UNIVERSITY of York

HEDG

HEALTH, ECONOMETRICS AND DATA GROUP

THE UNIVERSITY of York

WP 20/15

Neighborhoods, Networks and Delivery Methods

Emilia Barili; Paola Bertoli and Veronica Grembi

August 2020

Neighborhoods, Networks, and Delivery Methods*

Emilia Barili
University of Milan
University of Pavia

Paola Bertoli
University of Verona
University of Economics, Prague

Veronica Grembi
University of Milan

August 3, 2020

Abstract

We investigate potential mechanisms of information transmission among patients when explaining territorial variations in the use of cesarean sections. Defining networks as mothers living in the same Italian municipality (average size approximately 10,000 residents), we show that a one standard deviation increase of the incidence of cesarean sections for the 12 months before the delivery date in the future mother's municipality of residence increases the probability of her receiving the treatment by 3%. This result captures mainly network effects for Italian mothers, while it captures both network and neighborhood effects for foreign mothers. Both groups adjust for the transmission of complementary information, such as the incidence of complications due to cesarean sections. The selection of mothers across hospitals does not uniquely explain our results, which are robust to alternative sample selections.

JEL Classification: I1, I12

Keywords: Cesarean Sections, Networks, Neighborhood effects

*We thank Janet Currie, Michael Dickstein, Thomas Fujiwara, Benjamin Elsner, Bart Golsteyn, Catia Nicodemo, Maarten Lindeboom, Kathleen Mullen, Ariel Dora Stern, Steven Stillman, Sebastian Siegloch, and the participants to the seminars at the University of Milan, Vrije Univerisiteit Amsterdam, Insper-Sao Paolo, Erasmus University Rotterdam, CHW Princeton University, and EDEEM Doctoral Summer Workshop for their useful comments on previous versions of this project. Support from the Mobility Scholarship granted to Emilia Barili by the University of Pavia is gratefully acknowledged.

1 Introduction

Geographical variations in healthcare expenditures and in the use of medical treatments are generally explained with a supply side narrative, which addresses the roles of access to care, the economic incentives of providers, or the organization of the healthcare system (among others) to explain those differences (e.g., Skinner (2011), Frakes (2013), Molitor (2018), Ho and Pakes (2014), Clemens and Gottlieb (2014), Doyle et al. (2017), Alexander and Schnell (2019), Cutler et al. (2019)). The transmission of information among patients is rarely considered by a supply side approach. However, it is a common experience that we, as patients, often form medical decisions based on the experience of people in our networks who have similar medical conditions; these decisions can range from the selection of the hospital to the use of a certain treatment over an alternative, assuming that we have the ability to choose.[1] Disentangling the role of information transmission from the role of providers is extremely challenging, since information recovered through patients is affected by the health "environment" generated by the practice style or incentives of suppliers.

Aizer and Currie (2004) find a strong correlation within ethnic groups in the use of public prenatal care services in California. However, they argue that much of the correlation is explained by unmeasured characteristics of the location of the group, so-called neighborhood effects, rather than by information sharing between individuals, defined as networks effects. We build on Aizer and Currie (2004), addressing the role of neighborhood and network effects in the choice between a cesarean section (c-section) and a vaginal delivery. Deliveries are among the first causes of hospitalization in many countries and the large variance in the incidence of c-sections, even within a country, is only partially explained by supply side factors (e.g., Currie and MacLeod (2008), Shurtz (2014), Currie and MacLeod (2017),

[1] Finkelstein et al. (2016) attribute approximately half of the variation in health care utilization to patient-related factors. Exploiting the move of a selected sample of Medicare patients, they find that the role of demand is larger for those treatments over which patients can exert more discretion (e.g., use of preventive care), while it is smaller when they have less discretion (e.g., inpatient care). However, Finkelstein et al. (2016) exclude the possibility that, in their sample, the effect arises from pre-move habits due to supply side factors, while indicating the heterogeneity in health status and preferences as main drivers of geographical variations, assuming preferences orthogonal to habits.

