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ABSTRACT

Black mothers with a trial of labor are 25 percent more likely to deliver by C-section than non-Hispanic White mothers. The gap is largest among mothers with the lowest risk and is reduced by only one-fifth when controlling for observed medical risk factors, sociodemographic characteristics, hospital, and physician or medical practice group. Remarkably, the gap disappears when performing a C-section is more costly due to a concurrent pre-labor C-section limiting surgical resources. This finding is consistent with provider discretion—rather than differences in unobserved medical risk—accounting for persistent racial disparities in delivery method. The additional intrapartum C-sections that occur among low-risk women when hospitals are unconstrained negatively impact infant health.

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I Introduction

Persistent and well-documented differences in the medical care received by Black and White Americans raise questions about the sources of racial disparities in treatment (IOM, 2003; Caraballo et al., 2022). Gaps in income, wealth, education, insurance coverage, and other markers of socioeconomic status could affect access to health care and the providers that people of different races see (Himmelstein and Himmelstein, 2020; Office of Minority Health, 2022). These underlying socioeconomic factors, coupled with disparities in access to care, could also lead to racial differences in medical risk factors at the point of treatment.[1] It is also plausible that Black individuals have different preferences for medical care on average, potentially influenced by historical experiences of discrimination within the health care system (Darity and Turner, 1972; Washington, 2006; Alsan and Wanamaker, 2018). Additionally, disparities in care provision could arise from biases held by medical practitioners, whether explicit or implicit (Hall et al., 2015; Hoffman et al., 2016; Singh and Venkataramani, 2022).

This paper addresses the question of why Black infants are more likely to be delivered by Cesarean section (C-section) than White infants in the United States. In 2018, 34.0 percent of Black mothers delivered by C-section compared to 29.3 percent of non-Hispanic White mothers (NVSS, 2018).[2] While Cesarean deliveries can be lifesaving, unnecessary C-sections increase the costs of medical care and involve a higher risk of maternal complications than vaginal births (Sandall et al., 2018).[3] Higher rates of C-sections among Black mothers could thus be one contributor to higher rates of Black maternal morbidity (Kennedy-Moulton et al., 2022). Cesarean deliveries can also complicate future pregnancies, and, once a C-section has been performed, subsequent births are likely to require a C-section (Silver, 2012; Miller et al., 2025). Notably, the children themselves can also be affected, with recent evidence showing

[1] Black Americans have higher rates of diabetes, hypertension, obesity, asthma, and heart disease compared to White Americans (CDC, 2023).

[2] The higher use of C-sections among Black mothers contrasts with racial disparities in other types of care provision during and following labor. Studies have shown that Black mothers are less likely to undergo labor induction (Grobman et al., 2015), are less likely to be given epidural anesthesia while in labor (Glance et al., 2007), and are less likely to be given opioids despite reporting higher pain following delivery (Badreldin et al., 2019). These differences could be driven by differences in preferences—with Black mothers preferring less invasive treatments—or providers showing less concern for the comfort of Black mothers.

[3] C-sections also have labor market consequences, with mothers delaying their return to work and exhibiting reduced attachment to their pre-birth employer following a Cesarean delivery (Miller et al., 2025).

that children delivered by C-section are more likely to suffer from respiratory conditions in infancy and childhood (Costa-Ramon et al., 2018, 2022; Card et al., 2023).

We use exceptionally rich administrative data on nearly one million births in New Jersey from 2008 to 2017 to investigate the causes of racial disparities in delivery method. Much of our analysis focuses on deliveries involving a trial of labor, as intrapartum C-sections—those performed during labor—are less likely to reflect maternal demand than pre-labor procedures and account for the majority of racial disparities in C-section rates.[4] We compare delivery methods among mothers of different races who have similar medical appropriateness for a C-section, measured using a random forest algorithm applied to detailed maternal health data. We further condition on observable maternal characteristics such as insurance status and education, as well as hospital of delivery and attending physician, to examine how observably similar patients of different races are treated both within hospitals and by the same doctor. Finally, we exploit within-hospital variation in the timing of pre-labor C-sections to capture fluctuations in the costs of ordering intrapartum C-sections that arise from temporary constraints on surgical resources. As outlined below, this variation allows us to test whether the persistent racial gap among observably similar mothers delivering in the same hospital and by the same physician reflects differences in unobserved health risk or provider discretion. We then use linked hospital discharge data to examine how marginal intrapartum C-sections affect maternal and infant health.

Over the sample period, Black mothers in New Jersey who had a trial of labor were 25.2 percent more likely than non-Hispanic White mothers to deliver by C-section (p-value $=$ 0.002).[5] This disparity is most pronounced among mothers in the lowest risk quintile (162.3 percent, p-value < 0.001) and disappears among those in the highest risk quintile (1.2 percent, p-value $= 0.818$). These differences persist conditional on measures of socioeconomic status, including Medicaid coverage and education level, highlighting that substantial racial disparities in C-section rates exist among low-risk women with otherwise similar observable

[4]If someone desires to deliver by C-section, they can generally find a doctor willing to schedule a pre-labor delivery. The American College of Obstetricians and Gynecologists (ACOG) outlines that a "Cesarean delivery on maternal request" may be performed after 39 weeks if the risks and benefits have been discussed with the patient (ACOG, 2019).

[5]Intrapartum C-section rates are calculated as the number of intrapartum C-sections divided by the total number of births involving a trial of labor. From 2008–2017, the intrapartum C-section rate among Black mothers in New Jersey was 21.1 percent compared to 16.8 percent among White mothers (see Table 1).

characteristics. Strikingly, even after controlling for medical risk, measures of socioeconomic status, hospital fixed effects, and physician fixed effects, Black mothers remain 19.4 percent more likely than their White counterparts to have an intrapartum C-section (p-value < 0.001). These findings show that even the same physicians are treating Black patients differently.

Previous research has suggested that one potential solution for racial gaps in treatment is to encourage racial concordance between providers and patients (Alsan et al., 2019; Hill et al., 2023; Ye and Yi, 2023; Gruber and Frakes, 2025). We examine the effect of racial and gender concordance between patients and providers using hand-collected data on the race and gender of physicians inferred from pictures on provider websites. We find only suggestive evidence that racial concordance reduces the racial gap in C-section rates: although the racial gap in intrapartum C-sections among Black doctors is smaller than the racial gap among White doctors (13.8 percent versus 21.6 percent), the difference is not statistically significant (p-value $= 0.190$). We similarly find no significant differences between male and female doctors, with physicians of both genders treating Black and White mothers differently.

An important question is whether the persistent racial gap in intrapartum C-section rates among observably similar women is due to unmeasured risk factors affecting Black mothers. To address this possibility, we exploit plausibly exogenous variation in the costs to providers of ordering a C-section generated by variation in the timing of pre-labor C-sections. Pre-labor C-sections are either scheduled in advance—for example, for a repeat C-section or for mothers who prefer to deliver by C-section—or are performed emergently before labor begins. Given limited surgical resources within a labor and delivery unit, intrapartum C-sections are significantly less likely when the delivery occurs at the same time as a pre-labor C-section. If the racial gap in intrapartum C-section rates were driven by differences in unobserved risk factors—such that Black mothers were, on average, unobservably more in need of these procedures than their White counterparts—then physicians should reduce intrapartum C-sections among White mothers with similar observable risks when the costs of C-sections increase, thereby widening the racial gap. In contrast, if the gap reflects additional unnecessary C-sections being performed on Black mothers, then physicians should reduce those procedures first when faced with higher costs, thereby narrowing the racial gap.[6]

We find that the racial gap in intrapartum C-sections narrows when the costs of performing these procedures increase due to reduced surgical capacity. When no pre-labor C-section is occurring at the time of a delivery involving a trial of labor, 4.7 percent of non-Hispanic White mothers in the lowest risk quintile deliver by intrapartum C-section compared to 8.3 percent of Black mothers, yielding a racial gap of 77.4 percent (p-value < 0.001). In contrast, the racial gap in C-section rates among the lowest-risk mothers is statistically insignificant when a pre-labor C-section is occurring at the time of delivery: the rate for the lowest-risk White mothers falls to 1.6 percent, while the rate for the lowest-risk Black mothers falls to effectively zero. Among the highest-risk mothers with trials of labor, delivering at the same time as a pre-labor C-section reduces the probability of a C-section from 54.6 percent to 38.9 percent, with no significant difference in the reduction for Black versus White mothers (p-value $= 0.941$). Taken together, these findings suggest that the racial gap in C-sections reflects a higher propensity of physicians to perform C-sections on low-risk Black patients when the costs of doing so are low, rather than differences in underlying medical risk.

Changes in intrapartum C-section rates due to temporary fluctuations in hospital capacity have associated health effects. We follow mothers and their infants in the hospital discharge data, which allows us to measure complications that occur outside of the immediate postpartum period and therefore results in a more accurate measure of complications than is usually available.[7] Among low-risk mothers of both races, reductions in intrapartum C-sections when the delivery occurs at the same time as a pre-labor C-section reduce infant admissions to the neonatal intensive care unit (NICU).[8] In contrast, reductions in intra-

[6]The gap could also narrow if physicians deprioritize the care of Black patients when surgical resources are limited (Singh and Venkataramani, 2022). In our setting, however, additional reductions in intrapartum C-sections among Black mothers under reduced capacity occur only among low-risk deliveries—rather than across the risk distribution—and are accompanied by stable maternal outcomes and improved infant outcomes. These patterns are inconsistent with reduced access to necessary care and instead suggest a decline in the most discretionary procedures when surgical capacity is limited. The gap might also shrink if Black mothers are more likely to request C-sections during a trial of labor, and physicians are less likely to accommodate such requests when the costs of doing so are higher. Yet existing evidence indicates that Black mothers are, if anything, less likely than White mothers to request C-sections (Trahan et al., 2022).

[7]Birth certificate data have been shown to substantially under-estimate maternal postpartum morbidities and to have poor validity because many complications occur after the initial hospital stay for the delivery (Gemmill et al., 2024).

[8]This finding is consistent with medical evidence showing that infants delivered by C-section face a significantly higher risk of neonatal respiratory distress, a leading cause of NICU admission (Hansen et al.,

partum C-sections have no effect on postpartum complications among either Black or White mothers. Taken together, these findings indicate that the additional C-sections performed on low-risk women when the costs of doing so are low are not medically necessary, as reducing their use does not harm maternal health and improves infant health outcomes.

Our work is most closely related to three literatures. The first is a large body of work studying the drivers of high C-section rates. C-section rates in the United States rose steadily from the late 1990s through around 2010—from 20.7 percent of births in 1996 to roughly one in three by 2010—and have remained relatively stable since (Martin et al., 2017). At about 32 percent, Cesarean delivery is the most common major surgery in the country (NVSS, 2022). The high rate of C-sections has raised alarm among policymakers and professional organizations (ACOG, 2014; WHO, 2015; ODPHP, n.d.) and has led to a number of studies aimed at identifying contributing factors and potential solutions.[9] Racial disparities in C-section rates are also persistent and well documented (e.g., Braveman et al. 1995; Grant 2000; Fishel Bartal et al. 2022; Yang et al. 2024; McGregor et al. 2025). We build on this work by leveraging uniquely comprehensive administrative data and a novel cost shifter to examine the forces leading to different rates of C-sections among Black and non-Hispanic White mothers, finding that one of the prime candidates for explaining high C-section use—provider discretion—can likely also help explain racial differences in delivery method.

Our work further relates to the literature aimed at documenting and understanding the forces underlying racial disparities in access to and use of health care services in the United States. Black Americans have worse health on average, as evidenced by higher rates of chronic disease and lower life expectancy than non-Hispanic White Americans (National Academies, 2017; CDC, 2023). While these health disparities are driven by many forces, including pronounced differences in many social determinants of health (Town et al., 2024), of particular concern for the medical community are racial differences in the health care received by patients (IOM, 2003). We add to work showing that racial disparities in treatment

2007). This elevated risk arises because disruptions to the labor process can interfere with hormonal and mechanical changes that clear fluid from the lungs and prepare the infant to breathe at birth.

[9] For example, work has considered the role of financial incentives and physician induced demand (Gruber and Owings, 1996; Gruber et al., 1999; Johnson and Rehavi, 2016; Fischer et al., 2025), patient appropriateness for C-sections (Currie and MacLeod, 2017; Robinson et al., 2024), and the legal environment (Currie and MacLeod, 2008) in explaining levels and trends in C-section use. We review the large literature on determinants of C-section use and discuss implications for racial disparities in delivery method in Section II.

are driven by differences in the providers that patients see (Jha et al., 2011; Chandra et al., 2024), the health insurance that patients hold (Yearby, 2011), and bias among practitioners (Stepanikova, 2012; Centola et al., 2021; Singh and Venkataramani, 2022), by showing that provider discretion likely plays a role in explaining racial differences in the burden of unnecessary C-sections. These results suggest that policies aimed at reducing C-sections and racial disparities in birth outcomes could usefully target unnecessary C-sections among low-risk Black women.

Lastly, this paper contributes to a growing literature that seeks to identify racial bias in decision-making. Researchers often employ "outcome tests"—such as those examining the success rate of police searches (Knowles et al., 2001) or the incidence of pretrial misconduct following bail decisions (Arnold et al., 2018)—to infer discrimination from differences in post-decision outcomes across groups. As emphasized by Canay et al. (2024), however, such tests are valid only under strong assumptions, including that decisions follow a consistent threshold rule and that unobserved heterogeneity correlated with group membership is orthogonal to either the decision or the outcome. In contrast, our approach does not rely on outcome differences to identify racial bias. Instead, we combine detailed clinical data with a machine-learning model of medical risk to capture the observable factors influencing physicians' C-section decisions and exploit plausibly exogenous variation in surgical capacity that shifts the cost of performing a C-section. This "supply-shock" design operates as a quasi-experiment on physicians' decision thresholds, allowing us to distinguish differences in thresholds from differences in underlying risk distributions without requiring full knowledge of those distributions. Although the supply shock allows us to identify differential treatment independently of outcomes, we find that maternal health is unaffected while infant outcomes improve when surgical capacity is constrained, suggesting that the additional C-sections performed on low-risk Black mothers when capacity is ample represent overuse.

The rest of the paper proceeds as follows. Section II provides a background about factors contributing to the use of C-sections. The data sources used in our study are described in Section III, and Section IV provides new evidence on the racial gap in C-section rates. Sections V and VI investigate the drivers of the disparity, while Section VII considers the health consequences. A discussion and conclusions are provided in Section VIII.

II Background

This section outlines the reasons that C-section rates could differ by race, reviews the related literature, and shows how the detailed nature of our data allows us to extend existing work. The channels considered include factors stemming from differences across mothers—including medical risk factors, preferences, insurance coverage, and health literacy—and factors stemming from differences across and within providers—including in the average propensity to perform a C-section and bias.

Differences across mothers Medical risk factors for C-section include conditions such as breech presentation (Yang and Mullen, 2020), obesity (Glazer et al., 2020), and older maternal age (Penfield et al., 2017). It is therefore important to control flexibly for these risk factors when evaluating the causes of racial disparities. However, Robinson et al. (2024) show that C-section rates among Black mothers are less responsive to underlying medical risks, suggesting that mechanisms other than differences in reported risk factors must be at work. Moreover, as we show in Section III, Black mothers in New Jersey have a lower risk of needing a C-section than White mothers based on their observable medical characteristics. Although Black mothers have higher rates of obesity, herpes, and a few other indications for a C-section, Black mothers are significantly younger on average, and maternal age is a strong predictor of having a C-section.

Racial disparities in C-section rates could also reflect differences in patient tastes. McCourt et al. (2007) summarize the existing literature on the subject and conclude that despite persistent claims that consumer demand is a significant driver of C-sections, very few women actually request them in the absence of medical risk factors.[10] The American College of Obstetricians and Gynecologists (ACOG) estimates that about 2.5 percent of U.S. births are C-sections due to maternal request (ACOG, 2019), suggesting that the vast majority of C-sections are performed for other reasons. These findings are in line with Dranove et al. (2011), who find that expecting parents tend to avoid practitioners who have higher than expected C-section rates. The analysis that follows focuses primarily on deliveries involving

[10] Weaver and Magill-Cuerden (2013) analyze the rise of the phrase "too posh to push" and conclude that "press handling of the topic has continued to contribute to the impression that Cesarean purely for maternal request is common."

a trial of labor to examine the population for whom C-section was not their *a priori* preferred delivery method.

Differences in insurance coverage might also contribute to racial differences in delivery method. Many studies have documented higher C-section rates among mothers covered by private insurance relative to public insurance, differences that are typically attributed to higher provider reimbursement rates among the privately insured (Hoxha et al., 2017). However, financial incentives for performing C-sections are still present under public insurance, and C-section rates among Medicaid beneficiaries rise when the fee differential between C-sections and vaginal deliveries increases (Gruber et al., 1999). It is thus important to control for insurance type when examining disparities in delivery method, as we do below.

Maternal characteristics such as health literacy have also been shown to be important determinants of C-sections (Yee et al., 2021). Using detailed data from California, Johnson and Rehavi (2016) show that higher fees for C-sections compared to vaginal deliveries are associated with higher C-section rates, except when the mother is a physician. One interpretation of this finding is that the superior health knowledge and/or self-advocacy of mothers who are physicians defends them against the imposition of unnecessary C-sections. If health knowledge and self-advocacy vary with race, then these factors could contribute to racial disparities in health care (Wiltshire et al., 2006). Although we cannot directly control for health literacy and self-advocacy, we will show that the racial gap in C-sections holds conditioning on maternal education, a strong correlate of these factors (WHO, 2013).

Differences across and within providers A large literature documents substantial variation in the propensity to perform C-sections on patients with similar observable medical risk factors across hospitals (Card et al., 2023), medical practices (Chauhan et al., 2008b), and individual physicians (Epstein and Nicholson, 2009; Dranove et al., 2011; Currie and MacLeod, 2017). To the extent that Black patients receive care at different hospitals, practices, or from different providers, such sorting could explain part of the observed differences in C-section rates (Fischer et al., 2025). Jha et al. (2011) and Chandra et al. (2024) find that Black patients tend to receive care in lower-quality hospitals, which may be correlated with both higher rates of unnecessary C-sections and failures to perform necessary ones. Among individual physicians, variation in the propensity to perform a C-section can be attributed to differences in financial incentives (Gruber and Owings, 1996; Gruber et al., 1999), legal environments (Currie and MacLeod, 2008), diagnostic and surgical skills (Currie and MacLeod, 2017), and recent experience performing the procedure (Singh, 2021). These findings underscore the key role providers play in determining the mode of delivery and motivate the inclusion of hospital and medical group or physician fixed effects in Section V below.

Implicit and explicit forms of bias on the part of individual practitioners may also contribute to racial differences in C-section rates (Williams et al., 2019). Using health records from two hospitals, Singh and Venkataramani (2022) show that the racial gap in in-hospital mortality widens when hospitals are capacity constrained, suggesting that practitioners are more likely to direct scarce time and resources toward White patients.[11] In the context of childbirth, Black patients are more likely to report feeling pressure from clinicians to take medication to start or speed up labor and to have a C-section (Logan et al., 2022). Race may also be "baked into" medical practice, such as through the use of algorithms that predict a lower probability of successful vaginal birth after Cesarean in Black patients with otherwise identical risk factors (Vyas et al., 2020).[12] As outlined in Section VI, we exploit variation in the costs of ordering an intrapartum C-section—generated by whether the delivery coincides with a pre-labor C-section—to test whether higher C-section rates among Black mothers reflect a greater propensity of physicians to perform additional C-sections on Black patients, all else equal.

One potential solution to provider bias is to prioritize racial (or gender) concordance between doctors and patients. In an influential experiment, Alsan et al. (2019) found that Black men were more likely to accept recommended preventive care from Black providers. Recent work by Hill et al. (2023), Ye and Yi (2023), and Gruber and Frakes (2025) shows that racial concordance between physicians and patients can lead to improved care and better patient outcomes. Greenwood et al. (2020) provide descriptive evidence suggesting that Black physicians significantly reduce Black infant mortality. Focusing on gender concordance,

[11]These findings are consistent with evidence from Stepanikova (2012) that time pressure can exacerbate racial bias in clinical decision-making.

[12]The inclusion of race in clinical prediction models remains widely debated (Briggs, 2022; Manski, 2022), although recent work suggests that not using all of the information available to clinicians—including patient race—may lead to worse expected health outcomes (Manski et al., 2023).

Cabral and Dillender (2024) find that female doctors are more likely than male doctors to approve workers' compensation claims for female patients. Survey data also suggests that racial, ethnic, and gender concordance is associated with higher participation in cancer screenings and other preventive health services (LaVeist et al., 2003; Malhotra et al., 2017). The importance of race and gender concordance in our setting is investigated below.

In summary, the existing literature points to multiple potential sources of racial gaps in C-section rates. Such disparities may reflect racial differences in the prevalence of medical risk factors, insurance coverage, or in the hospitals or providers from whom patients receive care; the analysis that follows will account for these factors. It appears less likely that racial gaps are driven primarily by differences in maternal demand, and we limit the influence of this channel by focusing most of our analysis on deliveries involving a trial of labor. The results indicate that the same providers treat Black and White mothers who are otherwise observably similar differently, and we will consider several possible explanations. In particular, our research design allows us to examine whether higher intrapartum C-section rates among Black mothers reflect physicians' beliefs that these patients are better candidates for the procedure in some unobservable way,[13] or a greater willingness of physicians to perform additional low-value procedures on Black women.

III Data

The primary data for this study come from 993,165 New Jersey Electronic Birth Certificate (EBC) records for 2008 to 2017. The EBC records include rich information on delivery method, maternal medical risk factors, complications during labor and delivery, hospital of delivery (68 unique hospitals), and attendant provider's name (1,704 unique providers). The data further include self-identified patient race and other sociodemographic characteristics including education, age, marital status, zip code of residence, and participation in Medicaid.[14]

[13]Physicians might believe that Black women are generally better candidates for C-section because of higher rates of maternal morbidity among Black mothers (Kennedy-Moulton et al., 2022).

[14]Information on the EBC records come from a medical form that is completed by a medical practitioner and a background form that is completed by the mother. Variables such as medical risk factors and method of delivery come from the former, whereas race, education, and marital status come from the latter.

To evaluate the role of the physician's practice and of racial and gender concordance, we supplement the birth records with novel data on the attending physician's current practice group, race, and sex. This information was compiled by googling each physician's name to find the provider on an obstetrical practice group's website and/or on LinkedIn.[15] The physician's photograph was used to code their race and sex. Of the 1,582 physicians observed delivering babies in New Jersey over our sample period, information on race and sex was coded for 1,120 (70.8 percent). Among these physicians, 624 were female (55.7 percent), 137 were Black (12.2 percent), and 110 were Black females (9.8 percent).

Lastly, hospital discharge data are linked to the EBC records to assess impacts on maternal and infant health (Gemmill et al., 2024). Postpartum maternal health is considered to be poor if any of the following conditions occur up to 90 days following the delivery: postpartum hemorrhage, major puerperal infection, venous complications, pyrexia, pulmonary embolism, and other postpartum complications. We consider infant health at birth to be poor if any of the following complications are present: admission to a NICU, 5-minute Apgar score below 7, mechanical ventilation, and significant birth injury. Because of changes in the way that complications have been coded over time, attention is restricted to the period 2008–2015 when considering health outcomes.

Predicting C-section risk The detailed information about medical risk factors available in the EBC records can be used to determine each mother's appropriateness for a C-section.[16] To do so, we use 448,895 births to White mothers over the sample period and a random forest algorithm.[17] The model is trained using only White mothers to capture the relationship between medical risk factors and C-section risk without potential confounding due to racial bias, although the results are very similar when mothers of all races are included in the

[15] This method follows Singh and Venkataramani (2022). Information on practice group is available for only 63 percent of physicians; specifications that control for practice group therefore include fewer observations than the primary sample.

[16] We include all 22 maternal risk factors listed in the EBC records: maternal age, anemia, birth order, breech presentation, cardiac disease, chronic hypertension, cord prolapse, diabetes, drug misuse, eclampsia, excessive weight gain, herpes, hypertension during pregnancy, macrosomia, multiple births, obesity, placenta previa, placental abruption, preeclampsia, previous C-section, renal disease, and Rh sensitization. See Table A1 for means of these risk factors by race.

[17] Compared to a model with a single decision tree, a random forest is less likely to be affected by outliers and overfitting. Compared to a logit, a random forest is more flexible in that it is not necessary to choose interaction terms manually.

training sample. The algorithm creates multiple individual decision trees, each using a random set of medical risk factors and a bootstrap subsample of births from a training sample with 70 percent of the sample births. The algorithm parameters, such as the number of trees and the number of medical factors in the random subset, are chosen by minimizing the "out-of-bag" error (i.e., the classification error for the subsamples in the training sample that are not included in a tree). The final random forest has 1,000 trees and randomly selects five medical risk factors for each tree. The predicted C-section risk for each mother is then computed by averaging the predictions over the decision trees.

The random forest produces credible results that are strongly predictive of actual delivery method.[18] Table A2 reports the importance of each risk factor in predicting the probability of having a C-section, where "importance" measures how much information the model gains from all splits of the trees that are made based on a given risk factor. Reassuringly, factors that are known to be important determinants of C-section appropriateness, such as previous C-section and breech presentation, stand out as important risk factors. Table A3 shows how well this measure of C-section risk predicts whether a White mother has a C-section. Births in the testing sample are sorted into deciles based on predicted C-section risk, and the actual and predicted C-section rate for each decile is reported. Comparing these rates by decile shows that the model does an excellent job sorting mothers into risk groups.

