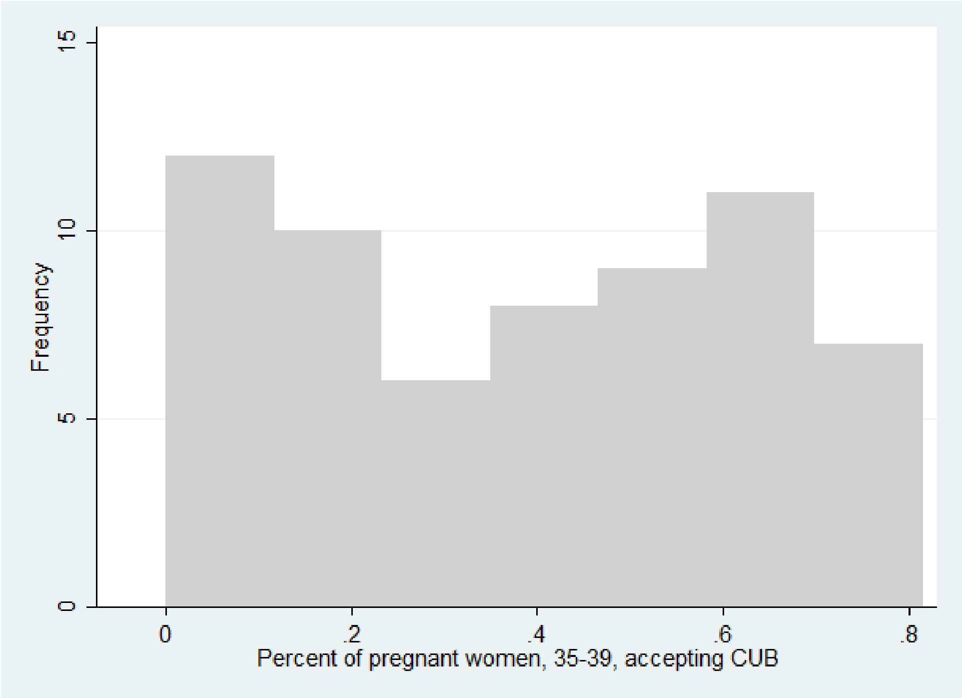


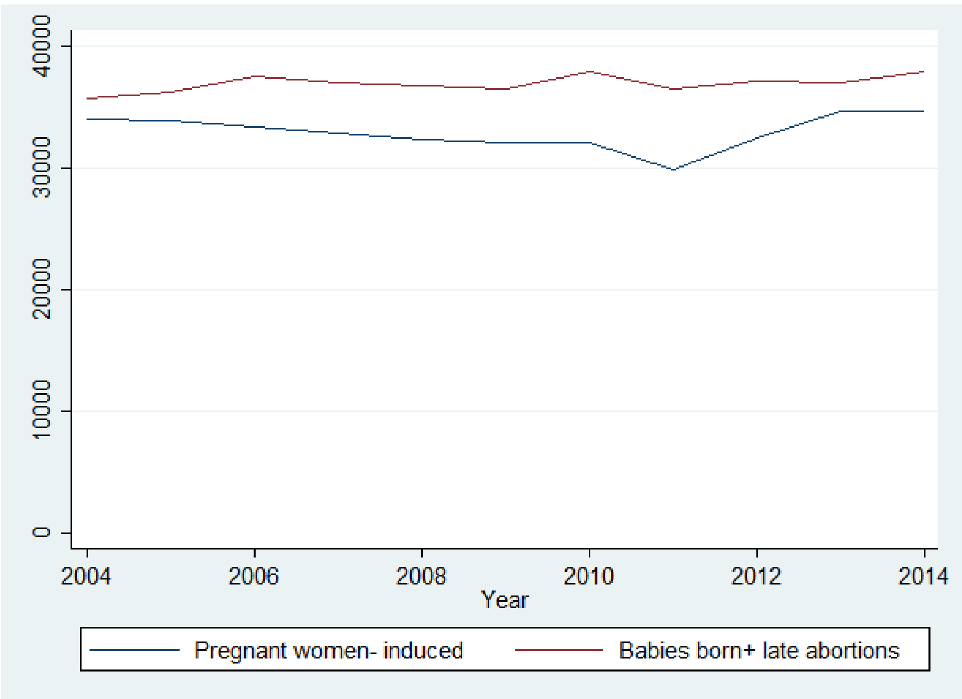
Figure 2: All Swedish counties 2010-2014 and the frequency of the percentage of pregnant women 35-39 years old accepting CUB.



My data suffers from low (70%) coverage rate in 2010 which leads to an underestimation of the real number of women accepting CUB. If the true average is larger or smaller is unclear and depends on the uptake rate in the missing clinics. The average number of pregnant women, 30-39, registered at a maternity clinic during 2000-2012 was 2414 with a variation between 99 and 15198. This means that on average 8% of the total population of women, 30-39 years old, are pregnant. 53% of the women are on average low educated and 75% are employed. About 16% are born abroad but the variation is large and ranges between 6 and 33%. The Gross Regional Product (GRP) per capita in the counties ranges between 242 thousand SEK and 549 thousand SEK with a mean value of 317 thousand SEK. The economic requisites varies arguable quite much between counties and years.