Bertoli and Grembi (2019), Costa-Ramón et al. (2018)). C-section rates do not match the actual distribution of risk factors in the reference population, and concerns about the inappropriate adoption of c-sections are not driven solely by budget constraints but also by the potential health consequences for both mothers and newborns (Tonei (2019), Costa-Ramón et al. (2019), Card et al. (2019)). Finally, the role of patients in the choice of delivery method is *ex ante* different from null, as shown for the very specific category of physician mothers by Johnson and Rehavi (2016). Given the non-random distribution of women across municipalities, we can observe geographic correlation in the use of c-sections that is driven by underlying characteristics of the specific location (e.g., distance from health care services) or the people living there (e.g., education, income, occupational status) rather than by information transmission between individuals.

We define networks as groups of mothers living in the same municipality using 2006-2014 hospital discharge data provided by the Italian Ministry of Health.[2] To minimize potential differences in the incentives to perform c-sections across geographical areas, we select one Italian region, Lombardy, which has approximately 10 million inhabitants (16% of the Italian population) and 1,546 municipalities (median size about 13,800 residents). Since 2005, the economic incentives to perform c-sections instead of vaginal deliveries have been eliminated in Lombardy by a policy equalizing the reimbursement for vaginal deliveries to that for c-sections (Barili et al. (2020)). For each mother delivering at time t (741,154 deliveries), we define an index of *exposure* to c-sections at the municipality level according to two time dimensions: t and *t-12m*. t captures the incidence of c-sections in the year of delivery, while *t-12m* in the 12 months before delivery. The *t-12m* time dimension is our preferred index. We control for neighborhood effects (i.e., behaviors driven by characteristics of the place where the patient is located) using several measures. To control for the suppliers' practice style we impose fixed effects for the hospital in which the delivery took place, since Italian physicians work in just one hospital. To control for the general approach to healthcare (e.g.,

[2]We assume people living in the same residential area are the relevant reference group for the diffusion of information through the informal channel of word of mouth. Nevertheless, we are aware that there are other dimensions of the word of mouth that do not necessarily coincide with the residential area but that might be relevant to affecting patient perceptions and preferences (e.g., coworkers, online communities) (Amaral-Garcia et al. (2019)).

more or less invasive), we exploit the geographical organization of the Italian healthcare system in local health authorities (LHAs, 15 in Lombardy), and we add LHA fixed effects and LHA time trends, to take into account managerial changes during the years. Finally, we control for changes in the practice style affecting the residential area (e.g. a gynecologist who strongly prefers c-sections) using the delivery hospital time trends and, alternatively, a weighted index capturing the incidence of c-sections across those hospitals treating patients from the same municipality (see Section 4).

In the unlikely scenario in which all mothers from the same municipality go to a single hospital that covers only their municipality, it would be impossible to disentangle the role of information transmission from the role of the neighborhood: hospital fixed effects would absorb the network effects. If mothers select the delivery hospital based on their strict preference for a specific type of delivery, again, hospital fixed effects would absorb any network effect. If it was only a neighborhood effect driven by a more or less invasive approach to health care, then LHA fixed effects and their time trends should make the role of networks irrelevant. If the choice of the delivery method was based on the distribution of risk factors, then the network effect would not play any role, since we are controlling for these factors. However, we find that an increase of one standard deviation in the exposure to c-sections in the mother's municipality of residence in the 12 months preceding her delivery (our preferred specification) increases the likelihood of receiving a c-section by 3% at the mean of c-sections. Our effect is robust to the selection of several samples as the drop of mothers from Milan, which is the largest city in Lombardy (about 1.3 million inhabitants), or the drop of mothers coming from other regions.

The magnitude of the effect that we estimate follows a cubic relationship: the larger the exposure is, the stronger its relevance in affecting the individual probability of receiving a c-section, with a saddle point at the median of the exposure distribution. This means that the response to exposure is heterogeneous, with both positive and negative spillovers. Indeed, we observe that the role of exposure to c-sections used in explaining the choice of the i^{th} mother is minimal if she is exposed to low levels of c-section use (i.e., "positive" spillover), while it is consistent and maximal when she is exposed to high levels (i.e., "negative" spillovers).