The baseline prediction model includes all 22 medical risk factors listed in the EBC records (reported in Table A1), consistent with prior work (Currie and MacLeod, 2017). While additional information in the birth records—including complications arising during labor and delivery and the use of other intrapartum management interventions—can, in principle, be used to predict C-section risk, two issues arise when incorporating these factors. First, although maternal risk factors on the EBCs are coded consistently over the full sample period, changes in the coding of labor and delivery complications and intrapartum interventions require a slightly shorter sample period when these variables are included in the random forest model (2008–2015 instead of 2008–2017). Second, the determination of several

[18] The area under the ROC curve (AUC) is higher for the random forest model than for a logistic regression model, indicating better separation between C-section and non-C-section cases. While the difference is small, it is statistically significant, and even modest improvements in AUC can be important for identifying high-risk mothers.

labor and delivery complications—such as arrested labor and fetal distress—is highly discretionary (e.g., Chauhan et al., 2008a; Langen et al., 2024), and intrapartum management interventions—such as epidural anesthesia or labor stimulation—are likely subject to the same discretionary forces that influence intrapartum C-section provision. For these reasons, these factors are not included in the primary analysis. Nonetheless, Table A4 shows that alternative approaches to predicting C-section risk yield individual-level measures that are highly correlated with our baseline measure. Moreover, Section VI.B demonstrates that our main results are robust to using risk measures generated from alternative models, training samples, and sets of variables (see Tables A17 and A18).

Sample restrictions We make three sample restrictions to arrive at the primary analysis sample. First, we focus on births to Black and non-Hispanic White mothers, reducing the sample to 646,656 births.[19] Second, we limit the sample to deliveries attended by a physician (M.D. or D.O.) with a valid National Provider Identifier (NPI), yielding 552,802 births for which the attending provider could have performed a C-section.[20] Finally, the primary analysis sample includes only births involving a trial of labor—excluding C-sections that were scheduled in advance or performed emergently before labor—resulting in 395,216 deliveries. Among these, 323,967 (82 percent) ended in a vaginal delivery, while 71,249 (18 percent) resulted in an intrapartum C-section.

Three considerations motivate our focus on deliveries involving a trial of labor. First, although more than two-thirds of C-sections in our data are either scheduled in advance or performed emergently before labor begins, racial disparities are most pronounced for C-sections that occur during a trial of labor, accounting for more than 60 percent of the overall gap in C-section rates. Understanding the sources of racial differences in intrapartum procedures is therefore essential to explaining disparities in delivery method overall. Second, despite a lack of supporting evidence, there is a persistent perception that C-sections are demand-driven by mothers who prefer the convenience of a scheduled delivery or wish to avoid the pain of labor. Because mothers who prefer a C-section can typically find a provider willing

[19]We also compare Hispanic and "other" (mostly Asian) mothers to White mothers in Section VI.B, although the starkest differences emerge between Black and White mothers.

[20]Midwives cannot perform C-sections.

to schedule one in advance (ACOG, 2019), excluding pre-labor C-sections focuses attention on women for whom a C-section was not the preferred delivery method. Finally, as outlined in Section VI and Appendix C, restricting the sample to deliveries involving a trial of labor enables us to exploit variation in the costs of ordering intrapartum C-sections that arises from the timing of pre-labor C-sections. We use this variation to test whether physicians view Black mothers as unobservably more in need of intrapartum C-sections than White mothers.[21]

Summary statistics Table 1 provides summary statistics by maternal race. We provide statistics both for the 395,216 births included in the primary analysis sample ("Deliveries with trial of labor") as well as all 552,802 births to Black or non-Hispanic White mothers delivered by a physician with a valid NPI ("All births"). As shown in panel (a), 44.1 percent of births among Black mothers in New Jersey from 2008–2017 were delivered by C-section compared to 39.5 percent among White mothers. While rates of both pre-labor and intrapartum C-sections are higher among Black mothers than White mothers, the racial gap is more pronounced for intrapartum C-sections.

C-section rates are higher among Black mothers despite the fact that Black mothers are predicted to be less in need of C-sections. As shown in panel (b), Black women on average have lower appropriateness for a C-section, especially when they have a trial of labor. This result is largely because Black mothers tend to be considerably younger than White mothers (see Table A1), and the random forest algorithm identifies maternal age as an important risk factor for C-section (Table A2). While Black mothers are therefore over-represented in the lowest risk quintiles, panel (b) shows that average risk conditional on risk quintile is quite similar between Black and White mothers.[22]

[21] If Black and White mothers have unequal access to pre-labor C-sections, there could be systematic differences in maternal risk factors or delivery preferences by race among mothers with a trial of labor. However, the analysis that follows directly controls for observable medical risk and includes a test for potential differences in unobserved medical risk, thereby addressing concerns about selection based on health status. Moreover, because Black mothers are more likely than their White counterparts to have pre-labor C-sections (see Table 1), unmet demand for C-sections among mothers with a trial of labor should, if anything, be higher among White mothers, thereby attenuating observed racial gaps in intrapartum C-section rates.

[22] In Table 1 and the subsequent analysis, risk quintiles are defined based on the distribution of predicted risk among mothers who had intrapartum C-sections. This approach was chosen because the primary focus of the analysis is on deliveries involving a trial of labor, and having an equal number of intrapartum C-sections in each quintile affords sufficient power to estimate the racial gap in intrapartum C-sections by risk level.

Average maternal and infant health outcomes are shown in panel (c) of Table 1. Postpartum complications for mothers and neonatal complications for infants are less common following deliveries involving a trial of labor than among all births. This difference is to be expected since pre-labor C-sections are frequently scheduled for the riskiest births. Notably, however, maternal and infant complications are more likely among Black mothers than among White mothers, both for all births and for the subset of deliveries with a trial of labor. Among deliveries involving a trial of labor, 7.1 percent of Black mothers have at least one postpartum complication compared to only 5.9 percent of White mothers. Similarly, 11.3 percent of infants born to Black mothers with a trial of labor have any neonatal complication compared to 7.1 percent among babies born to White mothers.

Black and White mothers further differ in terms of their sociodemographic characteristics and the characteristics of the providers that they see. As shown in panel (d) of Table 1, Black women are more likely to be covered by Medicaid, are less likely to have a college degree, and are less likely to be married than White women. Moreover, panel (e) shows that Black women are more than twice as likely to have an attendant physician who is Black (19.7 versus 8.6 percent). However, since most doctors are White, nearly half of all Black infants are delivered by White doctors. There is no apparent racial difference in the degree of attendant physicians (M.D. versus D.O.), although White women are somewhat more likely to have a female physician (47.3 versus 41.8 percent) and a physician who was trained in the United States (70.1 versus 59.2 percent).

IV Racial disparities in C-section rates

Using data from the National Vital Statistics birth records, Figure 1 shows annual C-section rates among Black and non-Hispanic White mothers across the United States and in New Jersey from 2003 to 2018. While C-section rates in New Jersey are higher than the national average for White and Black mothers, a pronounced racial gap in C-section rates is evident both nationally and in New Jersey. Moreover, the racial gap in C-section rates began to widen in the mid-2000s as C-section rates for White mothers started to fall while those for

Figure A1 shows the distribution of maternal risk by race among births with a trial of labor.

Black mothers continued to rise for much of the period.[23]

Figure 2 shows the share of New Jersey births delivered by C-section by maternal race and risk quintile in the EBC records.[24] Subfigure (a) uses the entire sample of births and plots the share of mothers in each race-risk group who had a C-section (pre-labor or intrapartum). Subfigure (b) also uses the entire sample of births but plots the share of mothers in each race-risk group that had a pre-labor C-section, whereas subfigure (c) focuses on deliveries involving a trial of labor and plots the share of mothers with intrapartum C-sections. The right subplots in each subfigure provide the relative effect for Black mothers for each C-section type by risk quintile, which is calculated by dividing the difference in C-section rates between Black and White mothers by the C-section rate among White mothers.

Unsurprisingly, the left subplots in Figure 2 show that the likelihood of delivery by C-section is increasing in the mother's appropriateness for the surgery. Notably, however, the probability of having any C-section (pre-labor or intrapartum) is significantly higher for Black mothers than for White mothers in all but the highest risk quintile (Figure 2(a)). As shown in Figure 2(b), pre-labor C-sections are more evenly distributed by race, though Black mothers remain more likely to have pre-labor C-sections in all but the highest risk quintile.

The higher C-section rate among low-risk Black mothers is therefore primarily driven by intrapartum procedures. As shown in Figure 2(c), Black mothers with a trial of labor are significantly more likely to deliver by C-section than White mothers across most of the risk distribution. Strikingly, among mothers in the lowest risk quintile, Black women are 162.3 percent (p-value < 0.001) more likely to have an intrapartum C-section than White women. The relative effect for Black mothers declines steeply with risk, with Black women with a trial of labor in the highest risk quintile no more likely that White women to deliver by C-section (1.2 percent, p-value $= 0.818$).

Figure A3 examines how C-section rates and C-section risk vary by gestational age. The left (right) subplots show average C-section rates (risk) by weeks of gestation. As in

[23] The fall in C-section rates among White mothers in New Jersey after 2007 and the slight decline among Black mothers in New Jersey after 2014 correspond to important ACOG announcements indicative of efforts to reduce C-section rates. In 2007, ACOG made a statement against conducting non-medically indicated C-sections before 39 weeks, while in 2014, ACOG issued guidelines aimed at preventing C-sections for first births by allowing women to labor for longer.

[24] Figure A2 shows an analogous figure by unweighted deciles of maternal risk (i.e., risk of 0–0.1, 0.1–0.2, etc.) rather than risk quintiles with equal numbers of intrapartum C-sections.

Figure 2, subfigure (a) considers all C-sections (pre-labor and intrapartum), subfigure (b) considers pre-labor C-sections, and subfigure (c) considers intrapartum C-sections. Across all gestational ages, Black mothers who undergo C-sections have systematically lower medical risk for the procedure than White mothers.[25]

V Drivers of C-section disparities: role of observables

As outlined in Section II, racial disparities in C-section rates could be driven by a number of factors, including racial differences in maternal demand, maternal medical risk, maternal sociodemographics, selection into different providers, and/ or provider bias. In what follows, we focus on C-sections performed during a trial of labor ("intrapartum C-sections") to minimize the role of maternal demand by restricting the sample to mothers who attempted labor rather than opting to schedule a pre-labor C-section in advance. This section examines how racial disparities in intrapartum C-section rates change when controls for observable maternal risk, maternal sociodemographics such as education and Medicaid coverage, and selection into providers are included. Section VI then considers the drivers of racial disparities in intrapartum C-section rates that persist among observationally equivalent mothers delivering in the same hospital, with a particular focus on the potential roles played by unobserved differences in medical risk and provider discretion.

V.A Conditioning on controls

To explore the importance of observable characteristics of the mother and selection into providers, we leverage the detailed nature of our data to estimate specifications of the fol-

[25]Figure A3 further shows that Black mothers are less likely than White mothers to have a C-section before 37 weeks of gestation. However, because only a small share of births occur before this point, this difference has little impact on overall rates. After 37 weeks, Black mothers become more likely to have intrapartum C-sections, and after 39 weeks, more likely to have pre-labor C-sections. The medical risk for C-section among mothers receiving pre-labor C-sections drops sharply after 39 weeks, consistent with earlier pre-labor C-sections reflecting stronger medical indications for surgery. In contrast, the medical risk among those undergoing intrapartum C-sections declines more gradually with gestational age.

lowing form:

$$C\text{-}section_{iodmyhpg} = \beta \cdot Black_i + \delta_o \cdot Day\ of\ week_d + \gamma_{my} + \alpha \cdot X_i + \gamma_h + \gamma_g + \gamma_p + \epsilon_{iodmyhpg}, \quad (1)$$

where $C\text{-}section_{iodmyhpg}$ is an indicator denoting whether mother i giving birth at hour o on day d in month m and year y in hospital h with physician p from practice group g had a C-section, $Black_i$ is an indicator denoting Black mothers, $Day\ of\ week_d$ is a full set of day-of-week fixed effects, γ_o are hour-of-day fixed effects, and γ_{my} are month-by-year fixed effects.[26]

Additional controls are progressively added to the specification to see how their inclusion changes the association between race and the probability of having a C-section. In particular, we include a vector of maternal characteristics X_i that includes medical appropriateness for a C-section based on the random forest algorithm (see Section III) and the socioeconomic controls outlined in Table 1. We further include fixed effects for hospital (γ_h), practice group (γ_g), and physician (γ_p). Standard errors are clustered by hospital. The sample is restricted to deliveries involving a trial of labor among Black and White mothers, and thus β captures the differential probability that Black mothers with a trial of labor have an intrapartum C-section relative to White mothers. In much of what follows, we divide β by the mean intrapartum C-section rate among White mothers to derive the relative effect for Black mothers.

Results from estimation of equation (1) are shown in Table 2. Column (1) reports the baseline disparity (i.e., including only controls for month-by-year and hour-by-day of week fixed effects). The estimate indicates that Black mothers with a trial of labor are 4.2 percentage points more likely to deliver by C-section than White mothers. Compared to the average rate of intrapartum C-sections among White mothers (16.8 percent), the estimate indicates that Black mothers with a trial of labor have a 25.2 percent (p-value $= 0.002$) higher probability of delivering by C-section than their White counterparts.

[26] By interacting hour-of-day fixed effects with day-of-week fixed effects, the specification controls for the full set of hour-by-day of week fixed effects. These fixed effects are included because C-sections—both pre-labor and intrapartum—are much less common during the night and on weekends (see Figure A5).

Columns (2)–(6) of Table 2 show how the relative effect for Black mothers changes as additional controls are progressively added to the specification. Since Black women are predicted to have lower medical risk on average, controlling for medical risk increases the relative effect for Black mothers from 25.2 to 37.2 percent (column (2)). Controlling for the mother's health insurance, marital status, and education reduces the relative effect to 25.5 percent, indicating that some of the gap can be explained by differences in socioeconomic characteristics (column (3)). Controlling for the hospital of delivery further reduces the gap from 25.5 to 20.3 percent (column (4)). Once hospital fixed effects are added, controlling for the provider's practice or the individual provider has little further impact. The fully saturated model in column (6) indicates that the same physician treating observably similar women in the same hospital is 19.4 percent (p-value < 0.001) more likely to perform an intrapartum C-section on a Black mother than on a White mother.

The last column of Table 2 shows estimates from estimation of equation (1) using all births and focusing on pre-labor C-sections as the outcome.[27] While Black mothers are more likely to have both pre-labor and intrapartum C-sections, the relative effect for Black mothers is smaller for pre-labor C-sections (11.8 percent, p-value < 0.001). As women with pre-labor C-sections frequently have risk factors that make them appropriate candidates for a C-section, this result is in line with the finding in Figure 2 that the racial gap in C-section rates is larger among lower risk mothers.

An alternative way to control for maternal characteristics is to estimate equation (1) separately on subsamples of the data defined by insurance, education, and marital status. As shown in Table A5, Black women with a trial of labor have higher probabilities of delivering by C-section in each category. The relative effect for Black mothers varies from 12.5 percent for unmarried women to 26.9 percent for college-educated women. Similarly, Table A6 shows additional splits of the data by when prenatal care began, child parity, and whether the hour of delivery is during normal business hours. Notably, Black women with trials of labor for births of higher parity are 40.9 percent more likely to have a C-section than White mothers. The relative effect for Black mothers is slightly higher during normal business hours compared

[27]Since practice group could not be determined for all physicians, and because practice is fixed within providers in our data, our preferred specification moving forward includes physician fixed effects γ_p in lieu of practice group fixed effects γ_g.

to at night (20.5 versus 17.5 percent), a pattern that is consistent with additional C-sections being done on Black mothers when resources are readily available. Table A6 also shows estimates that include a control for whether labor was induced or stimulated, as well as fixed effects for the zip code of the mother as an additional indicator of socioeconomic status. The estimates are very similar with these additional controls.

Complications during labor and delivery To further assess whether racial differences in delivery method are driven by differences in medical risk, we ask how complications during labor and delivery vary by maternal race. Specifically, equation (1) is estimated using indicators for labor and delivery complications recorded in the EBC as outcomes, rather than the intrapartum C-section indicator.[28] As outlined in Section III, discretionary diagnoses such as "arrested labor" and "fetal distress" are likely endogenous, and thus these variables were excluded from the baseline random forest model. Nevertheless, Section VI.B below shows that the results are robust to including labor and delivery complications when predicting maternal C-section risk.

Figure A4 shows that among deliveries involving a trial of labor, Black mothers are no more likely than White mothers to experience most labor and delivery complications, including arrested progress, prolonged labor, and premature or prolonged rupture of membranes. While physicians are more likely to report non-reassuring fetal heart rate patterns, moderate to heavy meconium staining, and fetal distress among Black mothers, these complications have been criticized for their lack of clinical specificity, susceptibility to inter- and intra-observer variability, and, in the case of fetal heart tracings and fetal distress, limited predictive value for neonatal outcomes (ACOG, 2005; Chauhan et al., 2008a; Gravett et al., 2016; Bolten and Chandraharan, 2019; Langen et al., 2024). Moreover, Black mothers are significantly more likely to experience precipitous labor and significantly less likely to have cord complications, both of which should reduce the likelihood of a C-section relative to White mothers. Strikingly, as shown in Table A7, Black mothers are 19 percent (p-value < 0.001) more likely than White mothers to undergo an intrapartum C-section with no documented labor or delivery complication in the medical record. This estimate closely mir-

[28]Lacerations (with or without hemorrhage) and shoulder dystocia are excluded from these analyses, as these complications result from vaginal delivery rather than influencing the mode of delivery.

rors the overall racial disparity in intrapartum C-section rates conditional on controls (19.4 percent, p-value < 0.001), providing compelling evidence that medical factors alone cannot account for the observed racial differences in intrapartum C-sections.

Of course, there might be unobservable (to the econometrician) characteristics of mothers that correlate with race and affect a doctor's propensity to perform a C-section. Section VI below examines the role of differences in unobserved medical risk by exploiting variation in the costs of ordering intrapartum C-sections. Here, we apply the intuition outlined in Altonji et al. (2005) and Oster (2019) to consider the potential importance of unobservable maternal characteristics in our setting. As shown in the first three columns of Table 2, controlling for maternal medical risk and sociodemographic variables increases the gap between White and Black mothers, implying that selection on unobservable maternal characteristics would have to be opposite in sign compared to selection on observable maternal characteristics to explain the relationship between maternal race and the probability of having an intrapartum C-section. This is true even when first controlling for selection into providers: as shown in Table A8, the relative effect for Black mothers increases from 15.4 percent to 19.4 percent when conditioning on observable maternal characteristics in specifications with hospital and physician fixed effects. Standard tests of selection on unobservables therefore suggest that unobservable maternal characteristics are unlikely to be important in explaining racial differences in delivery method, in line with the findings in Section VI below.

V.B Role of observables across the risk distribution

Equation (1) implicitly assumes that the effect of race is the same across the risk distribution. To allow the effects of race to vary with maternal risk (as in Figure 2), we estimate the following extension of equation (1):

$$\begin{aligned} C\text{-}section_{iodmyhp} = & \sum_{q\in[1,4]} \alpha_q \cdot R_i^q + \sum_{q\in[1,5]} \beta_q \cdot R_i^q \cdot Black_i \\ & + \delta_o \cdot Day\ of\ week_d + \gamma_{my} + \alpha \cdot X_i + \gamma_h + \gamma_p + \epsilon_{iodmyhp}, \end{aligned} \tag{2}$$

where R_i^q is an indicator for whether mother i is in risk quintile q. As in equation (1), the additional controls are added sequentially to assess how estimated racial disparities across the risk distribution change when observable maternal characteristics and selection into providers are taken into account.

Results from estimation of equation (2) are plotted in Figure 3 and reported in Table A9. Recall from Figure 2(c) that the baseline disparity in C-section rates is more pronounced among mothers with a lower predicted risk of needing a C-section: Black mothers with a trial of labor in the lowest risk quintile are 162.3 percent (p-value < 0.001) more likely to have a C-section than White mothers. Although there are slight differences in C-section risk by race within each risk quintile grouping, Black mothers in the lowest risk quintile are still 155 percent (p-value < 0.001) more likely to have an intrapartum C-section when controlling for a continuous measure of C-section risk.[29] After controlling for time fixed effects, further controlling for the socioeconomic status of the mother reduces the relative effect of being Black for the lowest risk mothers from 150.1 to 101.2 percent. Hence, in an accounting sense, about one-third of the baseline disparity for low-risk mothers can be "explained" by factors such as maternal education, insurance, and marital status, though it is unclear why these factors should be important in the C-section decision once medical risk is taken into account.[30] Moreover, even conditional on these controls and hospital and physician fixed effects, low-risk Black mothers remain 71.7 percent more likely than White mothers to have an intrapartum C-section (p-value < 0.001). In the highest risk quintile, the relative effect for Black mothers changes from a statistically insignificant 1.2 percent (p-value $= 0.818$) to an insignificant -3.9 percent (p-value $= 0.301$) conditional on these controls.

V.C Physician-specific estimates and the role of concordance

To examine the way that individual physicians treat mothers who are observably similar except for their race, Figure 4 plots provider-specific propensities to perform intrapartum C-sections on Black mothers against the same provider's propensity to perform intrapartum C-sections on White mothers. These propensities come from estimation of an analogue of

[29] The estimates are very similar when higher-order polynomials of C-section risk are included.

[30] One interpretation is that women who are less educated, enrolled in Medicaid, and/or unmarried may face greater difficulty refusing unnecessary C-sections, and that Black women are disproportionately represented among these groups. We examine the role of race versus class in Section VI.B.

equation (1) that includes all of the controls in column (6) of Table 2 and interacts the physician fixed effect with separate indicators for whether the mother is Black or White. As shown in Figure 4, most sample physicians have a higher propensity to perform intrapartum C-sections on Black mothers than on observationally similar White mothers (i.e., the estimates are above the 45-degree line). Although the estimates begin to move below the 45-degree line for doctors who perform intrapartum C-sections on a very high share of White mothers, over 70 percent of all deliveries with a trial of labor (75 percent of deliveries with a trial of labor among Black mothers) over the sample period were delivered by physicians who were more likely to perform intrapartum C-sections on Black mothers.

We further explore whether racial gaps systematically vary with observable physician characteristics. Given prior evidence on the importance of racial and gender concordance between physicians and patients, we estimate analogues of equation (1) that include an indicator for whether the physician is Black or female, as well as an interaction between this indicator and the indicator for a Black mother. Because race and gender are fixed at the physician level, physician fixed effects are excluded from these specifications. For example, letting $Black_p$ be an indicator denoting whether physician p is Black, we estimate the following specification:

$$\begin{aligned} C\text{-}section_{iodmyhp} =& \beta_1 \cdot Black_i + \beta_2 \cdot Black_p + \beta_3 \cdot Black_i \cdot Black_p \\ &+ \delta_o \cdot Day\ of\ week_d + \alpha \cdot X_i + \gamma_{my} + \gamma_h + \epsilon_{iodmyhp}, \end{aligned} \tag{3}$$

to assess whether the racial gap in intrapartum C-sections is larger or smaller when patients are treated by Black physicians. We also estimate analogous specifications that replace $Black_p$ with an indicator for whether the physician is female to examine whether the racial gap differs among female physicians.

Results from estimation of equation (3) are shown in Table 3. Column (1) shows that Black doctors are just as likely as non-Black physicians to perform intrapartum C-sections. Although the difference is not statistically significant (p-value = 0.190), there is suggestive evidence that Black physicians may be less likely to perform additional C-sections on Black mothers: the relative effect for Black mothers is 21.6 percent (p-value < 0.001) among patients treated by non-Black physicians and only 13.8 percent (p-value < 0.001) among those treated by Black physicians. Column (2) shows that, although female physicians are slightly less likely to perform intrapartum C-sections overall, there is no evidence that the racial disparity differs between female and male physicians.

Heterogeneity analyses by additional physician characteristics are presented in Table A10. D.O.s perform significantly fewer additional intrapartum C-sections on Black mothers compared to M.D.s, with a relative effect for Black mothers of 20.9 percent (p-value $<$ 0.001) when treated by an M.D. versus only 9.1 percent (p-value $= 0.108$) when treated by a D.O. There are no significant differences in overall intrapartum C-section rates or in racial disparities by physician training location or medical school rank, although there is suggestive evidence that the racial gap is smaller among U.S.-trained physicians (16.8 percent versus 25.0 percent, p-value on difference $= 0.103$).

VI Drivers of C-section disparities: provider discretion

There are at least two potential explanations for racial disparities in intrapartum C-section rates that persist conditional on a rich set of patient controls and provider fixed effects. First, even though we are able to observe more information about mothers than is typically available to researchers, there could be differences in unobservable risk factors that are correlated with race, affect a mother's appropriateness for a C-section, and are only observed by physicians. Put differently, Black mothers might be unobservably (to the econometrician) riskier than the random forest algorithm predicts. Alternatively, it could be that providers are exercising their discretion and are more likely to conduct low-value C-sections on Black mothers.