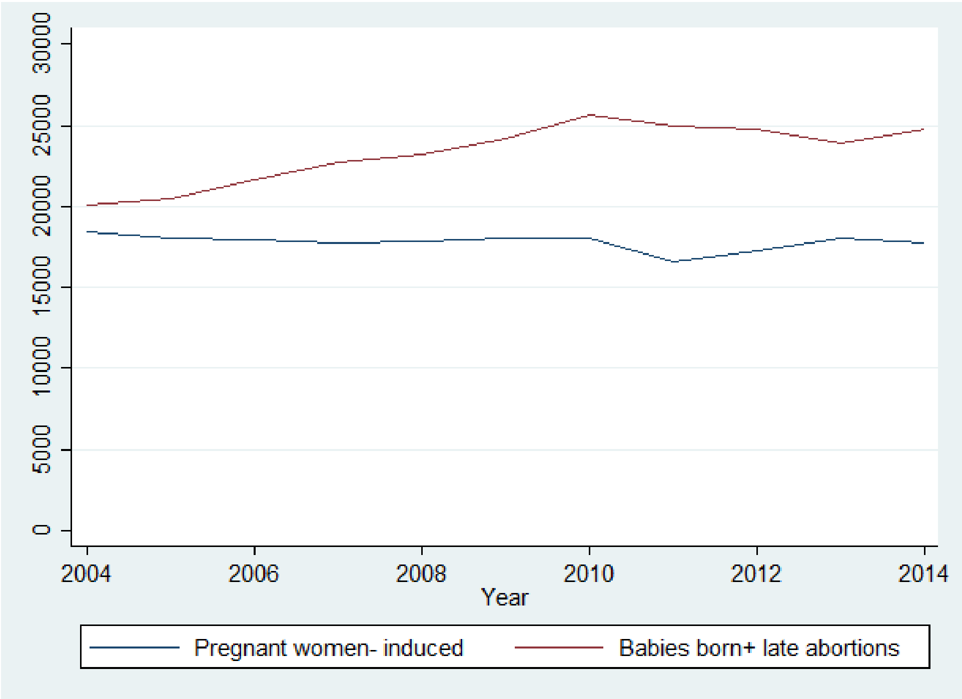
In Table A1 in Appendix A I present descriptive statistics from the years 2004-2012, where I compare women 35-39 years old living in a treated and untreated county in 2012. In 2012, 16 counties had been treated for this age group and five counties were untreated. The population between treated and untreated counties for women 35-39 were quite different. However the average late abortion rate was about 2% for both treated and untreated counties and 75% of the women in both treated and untreated counties were on average employed. The average GRP per capita was 320 thousand SEK for the treated counties compared to 308 for the untreated. Women in the untreated counties were slightly more probable to be low educated, 57% compared to 56% for treated counties.

Figure 3: The number of pregnant women, 30-34 years old, 2004-2012.



Lastly I investigate how well my two different definitions of the number of pregnant women correspond to each other. Figure 3 shows the trends in the number of pregnant women for women 30-34 years old, 2004-2012. The trends follow each other with the induced value for pregnant women being consistently lower than the number of babies born plus the late abortions. This pattern is even more articulated for women 35-39 years old shown in Figure 4 where the trends also seem to diverge over time.

Figure 4: The number of pregnant women, 35-39 years old, 2004-2012.



6 Methodology

In this section I introduce my identification strategy and identifying assumptions. I present my difference-in-difference model and methods to test and strengthen my identifying assumptions and the choice of method.

To investigate the effect of CUB on late abortions I want to compare women living in counties that have and have not yet introduced the test. I might however fear that there are factors other than CUB that differ between those women. If I estimate the effect by just comparing my two samples, there might be covariates not controlled for, both affecting the number of abortions and the error term that bias my estimate. The estimate could also suffer from reverse causality, the possibility that selective abortions create a change in the acceptance for such abortions and affect the number of pregnant individuals that take the CUB test. One way to solve these problems of identification is to set up an experiment. In the ideal experiment, that would capture my parameter of interest, women would be randomized into a treatment and a control group where CUB was only offered to women in the treatment group. This is however not possible to do. Instead I use of the institutional setting where some counties offer the CUB test but others do not (for more details see Table 1 in Section 2). The implementation procedure gives me variation in women's access to CUB between counties. Under certain assumptions, where I supposedly account for all other potential differences between women in treated and untreated counties, a calculated effect of CUB on abortions that can be interpreted causally. I use a difference-in-difference strategy with time and county fixed effects to investigate the effect of offering the CUB test on the abortion rate. Since the CUB test only points out fetuses with chromosomal aberrations the introduction of CUB should only affect abortions of fetuses with chromosomal aberrations. The county fixed effect control for differences between counties that stay constant over time. For example the number of abortion clinics. The time fixed effects control for changes over time that affect all counties the same. That could for example be a changed societal attitude towards abortions and children with chromosomal abnormalities. What I might worry about are changes over time that affect the different counties in different ways and correlates with CUB. To control for this I perform several tests and add control variables. I test the model adding a control for the regional economy (GPR). This since I might worry that the regional economy affects the propensity for a county to introduce CUB (since implementation of CUB is relatively costly) and that the local economy might vary over time and within a county. I also control for the unemployment rate for women since it could correlate with introduction of CUB. Local chocks in unemployment could potentially correlate with both CUB implementation and the number of late abortions. To check the robustness of my estimates and to increase precision I will also control for the share of uneducated women in a county. The propensity of accepting a prenatal test is correlated with education see Section 4. The necessary assumptions needed for the difference-in-difference results to be causally interpreted and unbiased is that the treatment county's selective abortion trend had evolved similarly to the trend of control counties had not the CUB test been introduced. This is generally referred to as the parallel trend assumption. My second assumption is the Stable Unit Treatment Value Assumption (SUTVA). In my context this means that pregnant individuals in the control counties are not affected by the introduction of the CUB test in the treated counties[24]. I must assume that neighbouring counties were not affected by the treatment. This should not be a problem in my case. Even if women from a neighbouring county travel to get CUB and eventually make an abortion this abortion will be added to the abortion rate in the home county of the treated. This will result in an underestimation of the true effect of CUB but not bias my estimates. The tendency to seek treatment in a neighbouring county should also be limited by the fact that the treatment only is offered for free to citizens of a county and all other women have to pay a cost price (1500-4000 SEK). I will further discuss the validity of this assumption in Section 8. To test the parallel trend assumption I perform a event study analysis, see Figure 6 in Section 7.2. This test is made to strengthen my claim that there were no effect of CUB prior to the introduction. To further test the same assumption I perform several placebo tests where I check if my results are robust against a change in the time of treatment. I introduce a lagged CUB, where CUB is introduced one and two years prior to the real treatment month to control for any pre-intervention trends. I also introduced a lead variable to test for post-intervention trends. I also test for how robust estimates are for changes in the number of years I include in my pre-intervention trend. Lastly I compare estimates for my two different definitions of the number of pregnant women. If my estimates are robust to these sensitivity checks I argue that the only thing that cause the differences in level is the change in knowledge (CUB).