We observe that mothers also adjust their choice based on complementary information, such as the incidence of c-section complications and the use of c-sections on low-risk mothers, in which case there is a greater lack of appropriateness. Conditional to the positive effect driven by the incidence of c-sections, a one standard deviation increase in the incidence of c-section complications reduces the probability of having a c-section by 1%, while a one standard deviation increase in exposure to potential unnecessary c-sections increases the effect by an additional 0.8%.

We test the hypothesis of information transmission by refining the concept of networks with the use of homogeneous groups of individuals – Italians vs. foreigners – within the same municipality and addressing the impact of complementary information separately. First, we observe that the baseline results are robust in the subsample of foreign mothers, even when we additionally control for their nationality and the c-section rate in the country of origin. Hence, contrary to Fernandez and Fogli (2009), we exclude the possibility that cultural background (e.g., approach to the healthcare system, use of prenatal care) may drive the effect. Following Aizer and Currie (2004), we then compute indexes for the incidence of c-sections in the 12 months preceding a delivery, distinguishing Italian versus foreign mothers. Relying on the assumption that information is more likely to be shared within homogeneous groups, if there are only network effects, mothers are expected to be significantly affected only by the incidence of c-sections in their own group. While this is true for Italian mothers, we cannot exclude the existence of a neighborhood effect for foreign mothers, who are indeed affected by the incidence in both groups. This may indicate, as in Aizer and Currie (2004), that the characteristics of the place where the individual is located significantly affect her use of health care. In particular, the fact that a neighborhood effect exists only for foreigners might be explained by the role played by the services offered to foreigners in the place where they live. This is specifically the case for all the services provided by immigrant associations that, among their main activities, help foreigners to deal with the local health care system.

The adjustments due to complementary information are confirmed for both groups. However, the magnitude of the effects differs between Italian and foreign mothers, probably because of the different possibilities for accessing information and the different ability to correctly interpret it and to include it in the decision process: foreign mothers are more subject to the transmission of inappropriate use of health care if it is broadly used within their group.

Our estimates are driven by Italian mothers having a delivery during weekdays, while the effect is not significant for deliveries taking place on weekends. This is consistent with findings by Finkelstein et al. (2016) on the role of discretion: weekday deliveries are more likely to be the object of elective c-sections, planned during pregnancy, compared to emergency c-sections, which are often performed after an attempted vaginal delivery. On the supply side, we observe for both groups that the potential sorting of a subset of individuals into high fixed-effects hospitals leads to a lower role of exposure. Moreover, for foreign mothers, the effect of exposure is stronger for lower quality providers (proxied by the readmission rate within 42 days since the delivery) and when patients interact with younger, thus less experienced, physicians (specialized after 1992).

Network effects provide indirect support for the health policy literature that focuses on the perception of consumers about maternity care quality measures. Maurer et al. (2016) find that mothers have limited interest in hospital-based clinical quality measures, valuing more the experience of friends and family members, the recommendation of their physician and, eventually, maternity-related websites. As reported by Declercq et al. (2007), the informal channel constituted by friends and relatives is particularly relevant for first-birth mothers. Similarly, both Gourevitch et al. (2017) and Gourevitch et al. (2019) confirm the weak role played by standard hospital-based quality measures in affecting mothers' preferences. They do observe a strong self-reported interest of mothers in the health of their baby and the quality of the obstetric care they receive, but this is mainly informed through the opinions of peers or relatives. The importance of informal channels through which patients can form ideas on delivery methods using access to the internet has been analyzed in depth by Amaral-Garcia et al. (2019), which confirms our evidence of the potential spillover effects of inappropriate care. However, informal channels also have the potential to affect health behaviors in an efficient way, as in the case of, among others, peer referrals to screenings (e.g., Goldberg et al. (2019)). Using descriptive evidence, we show that both men and women rely on friends and relatives to form their decisions on, among other things, preventive care (ISTAT (2000, 2005, 2013)).