As outlined below, we exploit variation in the costs of ordering intrapartum C-sections generated by the timing of pre-labor C-sections—which are either scheduled in advance or performed emergently before labor begins—to separate these two potential explanations. We further discuss how the findings are more consistent with a reduction in unnecessary intrapartum C-sections among Black mothers when surgical capacity is limited, rather than with a deprioritization of care for Black patients, whether for necessary or unnecessary procedures.

VI.A Exploiting variation in costs

If an obstetrical unit has only a few operating theaters that are designated for C-sections, then the costs of ordering a C-section will be higher when those theaters are already in use. As shown in Table A11, it is very rare for a hospital in New Jersey to have two or more C-sections in any given birth hour. Indeed, there are only three hospitals out of 64 that have two or more C-sections in a given birth hour more than five percent of the time, with a maximum of 10 percent of birth hours having two or more C-sections in the hospital with the highest C-section capacity.[31] If persistent gaps in intrapartum C-section rates are driven by unobserved differences in health risk, with Black patients being unobservably more in need of C-sections than their White counterparts, then providers should reduce intrapartum C-sections more among White mothers with the same observed medical risk when the costs of ordering a C-section rise.[32] In this case, the racial gap in intrapartum C-section rates will be *higher* at times when there is a pre-labor C-section. In contrast, if the persistent gap is driven by provider discretion, with the intrapartum C-sections undergone by Black patients being less medically necessary than those undergone by White patients, then physicians should cut back on C-sections among Black mothers more when the costs rise. That is, the racial gap in intrapartum C-sections should be *lower* when the birth occurs at the same time as a pre-labor C-section. Appendix C outlines a conceptual framework that formalizes this intuition.

Figure 5(a) shows the distribution of pre-labor and intrapartum C-sections across hours of the day. Pre-labor C-sections are concentrated during the day shift, peaking at 8am and then falling fairly continuously throughout the day.[33] In contrast, intrapartum C-sections

[31] Table A20 shows that the estimates are robust to excluding the four hospitals with the highest rates of hospital-day-hours with three or more C-sections (i.e., the hospitals with the highest C-section capacity). In addition to a limited number of dedicated operating theaters, conversations with physicians suggest that the number of anesthetists on duty is also a key factor limiting the ability to have multiple C-section deliveries simultaneously.

[32] Absent controls for observed medical risk, changes in intrapartum C-section rates for Black and White mothers during periods of limited surgical capacity could reflect differences in the distribution of observed risk across racial groups. That is, if physicians raise a race-neutral threshold for performing a C-section when capacity is limited, rates will decline more for the group with a higher concentration of observed risk between the original and new thresholds. To capture differences in the distribution of unobserved medical risk, we control for observed medical risk.

[33] Because some pre-labor C-sections are performed on an emergency basis, their number does not fall to zero overnight. However, the concentration of pre-labor C-sections during daytime hours reflects the fact

increase as pre-labor C-sections decline, reaching a peak around 8pm and falling overnight until approximately 7am. As shown in Figure 5(b), which presents regression-adjusted intrapartum C-section rates by race, this temporal pattern is more pronounced among Black mothers: while intrapartum C-sections among White mothers remain relatively low during regular business hours, intrapartum C-sections among Black mothers rise steadily over the course of the day.

The negative correlation between pre-labor and intrapartum C-sections is most evident among intrapartum C-sections for low-risk mothers. Figure A6(b) shows that intrapartum C-sections are fairly evenly distributed across the day for high-risk mothers of both races, aside from declines around shift changes. In contrast, the inverse relationship between pre-labor and intrapartum procedures is apparent for low-risk mothers of both races (Figure A6(a)), with the pattern particularly pronounced for low-risk Black mothers during the day shift. If intrapartum C-sections were being driven by unobserved medical risk, then there would be no reason for them to show this predictable temporal pattern that is strongly negatively correlated with the pattern of pre-labor C-sections.

To formalize the connection between pre-labor and intrapartum C-sections, we examine how the probability of an intrapartum C-section changes when a delivery involving a trial of labor coincides with a pre-labor C-section at the same hour. As in the primary specification below (see equation (4)), these regressions include hour-by-day of week fixed effects. With these fixed effects, the results are not driven by systematic across-hour variation in the prevalence of pre-labor C-sections. Instead, identification comes from idiosyncratic within hour-by-day of week variation in the timing of pre-labor C-sections.[34] This variation arises because the number of mothers scheduling pre-labor C-sections is limited, so most birth hours have no scheduled procedures, as well as from random variation in the arrival of emergent pre-labor births.

As shown in Table A12, mothers are 9.3 percentage points—or 51.3 percent of the mean of

that many are scheduled in advance.

[34] To illustrate, consider two mothers with trials of labor delivering at 8 a.m. on a Monday at the same hospital but in different weeks. For one mother, the delivery happens to coincide with a pre-labor C-section (that is, there was a pre-labor C-section at 8 a.m. on that Monday), while for the other it does not. The regression compares the probability that each mother delivers by intrapartum C-section based on this difference, conditional on medical risk, other observable maternal characteristics, and the attending physician.

18.1 percent—less likely to deliver by intrapartum C-section when there is a concurrent pre-labor C-section. Notably, intrapartum C-sections are also significantly less likely in the hour before and the hour after a pre-labor C-section, indicating that clinicians do not simply push back procedures of either type in response to the other.[35] Moreover, as shown in Table A13, the trade-off between pre-labor and intrapartum C-sections is very similar when the data are aggregated to the hospital-day or even to the hospital-week level, further indicating that intrapartum C-sections are not just deferred to a time when there is no pre-labor C-section (or vice-versa).[36] These patterns highlight how the timing of pre-labor C-sections—which are frequently scheduled in advance—affect decisions about whether to order intrapartum C-sections and suggest that medical necessity is not the only driver of C-section rates.

To examine how the racial gap changes when the costs of ordering an intrapartum C-section rise, we estimate an analogue of equation (1) that allows the effect of being Black to vary depending on whether there was a concurrent pre-labor C-section in the same hospital at the hour of delivery. Again letting $C\text{-}section_{iodmyhp}$ denote a C-section for mother i giving birth at hour o on day d in month m and year y at hospital h with physician p, we estimate specifications of the following form:

$$\begin{aligned} C\text{-}section_{iodmyhp} =& \beta_1 \cdot Black_i + \beta_2 \cdot ConcurrentCS_{odmyh} \\ &+ \beta_3 \cdot Black_i \cdot ConcurrentCS_{odmyh} \\ &+ \delta_o \cdot Day\ of\ week_d + \alpha \cdot X_i + \gamma_{my} + \gamma_h + \gamma_p + \epsilon_{iodmyhp}, \end{aligned} \tag{4}$$

where $ConcurrentCS_{odmyh}$ denotes whether there was a concurrent pre-labor C-section. All other variables are defined as in equation (1), and standard errors are again clustered by hospital.

Estimates of equation (4) are reported in the third column of Table 3. When there is no pre-labor C-section at the hour of delivery, 17.6 percent of White mothers with a trial

[35]There is some evidence that intrapartum C-sections are somewhat more likely two hours before and after a pre-labor C-section. However, the impacts are substantially smaller than the reductions in the three-hour window surrounding the pre-labor procedure (i.e., hours -1, 0 and 1), leading to aggregate reductions in intrapartum C-sections on days and in weeks with more pre-labor procedures (Table A13).

[36]These specifications control for the total number of births at the time-unit level to avoid any mechanical relationship between pre-labor and intrapartum C-section rates that could arise if variation in scheduled pre-labor deliveries drives fluctuations in total births.

of labor deliver by C-section. Black mothers with a trial of labor are 3.5 percentage points more likely to deliver by C-section in the same situation, meaning that Black mothers are 19.7 percent more likely to have an intrapartum C-section than White mothers when there is no concurrent pre-labor C-section. When there is a concurrent pre-labor C-section, the rate of intrapartum C-sections falls for both White and Black mothers. Only 9.1 percent of White mothers with a trial of labor deliver by C-section when the birth occurs at the same time as a pre-labor C-section. Strikingly, however, the rate of intrapartum C-sections falls by an additional 3 percentage points among Black mothers, leading the relative effect for Black mothers to fall from 19.7 percent (p-value < 0.001) to a statistically insignificant 5.9 percent (p-value $= 0.673$).

Figure 6 and Table A14 present estimates from an extension of equation (4) that allows the effects to vary by risk quintile, as in equation (2). The results show that the higher probability of intrapartum C-section among low-risk Black mothers first documented in Figure 2(c) is entirely driven by deliveries that occur when there is no concurrent pre-labor C-section. When a birth coincides with a pre-labor C-section, there is no statistically significant elevation in the risk of an intrapartum C-section for low-risk Black women. This narrowing of the racial gap when the costs of ordering intrapartum C-sections are higher is consistent with provider discretion—rather than differences in unobserved medical risk—driving the higher rates of intrapartum C-sections among Black mothers when surgical capacity is ample.

A potential alternative explanation for the reduction in intrapartum C-sections among Black mothers shown in Table 3 is a deprioritization of Black patients when surgical capacity is limited. As documented by Singh and Venkataramani (2022), Black patients receive less care when hospitals are busy. However, as shown in Figure 6 and Table A14, we find no differential reduction in intrapartum C-section rates between Black and White mothers at higher levels of predicted C-section risk when surgical capacity is limited. Instead, differential reductions appear only among Black mothers in the lowest two risk quintiles, a pattern more consistent with physicians cutting back on the least necessary C-sections in response to higher surgical costs. Moreover, if clinicians were broadly reducing care for Black mothers—including necessary care—when capacity is constrained, maternal or infant outcomes should deteriorate during these periods. Instead, as shown in Section VII below, we find no adverse effects on maternal health and observe improvements in Black infant health when surgical capacity is limited. Taken together, these findings suggest that the observed reductions are unlikely to reflect a general deprioritization of care for Black mothers. At the same time, discrimination by physicians could plausibly underlie both the deprioritization of care under strain documented by Singh and Venkataramani (2022) and the higher rates of discretionary intrapartum C-sections among Black mothers observed in our setting when surgical capacity is ample.

VI.B Extensions and robustness

Extensions Two additional sets of analyses are conducted to examine disparities among other racial groups and the relative importance of race versus class. First, the analysis up to this point has focused on differences between Black and non-Hispanic White mothers. Table A15 provides estimates comparing non-Black Hispanic (columns (3)–(4)) and "Other race" mothers (column (5)–(6)) to non-Hispanic White mothers. In New Jersey, the other race category is 80 percent Asian, but also includes Native Americans, Pacific Islanders, and people who self-classify as "other." Hispanic and other race mothers are more likely to have intrapartum C-sections than non-Hispanic White mothers, although the racial gaps are smaller than the gap between Black and White mothers. Moreover, when the costs of ordering an intrapartum C-section are higher due to the timing of pre-labor C-sections, the racial gap is significantly reduced only for Black mothers. This result suggests that physicians view the additional intrapartum C-sections performed on Black mothers when capacity allows as more marginal than those performed on mothers of other races.

The second extension explores the relative importance of race versus class. Since Black mothers have lower education than White mothers on average (Table 1), physicians might be systematically treating less educated patients—rather than Black patients *per se*—differently from their more educated counterparts. This mechanism would be particularly relevant if disparities were driven by differences in communication, patient self-advocacy, or health literacy, all of which have been posited in the literature as potential sources of differential treatment (e.g., Wiltshire et al., 2006; Johnson and Rehavi, 2016; Alsan et al., 2019; Yee et al., 2021).

Table A16 presents results from estimating equations (1) and (4), restricting the sample to White mothers with a trial of labor and replacing the indicator for Black mothers with an indicator for mothers with a high school degree or less ("low education"). As shown in column (2), low-education White mothers are slightly more likely (2.1 percentage points, or 12.2 percent) to have an intrapartum C-section than comparable White mothers with higher education. However, there is no differential reduction in intrapartum C-sections between more and less educated White mothers when the birth coincides with a pre-labor C-section (column (4)), suggesting that the additional intrapartum C-sections among less-educated White mothers are not viewed as more marginal by physicians. This pattern stands in sharp contrast to the results by race, where physicians significantly reduce the additional intrapartum C-sections conducted on low-risk Black mothers when capacity is more limited.

Robustness This section presents three additional sets of sensitivity analyses to assess the robustness of our findings. First, Tables A17 and A18 report results using alternative models and sets of risk factors to predict maternal C-section risk. Across specifications, the estimates are highly consistent. As shown in Table A17, estimates from equations (1) and (4) are very similar when a logit model is used in place of a random forest, as well as when the random forest is trained on mothers of all races rather than only on White mothers. Although changes in the coding of complications during labor and delivery (listed in Table A2) require a slightly shorter sample period when these variables are included (2008–2015 instead of 2008–2017), and some complications may themselves reflect provider discretion (Chauhan et al., 2008a; Langen et al., 2024), the results remain similar when these additional factors are incorporated into the prediction model (Table A18). The findings are also robust to the inclusion of other medical decisions that may influence the likelihood of an intrapartum C-section, such as epidural administration or labor stimulation. Because these decisions are highly discretionary and potentially correlated with physicians' C-section choices, their inclusion could constitute "bad controls" that bias the estimated effects (Angrist and Pischke, 2009). Nonetheless, the takeaways do not change when these variables are added.

Second, the analyses are re-estimated controlling for a cubic in maternal C-section risk rather than a linear term. This check is important because the empirical design relies on comparing mothers with similar observed medical risk when distinguishing physician discretion from unobserved risk differences (see Footnote 32). Consistent with the quintile-based results, which show robustness to controlling for C-section risk non-parametrically, Table A19 shows that estimates of equation (4) are nearly identical whether C-section risk is modeled linearly or with a higher-order polynomial.[37]

Finally, we analyze two subsamples to verify that the effects are concentrated in the expected settings and time periods. First, because a concurrent pre-labor C-section is likely to raise the costs of ordering an intrapartum C-section more in hospitals with limited surgical capacity, the models are re-estimated excluding the four hospitals with the highest C-section capacity, as identified in Table A11. As shown in Table A20, the results are more pronounced when these hospitals are excluded: among the remaining 60 hospitals, the reduction in intrapartum C-sections during hours with pre-labor C-sections is large enough to eliminate the racial gap in intrapartum C-section rates across the entire risk distribution. Second, building on the insight that intrapartum C-sections performed during daytime hours—when more staff are typically available—are likely to be more discretionary, we estimate the models separately for day (8 a.m.–8 p.m.) and night (9 p.m.–7 a.m.) shifts. Table A21 shows that the additional reduction in intrapartum C-sections among Black mothers when a birth coincides with a pre-labor C-section is concentrated during daytime hours.

VII Impacts on maternal and infant health

An important question is whether the additional C-sections performed on Black mothers affect maternal and infant health. To address this, we estimate extensions of equation (4) that relate measures of poor postpartum maternal and infant health to plausibly exogenous variation in intrapartum C-sections generated by the timing of pre-labor C-sections.

If marginal intrapartum C-sections performed on low-risk women are unnecessary, then reducing their use should either have no effect on health or improve outcomes. If, on the other hand, these apparently low-risk women have unobservable risk factors that make them good

[37] As an additional test, Figure 6 is replicated controlling for a cubic in C-section risk *within* each risk quintile. The results are nearly identical to those shown in Figure 6.

candidates for a C-section, then reductions in intrapartum C-sections should worsen health in this group. The calculus is the opposite for high-risk mothers: reductions in intrapartum C-sections among those who need the procedure should be associated with a deterioration in health outcomes.

To investigate these predictions, births are grouped into those that are relatively low risk (risk quintiles 1-3; $Risk^L$) and those that are relatively high risk (risk quintiles 4 and 5; $Risk^H$). Let $Health_{iodmyhp}$ denote poor health of mother (baby) i giving birth (being born) at hour o on day d in month m of year y at hospital h with physician p. We estimate the following specification for Black and White mothers separately:

$$\begin{aligned} Health_{iodmyhp} = \alpha_L \cdot Risk_i^L + \eta_L \cdot ConcurrentCS_{odmyh} \cdot Risk_i^L \\ + \eta_H \cdot ConcurrentCS_{odmyh} \cdot Risk_i^H + \delta_o \cdot Day\ of\ week_d \\ + \alpha \cdot X_i + \gamma_{my} + \gamma_h + \gamma_p + \epsilon_{iodmyhp}, \end{aligned} \tag{5}$$

where X_i includes maternal sociodemographics and all individual medical risk factors, and all other variables are defined as in equation (4). As before, the sample is restricted to deliveries involving a trial of labor, and standard errors are clustered by hospital. As outlined in Section III, the primary analysis uses indicators for whether mothers experienced any postpartum health complication and whether infants had any health complications at birth as dependent variables.[38] Each index component is also considered separately as an outcome to determine which complications drive any observed impacts on maternal and infant health. Because of changes in how complications were coded over time, these analyses use data from 283,723 births between 2008 and 2015 that meet the sample inclusion criteria and could be linked to hospital discharge records.

Results from estimation of equation (5) are presented in Table 4. As the specification and sample period are slightly different than in Table 3, columns (1) and (2) first confirm that both Black and White mothers with a trial of labor are significantly less likely to

[38] A mother is classified as having poor postpartum health if she has postpartum hemorrhage, major puerperal infection, venous complications, pyrexia, pulmonary embolism, or other complications in the 90 days following delivery. An infant is considered to have poor health if the baby was admitted to a NICU, had a 5-minute Apgar score below 7, required mechanical ventilation, or had a significant birth injury.

have an intrapartum C-section when the birth occurs at the same time as a pre-labor C-section. Although the reduction in intrapartum C-section rates is similar for high-risk Black and White mothers, the reduction among mothers with the lowest observable risk is more pronounced among Black mothers, consistent with the findings in Section VI.

Columns (3) and (4) of Table 4 consider the impacts of concurrent pre-labor C-sections on the postpartum health of Black and White mothers with a trial of labor, respectively. The interactions between risk quintile groupings and the indicator denoting whether the birth took place at the same time as a pre-labor C-section show that reductions in intrapartum C-sections stemming from reduced capacity do not significantly affect the index measure of poor postpartum health among Black or White mothers. Results for individual index components shown in Table A22 similarly show no consistent impacts on maternal health. These findings are noteworthy, as reductions in *necessary* intrapartum C-sections stemming from reductions in capacity would be expected to negatively affect maternal health.[39]

Impacts on infant health are shown in columns (5) and (6) of Table 4 for children born to Black and White mothers, respectively. The interactions between risk categories and the indicator denoting whether the birth coincides with a pre-labor C-section show that neonatal complications decline by 0.7 percentage points (7.6 percent, p-value $= 0.064$) for low-risk Black infants and by 0.6 percentage points (11 percent, p-value $= 0.027$) for low-risk White infants when hospitals are more constrained.[40] Moreover, Table A26 shows that the improvements in infant health are concentrated among daytime births, when intrapartum C-sections are more likely to be discretionary due to greater staff availability.

Table A24 presents results for the individual components of the infant health index. The estimates show that the improvements in infant health are driven by reductions in the probability of admission to the NICU. This finding is consistent with medical evidence indicating that delivery by C-section is associated with an increased risk of neonatal complications such as respiratory morbidity, a leading cause of NICU admission (Hansen et al., 2007).

[39]Results from a two-stage least squares analogue of equation (5) using measures of maternal postpartum health as the outcome are shown in Table A23. In line with Tables 4 and A22, the results show limited impacts of marginal intrapartum C-sections on maternal health.

[40]Two-stage least squares results presented in Table A25 mirror these reduced-form findings. Strikingly, marginal intrapartum C-sections among low-risk White and Black mothers increase the probability that the infant has poor health at birth by 9.5 percentage points (180.8 percent, p-value $= 0.040$) and 6.2 percentage points (70.8 percent, p-value $= 0.086$), respectively.

In contrast, column (6) of Table 4 shows that infants born to high-risk White mothers are 1.7 percentage points (12.7 percent, p-value = 0.024) more likely to have poor health at birth when the delivery coincides with a pre-labor C-section, an effect driven by increased NICU admissions (see Table A24). Similarly, Table A26 indicates that Black infants born during the night shift—when intrapartum C-sections are less likely to be discretionary—are 8.5 percentage points (37.4 percent, p-value = 0.048) more likely to experience poor health when there is a concurrent pre-labor C-section. Taken together, these findings are consistent with Currie and MacLeod (2017) and indicate that reductions in intrapartum C-sections among high-risk births when hospitals are constrained can adversely affect infant health. These results underscore that efforts to reduce C-sections should target low-risk mothers—the group for whom racial disparities are most pronounced and for whom reducing C-sections improves outcomes—rather than restricting access for high-risk patients.

VIII Discussion and conclusions

This paper sheds light on the drivers of the well-documented racial disparity in C-section rates. On average, Black mothers with a trial of labor are 25.2 percent more likely to have an intrapartum C-section than White mothers. This difference cannot be eliminated by controlling for observable medical risk factors or differences in socioeconomic characteristics, though including controls for these variables closes some of the gap. And while the racial gap is reduced by the inclusion of hospital and physician fixed effects, a significant racial gap remains. Even when treated by the same physician in the same hospital, Black mothers with a trial of labor are 19.4 percent more likely than observationally similar White mothers to deliver by C-section.

This persistent racial gap in treatment raises the question of whether it can be accounted for by unobservable differences between Black and White mothers. One possible difference is in terms of demand for C-sections. To reduce the possibility that racial gaps are driven by Black mothers being more likely to request C-sections, we focus on deliveries involving a trial of labor. Another possible difference is unobservable risk factors. If Black mothers are unobservably better candidates for C-sections than observationally similar White mothers, then physicians should reduce intrapartum C-sections more among White mothers with similar observable risk when reduced capacity causes the costs of ordering an intrapartum C-section to rise. In this case, the racial gap would grow in the face of increased costs. In contrast, the racial disparity shrinks when the costs of ordering an intrapartum C-section rise due to the delivery taking place at the same time as a pre-labor C-section. This finding is consistent with physicians being more willing to do additional C-sections on low-risk Black mothers when there is the capacity to do so. In addition to helping to uncover the drivers of racial disparities in delivery method, this "supply-shock" design contributes to the empirical literature on discrimination by providing a means of distinguishing between differences in decision thresholds and differences in underlying risk distributions without requiring full knowledge of the true risk distributions.

The impacts of marginal intrapartum C-sections on maternal and infant health further indicate that differences in unobserved medical risk are unlikely to explain the racial disparity in delivery method. If the Black mothers we classify as low risk for a C-section have unobservable factors that make them good candidates for the procedure, then reductions in intrapartum C-sections during periods of limited surgical capacity should harm their health or that of their infants. Strikingly, however, the sizable reductions in intrapartum C-sections among Black mothers that occur when the costs of ordering an intrapartum C-section rise have no adverse effects on maternal or infant health. In contrast, the results indicate that preventing marginal intrapartum C-sections for low-risk mothers improves infant outcomes for both races. At the same time, infants born to high-risk mothers with a trial of labor can experience more neonatal complications when capacity is constrained, underscoring that intrapartum C-sections among the highest-risk mothers—a group for whom no racial disparity in C-section rates exists—are likely to be medically necessary.

If racial gaps in C-section rates cannot be explained by either observable or unobservable patient characteristics, why then do providers treat otherwise similar mothers differently? Overall, the findings point to the role of provider discretion: many physicians appear to have a lower threshold for performing intrapartum C-sections on Black mothers, underscoring the need to align treatment decisions more closely with medical risk to reduce disparities and improve outcomes.