[24]These individuals must not have access to the CUB test at no monetary cost.

If that is the case, the estimated effect of interest has a causal interpretation. If these assumptions hold β in the following regression model has a causal interpretation for my two age group analysis where I look at women aged 30-34 and 35-39 separately:

$$Abortion_{ct} = \alpha_c + \lambda_t + \beta CubTest_{ct} + \gamma \boldsymbol{X}_{ct} + \epsilon_{ct} \tag{1}$$

Where Abortion$_{ct}$ is the outcome variable for county c and time t, that measure the effect on selective abortions due to the reform. α_c is the county-fixed effect. λ_t is the year-fixed effect. $\beta CubTest_{ct}$ is a dummy that takes the value one if the CUB test was introduced and zero if not. $\gamma_{ct}\boldsymbol{X}_{ct}$ is a vector of control variables and ϵ_{ct} is the error term. The error term must be uncorrelated with the CUB test for a causal interpretation of the average treatment effect β. I will use cluster-robust estimators at the county level to avoid serial correlations in the error term (Brewer, Crossley, and Joyce, 2018).

7 Results

In this section I first present my results in regression tables. Thereafter I perform several placebo tests and robustness checks. I conclude that CUB has a positive effect on the number of late abortions for women aged 35-39. A negative but not robust effect is found for women 30-34 years old.

7.1 Estimation results

I estimate the impact of CUB on late abortions. All tables in Section 7 present results where the *pregnant women* variable from the Swedish Pregnancy Register with imputed values for the years 2004-2009 is used. Tables where I instead use my alternative *pregnant women* variable (the number of babies born plus late abortions) are found in Appendix C. I perform the analysis for women 30-34 years old and 35-39 years old respectively, following equation 1 in the Methodology section. In Table 3 I analyse the effect of CUB for women aged 30-34. The county of Skåne is excluded since women get treated at age 33 which make just half of my treated sample from the county treated. The estimates are very small, slightly negative and not statistically significant when I add fixed effects in specification (2) and (3). When I control for GRP per capita and the share of employed women (16-74 years old) in specification (4) and (5) my estimate get slightly more negative. For my last and preferred specification, (6), I add the share of low educated women as a control variable and my estimate become statistically significant at the 5 % level. This result is counter-intuitive and not in line with my predictions in Section 3. My estimate suggest that late abortions decrease with 0.21 percentage units when CUB is introduced for women in this age group. This result should however be interpreted with caution. During 2004-2012 only 8 out of the 20 counties were treated and 3 of them were only treated during the last year of the time period. On top of this the uptake of CUB was low. Figure 1 shows the frequency of the uptake of CUB for women in 20 counties 2010-2014. In about 45% of all counties (both treated and untreated), less than 30% of the women 30-34 years old accepted CUB. This can be compared to the older age group, women aged 35-39, shown in Figure 2. Their distribution of women accepting CUB is closer to what one should expect when about half of the sample is treated and the other half is not, i.e. there are many observations in both ends of the distribution. I therefore expect the effect to be larger for women 35-39 years old.

Table 3: Regression results for women age 30-34 looking at late abortions for the years 2004-2012.

	Women 30-34 years old					
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
CUB	-0.000432	-0.000993	-0.000993	-0.00118	-0.00178	-0.00208**
	(0.000591)	(0.00106)	(0.00106)	(0.00107)	(0.00105)	(0.000887)
GRP/capita				4.12e-05*	5.61e-05*	6.22e-05**
				(2.21e-05)	(2.72e-05)	(2.39e-05)
Employment					-0.00130	-0.00117
					(0.00102)	(0.00100)
Low education						-0.0524
						(0.0586)
County FE	NO	NO	YES	YES	YES	YES
Year FE	NO	YES	YES	YES	YES	YES
Observations	179	179	179	179	179	179
Adjusted R^2	-0.005	-0.038	-0.038	-0.029	-0.013	-0.010
Counties	20	20	20	20	20	20

Note: The table present results for women, 30-34, in 20 counties during the time period 2004-2012 (Skåne is excluded). Statistically significant results are marked with stars as follows: *** p<0.01, ** p<0.05, * p<0.1. Cluster-robust estimators at the county level is used to calculate my standard errors. Standard errors are presented in parentheses.

Table 4 present estimation results when I regress CUB on the number of late abortions per pregnant women 35-39 years old. The estimate for my first specification suggests that CUB increase the number of late abortions per pregnant woman with 0.27 percentage units. The result is significant at the ten percent level. When I add fixed effects, column (2) and (3), the estimate increases in size as well as the standard error, and is no more statistically significant. The size of the estimate is about the same size and still not statistically significant when controlling for GRP per capita and the share of employed women in specification (4) and (5).

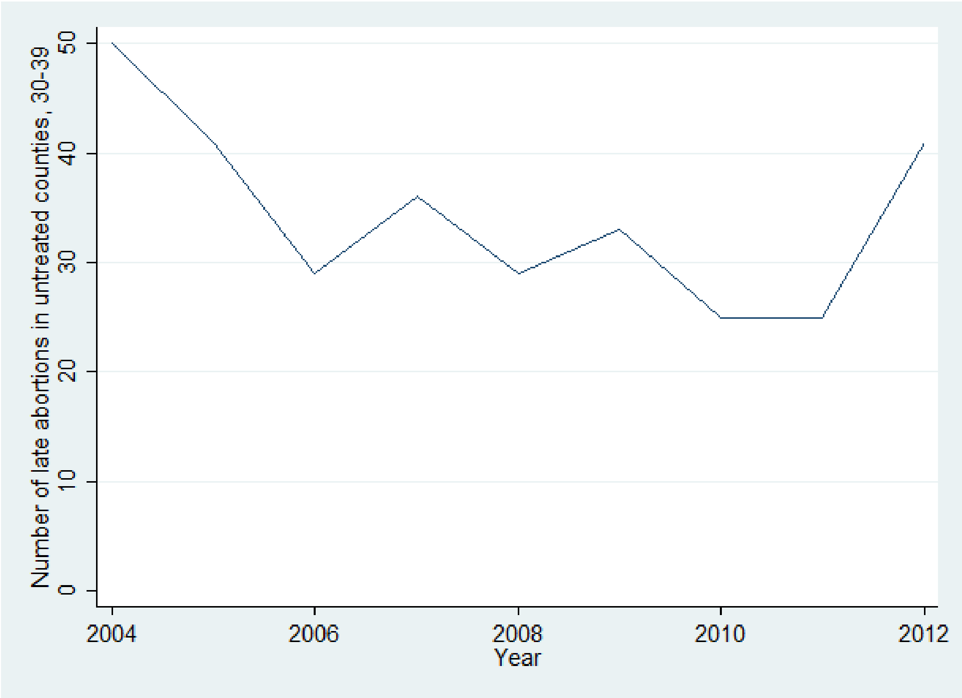
Table 4: Regression results for women age 35-39 looking at late abortions for the years 2004-2012

