



# Can Caesarean section improve child and maternal health? The case of breech babies<sup>☆</sup>



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## ABSTRACT

This paper examines the health effects of Caesarean section (CS) for children and their mothers. We use exogenous variation in the probability of CS in a fuzzy regression discontinuity design. Using administrative Danish data, we exploit an information shock for obstetricians that sharply altered CS rates for breech babies. We find that CS decreases the child's probability of having a low APGAR score and the number of family doctor visits in the first year of life. We find no significant effects for severe neonatal morbidity or hospitalizations. While mothers are hospitalized longer after birth, we find no effects of CS for maternal post-birth complications or infections. Although the change in mode of delivery for the marginal breech babies increases direct costs, the health benefits show that CS is the safest option for these children.

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## 1. Introduction

Since the 1970s, many developed countries have experienced an increase in the use of Caesarean section (CS) for childbirth. For example, in the U.S., the overall CS rate rose from 20.7 percent in 1996 to 31 percent in 2006 (MacDorman et al., 2008).<sup>1</sup> Critics argue that changes in the population of biological mothers cannot solely explain this huge increase. While the procedure has life-saving effects for some groups, the use of CS has been extended

to patients for whom the medical indication is not clear (Shearer, 1993; Declercq et al., 2006).

As a CS (in the U.S.) typically costs more than a natural delivery, economists have primarily analyzed non-medical reasons for the increase in CS use and its economic consequences for health care systems (see, e.g., Gruber and Owings, 1996; Gruber et al., 1999).<sup>2</sup> However, to evaluate the cost efficiency of increased CS use, we need to factor in consequences for patients' health. The only existing economic study on the consequences of CS that includes health effects into the analysis is Currie and MacLeod (2008). They find that increased CS use after tort reform does not coincide with

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<sup>1</sup> Diagnostic groups that often or always lead to CS use include multiple births, placenta praevia, earlier CS, and high risk of emergency CS due to pregnancy complications (Danish National Board of Health, 2005b).

<sup>2</sup> These analyses—that focus on the additional costs of a CS—relate to a large debate on the returns to increased medical spending. While cross-sectional studies of high vs. low-spending areas in the U.S. commonly find no health returns to higher spending (see, e.g., Fisher et al., 1994), studies using instrumental variables or panel data methods reach other conclusions. Almond et al. (2010) find that increased spending on at risk infants cost-effectively improves mortality outcomes. Exploiting admission of non-residential patients, Doyle (2011) demonstrates that higher spending improves health for emergency patients. However, the cost increase related to the increased use of CS depends on the costs of the relevant counterfactual. For complicated vaginal births (such as babies in breech position, that require expert presence throughout labor), cost increases induced by increased use of CS may at most be modest. Thus this paper does not study returns to additional spending on the marginal CS child.

improved infant health at birth measured as the APGAR score. Our study extends the existing research in two ways: first, by examining short- and longer-run health consequences of CS for children and their mothers, and second, by evaluating their direct economic impact.

The main challenge to our analysis is selection into CS based on expected returns. We deal with selection into treatment by using a regression discontinuity design and high-quality administrative data from Denmark. Our design allows us to investigate the effect of CS for the relevant pregnancies, namely the ones at the margin of either having a CS or a natural birth. We exploit an information shock to obstetricians (OBs) that discontinuously increased CS rates for breech babies at term. Breech babies account for around 4 percent of all births and around 20 percent of all performed CS in Denmark (authors' calculation based on data from [Danish National Board of Health, 2005a](#)).<sup>3</sup>

Our analysis of Danish data provides evidence that is more broadly applicable: for example, in the U.S., close to all breech babies are delivered by CS ([Lee et al., 2008](#)). This high CS rate for breech babies may partly be driven by other factors than underlying health—such as liability rules or financial incentives—and thus not be optimal for babies at the margin. The lack of variation in the U.S. data rules out an evaluation of the costs and benefits of CS for these marginal babies. Thus our analysis for marginal CS babies in Denmark provides instrumental knowledge that is relevant for other countries with highly developed health care systems and high CS rates for breech babies, such as the U.S.

The information shock we exploit is the dissemination of the multi-center, multi-country “Term Breech Trial” (TBT) in 2000 ([Hannah et al., 2000](#)). It randomly allocated mothers with babies in breech position at term to either planned vaginal birth or planned CS, and concluded that planned CS is superior with respect to child serious neonatal morbidity and to perinatal and neonatal mortality.

While highly cited at time of publication, today several concerns exist about the TBT and the external validity of its findings (see, e.g., [Turner, 2006](#); [Glezerman, 2006](#)). For example, in contrast to the protocol, not all mothers had an experienced OB present during labor, twins were included, different countries had different practices (e.g., with respect to external cephalic versions before labor) not accounted for in the randomization. In addition, the importance of the “serious morbidity” outcome measure has been challenged, as this measure combines various measures with potentially different longer-run consequences.<sup>4</sup> Importantly, given that in some countries very few women agreed to be randomized (e.g., only one woman from Denmark), the non-compliance among trial participants is likely to be influential in the TBT's intention to treat (ITT) analysis and may impact the conclusions we can draw from this analysis.