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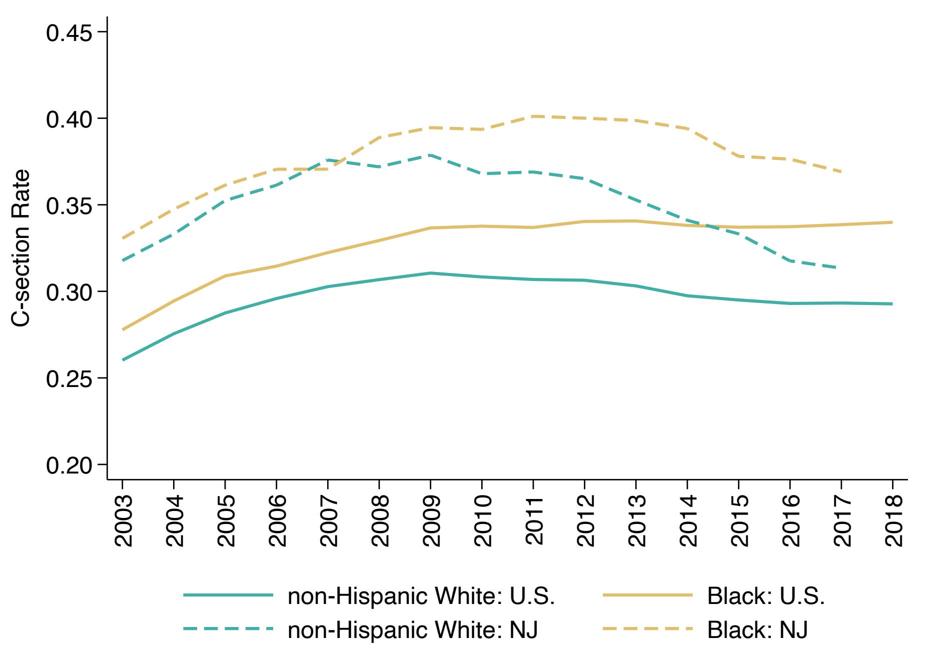
IX Figures

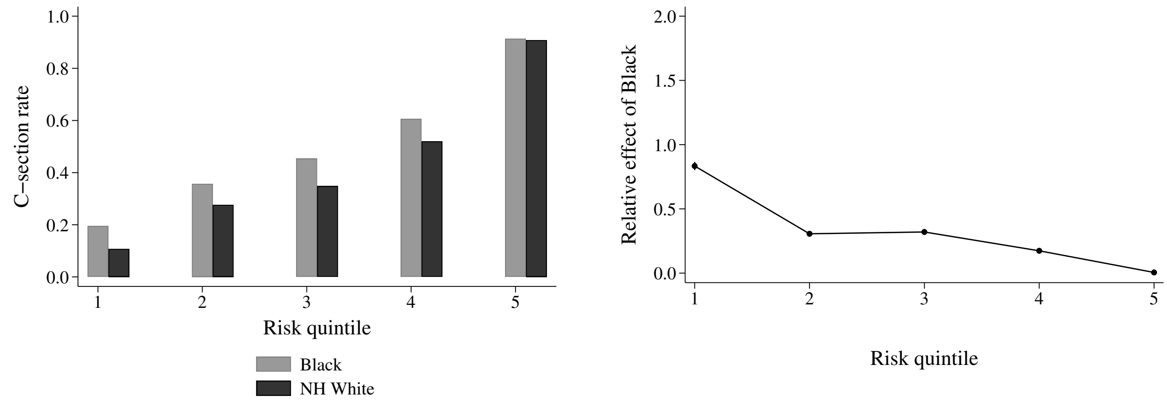
Figure 1: C-section rates by race in the United States and in New Jersey



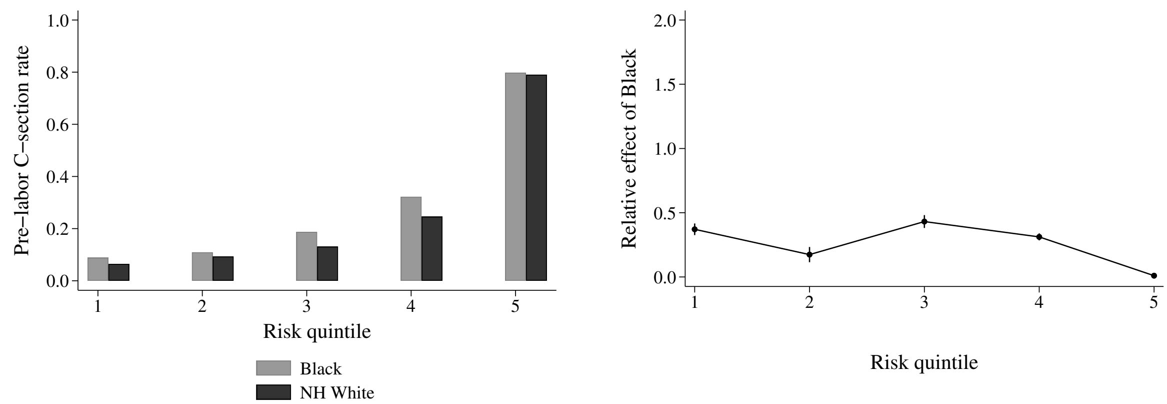
Notes: The above figure shows the share of births delivered by C-section across the United States (solid lines) and in New Jersey (dashed lines) from 2003 to 2018. These rates are shown separately for non-Hispanic White mothers (teal lines) and Black mothers (yellow lines). Data come from the National Vital Statistics birth data.

Figure 2: Raw disparities in C-section rates across risk quintiles

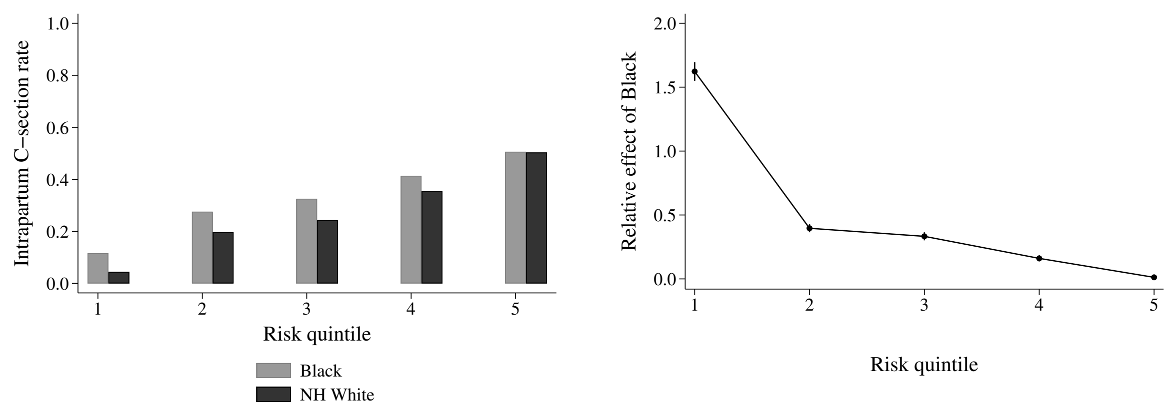
(a) All C-sections



(b) Pre-labor C-sections

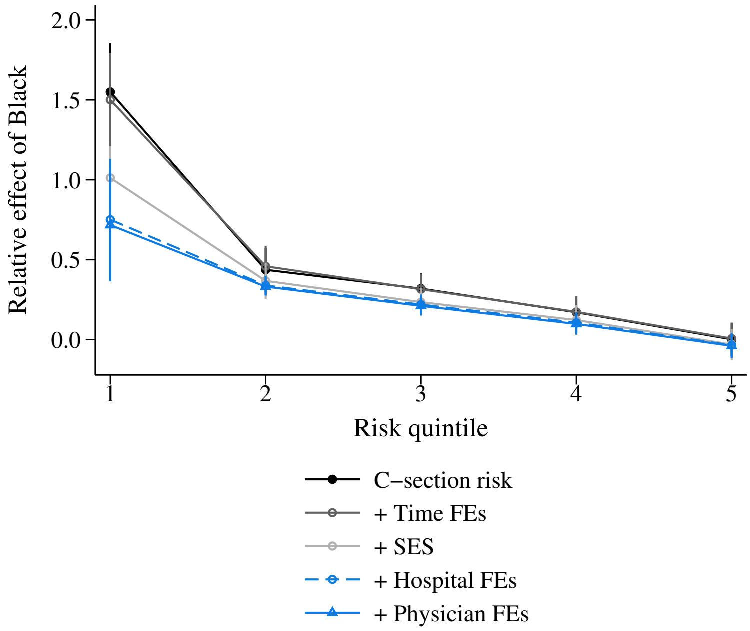


(c) Intrapartum C-sections



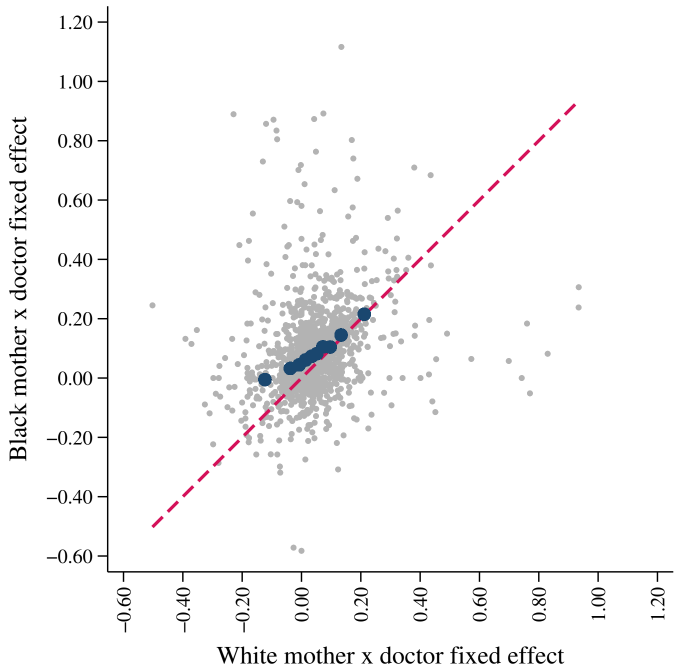
Notes: The above figures show the disparity in the share of births delivered by C-section by maternal race and risk quintile. The left subplots show raw C-section rates in each race-risk group; the right subplots show the relative effect for Black mothers and the associated 95 percent confidence intervals, where the relative effect for Black mothers is the difference in Black and non-Hispanic White rates divided by the non-Hispanic White rate. All births are included in subfigures (a) and (b); only births involving a trial of labor are included in subfigure (c). See page 12 for a description of how mothers are separated into risk quintiles. Data come from the New Jersey Electronic Birth Records and cover the period 2008 to 2017.

Figure 3: Intrapartum C-section disparities: conditional on maternal and hospital characteristics



Notes: The above figure shows the relative effect for Black mothers and the associated 95 percent confidence intervals derived from estimation of equation (2). Only births involving a trial of labor are included in these regressions, and the outcome is an indicator for whether the mother had an intrapartum C-section. The relative effect for Black mothers is calculated by dividing the estimated coefficient on Black by the relevant mean among non-Hispanic White mothers. The following controls are progressively added to the specification: time fixed effects (month-by-year and hour-by-day of week fixed effects); markers of the mother's socioeconomic status ("SES") including education, martial status, and an indicator for Medicaid coverage; hospital fixed effects; and physician fixed effects. All regressions include a control for continuous C-section risk in addition to indicators denoting C-section risk quintiles; see page 12 for a description of how mothers are separated into risk quintiles. The underlying coefficients and standard errors are provided in Table A9. Data come from the New Jersey Electronic Birth Records and cover the period 2008 to 2017.

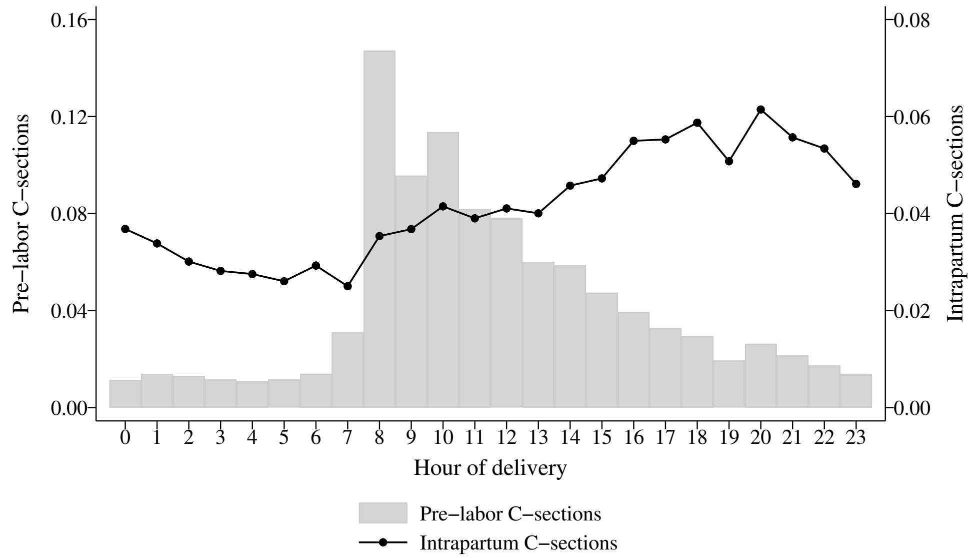
Figure 4: Physician-specific C-section propensities by race



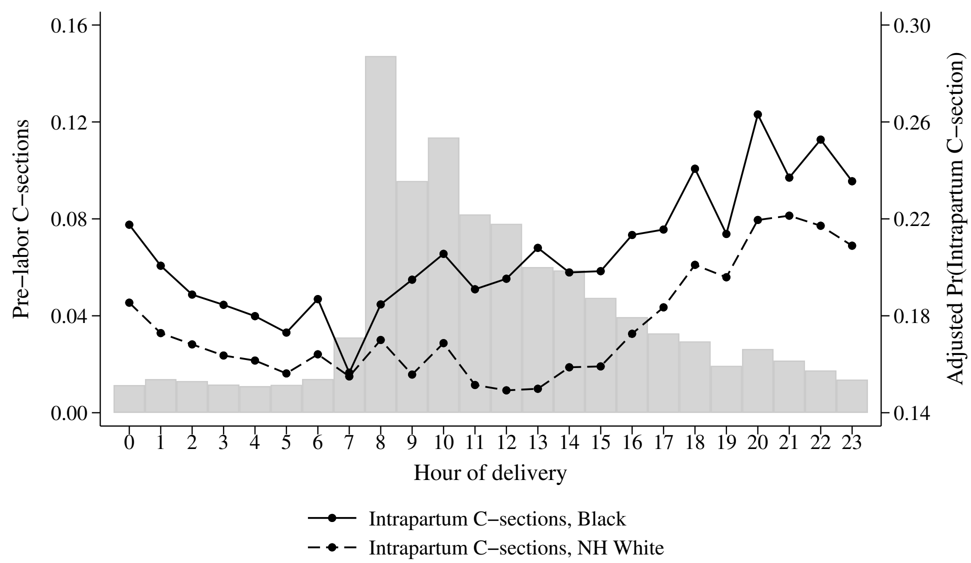
Notes: The above figure shows the association between physician-specific propensities to perform C-sections on Black and White mothers. Each small, gray dot represents an individual physician and plots the provider's race-specific fixed effects from estimation of an analogue of equation (1) that interacts the physician fixed effect with both an indicator denoting whether the mother is Black and an indicator denoting whether the mother is White. As in column (6) of Table 2, the regressions further control for C-section risk, maternal SES, and month-by-year, hour-by-day of week, and hospital fixed effects. The larger, blue dots plot the weighted average of coefficients in each decile of White C-section propensities, where the weights are given by the total number of births delivered by each physician over the sample period. The dashed, red line reflects the 45 degree line. Data come from the New Jersey Electronic Birth Records and cover the period 2008 to 2017.

Figure 5: Distribution of hour of delivery for pre-labor and intrapartum C-sections

(a) All races

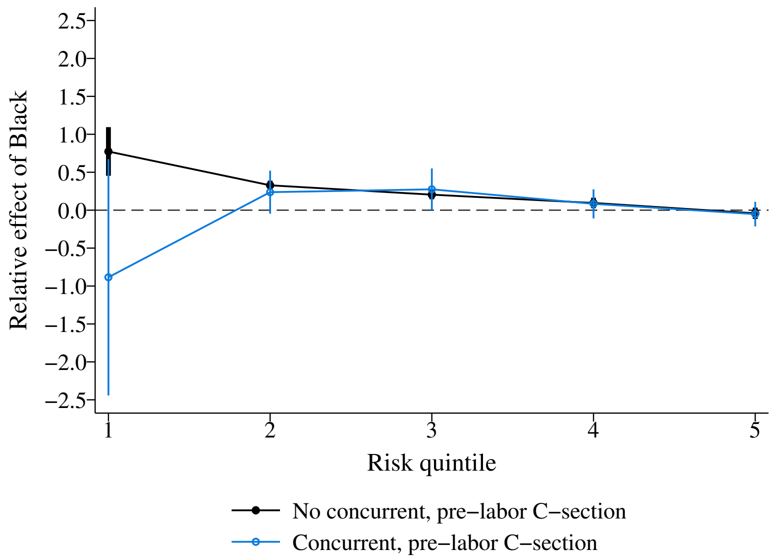


(b) By maternal race



Notes: The above figures show the distributions of pre-labor C-sections (bars) and intrapartum C-sections (lines) by hour of delivery. Subfigure (a) plots the raw distribution of intrapartum C-sections across all mothers; subfigure (b) plots the distribution by maternal race residualized from month-by-year, hour-by-day of week, hospital, and physician fixed effects and controls for maternal C-section risk and SES. Only births during weekdays are included; see Figure A5 for the distribution of pre-labor C-sections across weekends and weekdays. Data come from the New Jersey Electronic Birth Records and cover the period 2008 to 2017.

Figure 6: Intrapartum C-section disparities: with and without concurrent, pre-labor C-section



Notes: The above figure shows the relative effect for Black mothers and the associated 95 percent confidence intervals derived from estimation of an analogue of equation (4). Only births involving a trial of labor are included in the regression, and the outcome is an indicator for whether the mother had an intrapartum C-section. The relative effects of being Black are calculated by dividing the estimated coefficients on Black interacted with or without an indicator denoting whether there was a concurrent, pre-labor C-section by the relevant mean among non-Hispanic White mothers. The regression includes controls for time fixed effects (month-by-year and hour-by-day of week fixed effects); markers of the mother's socioeconomic status ("SES") including education, martial status, and an indicator for Medicaid coverage; and hospital and physician fixed effects. The regression further includes a control for continuous C-section risk in addition to indicators denoting C-section risk quintiles; see page 12 for a description of how mothers are separated into risk quintiles. The underlying coefficients and standard errors are provided in Table A14. Data come from the New Jersey Electronic Birth Records and cover the period 2008 to 2017.

X Tables

Table 1: Summary statistics by maternal race and delivery method

	Deliveries with trial of labor		All births	
	Black (1)	White (2)	Black (3)	White (4)
a. C-section rates				
Total C-section rate			0.441	0.395
Pre-labor C-section rate			0.292	0.274
Intrapartum C-section rate	0.211	0.168	0.148	0.121
b. C-section risk				
Average C-section risk	0.220	0.248	0.357	0.381
Quintile 1 (r <0.21)	0.101	0.096	0.101	0.098
Quintile 2 (0.21< r < 0.29)	0.241	0.252	0.241	0.252
Quintile 3 (0.29< r <0.38)	0.332	0.327	0.333	0.328
Quintile 4 (0.38< r < 0.62)	0.474	0.479	0.483	0.484
Quintile 5 (0.62< r < 1)	0.827	0.819	0.872	0.880
c. Maternal and infant health				
Maternal postpartum complication	0.071	0.059	0.077	0.060
Infant neonatal complication	0.113	0.071	0.133	0.084
d. Mother sociodemographic characteristics				
Medicaid	0.504	0.163	0.500	0.152
Less than BA	0.783	0.443	0.776	0.435
BA or graduate degree	0.211	0.553	0.218	0.561
Married	0.315	0.811	0.341	0.822
e. Attendant physician characteristics				
Non-Hispanic White	0.473	0.704	0.473	0.708
Black	0.197	0.086	0.194	0.083
Female	0.418	0.473	0.404	0.46
M.D. (versus D.O.)	0.885	0.859	0.888	0.864
U.S.-trained	0.592	0.701	0.582	0.697
Top 50 U.S. medical school	0.263	0.256	0.268	0.258
Observations	112,858	282,358	160,527	392,275

Notes: The above table provides summary statistics for the 395,216 births included in the primary analysis sample ("Deliveries with trial of labor") as well as all 552,802 births delivered by a physician with a National Provider Identifier (NPI) to mothers who were Black or non-Hispanic White ("White"). See page 12 for a description of how C-section risk is assigned to each mother. Data come from the New Jersey Electronic Birth Records and cover the period 2008 to 2017. Because of changes in how complications have been coded over time, panel (c) restricts attention to the 393,286 births (283,893 with a trial of labor) over the period 2008 to 2015.

Table 2: Racial gap in C-sections: role of maternal characteristics and health care resources

	C-section after trial of labor (intrapartum)						Pre-labor C-section
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Black mother	0.042***	0.063***	0.043***	0.034***	0.032***	0.033***	0.032***
	(0.014)	(0.010)	(0.008)	(0.003)	(0.003)	(0.003)	(0.003)
C-section risk		0.705***	0.710***	0.702***	0.712***	0.698***	0.853***
		(0.032)	(0.035)	(0.040)	(0.041)	(0.040)	(0.015)
Observations	395,216	395,216	395,216	395,216	331,351	395,216	552,802
Adjusted R-squared	0.013	0.155	0.158	0.169	0.183	0.183	0.492
Mean outcome: white mothers	0.168	0.168	0.168	0.168	0.169	0.168	0.274
Relative effect of Black	0.252***	0.372***	0.255***	0.203***	0.192***	0.194***	0.118***
	(0.083)	(0.057)	(0.046)	(0.020)	(0.017)	(0.016)	(0.011)
Month-by-year FEs	X	X	X	X	X	X	X
Hour-by-day of week FEs	X	X	X	X	X	X	X
Mother SES			X	X	X	X	X
Hospital FEs				X	X	X	X
Practice FEs					X		
Physician FEs						X	X

Notes: The above table presents coefficients and standard errors (in parentheses) from estimation of equation (1). Only births involving a trial of labor are included in columns (1)–(6), and the outcome is an indicator for whether the mother had a C-section. All births (those with and without a trial of labor) are included in column (7), and the outcome is an indicator for whether the mother had a pre-labor C-section. "Maternal SES" includes indicators for maternal education, marital status, and Medicaid coverage. Standard errors are clustered by hospital. The relative effect for Black mothers is calculated by dividing the estimated coefficient on Black by the mean outcome among non-Hispanic White mothers. Data come from the New Jersey Electronic Birth Records and cover the period 2008 to 2017. *** denotes p-values < 0.01, ** denotes p-values < 0.05, * denotes p-values < 0.10.

Table 3: Racial gap in intrapartum C-sections: role of capacity and concordance

	C-section after trial of labor (intrapartum)		
	(1)	(2)	(3)
Black mother	0.036***	0.034***	0.035***
	(0.004)	(0.005)	(0.003)
Black doctor	-0.002		
	(0.007)		
Black mother x Black doctor	-0.010		
	(0.007)		
Female doctor		-0.006*	
		(0.003)	
Black mother x female doctor		-0.001	
		(0.007)	
Concurrent pre-labor C-section			-0.085***
			(0.009)
Black mother x pre-labor C-section			-0.030***
			(0.011)
Observations	355,167	355,167	395,216
Adjusted R-squared	0.170	0.170	0.187
Mean outcome among white mothers			
Non-Black doctor	0.165		
Male doctor		0.169	
No concurrent pre-labor CS			0.176
Relative effect of being Black			
Black doctor	0.138***		
	(0.035)		
Non-Black doctor	0.216***		
	(0.024)		
Female doctor		0.201***	
		(0.032)	
Male doctor		0.200***	
		(0.027)	
Concurrent pre-labor CS			0.059
			(0.140)
No concurrent pre-labor CS			0.197***
			(0.015)

Notes: The above table presents coefficients and standard errors (in parentheses) from estimation of equation (3) (columns (1)–(2)) and equation (4) (column (3)). Only births involving a trial of labor are included, and the outcome is an indicator for whether the mother had a C-section. All regressions include month-by-year, hour-by-day of week, and hospital fixed effects and controls for maternal C-section risk and SES. Column (3) additionally includes physician fixed effects. "Concurrent pre-labor CS" is an indicator denoting whether there was at least one pre-labor C-section at the hour of the index delivery in the same hospital. Standard errors are clustered by hospital. The relative effect for Black mothers is calculated by dividing the estimated coefficient on Black by the relevant mean among non-Hispanic White mothers. Data come from the New Jersey Electronic Birth Records and cover the period 2008 to 2017. *** denotes p-values < 0.01, ** denotes p-values < 0.05, * denotes p-values < 0.10.

Table 4: Effects of concurrent pre-labor C-sections on maternal and infant health

	Intrapartum C-section		Maternal postpartum complication		Infant neonatal complication	
	Black (1)	White (2)	Black (3)	White (4)	Black (5)	White (6)
Concurrent pre-labor CS x quintile 1-3	-0.126***	-0.076***	0.002	-0.003	-0.007*	-0.006**
	(0.012)	(0.011)	(0.004)	(0.002)	(0.004)	(0.003)
Concurrent pre-labor CS x quintile 4-5	-0.176***	-0.173***	-0.016	0.004	-0.007	0.017**
	(0.032)	(0.030)	(0.011)	(0.005)	(0.016)	(0.007)
Observations	83,124	200,599	83,124	200,599	83,124	200,599
Adjusted R-squared	0.163	0.205	0.017	0.014	0.112	0.114
Mean outcome without concurrent pre-labor C-section						
Quintile 1-3	0.188	0.131	0.066	0.055	0.096	0.057
Quintile 4-5	0.509	0.465	0.105	0.078	0.213	0.133
Relative effect of concurrent pre-labor C-section						
Quintile 1-3	-0.669***	-0.583***	0.031	-0.056	-0.076*	-0.110**
	(0.064)	(0.082)	(0.060)	(0.044)	(0.041)	(0.050)
Quintile 4-5	-0.345***	-0.372***	-0.148	0.053	-0.031	0.127**
	(0.063)	(0.065)	(0.108)	(0.069)	(0.073)	(0.056)

Notes: The above table presents coefficients and standard errors (in parentheses) from estimation of equation (5). Only births involving a trial of labor are included. In columns (3) and (4), the outcome is an indicator for whether the mother experienced any of the following complications in the 90 days following delivery (ICD-9 in parentheses): postpartum hemorrhage (666), major puerperal infection (670), venous complications (671), pyrexia (672), pulmonary embolism (673), and other postpartum complications (674). In columns (5) and (6), the dependent variable is an indicator for whether the infant experienced any of the following complications: admission to the NICU, 5-minute Apgar score below 7, infant needing mechanical ventilation, and significant birth injury. Results by individual index components of maternal and infant health are provided in Tables A22 and A24, respectively. Data come from the New Jersey Electronic Birth Records and cover the period 2008 to 2015. *** denotes p-values $<$ 0.01, ** denotes p-values $<$ 0.05, * denotes p-values $<$ 0.10.