	Women 35-39 years old					
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
CUB	0.00267*	0.00415	0.00415	0.00428	0.00417	0.00465*
	(0.00148)	(0.00244)	(0.00244)	(0.00248)	(0.00244)	(0.00253)
GRP/capita				-7.45e-05	-5.70e-05	-8.46e-05
				(6.63e-05)	(5.63e-05)	(6.15e-05)
Employment					-0.00160	-0.00155
					(0.00166)	(0.00159)
Low education						0.157**
						(0.0736)
County FE	NO	NO	YES	YES	YES	YES
Year FE	NO	YES	YES	YES	YES	YES
Observations	187	187	187	187	187	187
Adjusted R^2	0.014	0.025	0.025	0.030	0.032	0.046
Counties	21	21	21	21	21	21

Note: The table present results for women, 35-39, in all 21 counties during the time period 2004-2012. Statistically significant results are marked with stars as follows: *** p<0.01, ** p<0.05, * p<0.1. Cluster-robust estimators at the county level is used to calculate my standard errors. Standard errors are presented in parentheses.

The estimate for my preferred specification (6) in Table 4 is about the same size as as the estimates in column (3)-(5) but significant at the 10 % level. It estimate an effect of CUB on late abortions of 0.47 percentage units. This result can be compared to the mean value of late abortions for untreated pregnant women in the 35-39 age cohort. This value is found in my summary statistics in Table A1 in Appendix A. The ratio becomes: $0.00465/0.018 \approx 0.26$. The interpretation is that introducing CUB in a county, on average increase the late abortions with 26%. The mean number of late abortions per year in the untreated counties (for women 35-39) was 6.867. An increase in late abortions with 26% would give 8.65 late abortions. I make an upper-bound and lower-bound prediction of how this would affect the total number of late abortions in the country if all my counties were treated. The trend in the number of late abortions for untreated women 35-39 years old is shown in Figure 5. The upper-bound analysis is based on the largest number of abortions during the time period. This was in 2004 when 50 children were in total aborted after week 12 in these five counties. An increase with 26% would give 63 late abortions, an increase with 13 late abortions.

Figure 5: The total number of late abortions for women 35-39 years old, in counties staying untreated during the time period 2004-2012.



The lower bound estimate is based on the number of late abortions in 2010 and 2011 when 25 late abortions were performed. An increase with 26% would give 31.5 late abortions, an increase with 6.5 late abortions. CUB should only affect late abortions and abortions of children with chromosomal aberrations. This is since the result from the CUB is not available before week 12 and because chromosomal aberrations are the types of birth defects detected by the test. The economic significance of 6.5-13 aborted children can be investigated using the number of children born with chromosomal abnormalities as a comparison. In 2012, 183 children were born with a chromosomal aberration (Gottvall, 2012) in Sweden. An increase in the abortion rate with 13 children corresponds to a 7.1% decrease of babies born with chromosomal aberrations. An increase of the abortion rate with 6.5 children corresponds to a 3.6% decrease of babies born with chromosomal aberrations. Thus, my upper and lower bound calculations predicts that the effect of CUB decrease the number of children born with chromosomal aberrations between 3.6-7.1%.

7.2 Robustness of results

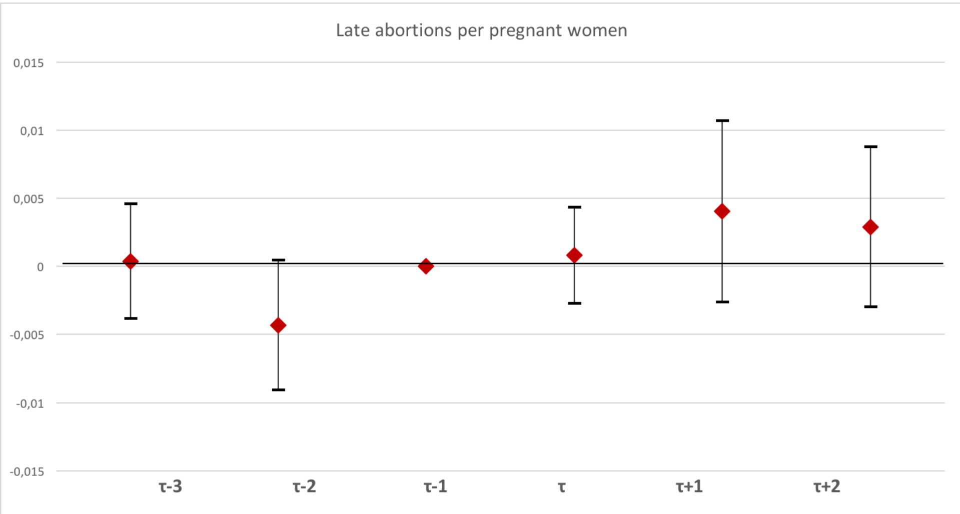
One of my main identifying assumptions states that the pretreatment trend for the treatment group and the control group should be parallel. Since this is difficult to visualize graphically when treatment occurred at different times in different counties, I instead test this assumption using an event study analysis. For women 35-39 years old, I normalize the time of treatment for all counties that was ever treated during the time period 2004-2012 to one. I use the event study analysis to rule out the existence of pretreatment trends in late abortions per woman, between women in treated and untreated counties.