Using a decade of Danish administrative data, [Tharin et al. \(2011\)](#) show that the TBT elevated CS rates for breech babies in Denmark. We extend their analysis in three ways: First, we focus on data closer to the TBT, thereby exploiting local exogenous variation

induced by the information shock. Second, as opposed to earlier ITT analyses, we consider health effects for the marginal breech baby delivered by CS. This analysis examines the immediate effect of expanding Danish CS rates to a relevant “next-in-line patient group”. Third, to examine persistent health effects, we consider longer-run child health outcomes.

Our first-stage results show that, in line with earlier findings, breech babies born after the TBT dissemination have a significantly higher probability of being delivered by CS. This increase is driven by higher parity children—in accordance with stricter selection of relatively uncomplicated cases into CS. This result contributes to a growing literature on the driving forces behind increased CS use. This literature has focused on technological innovations in the procedure itself; other technologies, such as monitoring the child's heart rate (continuous cardiotocography (CTG)) ([Zarko et al., 2006](#))<sup>5</sup>; “physician style”, i.e., geographic variation that remains after control for factors such as maternal risk profiles ([Baicker et al., 2006](#); [Epstein and Nicholson, 2009](#)); and physician-induced demand (e.g., [Gruber and Owings, 1996](#); [Gruber et al., 1999](#); [Grant, 2009](#); [Triunfo and Rossi, 2009](#)). Finally, and studied in the U.S., liability rules may contribute to increased use of CS. [Currie and MacLeod \(2008\)](#) discuss the notion of “defensive medicine”—by which OBs attempt to reduce legal liability risks—and the impact of this behavior on childbirth practices. They find that certain types of tort reforms increase, and others decrease, procedure use. In line with the finding that liability matters for physician behavior, a very recent study based on U.S. data is the first to show that physicians react to medical error (and related litigation) and increase CS rates as a consequence ([Shurtz, 2013](#)).

We add to this literature with the finding that newly available information for OBs can rapidly affect the use of CS. As both performing a vaginal breech birth or a CS require considerable resources (due to similar requirements for doctors' presence and reflected by very similar prices for the two procedures in Denmark), we study a context in which financial incentives for OBs and hospitals are at most modest and indirect. Thus we highlight the importance of newly available information for procedure use. As such, our study relates to other studies that highlight the impact of new information on medical procedure use, as in [Price and Simon \(2009\)](#), [Del Bono et al. \(2011\)](#) and [Anderberg et al. \(2011\)](#). While these previous studies have focused on patients' responses, our study examines a case in which the released information was subject to an expert debate and was not broadly discussed in the public media.

Our second-stage results show that the marginal baby is in better health at birth, measured as having a higher five minute APGAR score. Extending the analysis to longer-run outcomes, we find that the marginal CS child has fewer general practitioner (GP) visits in the first years of life, but we find no persistent effects for the marginal baby with respect to severe neonatal morbidity and hospitalizations in the first three years of life. For mothers, we find that CS prolongs post-birth hospital stay but—potentially because we lack precision—we find no significant effects on the probability of post-birth infections and complications.

Our results are stable across specifications and largely independent from the functional form chosen in our regressions. We find no indication for jumps in other mother or child observable characteristics at the cut-off, which (if present) would invalidate our RD design. Given that we find that the prevalence of breech pregnancies is smooth throughout the cut-off, we rule out manipulation of

<sup>3</sup> Babies that have not turned head down in the womb by week 37 of the pregnancy are considered breech at term. While breech position is more frequent among preterm babies, who move around in the womb more actively before term, among babies at term breech position is as good as random ([Danish National Board of Health, 2005b](#); [Tharin et al., 2011](#)). Why some babies do not turn head-down in the last part of the pregnancy is unclear. Similarly, we do not know why most babies turn around. While most breech babies have not turned for unknown reasons, rare conditions that correlate with breech at term are congenital anomalies, placenta praevia, tumors, and a large amount of amniotic fluid.

<sup>4</sup> Longer-run follow-ups of the TBT show no significant differences between groups. A number of country-specific observational studies have at most shown minimal differences in short-run outcomes for breech babies according to the mode of delivery (e.g., [Kotaska, 2004](#); [Glezerman, 2006](#)).

<sup>5</sup> Several randomized trials show that the use of CTG increases CS rates. However, the evidence on health effects of CTG is mixed. Studies show that while CTG decreases the probability of neonatal seizures, it does not lead to reduced prevalence of cerebral palsy or infant mortality.

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