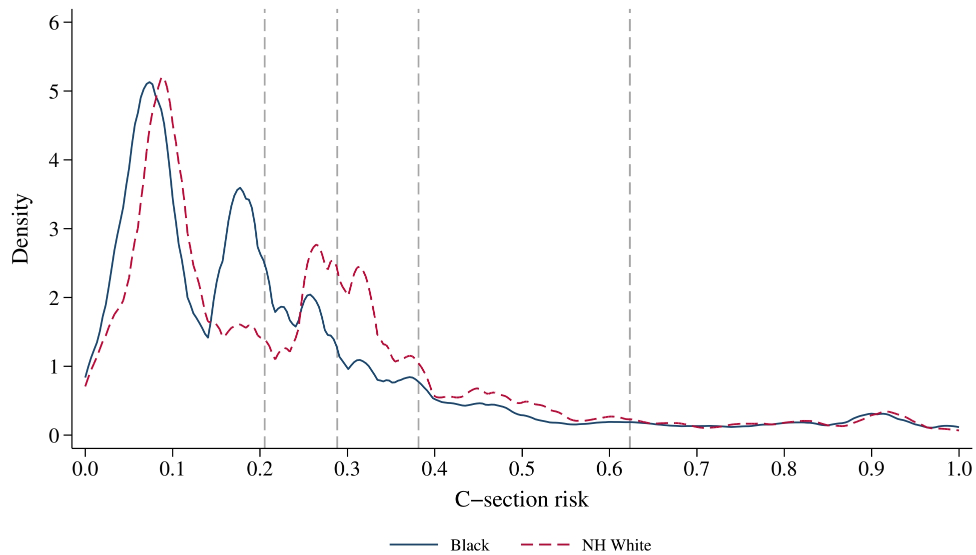
For Online Publication

Drivers of Racial Differences in C-Sections

Corredor-Waldron, Currie, and Schnell (2025)

A Supplementary figures

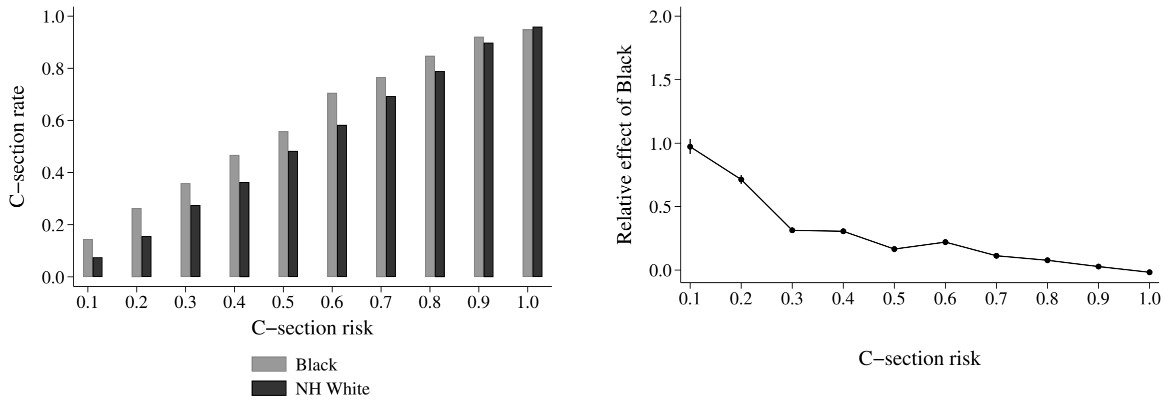
Figure A1: Distribution of maternal risk by race among births with a trial of labor



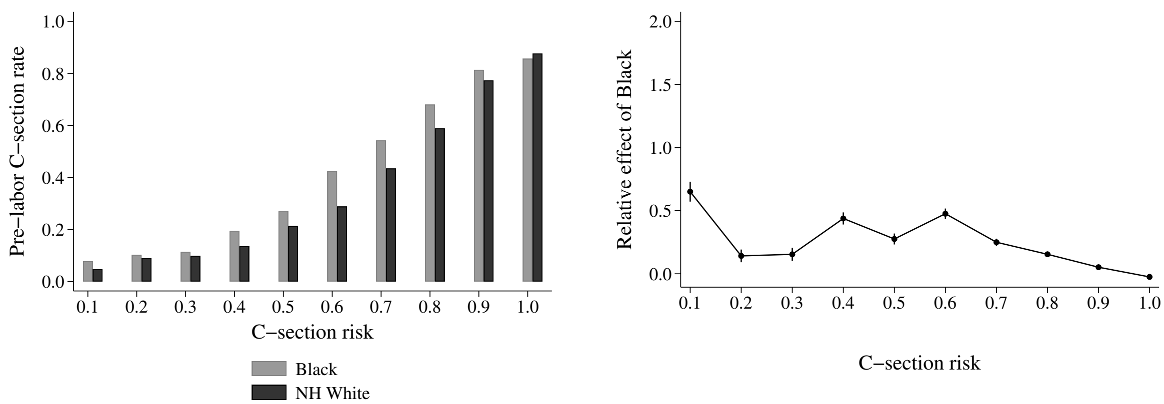
Notes: The above figure shows the distribution of medical appropriateness for a C-section ("risk") among deliveries with a trial of labor by race. The distribution is shown separately for White mothers (dashed, red line) and Black mothers (solid, blue line). The vertical lines denote the quintile cut-offs used in the analysis; as outlined in the text, these risk quintiles are defined using the distribution of predicted risk among mothers with intrapartum C-sections (rather than all deliveries involving a trial of labor). See page 12 for a description of how C-section risk is assigned to each mother. Data come from the New Jersey Electronic Birth Records and cover the period 2008 to 2017.

Figure A2: Raw disparities in C-section rates across risk deciles

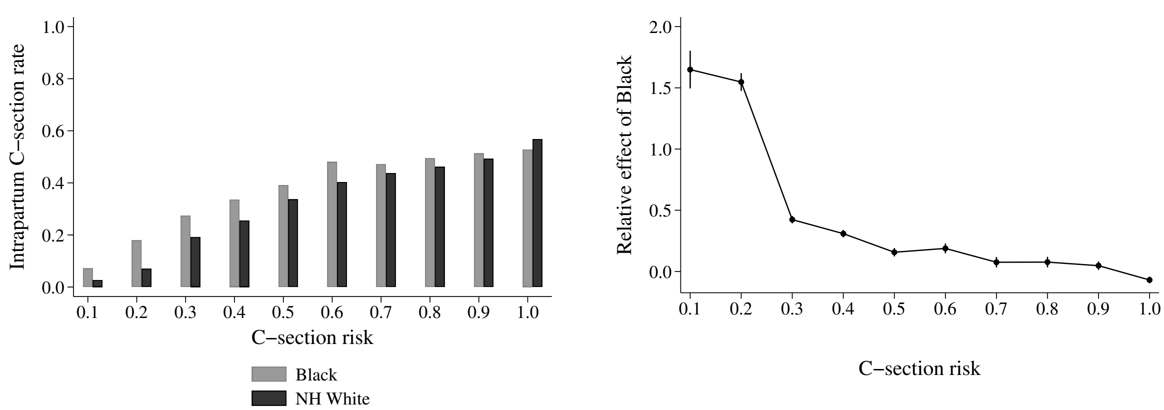
(a) All C-sections



(b) Pre-labor C-sections



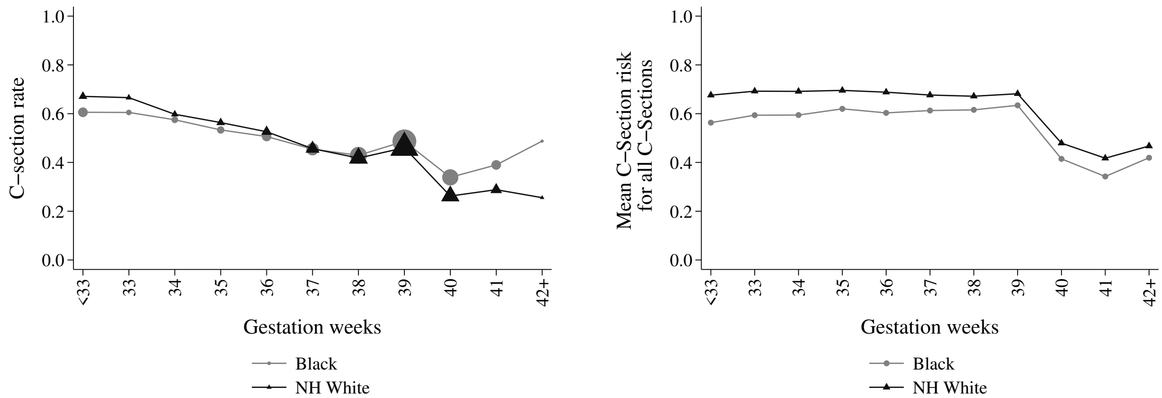
(c) Intrapartum C-sections



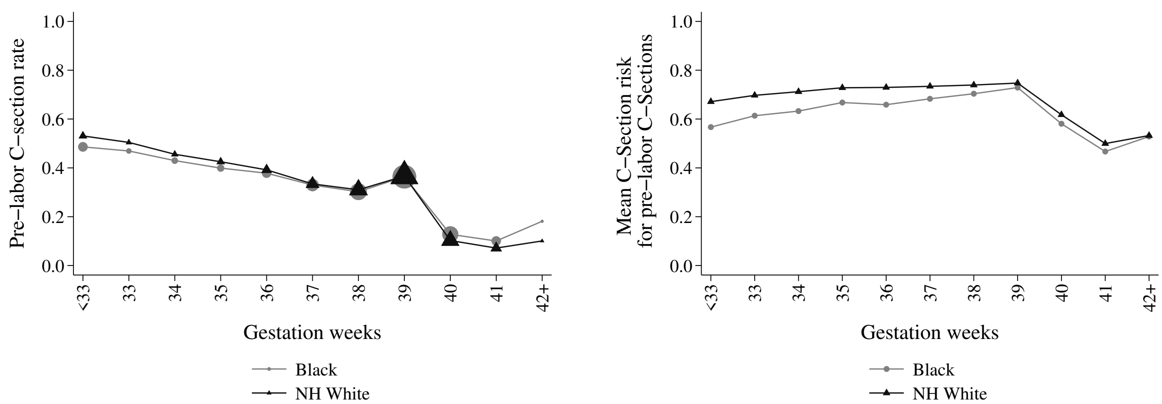
Notes: The above figures show the disparity in the share of births delivered by C-section by maternal race and risk decile. The left subplots show raw C-section rates in each race-risk group; the right subplots show the relative effect for Black mothers and the associated 95 percent confidence intervals, where the relative effect for Black mothers is the difference in Black and non-Hispanic White rates divided by the non-Hispanic White rate. All births are included in subfigures (a) and (b); only deliveries involving a trial of labor are included in subfigure (c). For this figure only, mothers are separated into unweighted risk deciles each covering 10 percent of the range of potential risk (i.e. 0–0.1, 0.1–0.2, etc.). Data come from the New Jersey Electronic Birth Records and cover the period 2008 to 2017.

Figure A3: Average C-section rates and risk by race and gestation weeks

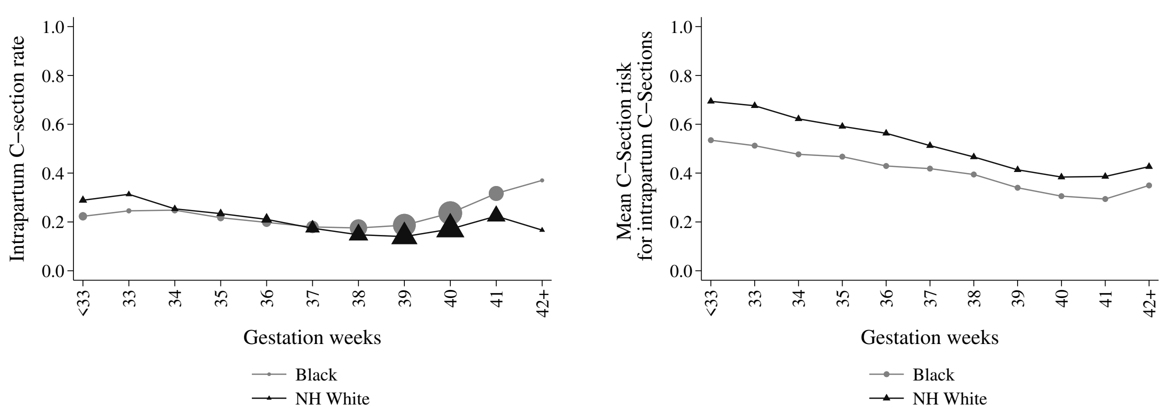
(a) All C-sections



(b) Pre-labor C-sections

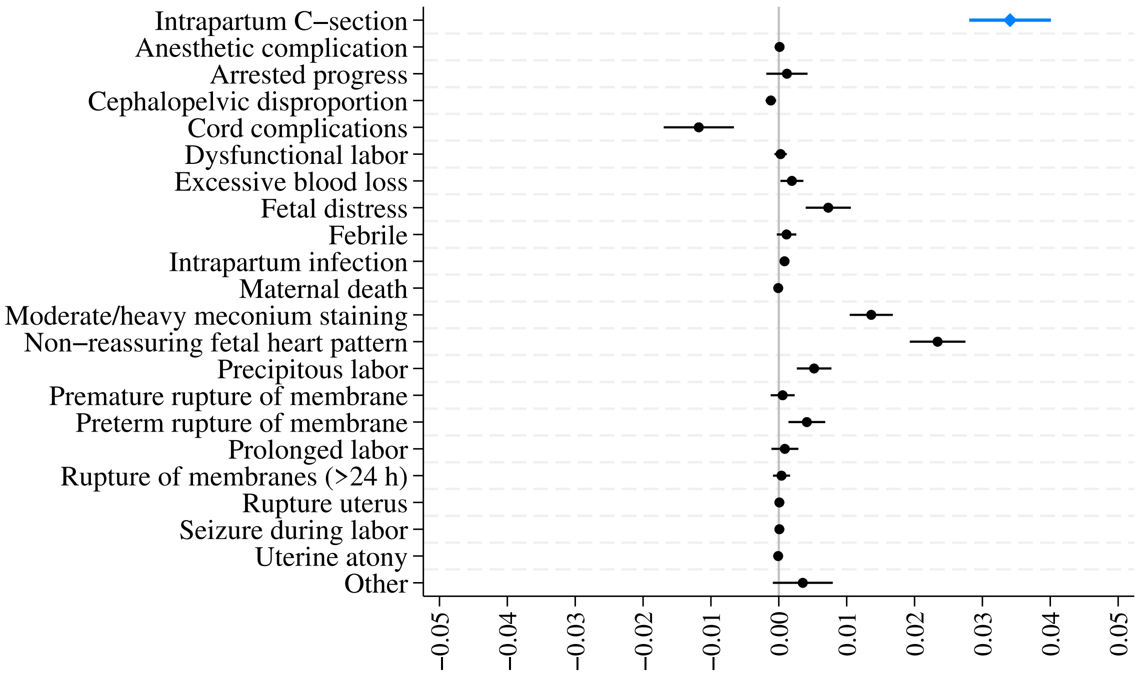


(c) Intrapartum C-sections



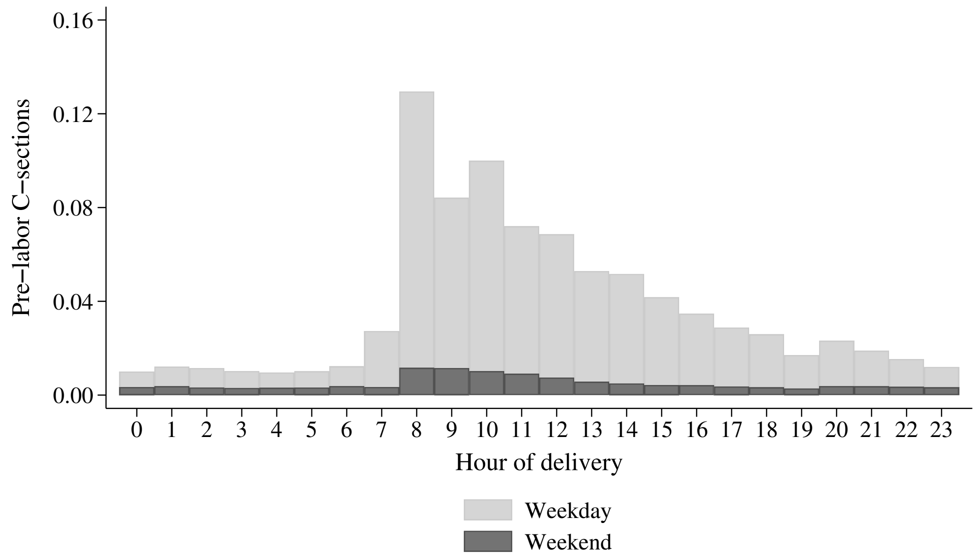
Notes: The above figures show the share of births delivered by C-section (left subfigures) and the average maternal risk for a C-section among births delivered by C-section (right subfigures) by maternal race and gestational weeks at delivery. All births are included in subfigures (a) and (b); only deliveries involving a trial of labor are included in subfigure (c). Figures are shown for non-Hispanic White mothers (dark series) and for Black mothers (light series). See page 12 for a description of how C-section risk is assigned to each mother. Data come from the New Jersey Electronic Birth Records and cover the period 2008 to 2017.

Figure A4: Racial gap in labor and delivery complications



Notes: The above figure presents coefficients (dots) and 95% confidence intervals (bars) from estimation of a version of equation (1) that excludes practice group fixed effects. Only births involving a trial of labor are included, and the outcome is an indicator for whether the mother had the listed complication during labor and delivery. For comparison, the top row replicates the analysis using an indicator denoting whether the mother had an intrapartum C-section as the outcome (also reported in column (4) of Table 2). All regressions include month-by-year, hour-by-day of week, and hospital fixed effects and controls for maternal C-section risk and SES (education, marital status, and Medicaid coverage). Standard errors are clustered by hospital. Data come from the New Jersey Electronic Birth Records and cover the period 2008 to 2015.

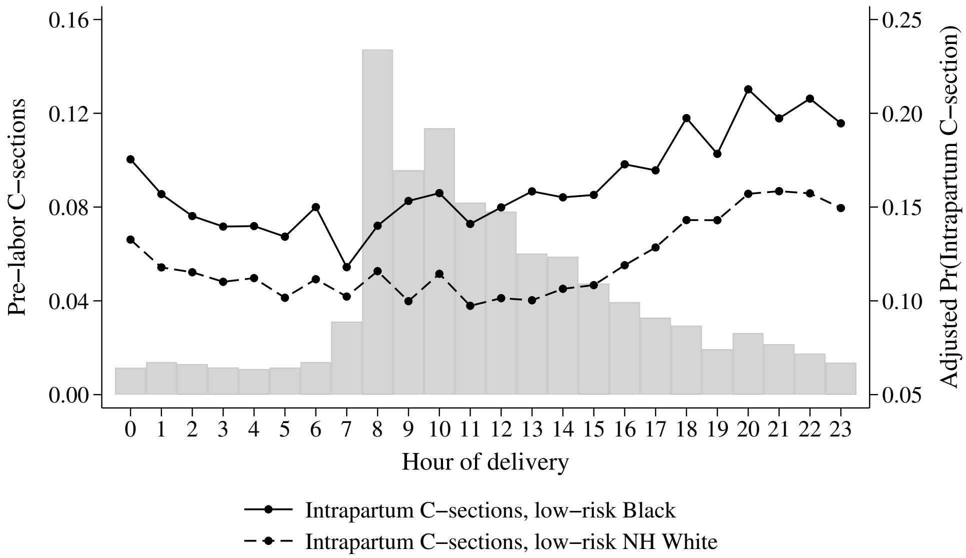
Figure A5: Timing distribution of pre-labor C-sections: weekends versus weekdays



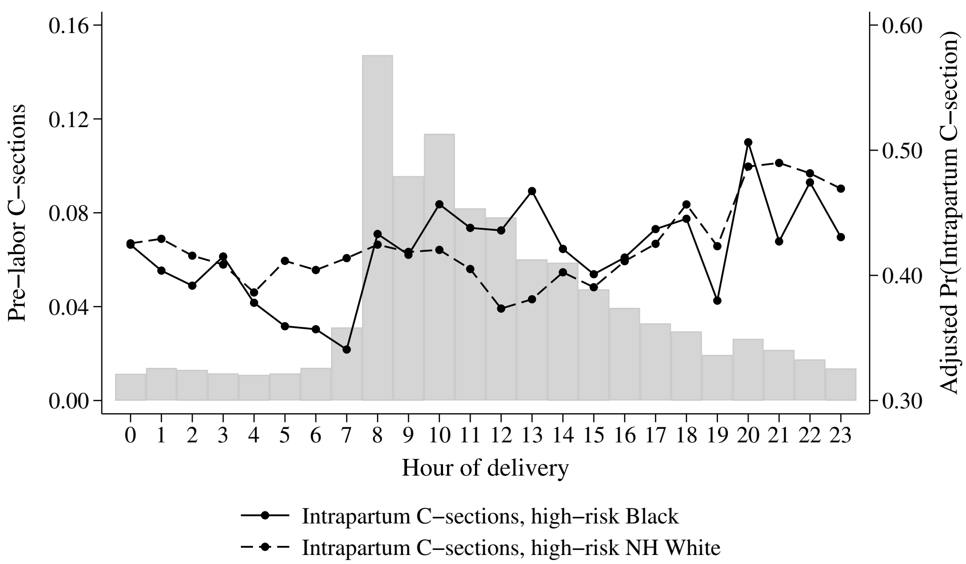
Notes: The above figure shows the distribution of pre-labor C-sections by hour of delivery across weekends (dark bars) and weekdays (light bars). Only pre-labor C-sections are included; see Figure 5 for the distribution of pre-labor and intrapartum C-sections by hour of delivery on weekdays. Data come from the New Jersey Electronic Birth Records and cover the period 2008 to 2017.

Figure A6: Distribution of hour of delivery for pre-labor and intrapartum C-sections by maternal risk

(a) Quintiles 1–3 (low risk)



(b) Quintiles 4–5 (high risk)



Notes: The above figures show the distributions of pre-labor C-sections (bars) and intrapartum C-sections (lines) by hour of delivery. The distributions by maternal race are residualized from month-by-year, hour-by-day of week, hospital, and physician fixed effects and controls for maternal C-section risk and SES. Subfigure (a) considers intrapartum C-sections among mothers with low C-section risk (quintiles 1–3); subfigure (b) considers intrapartum C-sections among mothers with high C-section risk (quintiles 4–5). Only births during weekdays are included; see Figure A5 for the distribution of pre-labor C-sections across weekends and weekdays. Data come from the New Jersey Electronic Birth Records and cover the period 2008 to 2017.

B Supplementary tables

Table A1: C-section risk and medical risk factors by race

	non-Hispanic white (1)	Black (2)	non-Black Hispanic (3)	Other race (4)
C-section risk	0.262	0.236***	0.221***	0.278***
Medical risk factors				
Macrosomia	0.089	0.048***	0.064***	0.034***
Weight gain: 60+ pounds	0.033	0.043***	0.027***	0.013***
Obesity	0.034	0.053***	0.034	0.009***
Age <20	0.015	0.087***	0.074***	0.006***
Age [20,25)	0.115	0.271***	0.245***	0.056***
Age [25-30)	0.245	0.269***	0.281***	0.273***
Age [30-34]	0.370	0.220***	0.241***	0.423***
Age 35+	0.255	0.152***	0.160***	0.242***
Birth order = 1	0.476	0.453***	0.429***	0.557***
Birth order = 2	0.299	0.278***	0.293***	0.338***
Birth order = 3	0.129	0.154***	0.166***	0.079***
Birth order = 4+	0.095	0.115***	0.111***	0.025***
Previous C-section	0.029	0.035***	0.030	0.032***
Previous pre-term birth	0.011	0.018***	0.014***	0.008***
Plural	0.021	0.019***	0.011***	0.013***
Breech	0.016	0.016	0.015**	0.016
Herpes	0.009	0.016***	0.008***	0.003***
Placenta previa	0.001	0.001	0.001	0.001
Placenta abruptia	0.004	0.006***	0.004**	0.004
Cord prolapse	0.001	0.002*	0.002*	0.002
Eclampsia	0.0002	0.001***	0.001**	0.0004
Chronic hypertension	0.009	0.026***	0.008***	0.007***
Hypertension during pregnancy	0.033	0.052***	0.033	0.024***
Cardiac disease	0.009	0.006***	0.004***	0.003***
Diabetes	0.040	0.043***	0.059***	0.106***
Anemia	0.026	0.065***	0.045***	0.030***
Renal disease	0.005	0.003***	0.004***	0.002***
RH sensitization	0.006	0.004***	0.003***	0.002***
Drug misuse	0.015	0.029***	0.011***	0.002***
Observations	282,358	112,858	148,066	77,830

Notes: The above table provides summary statistics for C-section risk and medical risk factors among mothers with deliveries involving a trial of labor (vaginal or C-section). The primary analysis sample focuses on the 395,216 births to non-Hispanic White and Black mothers shown in the first two columns. As outlined on page 12, C-section risk is assigned to each mother using a random forest algorithm and the medical risk factors shown above. The stars in columns (2)–(4) denote differences relative to non-Hispanic White mothers (column (1)); *** denotes p-values < 0.01, ** denotes p-values < 0.05, and * denotes p-values < 0.10. Data come from the New Jersey Electronic Birth Records and cover the period 2008 to 2017.