For my parallel trend assumption to hold the pretreatment trend should be zero. The following dynamic version of equation 1 is used:

$$Abortion_{ct} = \alpha_c + \lambda_t + \sum_{\tau} \beta_\tau D_c \mathbb{1}[\tau] + \gamma \boldsymbol{X}_{ct} + \epsilon_{ct} \tag{2}$$

Figure 6 plot the β coefficients obtained when estimating the model given in equation 2. When I plot the data the pretrend is not distinguishable from zero at the 95% confidence level. There is an indication of a pretrend effect at τ-2 but this effect is not visible at τ-3 which strengthen my claim of there being no pretreatment effect of CUB on late abortions per pregnant woman. The event study graph can however not strengthen my claim that there is a positive effect of CUB on late abortions per pregnant woman. This might be due to lack of statistical power that makes the estimation of precise dynamic estimates difficult. To strengthen my claim that the there is a positive effect for my sample of women 35-39 years old I will perform two placebo test. The first one using a lagged CUB variable and the second one using leads.

Figure 6: Event study analysis, graph using data for women 35-39 years old.



One might worry that there are some underlying variation other than CUB that cause the direction of my estimates. I want to test if there was nothing else happening during those years that caused the directions and size of my estimates. I want to confirm that the timing of the treatment is important for the estimates. For my claim that CUB has an effect on abortions to hold there should be no effect of CUB on abortions during the years CUB was not introduced. I test this with a placebo test where my treatment variable, CUB, is coded as occurring one and two years before the actual treatment. I want the placebo to occur close to the real treatment in time. The closer the real treatment time I get and still do not observe an effect the more plausible is my claim that the observed effect of treatment actually is due to CUB. The results from my placebo tests are shown in Table 5 and Table 6. Specification (1) and (2) in the tables corresponds to specification (3) and (6) in my main results. For the analysis of women 30-34 years old in Table 5 the estimates are small with large standard deviations. There seems to be no effect on late abortions when applying the placebo treatment. The estimates for the analysis containing women in the 35-39 year age cohort is displayed in Table 6. Non of the estimates are statistically significant. The estimates become even smaller with larger standard errors for the two year lag. This indicates that the placebo treatment had no effect on the number of late abortions for neither women 30-34 years old or women 35-39.

Table 5: Placebo estimates for women age 30-34, 2004-2012, CUB lagged -1 year and -2 years

VARIABLES	(1)	(2)	(1)	(2)
Lag	-1 year	-1 year	-2 years	-2 years
CUB	-0.000209	-0.00117	-0.000623	-0.00163
	(0.00117)	(0.00116)	(0.00135)	(0.00146)
GRP/capita		5.80e-05**		5.92e-05**
		(2.33e-05)		(2.28e-05)
Employment		-0.00113		-0.00124
		(0.00105)		(0.00102)
Low educ		-0.0438		-0.0453
		(0.0579)		(0.0579)
County FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Observations	179	179	179	179
Counties	20	20	20	20
Adjusted R^2	-0.042	-0.021	-0.040	-0.015

Note: The table present lagged results for women, 30-34, in 20 counties during the time period 2004-2012 (Skåne is excluded). For a one year lag, CUB is introduced at time t-1. For a two year lag CUB is introduced at t-2. Statistically significant results are marked with stars as follows: *** p<0.01, ** p<0.05, * p<0.1. Cluster-robust estimators at the county level is used to calculate my standard errors. Standard errors are presented in parentheses.

Table 6: Placebo estimates for women age 35-39, 2004-2012, CUB lagged -1 year and -2 years

VARIABLES	(1)	(2)	(1)	(2)
Lag	-1 year	-1 year	-2 years	-2 years
CUB	0.00302	0.00272	0.000191	-0.000737
	(0.00247)	(0.00188)	(0.00251)	(0.00228)
GRP/capita		-7.06e-05		-7.71e-05
		(7.25e-05)		(7.41e-05)
Employment		-0.00148		-0.00174
		(0.00175)		(0.00168)
Low educ		0.144*		0.135
		(0.0805)		(0.0819)
County FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Observations	187	187	187	187
Counties	21	21	21	21
Adjusted R^2	0.014	0.028	0.004	0.021

Note: The table present lagged results for women, 35-39 in 21 counties during the time period 2004-2012. For a one year lag, CUB is introduced at time t-1. For a two year lag CUB is introduced at t-2. Statistically significant results are marked with stars as follows: *** p<0.01, ** p<0.05, * p<0.1. Cluster-robust estimators at the county level is used to calculate my standard errors. Standard errors are presented in parentheses.

In Table 7 and 8 I present the same specifications as with lagged variables but with leads. I present estimates for a +1 year CUB lead and +2 year CUB lead respectively. CUB is then introduced one and two years after the true treatment. For my analysis of women 30-34, the standard errors for all four specifications are larger than the estimates. The same is true when I analyze women 35-39 and I find no significant effects. This strengthens my claim that there are no pretreatment effect of CUB.

Table 7: Placebo estimates for women age 30-34, 2004-2012, CUB lead +1 year and +2 years

VARIABLES	(1)	(2)	(1)	(2)
Lead	+1 year	+1 year	+2 years	+2 years
CUB	0.000299	-0.000514	0.00105	0.000104
	(0.00137)	(0.00128)	(0.00146)	(0.00147)
GRP/capita		5.54e-05**		5.30e-05**
		(2.43e-05)		(2.48e-05)
Employment		-0.000947		-0.000925
		(0.000995)		(0.000998)
Low educ		-0.0415		-0.0379
		(0.0593)		(0.0598)
County FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Observations	179	179	179	179
Counties	20	20	20	20
Adjusted R^2	-0.041	-0.026	-0.039	-0.027

Note: The table present lead estimates for women, 30-34, in 20 counties during the time period 2004-2012 (Skåne is excluded). A one year lead of CUB is introduced at time t+1. A two year lead of CUB is introduced at t+2. Statistically significant results are marked with stars as follows: *** p<0.01, ** p<0.05, * p<0.1. Cluster-robust estimators at the county level is used to calculate my standard errors. Standard errors are presented in parentheses.