The paper proceeds as follows. Section 2 provides an overview of the institutional background. The data used are described in Section 3, while the quantitative indexes and the econometric strategy are described in Section 4. The results, robustness checks and drivers of the effect are discussed in Sections 5, 6, and 7, respectively. Section 8 concludes.

2 Institutional Background

The Italian health care system provides universal coverage to all citizens and it is mainly funded through general taxation. The system is organized at the regional level (21 regions), and each region is divided into health districts, called local health authorities (LHAs) (i.e., *Aziende Sanitarie Locali*), which encompass groups of municipalities. Each LHA may run its own hospitals and local clinics or buy health services from independent public hospitals or private-accredited hospitals.[3] Figure A.1 shows how municipalities and hospitals are grouped into LHAs in Lombardy, the region considered in the analysis. Providers are reimbursed on a prospective system based on diagnosis-related groups (DRGs) (Bertoli and Grembi (2017)): physicians work for only one hospital and receive a monthly salary.[4] Patients are free to choose the hospital they prefer, facing no constraints other than the cost represented by the distance between their municipality of residence and the hospital. In the case of deliveries, mobility is limited. The average distance traveled by a mother is 10.9 km –6.8 miles– (median 9.2 km –5.7 miles), with 40% of mothers in our sample selecting the closest hospital. A total of 98% of deliveries take place in public or private-accredited hospitals, while home births are extremely rare as they are not covered by public insurance and are strongly discouraged by Italian physicians' associations.

Since 2002, the Ministry of Health has published guidelines to discourage c-sections when not justified by clinical conditions of either the mother or the newborn.[5] If a mother requests

[3]The Ministry of Health defines national standards annually (i.e., *LEA - Livelli Essenziali di Assistenza*), while each region is responsible for adopting adequate measures to meet them.

[4]The standard physician's contract in Italian hospitals requires 38 hours of work per week, organized over shifts to meet the needs of the ward.

[5]See the Piano Sanitario Nazionale 2002-2004 and its updates. Italy is characterized by a c-section incidence far above the suggested thresholds: while the WHO estimates that, on average, only 15% of deliveries require a c-section, the national rate was 36.7% in 2011 and is only slightly decreasing over time. The large differences across regions are only marginally affected by policies aimed at reducing the trend in

a c-section, physicians are required to explain the potential side effects of the procedure and to give sufficient support to overcome any requests driven by fear and misinformation. However, some regional regulations, such as those adopted in Lombardy (*DGR 22957/2003 - Direzione Generale Sanità - Regione Lombardia*), do not allow a physician to refuse a c-section if, after being properly informed, a mother still demands one. In such a case, the mother has to sign a disclaimer for the physician (i.e., *Consenso informato per taglio cesareo elettivo*). Since there are no available data on the distribution of these disclaimers, to provide a sense of how relevant this phenomenon is, we rely on a national survey on mothers of newborns run in 2012, conducted on a representative sample of mothers who had a delivery in the years 2009-2010 (ISTAT (2012)). Mothers were explicitly asked why they received a c-section and the possible answers included "mother's request not related to medical conditions". Overall, 8% of the respondents who had undergone an elective c-section choose to have it; the percentage increases up to 13% when considering first-birth mothers only. We run a basic OLS on the probability that a mother opted for a c-section as a function of parents' demographics, household characteristics, and specific information on the pregnancy and maternal status. The estimated coefficients are plotted in Figure A.2: the choice is positively correlated with first births and negatively correlated with the mother being employed, which means that working mothers are less likely to opt for a c-section. The educational level of both parents does not exert a statistically significant role (e.g., if any influence exists, the education of the mother is more significant), but mothers belonging to high-income households seem to be less affected by the inappropriate use of c-sections.