Table A2: Importance of variables in the random forest models

Medical risk factors *Labor and delivery complications* INTRAPARTUM MANAGEMENT INTERVENTIONS	Factor importance		
	(1)	(2)	(3)
Previous C-section	1.000	1.000	0.879
Arrested progress		0.822	1.000
Mother's age	0.543	0.851	0.853
Birth order	0.520	0.797	0.800
Plural	0.425	0.420	0.477
INDUCTION OF LABOR			0.719
Non-reassuring fetal heart pattern		0.811	0.759
EPIDURAL			0.718
Other		0.799	0.715
STIMULATION OF LABOR			0.666
Cord complications		0.795	0.644
Breech	0.312	0.636	0.559
Moderate/heavy meconium staining		0.630	0.543
Fetal distress		0.542	0.518
Macrosomia	0.280	0.479	0.506
Dysfunctional labor		0.467	0.508
Precipitous labor		0.515	0.434
Prolonged labor		0.448	0.430
Excessive blood loss		0.489	0.399
Diabetes	0.254	0.464	0.420
Obesity	0.255	0.437	0.381
Rupture of membranes (>24 h)		0.462	0.404
Febrile		0.418	0.409
Hypertension during pregnancy	0.237	0.402	0.400
Preterm rupture of membrane		0.519	0.403
Premature rupture of membrane		0.435	0.373
Previous Preterm	0.200	0.376	0.313
Intrapartum infection		0.361	0.339
Anemia	0.196	0.348	0.291
Cephalopelvic disproportion		0.282	0.294
Rupture uterus		0.258	0.271
Weight gain: 60+ pounds	0.191	0.178	0.247
Chronic hypertension	0.155	0.330	0.264
Drug misuse	0.156	0.210	0.245
Uterine atony		0.289	0.233
Cardiac disease	0.133	0.242	0.207
Renal disease	0.125	0.229	0.172
Placenta abruptia	0.125	0.339	0.325
Herpes	0.120	0.257	0.249
Placenta previa	0.092	0.256	0.246
Cord prolapse	0.085	0.322	0.291
Seizure during labor		0.211	0.116
Anesthetic complication		0.136	0.132
RH sensitization	0.079	0.164	0.149
Eclampsia	0.047	0.122	0.078
Maternal death		0.099	0.039

Notes: The above table shows the importance of each variable in predicting the probability of having a C-section. "Importance" measures how much information the model gains from all the splits of the trees that are made based on the given variable. See page 12 for information on the procedure used to assign C-section risk to each mother.

Table A3: Performance of random forest in testing sample

C-section risk percentile (1)	Mean C-section risk (2)	C-section rate (3)
1	0.039	0.053
2	0.082	0.082
3	0.108	0.104
4	0.165	0.168
5	0.251	0.251
6	0.309	0.299
7	0.388	0.393
8	0.614	0.626
9	0.875	0.889
10	0.952	0.933
Observations	134,688	

Notes: The above table shows the relationship between the average predicted probability of having a C-section ("C-section risk") and the average realized C-section rate in each decile of predicted C-section risk. Only deliveries in the testing sample are included; that is, we do not include births in the training sample for the random forest algorithm when constructing this table. See page 12 for more information on the procedure used to assign C-section risk to each mother. Results for the baseline prediction are shown, which uses only the medical risk factors shown in Table A2 to predict C-section risk. Because only White mothers are used to train the random forest algorithm, the testing sample likewise includes only White mothers. Model performance, however, is very similar for non-White mothers.

Table A4: Correlation between alternative C-section risk predictions

	RF main	RF main, all races	Logit main	RF model 2	RF model 3
RF with risk factors, White only (main)	1.000				
RF with risk factors, all races	0.974	1.000			
Logit with risk factors, White only	0.965	0.969	1.000		
RF main + L&D complications (model 2)	0.848	0.847	0.839	1.000	
RF model 2 + interventions (model 3)	0.787	0.790	0.781	0.903	1.000

Notes: The above table reports the pairwise correlations between five alternative measures of maternal C-section risk. Maternal C-section risk is predicted using a random forest ("RF") algorithm in all rows except the third, which instead relies on a logistic regression model. Similarly, all models are trained using only White mothers, except in the second row, where mothers of all races are included in the training sample. In the first three rows, predictions are based solely on the maternal medical risk factors listed in Table A2 ("main"). The fourth row additionally includes complications during labor and delivery ("model 2"), while the fifth row further incorporates intrapartum management interventions ("model 3"). See page 12 for additional details on the procedure used to assign C-section risk to each mother.

Table A5: Racial gap in intrapartum C-sections: heterogeneity by maternal socioeconomic characteristics

	Payer		Education			Marital status	
	Medicaid	Non-Medicaid	HS or less	Some college	College+	Married	Non-Married
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Black mother	0.026***	0.035***	0.023***	0.028***	0.046***	0.037***	0.026***
	(0.005)	(0.003)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)
C-section risk	0.643***	0.715***	0.678***	0.709***	0.704***	0.696***	0.705***
	(0.057)	(0.036)	(0.051)	(0.042)	(0.037)	(0.045)	(0.040)
Observations	102,829	292,259	126,170	87,044	179,988	264,559	130,573
Adjusted R-squared	0.179	0.187	0.176	0.186	0.189	0.201	0.151
Mean outcome: white mothers	0.128	0.176	0.158	0.169	0.173	0.160	0.205
Relative effect of Black	0.204***	0.200***	0.147***	0.167***	0.269***	0.234***	0.125***
	(0.036)	(0.015)	(0.025)	(0.023)	(0.024)	(0.021)	(0.014)

Notes: The above table presents coefficients and standard errors (in parentheses) from estimation of a version of equation (1) that excludes practice group fixed effects. Only births involving a trial of labor are included, and the outcome is an indicator for whether the mother had a C-section. All regressions include month-by-year, hour-by-day of week, hospital, and physician fixed effects and controls for maternal C-section risk and SES (education, marital status, and Medicaid coverage) excluding the variable used to split the sample. The subgroup observations by education do not sum to the total sample size because maternal education is missing from some birth records; we include an indicator denoting missing education when controlling for education in our primary specifications. Standard errors are clustered by hospital. The relative effect for Black mothers is calculated by dividing the estimated coefficient on Black by the relevant mean among non-Hispanic White mothers. Data come from the New Jersey Electronic Birth Records and cover the period 2008 to 2017. *** denotes p-values < 0.01, ** denotes p-values < 0.05, * denotes p-values < 0.10.

Table A6: Racial gap in intrapartum C-sections: additional heterogeneity and robustness

	First prenatal visit		Birth order		Hour of delivery		Additional controls	
	< 4 months	4+ months	First birth	Second+ birth	8am-8pm	9pm-7am	Induction/ stimulation	Zip Code FEs
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Black mother	0.034***	0.034***	0.049***	0.030***	0.034***	0.030***	0.036***	0.029***
	(0.003)	(0.008)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
C-section risk	0.700***	0.641***	0.733***	0.588***	0.710***	0.677***	0.692***	0.698***
	(0.044)	(0.047)	(0.031)	(0.051)	(0.038)	(0.044)	(0.044)	(0.039)
Observations	294,892	27,604	185,646	209,505	238,838	156,321	324,765	395,214
Adjusted R-squared	0.187	0.154	0.110	0.231	0.190	0.178	0.191	0.184
Mean outcome: white mothers	0.180	0.159	0.272	0.074	0.167	0.170	0.178	0.168
Relative effect of Black	0.191***	0.217***	0.181***	0.409***	0.205***	0.175***	0.200***	0.171***
	(0.017)	(0.049)	(0.014)	(0.036)	(0.020)	(0.018)	(0.018)	(0.017)

Notes: The above table presents coefficients and standard errors (in parentheses) from estimation of a version of equation (1) that excludes practice group fixed effects. Only births involving a trial of labor are included, and the outcome is an indicator for whether the mother had a C-section. All regressions include month-by-year, hour-by-day of week, hospital, and physician fixed effects and controls for maternal C-section risk and SES (education, marital status, and Medicaid coverage). The subgroup observations by month of first prenatal visit do not sum to the total sample size because the starting month of prenatal care is missing from some birth records. Standard errors are clustered by hospital. The relative effect for Black mothers is calculated by dividing the estimated coefficient on Black by the relevant mean among non-Hispanic White mothers. Data come from the New Jersey Electronic Birth Records and cover the period 2008 to 2017. *** denotes p-values < 0.01, ** denotes p-values < 0.05, * denotes p-values < 0.10.

Table A7: Racial gap in intrapartum C-sections with and without listed complications

	Intrapartum C-section		
	Any	Any	No complication listed
	(1)	(2)	(3)
Black mother	0.033***	0.034***	0.007***
	(0.003)	(0.003)	(0.002)
C-section risk	0.698***	0.695***	0.178***
	(0.040)	(0.043)	(0.030)
Observations	395,216	321,402	321,402
Years	2008–2017	2008–2015	2008–2015
Adjusted R-squared	0.183	0.184	0.074
Mean outcome: white mothers	0.168	0.179	0.037
Relative effect of Black	0.194***	0.191***	0.190***
	(0.016)	(0.017)	(0.045)

Notes: The above table presents coefficients and standard errors (in parentheses) from estimation of a version of equation (1) that excludes practice group fixed effects. Only births involving a trial of labor are included, and the outcome is an indicator for whether the mother had a C-section (columns (1)–(2)) or a C-section without any listed complications. All regressions include month-by-year, hour-by-day of week, hospital, and physician fixed effects and controls for maternal C-section risk and SES (education, marital status, and Medicaid coverage). Column (1) uses data from 2008–2017 (reproducing column (6) from Table 2 for reference); columns (2) and (3) use data from 2008–2015. The relative effect for Black mothers is calculated by dividing the estimated coefficient on Black by the relevant mean among non-Hispanic White mothers. Data come from the New Jersey Electronic Birth Records. *** denotes p-values < 0.01, ** denotes p-values < 0.05, * denotes p-values < 0.10.

Table A8: Role of observable maternal characteristics on racial gap

	Without supply-side fixed effects		With supply-side fixed effects	
	(1)	(2)	(3)	(4)
Black mother	0.042***	0.043***	0.026***	0.033***
	(0.014)	(0.008)	(0.003)	(0.003)
C-section risk		0.710***		0.698***
		(0.035)		(0.040)
Observations	395,216	395,216	395,216	395,216
Adjusted R-squared	0.013	0.158	0.050	0.183
Mean outcome: white mothers	0.168	0.168	0.168	0.168
Relative effect of Black	0.252***	0.255***	0.154***	0.194***
	(0.083)	(0.046)	(0.017)	(0.016)
Month-by-year FEs	X	X	X	X
Hour-by-day of week FEs	X	X	X	X
Mother SES		X		X
Hospital FEs			X	X
Physician FEs			X	X

Notes: The above table presents coefficients and standard errors (in parentheses) from estimation of equation (1). Only births involving a trial of labor are included, and the outcome is an indicator for whether the mother had a C-section. "Maternal SES" includes indicators for maternal education, marital status, and Medicaid coverage. Standard errors are clustered by hospital. The relative effect for Black mothers is calculated by dividing the estimated coefficient on Black by the mean outcome among non-Hispanic White mothers. Data come from the New Jersey Electronic Birth Records and cover the period 2008 to 2017. *** denotes p-values < 0.01, ** denotes p-values < 0.05, * denotes p-values < 0.10.

Table A9: Estimates underlying Figure 3

		No controls		C-section risk		+ Time FEs		+ Maternal SES		+ Hospital FEs		+ Physician FEs	
	White mean	Coeff.	Relative effect	Coeff.	Relative effect	Coeff.	Relative effect	Coeff.	Relative effect	Coeff.	Relative effect	Coeff.	Relative effect
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Risk quintile 1	0.044	-0.491***		0.060***		0.057***		0.057***		0.035		0.034	
		(0.033)		(0.019)		(0.019)		(0.019)		(0.028)		(0.026)	
Risk quintile 2	0.198	-0.337***		0.095***		0.087***		0.085***		0.062**		0.060**	
		(0.031)		(0.019)		(0.019)		(0.019)		(0.028)		(0.026)	
Risk quintile 3	0.245	-0.291***		0.084***		0.085***		0.090***		0.070***		0.068***	
		(0.034)		(0.020)		(0.019)		(0.019)		(0.026)		(0.024)	
Risk quintile 4	0.358	-0.177***		0.082***		0.083***		0.084***		0.070***		0.069***	
		(0.031)		(0.021)		(0.021)		(0.021)		(0.024)		(0.023)	
Risk quintile 5	0.536												
Black x quintile 1		0.072***	1.623***	0.069***	1.550***	0.067***	1.501***	0.045***	1.012***	0.033***	0.751***	0.032***	0.717***
		(0.008)	(0.181)	(0.007)	(0.153)	(0.007)	(0.147)	(0.004)	(0.099)	(0.008)	(0.191)	(0.008)	(0.177)
Black x quintile 2		0.078***	0.396***	0.087***	0.437***	0.091***	0.459***	0.073***	0.368***	0.067***	0.339***	0.066***	0.331***
		(0.014)	(0.071)	(0.014)	(0.069)	(0.013)	(0.065)	(0.011)	(0.057)	(0.006)	(0.030)	(0.006)	(0.028)
Black x quintile 3		0.082***	0.333***	0.078***	0.319***	0.077***	0.315***	0.057***	0.234***	0.054***	0.219***	0.052***	0.211***
		(0.012)	(0.050)	(0.012)	(0.050)	(0.012)	(0.049)	(0.011)	(0.044)	(0.008)	(0.032)	(0.007)	(0.029)
Black x quintile 4		0.058***	0.161***	0.061***	0.171***	0.062***	0.174***	0.044***	0.122***	0.038***	0.106***	0.035***	0.098***
		(0.018)	(0.050)	(0.018)	(0.050)	(0.018)	(0.049)	(0.017)	(0.047)	(0.012)	(0.033)	(0.012)	(0.034)
Black x quintile 5		0.007	0.012	0.001	0.002	0.004	0.007	-0.016	-0.031	-0.019	-0.035	-0.021	-0.039
		(0.028)	(0.053)	(0.027)	(0.051)	(0.027)	(0.050)	(0.026)	(0.048)	(0.020)	(0.038)	(0.020)	(0.038)
Observations		395,216		395,216		395,216		395,216		395,216		395,216	
Adj. R-squared		0.142		0.153		0.160		0.163		0.173		0.188	

Notes: The above table presents coefficients and standard errors (in parentheses) underlying Figure 3. The estimates come from regressions of an indicator denoting a C-section on indicators denoting each risk quintile and interactions between these risk quintiles indicators and an indicator denoting whether the mother is Black. Only births involving a trial of labor are included in these regressions. Controls for continuous C-section risk; time fixed effects (month-by-year and hour-by-day of week fixed effects); markers of the mother's socioeconomic status ("SES") including education, martial status, and an indicator for Medicaid coverage; hospital fixed effects; and physician fixed effects are progressively added to the specification. The relative effect for Black mothers (shown above and plotted in Figure 3) is calculated by dividing the estimated coefficient on Black by the relevant mean among non-Hispanic White mothers. Data come from the New Jersey Electronic Birth Records and cover the period 2008 to 2017. *** denotes p-values < 0.01, ** denotes p-values < 0.05, * denotes p-values < 0.10.

Table A10: Racial gap in intrapartum C-sections: heterogeneity by physician characteristics

	Intrapartum C-section		
	(1)	(2)	(3)
Black mother	0.036***	0.041***	0.031***
	(0.003)	(0.006)	(0.004)
D.O. doctor	-0.001		
	(0.004)		
Black mother x D.O. doctor	-0.022**		
	(0.009)		
U.S.-trained doctor		-0.002	
		(0.003)	
Black mother x U.S.-trained doctor		-0.013	
		(0.008)	
Top 50 U.S. medical school			0.001
			(0.007)
Black mother x top 50 U.S. medical school			-0.001
			(0.010)
Observations	378,046	378,046	232,333
Adjusted R-squared	0.169	0.169	0.177
Mean outcome among white mothers			
M.D. doctor	0.171		
Foreign-trained doctor		0.166	
Non-top 50 medical school doctor			0.170
Relative effect of being Black			
M.D. doctor	0.209***		
	(0.020)		
D.O. doctor	0.091		
	(0.057)		
Foreign-trained doctor		0.250***	
		(0.038)	
U.S.-trained doctor		0.168***	
		(0.026)	
Non-top 50 medical school doctor			0.180***
			(0.024)
Top 50 U.S. medical school			0.179***
			(0.054)

Notes: The above table presents coefficients and standard errors (in parentheses) from estimation of variants of equation (3). Only births involving a trial of labor are included, and the outcome is an indicator for whether the mother had a C-section. All regressions include month-by-year, hour-by-day of week, and hospital fixed effects and controls for maternal C-section risk and SES. Standard errors are clustered by hospital. The relative effect for Black mothers is calculated by dividing the estimated coefficient on Black by the relevant mean among non-Hispanic White mothers. Data come from the New Jersey Electronic Birth Records and the AMA Master File and cover the period 2008 to 2017. *** denotes p-values < 0.01, ** denotes p-values < 0.05, * denotes p-values < 0.10.

Table A11: Share of birth hours with multiple C-sections across sample hospitals

	Share of birth hours† with ≥3 C-sections		Share of birth hours† with ≥2 C-sections	
Hospital	All C-sections (1)	Pre-labor C-sections (2)	All C-sections (3)	Pre-labor C-sections (4)
1	0.011	0.007	0.103	0.067
2	0.008	0.357	0.081	0.046
3	0.005	0.258	0.055	0.034
4	0.003	0.179	0.049	0.031
5	0.002	0.201	0.024	0.022
6	0.002	0.148	0.044	0.036
7	0.002	0.184	0.037	0.028
8	0.002	0.140	0.040	0.031
9	0.002	0.172	0.029	0.026
10	0.001	0.098	0.026	0.020
11	0.001	0.124	0.018	0.015
12	0.001	0.054	0.025	0.017
13	0.001	0.071	0.019	0.016
14	0.001	0.071	0.019	0.014
15	0.001	0.058	0.021	0.018
16	0.001	0.048	0.022	0.018
17	0.000	0.022	0.015	0.010
18	0.000	0.027	0.022	0.017
19	0.000	0.030	0.024	0.021
20	0.000	0.028	0.014	0.011
21	0.001	0.028	0.012	0.005
22	0.001	0.047	0.014	0.011
23	0.000	0.019	0.015	0.010
24	0.000	0.024	0.015	0.013
25	0.000	0.006	0.016	0.012
26	0.000	0.020	0.013	0.010
27	0.000	0.000	0.021	0.019
28	0.000	0.009	0.020	0.017
29	0.000	0.000	0.018	0.013
30	0.000	0.011	0.015	0.014
31	0.000	0.000	0.012	0.010
32	0.000	0.000	0.019	0.017
33	0.000	0.019	0.009	0.007
34	0.000	0.000	0.011	0.010
35–68	0.000	0.001	0.009	0.008

† Number of hospital-day-hours with at least one birth

Notes: The above table shows the share of hospital-day-hours with at least one birth by any delivery method ("birth hours") in which there were at least three C-sections (column (1)), three pre-labor C-sections (column (2)), two C-sections (column (3)), or two pre-labor C-sections (column (4)). The final row reports the average among hospitals in the bottom half of the distribution of the share of birth-hours with multiple C-sections. Data come from the New Jersey Electronic Birth Records and cover the period 2008 to 2017.

Table A12: Relationship between pre-labor C-sections and probability of intrapartum C-sections

a. Pre-labor C-sections in hours leading up to birth

	Intrapartum C-section					
	(1)	(2)	(3)	(4)	(5)	(6)
Pre-labor CS *t*	-0.093***					-0.097***
	(0.009)					(0.009)
Pre-labor CS *t-1*		-0.035***				-0.039***
		(0.006)				(0.006)
Pre-labor CS *t-2*			0.021***			0.026***
			(0.004)			(0.004)
Pre-labor CS *t-3*				0.002		0.011***
				(0.002)		(0.003)
Pre-labor CS *t-4*					0.002	0.005
					(0.003)	(0.003)
Observations	395,216	395,209	395,207	395,201	395,198	395,198
Adjusted R-squared	0.186	0.183	0.183	0.183	0.183	0.188
Mean outcome	0.181	0.181	0.181	0.181	0.181	0.181
Relative effect	-0.513***	-0.194***	0.114***	0.013	0.011	-0.540***
	(0.048)	(0.032)	(0.024)	(0.011)	(0.016)	(0.051)

b. Pre-labor C-sections in hours following birth

	Intrapartum C-section					
	(1)	(2)	(3)	(4)	(5)	(6)
Pre-labor CS *t*	-0.093***					-0.099***
	(0.009)					(0.009)
Pre-labor CS *t+1*		-0.043***				-0.047***
		(0.008)				(0.008)
Pre-labor CS *t+2*			0.030***			0.036***
			(0.007)			(0.006)
Pre-labor CS *t+3*				0.012***		0.021***
				(0.004)		(0.005)
Pre-labor CS *t+4*					0.004	0.007**
					(0.003)	(0.003)
Observations	395216	395213	395211	395210	395210	395210
Adjusted R-squared	0.186	0.184	0.183	0.183	0.183	0.188
Mean outcome	0.181	0.181	0.181	0.181	0.181	0.181
Relative effect	-0.513***	-0.238***	0.168***	0.065***	0.023	-0.548***
	(0.048)	(0.042)	(0.037)	(0.023)	(0.016)	(0.052)

Notes: The above table presents coefficients and standard errors (in parentheses) from estimation of an analogue of equation (1) that includes a control for whether there was a pre-labor C-section in the hours surrounding the delivery in place of an indicator denoting whether the mother was Black. Only births involving a trial of labor are included, and the outcome is an indicator for whether the mother had a C-section. The regression includes month-by-year, hour-by-day of week, hospital, and physician fixed effects and controls for maternal C-section risk and SES. Standard errors are clustered by hospital. Data come from the New Jersey Electronic Birth Records and cover the period 2008 to 2017. *** denotes p-values < 0.01, ** denotes p-values < 0.05, * denotes p-values < 0.10.

Table A13: Relationship between pre-labor and intrapartum C-section shares

	Intrapartum C-section share		
Unit of observation:	Hospital-day-hour (1)	Hospital-day (2)	Hospital-week (3)
Pre-labor C-section share	-0.179***	-0.165***	-0.173***
	(0.001)	(0.002)	(0.004)
Number of births	-0.023***	0.000*	0.000
	(0.001)	(0.000)	(0.000)
Observations	860,255	175,493	27,455
Adjusted R-squared	0.066	0.065	0.152
Mean outcome	0.170	0.156	0.115

Notes: The above table presents coefficients and standard errors (in parentheses) from regressions of the share of all births (with and without a trial of labor) delivered by intrapartum C-section on the share of all births delivered by pre-labor C-section conditional on the total number of births. The regressions include hospital fixed effects, and standard errors are clustered by hospital. In column (1), the unit of observation is the hospital-day-hour (e.g., births on January 1, 2008 between 9:00am and 9:59am in Hospital A); in columns (2) and (3), the unit of observation is the hospital-day and the hospital-week, respectively. Over the sample period (2008–2017), the 68 hospitals operating in New Jersey delivered babies on average during five hours per day, on five days per week, and in 43 weeks per year. Data come from the New Jersey Electronic Birth Records. *** denotes p-values < 0.01, ** denotes p-values < 0.05, * denotes p-values < 0.10.

Table A14: Estimates underlying Figure 6

	Coefficient (1)	Standard error (SE) (2)	White mean (3)	Relative effect of Black (4)	SE of relative effect (5)
Risk quintile 1	0.023	(0.026)	0.047		
Risk quintile 2	0.057**	(0.026)	0.208		
Risk quintile 3	0.067***	(0.023)	0.256		
Risk quintile 4	0.070***	(0.022)	0.371		
Risk quintile 5			0.546		
Black x quintile 1	0.036***	(0.008)		0.774***	(0.161)
Black x quintile 2	0.068***	(0.006)		0.328***	(0.031)
Black x quintile 3	0.052***	(0.008)		0.205***	(0.031)
Black x quintile 4	0.035***	(0.013)		0.095***	(0.035)
Black x quintile 5	-0.022	(0.021)		-0.041	(0.038)
Pre-labor CS x quintile 1	-0.033***	(0.005)	0.016		
Pre-labor CS x quintile 2	-0.123***	(0.012)	0.088		
Pre-labor CS x quintile 3	-0.141***	(0.012)	0.118		
Pre-labor CS x quintile 4	-0.182***	(0.024)	0.188		
Pre-labor CS x quintile 5	-0.152***	(0.029)	0.389		
Pre-labor CS x Black x quintile 1	-0.051***	(0.008)		-0.885	(0.780)
Pre-labor CS x Black x quintile 2	-0.047***	(0.017)		0.237*	(0.142)
Pre-labor CS x Black x quintile 3	-0.020	(0.020)		0.275**	(0.138)
Pre-labor CS x Black x quintile 4	-0.020	(0.022)		0.083	(0.096)
Pre-labor CS x Black x quintile 5	0.002	(0.031)		-0.052	(0.081)
Observations	395,216				
R-squared	0.193				

Notes: The above table presents coefficients and standard errors (in parentheses) underlying Figure 6. The estimates come from estimation of an analogue of equation (4). Only births involving a trial of labor are included, and the outcome is an indicator for whether the mother had a C-section. The regression includes month-by-year, hour-by-day of week, hospital, and physician fixed effects and controls for maternal C-section risk and SES. "Scheduled CS" is an indicator denoting whether there was at least one pre-labor C-section at the hour of the delivery with a trial of labor in the same hospital. Standard errors are clustered by hospital. The relative effect for Black mothers (shown above and plotted in Figure 6) is calculated by dividing the estimated coefficient on Black by the relevant mean among non-Hispanic White mothers. Data come from the New Jersey Electronic Birth Records and cover the period 2008 to 2017. *** denotes p-values < 0.01, ** denotes p-values < 0.05, * denotes p-values < 0.10.