Table 8: Placebo estimates for women age 35-39, 2004-2012, CUB lead +1 year and +2 years

VARIABLES	(1)	(2)	(1)	(2)
Lead	+1 year	+1 year	+2 years	+2 years
CUB	0.00325	0.00399	0.000161	0.000695
	(0.00284)	(0.00304)	(0.00362)	(0.00365)
GRP/capita		-8.00e-05		-7.51e-05
		(6.59e-05)		(7.31e-05)
Employment		-0.00183		-0.00168
		(0.00159)		(0.00173)
Low educ		0.150*		0.138
		(0.0803)		(0.0839)
County FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Observations	187	187	187	187
Counties	21	21	21	21
Adjusted R^2	0.016	0.038	0.004	0.021

Note: The table present lead estimates for women, 35-39, in 21 counties during the time period 2004-2012. A one year lead of CUB is introduced at time t+1. A two year lead of CUB is introduced at t+2. Statistically significant results are marked with stars as follows: *** p<0.01, ** p<0.05, * p<0.1. Cluster-robust estimators at the county level is used to calculate my standard errors. Standard errors are presented in parentheses.

Lastly I want to check how robust my estimates are for using another definition of pregnant women and for a change in the length of the time trend. When I use my alternative *pregnant women* variable, babies born (adjusted for multiple births) plus late abortions, my estimates stays positive but I do not find an effect of CUB on late abortions for the 35-39 sample in Table C2 in Appendix C. For women 30-34 the estimate is smaller but still statistically significant in Table C1 in Appendix C. For both my definitions of the number of pregnant women, my analysis for women age 30-34 is sensitive for the span of years used in my regression. When I use the time period 2000-2012 (see Table B1 in Appendix B) the estimates gets small (but are still negative) with large standard errors and no effect of CUB is found. Not until the time trend is cut to 2004 are estimates for specification (6) for women 30-34, much larger and statistically significant. The estimates for the group of women 35-39 is not as sensitive for a change of the year span. When using the years 2000-2012 (see Table B2 in Appendix B) the estimates are of about the same size as in my main analysis and all specifications are statistically significant at least at the 10% level. When I shorten my time span the model seem to loose some statistical power but the size of the estimates are robust to such a change. I discuss the results and reasons why babies born + late abortions as an approximation of pregnant women may be less accurate than the variable used in my discussion (Section 8). I also discuss robustness of the results and the economic significance.

8 Discussion

Several reports from the National Board of Health and Welfare have shown that the number of children born with Down syndrome has stayed constant in recent years despite a steadily aging group of pregnant women (Gottvall, 2016). The reason for the decline in the number of children expected to have Down syndrome (and other more rare chromosomal abnormalities) has not been well investigated. According to my economic framework of the knowledge effect discussed in Section 3 the number of abortions should increase with the introduction of a test that increases parents knowledge of their child's health characteristics. This prediction holds true as long as some parents expect their utility of having a non-disabled and a disabled child to differ more than the expected utility of performing CUB and eventually an abortion. The utility maximizing parents will then use CUB to get more knowledge about their expected utility from the child they are expecting. First thereafter they make a decision about aborting or keeping the baby due to their preferences of different types of children. I find empirical evidence that there is a positive effect of CUB on the number of late abortions for women 35-39. This suggests that there are parents that value disabled and non-disabled children differently. This is since the decision of having a late abortion after a CUB test is very likely to be caused by the detection of chromosomal aberrations.

I find a negative effect of CUB on the number of late abortions per pregnant woman for women 30-34 years old. In relation to my theoretical framework this result suggest that women accepting CUB is less likely to perform an abortion. The result is counter-intuitive and not in line with my theoretical framework. There are no reasons to believe that the introduction of CUB should decrease the number of late abortions for the treated group of women. I interpret the result with caution due to several reasons. The result for women 30-34, is sensitive to a change in the years used for my regression as well as for different specifications in my regression table. The estimate becomes much larger and significant when I add the share of low educated women as a control variable. This estimate is also significantly larger compared to all other specifications where the estimate was small and insignificant. The uptake of CUB for this group was low during my sample period. I would need some more years of data to be able to better investigate the effect for this particular age cohort. There are however reasons to believe that the effect of CUB differ between women 30-34 and 35-39 years old. Women 30-34 years old are less likely to carry a child with chromosome aberrations (the risk increases with age). This means that even if more women in this group would accept CUB, on average fewer fetuses with a chromosomal abnormality would be found (and potentially aborted) than for the group of women 35-39 years old. Another explanation for why the results for women in the age cohorts 30-34 and 35-39 differ is that the taste for having a disabled child could differ between women in the two age cohorts. If women 30-34 expect their utility of having a disabled child to be larger than women 35-39 then CUB would have less of an effect on late abortions for them. Having a disabled child, that have extra needs of care, could be expected to be more tiresome for older women than younger. This does not explain the negative coefficients that I interpret with caution. Both since the estimates seem to be less robust for women 30-34 than for women 35-39. But also since this group is less effected by CUB. My main analysis will therefore focus on the main group of interest, women 35-39 years old.

My estimates for women 35-39 suggest that the introduction of CUB increase the number of late abortions. This can be confirmed at the 10% statistical significance level. When using a two sided significance test a 95% confidence interval cannot rule out that the effect is different from zero. If I however instead set up a one sided hypothesis where H_0=*the number of abortions decreases or stays constant*, my estimate is significantly different from zero at the 95% significance level. When using a one sided hypothesis I get more statistical power. Therefore, the use of a one sided hypothesis test must be well motivated. In my case I must argue why it is unreasonable that the introduction of CUB would lead to less late abortions. At first CUB is optional. There is no reason to believe that people who are offered CUB and decline will perform less abortions then had they if not offered CUB. Their situation should be unchanged. For women accepting CUB there must be no aspect in the procedure that makes them less probable to abort than if they had not been offered CUB. It is for example possible that women offered CUB become more informed about the consequences of having a child with a disability and therefore less prone to abort a disabled child. This should decrease the positive effect of CUB on abortions. This should however not effect the number of late abortions not related to CUB. As long as no less women accept CUB than the number that did accept some type of testing before, should the rate of abortions not decrease. These arguments all strengthen my claim that a one sided hypothesis test is appropriate for my study. This helps me to strengthen my claim that the effect of CUB on late abortions is positive. The size of the effect is however to be supported by more research.

My study is limited by lack of data. Ideally, I had had access to individual level abortion data to be able to perform a regression discontinuity design and test the effect of CUB around the 35 year old age threshold. That study is however left to later research. Individual level data and a regression discontinuity design had strengthen my claim that the offer of CUB increases late abortions and ultimately increase the abortions of fetuses with chromosomal aberrations. Better data had enable me to connect women that accepted CUB to the women that accepted an invasive test an therefore better been able to investigate the mechanism. In a second step these women would be connected to the data of women that chose to have a late abortion following CUB. This would provide the researcher with personal characteristics of the women in each of the groups which would enable heterogeneity analyses. This data is however not accessible to me during my thesis work, mostly because of ethical reasons. Another limitation of my study is my lack of precise estimates. One reason can be my few clusters (21 for women 35-39 and 20 for women 30-34), another my use of an induced number of pregnant women for the years 2004-2009. I still estimated this measure of the number of pregnant women to be better than the number of babies born plus late abortions. This since it catches women that actually have been registered at a maternity clinic and the induced estimates are based on those values. A further discussion about the main flaws of the number of babies born plus late abortions as a proxy for the number of pregnant women is found in Appendix C. Even though treatment was introduced at the county level, there is a potential delay in when all maternity clinics within a county actually were treated. A delay in treatment suggests that the size of the effect is underestimated. A threat to my identification is if women that are more prone to have an abortion due to the detection of a chromosomal aberration in untreated counties, move to a treated county as soon as they plan to become pregnant. This is however very unlikely. Both since moving is costly and the risk of chromosomal aberration is very small for most women. I also worry that women in some untreated counties systematically become treated by simply buying a CUB test. This should however not be a concern if this practice is not related to a certain county. I am interested of the effect when CUB is offered to women for free[25]. The estimated effect of introducing CUB is smaller if many women treated themselves prior to treatment but should not bias my estimates. It could also be worrisome if women coded as untreated, take part of treatment in another county. If this occurs, my estimates should be downward biased since the measured effect appears smaller than the true effect.

My study find that CUB increases the number of late abortions for women 35-39 years old. This increase is likely to be directly connected to fetuses with chromosomal aberrations. My estimates for women aged 35-39 suggested that introduction of CUB caused a lower bound estimation of a 3.6% decrease in the number of children born with chromosomal aberrations and an upper bound of 7.1% decrease. This effect is quite large in an economic sense. The implications for society could be many. The cost of rearing these children are generally higher throughout their lives. Some of them will die at a very young age which induce less monetary cost on society but a larger cost for the family. There could also be a societal value connected to plurality which will be lost if no more children are born with for example Down syndrome. Another potential consequence is that the support to the population living with chromosomal aberrations are at risk of being excavated if these diagnosis are seen as a choice rather than a coincidence. The issue of the cost and expected utility for individuals and the society is both complex and ethically complicated. What is clear is that policy makers should take into consideration that CUB and certainly other, more effective tests that have already been introduced, will have a direct effect on the number of children born with the disabilities that the tests are searching for. I leave to future research to further discover heterogeneous effect of CUB and the effect of more advanced test introduced in later years such as NIPT[26].

[25] Or at a highly subsidized prize as in Uppsala and for women younger than 35 from 2010 in Värmland.

[26] A so called non-invasive prenatal test.

9 Conclusion

As supported with theory I find a positive effect of CUB on late abortions for women in the age cohort 35-39. The positive effect of 0.47 percentage units is statistically significant at the 10% level. The estimate suggest that number of late abortions would increase with 26% in the untreated counties if they implemented CUB. This correspond to a lower bound of 6.5 late abortions per year in this age group and an upper bound of 13 abortions. This in turn correspond to a 3.6-7.1% decrease in the number of babies born with chromosomal aberrations. A negative effect is found for women 30-34 years old. This estimate was less robust to changes in the specification and the years used in the regression. This age cohort was to a lesser extent affected by the treatment during the sample period. These women are also on average less likely to carry a child with chromosomal aberrations which suggest that the effect of CUB should be smaller in the first place. To conclude I find evidence that suggest that the effect of CUB on late abortions is positive for women 35-39 and negative for women 30-34. More research is needed to verify the size of the effects.

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Appendices

Appendix A

Table A1: Treated and untreated counties for women 35-39 years old 2004-2012.

Variable	Mean	Std. Dev.	Min.	Max.
	Descriptive statistics for treated counties*			
Population	17208.169	20621.096	1497	80363
Total ab.	275.789	372.872	23	1585
Late ab.	19.648	27.719	1	125
Late ab./pregnant	0.02	0.009	0.005	0.058
Accepting CUB	539.354	973.104	0	4165
Accepting CUB/preg.	0.447	0.218	0	0.816
Total preg.	997.693	1397.708	90	5993
Share low educ.	0.558	0.067	0.404	0.701
Employed (%)	75.003	2.348	68.553	80.321
Share born abroad	0.158	0.057	0.058	0.316
GRP/capita	319.915	55.98	242	549
	Descriptive statistics for untreated counties**			
Population	7642.689	1706.533	4360	9927
Total ab.	112.867	32.374	43	172
Late ab.	6.867	3.859	1	16
Late ab./pregnant	0.018	0.009	0.004	0.04
Accepting CUB	35.6	32.778	4	95
Accepting CUB/preg.	0.09	0.061	0.012	0.181
Total preg.	379.115	112.582	187	570.595
Share low educ.	0.565	0.053	0.475	0.677
Employed (%)	74.984	2.399	71.202	80.092
Share born abroad	0.154	0.034	0.101	0.235
GRP/capita	307.911	38.68	246	424

*Stockholm, Uppsala, Östergötland,Jönköping, Kronoberg, Kalmar, Gotland, Skåne, Västra Götaland, Värmland, Örebro, Dalarna, Gävleborg, Västernorrland, Jämtland, Västerbotten.