Table A15: Gaps in intrapartum C-sections by maternal race and ethnicity

	Intrapartum C-section					
	(1)	(2)	(3)	(4)	(5)	(6)
Black mother	0.033***			0.035***		
	(0.003)			(0.003)		
Concurrent pre-labor C-section				-0.085***	-0.085***	-0.083***
				(0.009)	(0.009)	(0.009)
Black mother x pre-labor C-section				-0.030***		
				(0.011)		
Non-Black Hispanic mother		0.016***			0.016***	
		(0.003)			(0.003)	
Non-Black Hispanic x pre-labor C-section					-0.005	
					(0.008)	
Other race mother			0.023***			0.024***
			(0.003)			(0.003)
Other race x pre-labor C-section						-0.014
						(0.010)
C-section risk	0.698***	0.705***	0.721***	0.694***	0.701***	0.718***
	(0.040)	(0.041)	(0.040)	(0.040)	(0.040)	(0.040)
Observations	395,216	430,420	360,160	395,216	430,420	360,160
Adjusted R-squared	0.183	0.185	0.190	0.187	0.188	0.193
Mean outcome among white mothers						
Overall	0.168	0.168	0.168			
No concurrent pre-labor CS				0.176	0.176	0.176
Relative effect of race						
Overall	0.194***	0.093***	0.135***			
	(0.016)	(0.016)	(0.018)			
Concurrent pre-labor CS				0.059	0.139	0.129
				(0.140)	(0.106)	(0.127)
No concurrent pre-labor CS				0.197***	0.091***	0.135***
				(0.015)	(0.015)	(0.018)

Notes: The above table presents coefficients and standard errors (in parentheses) from estimation of variants of equation (1) (columns (1)–(3)) and equation (4) (columns (4)–(6)). Only births involving a trial of labor are included, and the outcome is an indicator for whether the mother had a C-section. All regressions include month-by-year, hour-by-day of week, hospital, and physician fixed effects and controls for maternal C-section risk and SES (education, marital status, and Medicaid coverage). For reference, columns (1) and (4) reproduce column (6) from Table 2 and column (3) from Table 3, respectively. Only non-Hispanic White mothers and mothers with the race/ethnicity being considered are included in each regression. Standard errors are clustered by hospital. The relative effect of each race/ethnicity is calculated by dividing the estimated coefficient by the relevant mean among non-Hispanic White mothers. Data come from the New Jersey Electronic Birth Records and cover the period 2008 to 2017. In these data, the "other race" category is 80 percent Asian and also includes American Indians, Pacific Islanders, and people who self-identified as "other." *** denotes p-values < 0.01, ** denotes p-values < 0.05, * denotes p-values < 0.10.

Table A16: Disparities in intrapartum C-sections by maternal race and education

	Intrapartum C-section			
	(1)	(2)	(3)	(4)
Black mother	0.033***		0.035***	
	(0.003)		(0.003)	
Concurrent pre-labor C-section			-0.085***	-0.084***
			(0.009)	(0.008)
Black mother x pre-labor C-section			-0.030***	
			(0.011)	
Low-education mother		0.021***		0.020***
		(0.003)		(0.004)
Low-educ. mother x pre-labor C-section				0.007
				(0.008)
C-section risk	0.698***	0.710***	0.694***	0.707***
	(0.040)	(0.047)	(0.040)	(0.046)
White mothers only		X		X
Observations	395,216	282,314	395,216	282,314
Adjusted R-squared	0.183	0.195	0.187	0.199
Mean outcome among white mothers				
Overall	0.168			
No concurrent pre-labor CS			0.176	
High education		0.172		
High education, no concurrent pre-labor CS				0.180
Relative effect of being Black				
Overall	0.194***			
	(0.016)			
Concurrent pre-labor CS			0.059	
			(0.140)	
No concurrent pre-labor CS			0.197***	
			(0.015)	
Relative effect of being low education				
Overall		0.122***		
		(0.018)		
Concurrent pre-labor CS				0.334***
				(0.065)
No concurrent pre-labor CS				0.112***
				(0.020)

Notes: The above table presents coefficients and standard errors (in parentheses) from estimation of variants of equation (1) (columns (1)–(2)) and equation (4) (columns (3)–(4)). Only births involving a trial of labor are included, and the outcome is an indicator for whether the mother had a C-section. Columns (1) and (3) estimate equations (1) and (4) using all births among White and Black mothers with a trial of labor, while columns (2) and (4) replace the Black indicator with an indicator for whether the mother has a high school degree or less ("low education") and restrict the sample to White mothers. All regressions include month-by-year, hour-by-day of week, hospital, and physician fixed effects and controls for maternal C-section risk and SES. "Concurrent pre-labor CS" is an indicator denoting whether there was at least one pre-labor C-section at the hour of the index delivery in the same hospital. Standard errors are clustered by hospital. The relative effect for Black mothers is calculated by dividing the estimated coefficient on Black by the relevant mean among non-Hispanic White mothers. Data come from the New Jersey Electronic Birth Records. *** denotes p-values < 0.01, ** denotes p-values < 0.05, * denotes p-values < 0.10.

Table A17: Racial gap in intrapartum C-sections: robustness to alternative maternal C-section risk prediction models

	Intrapartum C-section					
	(1)	(2)	(3)	(4)	(5)	(6)
Black mother	0.033***	0.032***	0.033***	0.035***	0.035***	0.035***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Concurrent pre-labor C-section				-0.085***	-0.087***	-0.084***
				(0.009)	(0.009)	(0.009)
Black mother x pre-labor C-section				-0.030***	-0.030**	-0.030***
				(0.011)	(0.011)	(0.011)
C-section risk (RF, White only)	0.698***			0.694***		
	(0.040)			(0.040)		
C-section risk (Logit, White only)		0.693***			0.689***	
		(0.047)			(0.046)	
C-section risk (RF, all races)			0.689***			0.685***
			(0.042)			(0.041)
Observations	395,216	395,216	395,216	395,216	395,216	395,216
Years	2008–2017	2008–2017	2008–2017	2008–2017	2008–2017	2008–2017
Adjusted R-squared	0.183	0.166	0.189	0.187	0.170	0.192
Mean outcome among white mothers						
Overall	0.168	0.168	0.168			
No concurrent pre-labor CS				0.176	0.176	0.176
Relative effect of being Black						
Overall	0.194***	0.193***	0.198***			
	(0.016)	(0.016)	(0.015)			
Concurrent re-labor CS				0.059	0.062	0.072
				(0.140)	(0.144)	(0.139)
No concurrent pre-labor CS				0.197***	0.196***	0.201***
				(0.015)	(0.015)	(0.014)

Notes: The above table presents coefficients and standard errors (in parentheses) from estimation of equation (1) (columns (1)–(3)) and equation (4) (columns (4)–(6)). Only births with a trial of labor are included, and the outcome is an indicator for whether the mother had a C-section. All regressions include month-by-year, hour-by-day of week, hospital, and physician fixed effects and controls for maternal C-section risk and SES. Maternal C-section risk in columns (1), (2), (4), and (5) is predicted using a random forest ("RF") algorithm, while columns (3) and (6) instead rely on a logistic regression model. The models in columns (1), (3), (4), and (6) are trained using only White mothers, whereas those in columns (2) and (5) are trained using mothers of all races. In all cases, maternal C-section risk is predicted solely from the medical risk factors listed in Table A2. "Concurrent pre-labor CS" is an indicator denoting whether there was at least one pre-labor C-section at the hour of the index delivery in the same hospital. Standard errors are clustered by hospital. The relative effect for Black mothers is calculated by dividing the estimated coefficient on Black by the relevant mean among non-Hispanic White mothers. Data come from the New Jersey Electronic Birth Records. *** denotes p-values < 0.01, ** denotes p-values < 0.05, * denotes p-values < 0.10.

Table A18: Racial gap: robustness to alternative variable sets included in maternal C-section risk prediction

	Intrapartum C-section					
	(1)	(2)	(3)	(4)	(5)	(6)
Black mother	0.034***	0.025***	0.017***	0.036***	0.027***	0.020***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Concurrent pre-labor C-section				-0.090***	-0.059***	-0.052***
				(0.011)	(0.008)	(0.007)
Black mother x pre-labor C-section				-0.033**	-0.031***	-0.035***
				(0.013)	(0.008)	(0.008)
C-section risk (RF main)	0.696***			0.691***		
	(0.043)			(0.042)		
C-section risk (RF with L&D complications)		0.882***			0.879***	
		(0.023)			(0.023)	
C-section risk (RF with interventions)			0.897***			0.894***
			(0.017)			(0.017)
Observations	324,765	324,765	324,765	324,765	324,765	324,765
Years	2008–2015	2008–2015	2008–2015	2008–2015	2008–2015	2008–2015
Adjusted R-squared	0.183	0.468	0.519	0.188	0.470	0.521
Mean outcome among white mothers						
Overall	0.178	0.178	0.178			
No concurrent pre-labor CS				0.187	0.187	0.187
Relative effect of being Black						
Overall	0.191***	0.139***	0.097***			
	(0.017)	(0.015)	(0.014)			
Concurrent pre-labor CS				0.043	-0.044	-0.175*
				(0.153)	(0.097)	(0.091)
No concurrent pre-labor CS				0.195***	0.145***	0.107***
				(0.016)	(0.014)	(0.014)

Notes: The above table presents coefficients and standard errors (in parentheses) from estimation of equation (1) (columns (1)–(3)) and equation (4) (columns (4)–(6)). Only births involving a trial of labor are included, and the outcome is an indicator for whether the mother had a C-section. All regressions include month-by-year, hour-by-day of week, hospital, and physician fixed effects and controls for maternal C-section risk and SES. Maternal C-section risk in all columns is predicted using a random forest ("RF") algorithm. In columns (1) and (4), only maternal risk factors listed in Table A2 are used in the RF algorithm; columns (2) and (5) additionally include complications during labor and delivery listed in Table A2, while columns (3) and (6) further include intrapartum management interventions listed in Table A2. "Concurrent pre-labor CS" is an indicator denoting whether there was at least one pre-labor C-section at the hour of the index delivery in the same hospital. Standard errors are clustered by hospital. The relative effect for Black mothers is calculated by dividing the estimated coefficient on Black by the relevant mean among non-Hispanic White mothers. Data come from the New Jersey Electronic Birth Records. *** denotes p-values < 0.01, ** denotes p-values < 0.05, * denotes p-values $<$ 0.10.

Table A19: Racial gap: robustness to cubic in maternal C-section risk

	Intrapartum C-section			
	(1)	(2)	(3)	(4)
Black mother	0.033***	0.036***	0.035***	0.038***
	(0.003)	(0.003)	(0.003)	(0.003)
Concurrent pre-labor C-section			-0.085***	-0.085***
			(0.009)	(0.009)
Black mother x pre-labor C-section			-0.030***	-0.029**
			(0.011)	(0.011)
C-section risk	0.698***	1.020***	0.694***	1.013***
	(0.040)	(0.156)	(0.040)	(0.155)
(C-section risk)^2		-0.478		-0.470
		(0.295)		(0.294)
(C-section risk)^3		0.109		0.104
		(0.202)		(0.202)
Observations	395,216	395,216	395,216	395,216
Adjusted R-squared	0.183	0.186	0.187	0.190
Mean outcome among white mothers				
Overall	0.168	0.168		
No concurrent pre-labor CS			0.176	0.176
Relative effect of being Black				
Overall	0.194***	0.212***		
	(0.016)	(0.019)		
Concurrent pre-labor CS			0.059	0.105
			(0.140)	(0.144)
No concurrent pre-labor CS			0.197***	0.215***
			(0.015)	(0.017)

Notes: The above table presents coefficients and standard errors (in parentheses) from estimation of equation (1) (columns (1)–(2)) and equation (4) (columns (3)–(4)). Only births involving a trial of labor are included, and the outcome is an indicator for whether the mother had a C-section. All regressions include month-by-year, hour-by-day of week, hospital, and physician fixed effects and controls for maternal C-section risk and SES. "Concurrent pre-labor CS" is an indicator denoting whether there was at least one pre-labor C-section at the hour of the index delivery in the same hospital. Standard errors are clustered by hospital. The relative effect for Black mothers is calculated by dividing the estimated coefficient on Black by the relevant mean among non-Hispanic White mothers. Data come from the New Jersey Electronic Birth Records. *** denotes p-values < 0.01, ** denotes p-values < 0.05, * denotes p-values < 0.10.

Table A20: Racial gap: robustness to excluding high-capacity C-section hospitals

	Intrapartum C-section			
	(1)	(2)	(3)	(4)
Black mother	0.033***	0.032***	0.035***	0.034***
	(0.003)	(0.003)	(0.003)	(0.003)
Concurrent pre-labor C-section			-0.085***	-0.094***
			(0.009)	(0.014)
Black mother x pre-labor C-section			-0.030***	-0.043***
			(0.011)	(0.016)
C-section risk	0.698***	0.668***	0.694***	0.664***
	(0.040)	(0.044)	(0.040)	(0.043)
Excluding large hospitals		X		X
Observations	395,216	329,372	395,216	329,372
Adjusted R-squared	0.183	0.176	0.187	0.180
Mean outcome among white mothers				
Overall	0.168	0.163		
No concurrent pre-labor CS			0.176	0.171
Relative effect of being Black				
Overall	0.194***	0.194***		
	(0.016)	(0.021)		
Concurrent pre-labor CS			0.059	-0.181
			(0.140)	(0.303)
No concurrent pre-labor CS			0.197***	0.199***
			(0.015)	(0.019)

Notes: The above table presents coefficients and standard errors (in parentheses) from estimation of equation (1) (columns (1)–(2)) and equation (4) (columns (3)–(4)). Only births involving a trial of labor are included, and the outcome is an indicator for whether the mother had a C-section. All regressions include month-by-year, hour-by-day of week, hospital, and physician fixed effects and controls for maternal C-section risk and SES. Columns (1) and (3) include births at all hospitals in New Jersey; columns (2) and (4) exclude births at the four hospitals with the highest capacity for C-sections (see Table A11). "Concurrent pre-labor CS" is an indicator denoting whether there was at least one pre-labor C-section at the hour of the index delivery in the same hospital. Standard errors are clustered by hospital. The relative effect for Black mothers is calculated by dividing the estimated coefficient on Black by the relevant mean among non-Hispanic White mothers. Data come from the New Jersey Electronic Birth Records and cover the period 2008 to 2017. *** denotes p-values < 0.01, ** denotes p-values < 0.05, * denotes p-values < 0.10.

Table A21: Racial gap in intrapartum C-sections: heterogeneity by time of day

	Intrapartum C-section					
	(1)	(2)	(3)	(4)	(5)	(6)
Black mother	0.033***	0.034***	0.030***	0.035***	0.038***	0.030***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Concurrent pre-labor C-section				-0.085***	-0.083***	-0.089***
				(0.009)	(0.009)	(0.015)
Black mother x pre-labor C-section				-0.030***	-0.035***	-0.022
				(0.011)	(0.012)	(0.015)
C-section risk	0.698***	0.710***	0.677***	0.694***	0.704***	0.676***
	(0.040)	(0.038)	(0.044)	(0.040)	(0.038)	(0.044)
Time of day	All	8am–8pm	9pm–7am	All	8am–8pm	9pm–7am
Observations	395,216	238,838	156,321	395,216	238,838	156,321
Adjusted R-squared	0.183	0.190	0.178	0.187	0.195	0.180
Mean outcome among white mothers						
Overall	0.168	0.167	0.170			
No concurrent pre-labor CS				0.176	0.178	0.174
Relative effect of being Black						
Overall	0.194***	0.205***	0.175***			
	(0.016)	(0.020)	(0.018)			
Concurrent pre-labor CS				0.059	0.032	0.133
				(0.140)	(0.136)	(0.264)
No concurrent pre-labor CS				0.197***	0.213***	0.174***
				(0.015)	(0.019)	(0.017)

Notes: The above table presents coefficients and standard errors (in parentheses) from estimation of equation (1) (columns (1)–(3)) and equation (4) (columns (4)–(6)). Only births involving a trial of labor are included, and the outcome is an indicator for whether the mother had a C-section. All regressions include month-by-year, hour-by-day of week, hospital, and physician fixed effects and controls for maternal C-section risk and SES. Columns (1) and (4) include births during all hours; columns (2) and (5) restrict the sample to deliveries that occurred between 8am and 8pm, while columns (3) and (6) restrict to deliveries between 9pm and 7am. "Concurrent pre-labor CS" is an indicator denoting whether there was at least one pre-labor C-section at the hour of the index delivery in the same hospital. Standard errors are clustered by hospital. The relative effect for Black mothers is calculated by dividing the estimated coefficient on Black by the relevant mean among non-Hispanic White mothers. Data come from the New Jersey Electronic Birth Records. *** denotes p-values < 0.01, ** denotes p-values < 0.05, * denotes p-values < 0.10.

Table A22: Effects of concurrent pre-labor C-sections on maternal health (reduced form)

a. White mothers		Individual maternal postpartum complications						
	Any	Infection	Pyrexia	Venous	Embol.	Hemorr.	Wound	Other
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Pre-CS x quintile 1-3	-0.003	-0.000	-0.000	0.000	-0.000*	0.000	-0.001**	-0.002*
	(0.002)	(0.000)	(0.001)	(0.002)	(0.000)	(0.001)	(0.000)	(0.001)
Pre-CS x quintile 4-5	0.004	-0.001	0.002	0.005	-0.001***	0.003	-0.003***	-0.003
	(0.005)	(0.002)	(0.002)	(0.003)	(0.000)	(0.005)	(0.001)	(0.005)
Observations	200,599	200,599	200,599	200,599	200,599	200,599	200,478	200,599
Adjusted R-squared	0.014	0.005	0.003	0.013	0.003	0.012	0.009	0.007
Mean outcome without concurrent pre-labor C-section								
Quintile 1-3	0.055	0.003	0.003	0.011	0.000	0.023	0.002	0.016
Quintile 4-5	0.078	0.006	0.006	0.009	0.001	0.036	0.006	0.023
Relative effect of concurrent pre-labor C-section								
Quintile 1-3	-0.056	-0.094	-0.040	0.025	-0.781*	0.005	-0.360***	-0.099*
	(0.044)	(0.134)	(0.244)	(0.132)	(0.414)	(0.041)	(0.138)	(0.052)
Quintile 4-5	0.053	-0.135	0.298	0.580*	-0.957***	0.085	-0.494***	-0.125
	(0.069)	(0.363)	(0.342)	(0.351)	(0.303)	(0.134)	(0.183)	(0.194)

b. Black mothers		Individual maternal postpartum complications						
	Any	Infection	Pyrexia	Venous	Embol.	Hemorr.	Wound	Other
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Pre-CS x quintile 1-3	0.002	-0.001	-0.001	0.001	0.000	0.006**	-0.001	-0.002
	(0.004)	(0.001)	(0.001)	(0.001)	(0.000)	(0.003)	(0.001)	(0.002)
Pre-CS x quintile 4-5	-0.016	-0.008***	-0.000	-0.004*	0.000	-0.003	-0.001	-0.002
	(0.011)	(0.003)	(0.005)	(0.002)	(0.001)	(0.007)	(0.002)	(0.008)
Observations	83,124	83,124	83,124	83,124	83,124	83,124	83,010	83,124
Adjusted R-squared	0.017	0.015	0.003	0.008	-0.004	0.013	0.007	0.009
Mean outcome without concurrent pre-labor C-section								
Quintile 1-3	0.066	0.008	0.006	0.005	0.000	0.027	0.005	0.023
Quintile 4-5	0.105	0.014	0.008	0.007	0.002	0.043	0.012	0.036
Relative effect of concurrent pre-labor C-section								
Quintile 1-3	0.031	-0.091	-0.191	0.110	1.116	0.223**	-0.223	-0.100
	(0.060)	(0.152)	(0.161)	(0.202)	(1.107)	(0.099)	(0.164)	(0.069)
Quintile 4-5	-0.148	-0.557***	-0.025	-0.557*	0.038	-0.071	-0.078	-0.060
	(0.108)	(0.179)	(0.667)	(0.332)	(0.787)	(0.173)	(0.198)	(0.228)

Notes: The above table presents coefficients and standard errors (in parentheses) from estimation of equation (5). "Pre-CS" denotes whether the birth occured at the same time as a pre-labor C-section. Only births involving a trial of labor among White mothers (panel (a)) and Black mothers (panel (b)) are included. In columns (2)–(7), the outcome is an indicator for whether the mother experienced each of the following complications in the 90 days following delivery (ICD-9 in parentheses), respectively: major puerperal infection (670), pyrexia (672), venous complications (671), pulmonary embolism (673), postpartum hemorrhage (666), complications of the obstetrical wound (674), and other postpartum complications. The outcome in column (1) is an indicator denoting whether the mother experienced any of the aforementioned conditions. Data come from the New Jersey Electronic Birth Records and cover the period 2008 to 2015. *** denotes p-values < 0.01, ** denotes p-values < 0.05, * denotes p-values < 0.10.

Table A23: Effects of intrapartum C-sections on maternal health (2SLS)

a. White mothers		Individual maternal postpartum complications						
	Any	Infection	Pyrexia	Venous	Embol.	Hemorr.	Wound	Other
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ICS x quintile 1-3	0.045	0.003	0.003	-0.002	0.003*	-0.000	0.011**	0.021*
	(0.037)	(0.005)	(0.011)	(0.021)	(0.002)	(0.013)	(0.005)	(0.012)
ICS x quintile 4-5	-0.022	0.005	-0.010	-0.030	0.004***	-0.018	0.019**	0.018
	(0.030)	(0.012)	(0.012)	(0.021)	(0.001)	(0.026)	(0.008)	(0.025)
Observations	200,599	200,599	200,599	200,599	200,599	200,599	200,478	200,599
Adjusted R-squared	-0.004	-0.005	-0.007	-0.007	-0.010	-0.004	-0.000	-0.006
Mean outcome with vaginal delivery								
Quintile 1-3	0.051	0.002	0.002	0.012	0.000	0.023	0.001	0.015
Quintile 4-5	0.079	0.003	0.004	0.013	0.001	0.045	0.002	0.019
Relative effect of intrapartum C-section								
Quintile 1-3	0.886	1.668	1.213	-0.139	13.163*	-0.006	16.326**	1.439*
	(0.724)	(2.698)	(5.265)	(1.711)	(7.796)	(0.594)	(7.424)	(0.782)
Quintile 4-5	-0.272	1.390	-2.201	-2.204	7.046***	-0.394	11.029**	0.929
	(0.381)	(3.623)	(2.646)	(1.528)	(1.967)	(0.572)	(4.945)	(1.273)

b. Black mothers		Individual maternal postpartum complications						
	Any	Infection	Pyrexia	Venous	Embol.	Hemorr.	Wound	Other
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ICS x quintile 1-3	-0.025	0.003	0.010	-0.007	-0.004	-0.055*	0.009	0.020
	(0.038)	(0.010)	(0.009)	(0.011)	(0.005)	(0.030)	(0.006)	(0.014)
ICS x quintile 4-5	0.088	0.045**	0.001	0.023	-0.000	0.017	0.005	0.012
	(0.070)	(0.019)	(0.030)	(0.015)	(0.007)	(0.044)	(0.013)	(0.046)
Observations	83,124	83,124	83,124	83,124	83,124	83,124	83,010	83,124
Adjusted R-squared	-0.020	-0.017	-0.013	-0.023	-0.021	-0.027	-0.008	-0.015
Mean outcome with vaginal delivery								
Quintile 1-3	0.058	0.005	0.004	0.006	0.000	0.028	0.001	0.021
Quintile 4-5	0.093	0.007	0.003	0.01	0.001	0.053	0.001	0.03
Relative effect of intrapartum C-section								
Quintile 1-3	-0.436	0.590	2.846	-1.209	-10.105	-1.970*	8.864	0.935
	(0.647)	(2.173)	(2.405)	(1.803)	(10.627)	(1.081)	(6.343)	(0.661)
Quintile 4-5	0.937	6.468**	0.366	2.345	-0.330	0.312	4.391	0.411
	(0.750)	(2.783)	(8.788)	(1.558)	(6.059)	(0.828)	(10.634)	(1.542)

Notes: The above table presents coefficients and standard errors (in parentheses) from estimation of a two-stage least squares analogue of equation (5). We instrument for whether the mother had an intrapartum C-section (ICS) using an indicator denoting whether the birth occured at the same time as a pre-labor C-section; the Kleibergen-Paap F-statistic is 30.29 and 28.76 in panels (a) and (b), respectively. Only births involving a trial of labor among White mothers (panel (a)) and Black mothers (panel (b)) are included. In columns (2)–(7), the outcome is an indicator for whether the mother experienced each of the following complications in the 90 days following delivery (ICD-9 in parentheses), respectively: major puerperal infection (670), pyrexia (672), venous complications (671), pulmonary embolism (673), postpartum hemorrhage (666), complications of the obstetrical wound (674), and other postpartum complications. The outcome in column (1) is an indicator denoting whether the mother experienced any of the aforementioned conditions. Data come from the New Jersey Electronic Birth Records and cover the period 2008 to 2015. *** denotes p-values < 0.01, ** denotes p-values < 0.05, * denotes p-values < 0.10.