**Södermanland, Blekinge, Halland, Västmanland, Norrbotten.

Appendix B

Table B1: Regression results for women age 30-34 looking at late abortions for the years 2000-2012

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
CUB	0.000526	-0.000281	-0.000281	-0.000501	-0.000801	-0.000801
	(0.000563)	(0.00108)	(0.00108)	(0.00106)	(0.00104)	(0.000931)
GRP/capita				3.52e-05**	3.98e-05**	3.99e-05***
				(1.42e-05)	(1.41e-05)	(1.38e-05)
Employment					-0.000338	-0.000338
					(0.000384)	(0.000407)
Low education						-0.000126
						(0.0440)
County FE	NO	NO	YES	YES	YES	YES
Year FE	NO	YES	YES	YES	YES	YES
Observations	256	256	256	256	256	256
Adjusted R^2	-0.003	-0.015	-0.015	-0.006	-0.008	-0.012
Counties	20	20	20	20	20	20

Note: The table present results for women, 30-34, in 20 counties (Skåne is excluded) during the time period 2000-2012. Statistically significant results are marked with stars as follows: *** p<0.01, ** p<0.05, * p<0.1. Cluster-robust estimators at the county level is used to calculate my standard errors. Standard errors are presented in parentheses.

Table B2: Regression results for women age 35-39 looking at late abortions for the years 2000-2012

	Women 35-39 years old					
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
CUB	0.00375**	0.00411*	0.00411*	0.00415*	0.00410*	0.00422*
	(0.00132)	(0.00203)	(0.00203)	(0.00202)	(0.00214)	(0.00210)
GRP/capita				-4.08e-05	-3.92e-05	-6.37e-05
				(4.86e-05)	(4.47e-05)	(4.44e-05)
Employment					-0.000131	5.31e-05
					(0.000960)	(0.000991)
Low education						0.100*
						(0.0506)
County FE	NO	NO	YES	YES	YES	YES
Year FE	NO	YES	YES	YES	YES	YES
Observations	270	270	270	270	270	270
Adjusted R^2	0.035	0.050	0.050	0.051	0.047	0.053
Counties	21	21	21	21	21	21

Note: The table present results for women, 35-39, in all 21 counties during the time period 2000-2012. Statistically significant results are marked with stars as follows: *** p<0.01, ** p<0.05, * p<0.1. Cluster-robust estimators at the county level is used to calculate my standard errors. Standard errors are presented in parentheses.

Appendix C

This section present the same regression analysis as in Section 7 but with babies born plus late abortions as a proxy for pregnant women. The estimates in Table C2 for women age 35-39, are somewhat smaller than the estimates in Table 4 in Section 7 and no longer significant at the 10% level. This could be due to several reasons. At first the number of babies plus the number of late abortions are not a perfect estimation of the group pregnant women offered CUB. There are women that register at the maternity central after the deadline of being offered CUB (generally after week 11)[27]. There are also more babies born than women pregnant due to multiple births. I have adjusted for this by using the share of multiple birth from 2014 when I calculated the value for each year and age cohort. This share was a national average and was not adjusted to differences between counties and age cohorts due to lack of data. Another concern is that the data on number of children born was only available in three of the age cohorts useful for me. The oldest age cohort was women 35 or older compared to earlier used 35-39 and 40+. There are reasons to believe that women in the oldest age cohort more often fit in to the group of risk pregnancies only based on their age. Most counties offered women in the risk group prenatal diagnosis even before CUB. The treatment effect in this age cohort should therefore be small (most fetuses with chromosomal abnormalities are likely to be discovered even before the introduction of CUB for this group of women.). My final estimate for this group would then be less precise and smaller than when using my other variable for pregnant women. The result for the women aged 30-34 are shown in Table C1 and as in my main analysis there is a negative effect of CUB on late abortions.

[27]Even if CUB is performed at earliest week 11, women registering late at a maternity clinic will pass the deadline for when CUB is offered (which is before the start of the test procedure).

Table C1: Estimates for women age 30-34 using number of babies born as proxy for pregnant women, 2004-2012

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
CUB	-0.000879	-0.000405	-0.000405	-0.000567	-0.00113	-0.00157**
	(0.000573)	(0.00103)	(0.00103)	(0.00103)	(0.000807)	(0.000669)
GRP/capita				3.67e-05*	5.02e-05*	5.86e-05**
				(2.12e-05)	(2.68e-05)	(2.33e-05)
Employment					-0.00118	-0.000984
					(0.000968)	(0.000867)
Low educated						-0.0755
						(0.0464)
County FE	NO	NO	YES	YES	YES	YES
Year FE	NO	YES	YES	YES	YES	YES
Adjusted R^2	0.000	-0.036	-0.036	-0.026	-0.006	0.012
N	20	20	20	20	20	20

Note: The table present results for women, 30-34, in 20 counties (Skåne is excluded) during the time period 2004-2012. Babies born plus the number of late abortions is used as the proxy for the number of pregnant women in a county. Statistically significant results are marked with stars as follows: *** p<0.01, ** p<0.05, * p<0.1. Cluster-robust estimators at the county level is used to calculate my standard errors. Standard errors are presented in parentheses.

Table C2: Estimates for women age 35-39 using number of babies born as proxy for pregnant women, 2004-2012

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
CUB	-0.000707	0.00406	0.00406	0.00421	0.00411*	0.00406
	(0.00150)	(0.00257)	(0.00257)	(0.00248)	(0.00232)	(0.00241)
GRP/capita				-8.95e-05	-6.15e-05	-9.52e-05**
				(5.72e-05)	(4.19e-05)	(4.23e-05)
Employment					-0.00257	-0.00230
					(0.00170)	(0.00179)
Low educated						0.243
						(0.150)
County FE	NO	NO	YES	YES	YES	YES
Year FE	NO	YES	YES	YES	YES	YES
Adjusted R^2	-0.004	0.076	0.076	0.088	0.106	0.118
N	21	21	21	21	21	21

Note: The table present results for women, 35-39, in all 21 counties during the time period 2004-2012. Babies born plus the number of late abortions is used as the proxy for the number of pregnant women in a county. Statistically significant results are marked with stars as follows: *** p<0.01, ** p<0.05, * p<0.1. Cluster-robust estimators at the county level is used to calculate my standard errors. Standard errors are presented in parentheses.