Table A24: Effects of concurrent pre-labor C-sections on infant health (reduced form)

a. Infants born to white mothers		Individual infant health complications			
	Any (1)	NICU admission (2)	Low Apgar score (3)	Mechanical ventilation (4)	Significant birth injury (5)
Pre-CS x quintile 1-3	-0.006**	-0.007**	-0.000	-0.003	0.001
	(0.003)	(0.003)	(0.000)	(0.002)	(0.001)
Pre-CS x quintile 4-5	0.017**	0.017**	0.004	0.003	-0.001
	(0.007)	(0.008)	(0.003)	(0.004)	(0.001)
Observations	200,599	200,599	200,599	200,599	200,389
Adjusted R-squared	0.114	0.118	0.021	0.051	0.042
Mean outcome without concurrent pre-labor C-section					
Quintile 1-3	0.057	0.051	0.004	0.007	0.002
Quintile 4-5	0.133	0.122	0.011	0.024	0.003
Relative effect of concurrent pre-labor C-section					
Quintile 1-3	-0.110**	-0.141**	-0.056	-0.411	0.304
	(0.050)	(0.061)	(0.118)	(0.269)	(0.254)
Quintile 4-5	0.127**	0.137**	0.395	0.114	-0.239
	(0.056)	(0.063)	(0.254)	(0.161)	(0.202)

b. Infants born to Black mothers		Individual infant health complications			
	Any (1)	NICU admission (2)	Low Apgar score (3)	Mechanical ventilation (4)	Significant birth injury (5)
Pre-CS x quintile 1-3	-0.007*	-0.008**	0.000	-0.002	-0.000
	(0.004)	(0.004)	(0.002)	(0.002)	(0.000)
Pre-CS x quintile 4-5	-0.007	-0.005	-0.009	0.007	0.001
	(0.016)	(0.015)	(0.006)	(0.006)	(0.002)
Observations	83,124	83,124	83,124	83,124	83,002
Adjusted R-squared	0.112	0.114	0.036	0.051	0.023
Mean outcome without concurrent pre-labor C-section					
Quintile 1-3	0.096	0.089	0.012	0.015	0.001
Quintile 4-5	0.213	0.193	0.035	0.045	0.001
Relative effect of concurrent pre-labor C-section					
Quintile 1-3	-0.076*	-0.085**	0.017	-0.133	-0.561
	(0.041)	(0.042)	(0.190)	(0.140)	(0.546)
Quintile 4-5	-0.031	-0.028	-0.257	0.148	0.803
	(0.073)	(0.078)	(0.177)	(0.142)	(1.552)

Notes: The above table presents coefficients and standard errors (in parentheses) from estimation of equation (5). "Pre-CS" denotes whether the birth occured at the same time as a pre-labor C-section. Only births involving a trial of labor among White mothers (panel (a)) and Black mothers (panel (b)) are included. In columns (2)–(5), the dependent variable is an indicator for whether the infant experienced each of the following complications, respectively: admission to the NICU, 5-minute Apgar score below 7, mechanical ventilation needed, and significant birth injury. The outcome in column (1) is an indicator denoting whether the infant experienced any of the aforementioned conditions. Data come from the New Jersey Electronic Birth Records and cover the period 2008 to 2015. *** denotes p-values < 0.01, ** denotes p-values < 0.05, * denotes p-values < 0.10.

Table A25: Effects of intrapartum C-sections on infant health (2SLS)

a. Infants born to white mothers		Individual infant health complications			
	Any (1)	NICU admission (2)	Low Apgar score (3)	Mechanical ventilation (4)	Significant birth injury (5)
ICS x quintile 1-3	0.095**	0.109**	0.005	0.042	-0.011
	(0.046)	(0.051)	(0.007)	(0.028)	(0.009)
ICS x quintile 4-5	-0.093**	-0.091**	-0.024*	-0.013	0.004
	(0.042)	(0.045)	(0.015)	(0.020)	(0.003)
Observations	200,599	200,599	200,599	200,599	200,389
Adjusted R-squared	0.029	0.022	-0.002	-0.001	-0.011
Mean outcome with vaginal delivery					
Quintile 1-3	0.053	0.048	0.004	0.006	0.003
Quintile 4-5	0.123	0.110	0.013	0.019	0.004
Relative effect of intrapartum C-section					
Quintile 1-3	1.808**	2.289**	1.433	6.802	-4.026
	(0.881)	(1.069)	(1.893)	(4.567)	(3.371)
Quintile 4-5	-0.754**	-0.830**	-1.940*	-0.688	0.980
	(0.344)	(0.414)	(1.161)	(1.033)	(0.832)

b. Infants born to Black mothers		Individual infant health complications			
	Any (1)	NICU admission (2)	Low Apgar score (3)	Mechanical ventilation (4)	Significant birth injury (5)
ICS x quintile 1-3	0.062*	0.065*	-0.006	0.021	0.004
	(0.036)	(0.035)	(0.018)	(0.021)	(0.004)
ICS x quintile 4-5	0.038	0.032	0.051	-0.037	-0.005
	(0.089)	(0.087)	(0.038)	(0.037)	(0.009)
Observations	83,124	83,124	83,124	83,124	83,002
Adjusted R-squared	0.031	0.025	-0.010	0.000	-0.021
Mean outcome with vaginal delivery					
Quintile 1-3	0.088	0.081	0.011	0.014	0.001
Quintile 4-5	0.197	0.170	0.044	0.041	0.002
Relative effect of intrapartum C-section					
Quintile 1-3	0.708*	0.798*	-0.546	1.517	5.171
	(0.413)	(0.429)	(1.624)	(1.578)	(5.133)
Quintile 4-5	0.194	0.186	1.163	-0.905	-2.919
	(0.453)	(0.511)	(0.863)	(0.905)	(5.616)

Notes: The above table presents coefficients and standard errors (in parentheses) from estimation of a two-stage least squares analogue of equation (5). We instrument for whether the mother had an intrapartum C-section (ICS) using an indicator denoting whether the birth occured at the same time as a pre-labor C-section; the Kleibergen-Paap F-statistic is 30.29 and 28.76 in panels (a) and (b), respectively. Only births involving a trial of labor among White mothers (panel (a)) and Black mothers (panel (b)) are included. In columns (2)–(5), the dependent variable is an indicator for whether the infant experienced each of the following complications, respectively: admission to the NICU, 5-minute Apgar score below 7, mechanical ventilation needed, and significant birth injury. The outcome in column (1) is an indicator denoting whether the infant experienced any of the aforementioned conditions. Data come from the New Jersey Electronic Birth Records and cover the period 2008 to 2015. *** denotes p-values < 0.01, ** denotes p-values < 0.05, * denotes p-values < 0.10.

Table A26: Effects of concurrent pre-labor C-sections on health: heterogeneity by time of day

	Maternal postpartum complication				Infant neonatal complication			
	Black (1)	White (2)	Black (3)	White (4)	Black (5)	White (6)	Black (7)	White (8)
Concurrent pre-labor CS x quintile 1-3	0.004	-0.002	-0.012*	-0.006	-0.008**	-0.008***	-0.013	-0.000
	(0.004)	(0.002)	(0.007)	(0.006)	(0.004)	(0.003)	(0.013)	(0.006)
Concurrent pre-labor CS x quintile 4-5	-0.015	0.009	-0.022	-0.012	-0.025*	0.019**	0.085*	0.014
	(0.012)	(0.006)	(0.022)	(0.018)	(0.014)	(0.007)	(0.043)	(0.027)
Time of day	8am–8pm	8am–8pm	9pm–7am	9pm–7am	8am–8pm	8am–8pm	9pm–7am	9pm–7am
Observations	49,262	125,829	33,740	74,685	49,262	12,829	33,740	74,685
Adjusted R-squared	0.018	0.015	0.019	0.015	0.112	0.113	0.111	0.118
Mean outcome without concurrent pre-labor C-section								
Quintile 1-3	0.066	0.055	0.065	0.056	0.090	0.053	0.105	0.062
Quintile 4-5	0.106	0.076	0.102	0.081	0.203	0.125	0.227	0.146
Relative effect of concurrent pre-labor C-section								
Quintile 1-3	0.068	-0.045	-0.182*	-0.113	-0.092**	-0.146***	-0.120	-0.007
	(0.065)	(0.045)	(0.103)	(0.104)	(0.043)	(0.053)	(0.120)	(0.104)
Quintile 4-5	-0.138	0.115	-0.211	-0.147	-0.121*	0.155***	0.374**	0.099
	(0.114)	(0.082)	(0.211)	(0.225)	(0.071)	(0.059)	(0.189)	(0.187)

Notes: The above table presents coefficients and standard errors (in parentheses) from estimation of equation (5). Only births involving a trial of labor are included. Columns (1), (2), (5), and (6) restrict the sample to deliveries that occurred between 8am and 8pm, while columns (3), (4), (7), and (8) restrict to deliveries between 9pm and 7am. Results for births during all hours are provided in Table 4. In columns (1)–(4), the outcome is an indicator for whether the mother experienced any of the following complications in the 90 days following delivery (ICD-9 in parentheses): postpartum hemorrhage (666), major puerperal infection (670), venous complications (671), pyrexia (672), pulmonary embolism (673), and other postpartum complications (674). In columns (5)–(8), the dependent variable is an indicator for whether the infant experienced any of the following complications: admission to the NICU, 5-minute Apgar score below 7, infant needing mechanical ventilation, and significant birth injury. Data come from the New Jersey Electronic Birth Records and cover the period 2008 to 2015. *** denotes p-values < 0.01, ** denotes p-values < 0.05, * denotes p-values < 0.10.

C Conceptual framework

This section introduces a simple framework for thinking about a physician's decision to perform a C-section. The framework captures the factors that could lead to the racial differences in C-section rates outlined in Section II and shows how changes in the racial gap in the presence of capacity constraints can help differentiate between potential drivers of observed treatment disparities.

Set-up Suppose that patients are ordered by their appropriateness for a C-section, denoted by A. For each patient, the physician decides whether to perform a C-section or proceed with a vaginal delivery. We assume that providers care about patient health and, all else equal, seek to choose the delivery method that maximizes health benefits for the mother and infant. That is, if $A > A'$, then the physician derives higher utility from performing a C-section on a patient with appropriateness A than a patient with appropriateness A'. In addition to caring about patient outcomes, physicians also derive disutility from the effort they need to exert (e) and utility from the financial payment associated with the service (f).

The utility that a physician receives from performing a C-section (U_c) or a vaginal delivery (U_v) can therefore be denoted as follows:

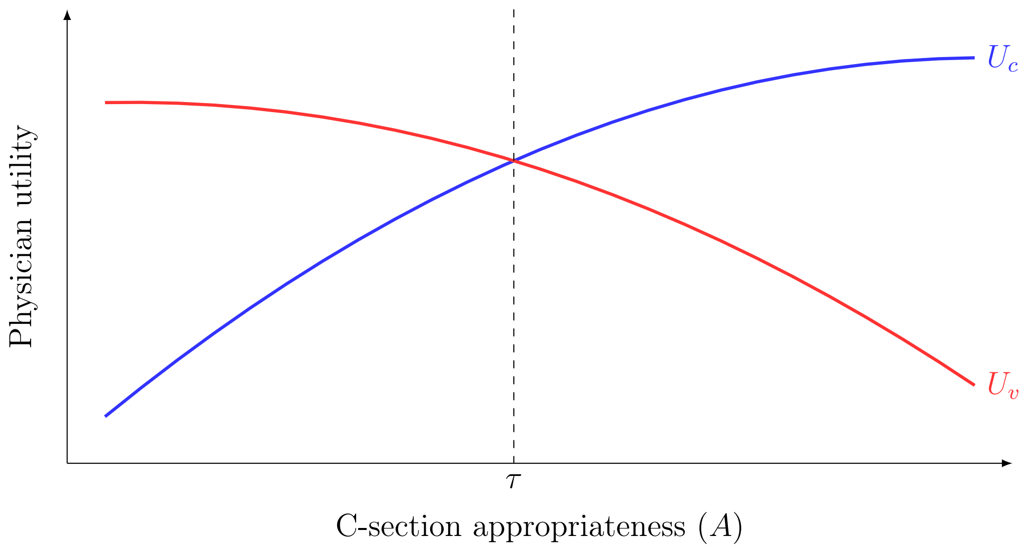
$$U_c = g\left(A, e_c, f_c\right) \quad \text{where } g_A > 0,\ g_{e_c} < 0,\ g_{f_c} > 0$$
$$U_v = h\left(A, e_v, f_v\right) \quad \text{where } h_A < 0,\ h_{e_v} < 0,\ h_{f_v} > 0$$

Since $g_A > 0$ and $h_A < 0$, the two curves cross. The crossing point yields a threshold level of A, denoted by τ, which determines whether a C-section is performed. As shown in Figure A7(a), the doctor derives less (more) utility from doing a C-section to the left (right) of τ, and thus C-sections are only performed on mothers with $\tau \leq A$.

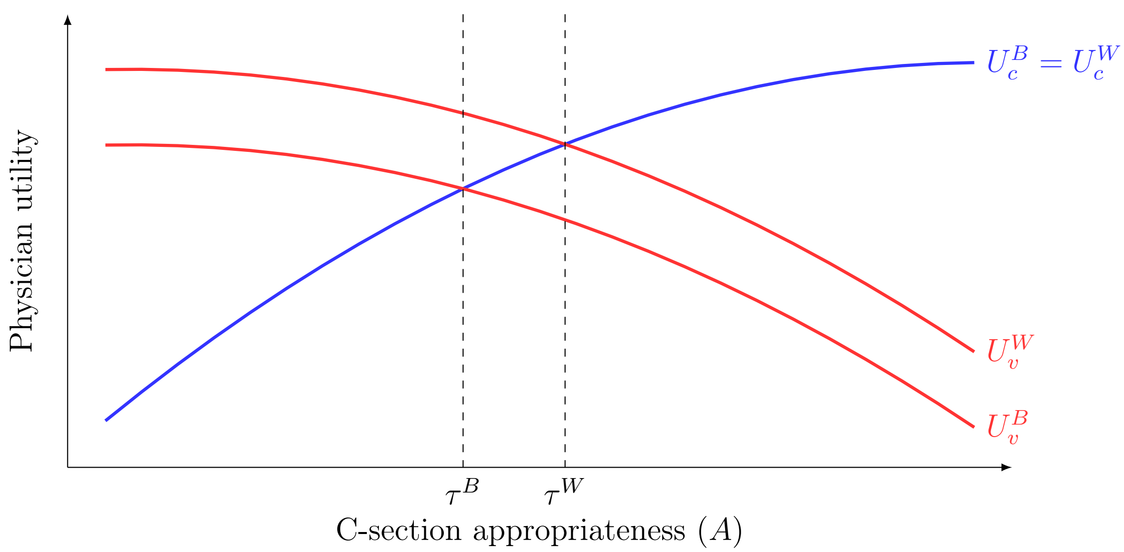
If there is a racial dimension to the physician's choices, this can be depicted by assuming that the physician's utility differs depending on whether they are treating a Black patient (U^B) or a White patient (U^W). Figure A7(b) depicts a case in which the physician's utility from providing a vaginal delivery for a Black patient is less than the physician's utility from providing a vaginal delivery to a White patient with the same appropriateness for a C-section.

Figure A7: Physician utility from C-section versus vaginal delivery

(a) Baseline model



(b) Heterogeneity by maternal race



Notes: The above figure shows the utility that a physician receives from performing a C-section (U_c) or vaginal birth (U_v) as a function of patient appropriateness for a C-section (A). Since the utility from performing a C-section (vaginal birth) is increasing (decreasing) in patient appropriateness, the two curves cross. The crossing yields a threshold level of appropriateness τ above (below) which the doctor performs a C-section (vaginal birth). Subfigure (a) presents the case in which there is no racial dimension to the doctor's choice. Subfigure (b) instead presents a case in which doctors have lower utility from performing a vaginal birth on Black mothers relative to White mothers. This difference in utility leads doctors to set a lower threshold for Black mothers ($\tau^B < \tau^W$) and perform additional C-sections on Black mothers who are less appropriate for the surgery.

If physicians find that it requires more effort to communicate and monitor Black patients (i.e., $e_v^B > e_v^W$), then this could result in a lower utility.[41] As shown in Figure A7(b), more low-risk Black mothers will receive C-sections than low-risk White mothers if U_v^B lies below U_v^W. However, since all high-risk mothers receive C-sections, there is no racial gap for the patients who are most appropriate for the procedure.

Changes in capacity We now consider the impacts of capacity constraints on the racial gap in C-sections across the risk spectrum. If it is obvious that a patient does not need a C-section, then it will be more costly for a physician to procure the hospital resources necessary to perform one when the obstetrical unit is more constrained. The physician's utility from performing an unnecessary intrapartum C-section is therefore reduced when there is a pre-labor C-section in progress. In contrast, if a patient truly needs an intrapartum C-section, then the physician will gain a lot of utility from performing one even if the hospital is busy. For a true medical emergency, other hospital resources—such as other locations and staff typically reserved for units other than labor and delivery—can be pressed into service.

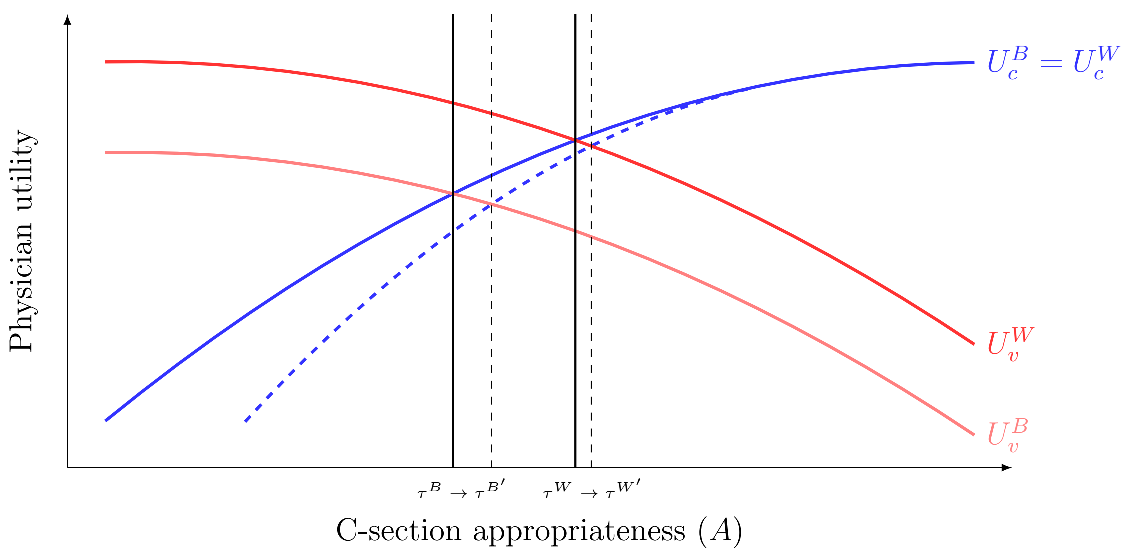
Changes in C-section rates in the presence of reduced capacity can be used to shed light on the drivers of racial differences in C-section rates. Suppose first that the observed racial gap in C-section rates is driven by physicians setting a lower threshold for Black patients than for White patients (as in Figure A7(b)). As shown in Figure A8(a), reductions in the utility that physicians receive from doing intrapartum C-sections on lower risk mothers when there is a concurrent pre-labor C-section leads physicians to set higher thresholds for both Black and White patients. However, because marginal Black mothers are less in need of C-sections, the threshold rises more for Black patients than for White patients. Hence, if the racial gap is driven by providers setting a lower threshold for Black patients, then the racial gap in C-section rates should narrow when there is a concurrent pre-labor C-section.

Now suppose that doctors treat Black and White patients equally (as in Figure A7(a)).

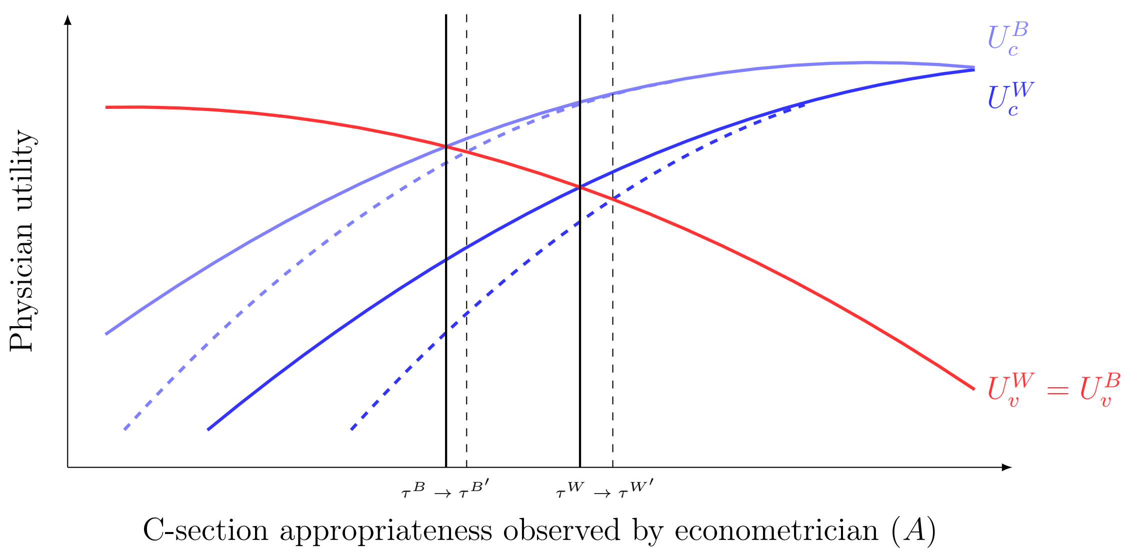
[41] Figure A7(b) depicts the physician's utility of performing a C-section as being the same for Black and White mothers (i.e., $U_c^B = U_c^W$). This might be the case if, for example, the doctor is biased but interaction with the patient is minimized in a C-section compared to a vaginal delivery. However, it is not necessary that the curves be identical to generate $\tau^B < \tau^W$. Rather, it is only necessary that the vertical distance between the U_c^B and U_c^W curves is less than the vertical distance between the U_v^B and U_v^W curves.

Figure A8: Physician utility by delivery method with reduced capacity

(a) Differences in provider discretion



(b) Differences in unobserved health risk



Notes: The above figures show how the optimal thresholds set by physicians change in the presence of reduced capacity. Subfigure (a) presents the case in which doctors set different thresholds for Black and White patients at baseline. When the capacity for C-sections declines, physician utility from performing C-sections on lower risk mothers is reduced (dashed line). This leads doctors to set higher thresholds for mothers of both races, with the change in optimal threshold being higher for Black mothers. Hence, the racial gap falls in the presence of reduced capacity. Subfigure (b) presents the case in which Black mothers are more appropriate for C-sections than is observed by the econometrician, leading to the (false) appearance of different thresholds by race. Doctors again set higher thresholds in the presence of reduced capacity, but, since Black mothers are more appropriate conditional on observed risk, the change in the observed threshold for White mothers is greater than for Black mothers. Hence, the racial gap rises in the presence of reduced capacity.

For researchers to observe a difference in C-section rates conditional on observed risk, it must be the case that Black mothers are unobservably (to the econometrician) riskier than their White counterparts. Suppose that physicians observe a patient's true risk for a C-section, denoted by $\tilde{A}$. As shown in Figure A8(b), if $\tilde{A}_B > A_B$ and $\tilde{A}_W = A_W$, then it will appear to the econometrician that physicians are setting a lower threshold for Black mothers ($\tau_B < \tau_W$) when in fact the true threshold is the same ($\tilde{\tau}_B = \tilde{\tau}_W = \tilde{\tau}$). In this case, the presence of reduced capacity will lead physicians to raise the true threshold for mothers of both races equally. However, because marginal White mothers are less in need of C-sections conditional on observed risk, the observed threshold will be raised more for White mothers. Hence, if the racial gap is driven by higher unobserved risk among Black patients, then the racial gap in C-section rates should grow when there is a concurrent pre-labor C-section.[42]

[42]The gap will grow both if Black mothers truly have higher risk than the econometrician observes or if physicians simply perceive Black mothers' risk to be higher. That is, if physicians believe that there is a higher risk of negative outcomes among Black mothers, then they should reduce intrapartum C-sections among White mothers first when the costs of intrapartum C-sections rise, regardless of whether their beliefs about higher risk among Black mothers are true.