3 Data

We restrict the analysis to deliveries that occurred in a single Italian region to minimize the relevance of supply side factors such as financial incentives and legal liability rules. For the scope of our analysis, we only impose that the delivery to be performed in Lombardy, while allowing mothers to be registered in any Italian municipality. Indeed, individuals can relocate

inappropriate c-section use. Geographic differences are also observed at smaller administrative units (Figure A.7).

within the country without moving their officially registered municipality of residence if they believe their move to be on a temporary basis. In that situation, it is reasonable to assume that each individual is more affected by the information she gets from the municipality where she is officially registered and to which she has stronger ties.[6]

We opt for Lombardy due to its characteristics: it has the largest resident population (10 million inhabitants or 16% of the Italian population), the highest number of municipalities (1,546) and one of the greatest net within-country migration flows for work reasons (more than 55,000 individuals per year relocate in Lombardy from other Italian regions), with a net-migration flow higher than 10,000 units per year (ISTAT (2014)). Additionally, during our observation period (2006-2014), the reimbursement level for vaginal deliveries was equalized to the reimbursement level for c-sections, discouraging opportunistic behaviors by health care providers driven by financial incentives (Barili et al. (2020)). As shown in Figure A.3a, most mothers come from small municipalities (i.e., up to 5,000 inhabitants) where information transmission through informal channels within the network is likely to be effective. Mothers coming from small municipalities are also those contributing the most to the number of observed deliveries (Figure A.3b); therefore, they have a major role in driving the effect.

Our main data source is hospital discharge cards at the individual level provided by the Ministry of Health. These include detailed information on the medical conditions of the pregnancy, together with the mother's demographics, such as age, marital status, citizenship, and municipality of residence.[7]

Overall, the original dataset includes all childbirths covered by the Italian health care system between 2006 and 2014. During our observation period, the average incidence of c-sections in Lombardy was 28.6%, mothers had an average age of 31.7 years, they could

[6] Table A.1 presents the geographic distribution of women delivering in Lombardy by their municipality of residence. The potential mismatch between municipality of residence and municipality of relocation accounts for 4% of our sample; it is computed as the number of women delivering in Lombardy but officially registered outside.

[7] There is no information on the use of prenatal care. Regarding prenatal and maternal care, the Ministry of Health defined a set of screening tests and specialist visits that all women can access free of charge in any hospital or local clinic, facing no geographical restrictions. The rules for access to prenatal and maternal care are defined in the *Decreto Ministeriale 10/09/1998*.

deliver in 51 hospitals, and they were classified as low-risk patients in 78.6% of the cases. We enrich the existing data with additional information at the municipality and hospital level, provided by the National Institute of Statistics, the Ministry of Health, and the National Board of Physicians, as explained in more detail in Table A.2.

4 Econometric Strategy

The probability of receiving a c-section is a combination of network effects, neighborhood effects, the risk profile of mothers, and the characteristics of the health care system. For each mother i giving birth in hospital h in year t, Equation 1 predicts the probability that she receives a c-section $Csection_{iht}$. We control for a wide range of factors ($X1'_{iht}$) that could unambiguously affect the likelihood of receiving a c-section ($Csection_{iht}$) as listed in Table 1: her age, marital status, citizenship, and a long list of risk factors that the medical literature recommends taking into account when selecting the delivery method (e.g. breech baby, eclampsia). $X2'_{imt}$ contains socioeconomic information as proxied by the characteristics of the municipality of residence (m) of the mother such as the level of urbanization, population density, average education, and income level. We use quarter-year fixed effects (ρ_q) to control for seasonality issues that might affect the pregnancy and the delivery day-of-the-week fixed effects (σ_d) to control for other factors affecting the probability of having a delivery and an elective rather than an emergency c-section (see Figure A.4). Year of delivery fixed effects are captured by π_t, while the delivery hospital fixed effects (ω_h) account for any time-invariant characteristics at the provider level, such as average quality standards or differences in practice styles. If a patient lives in an area where the surgical approach is much more frequent than the equally effective non-surgical approach, she might develop an overall preference (or a lack of resistance) to surgical treatments such as c-sections. Such case is described by Finkelstein et al. (2016), who observe that the component of health care utilization specific to the patient could be correlated to place-specific elements such as the share of "cowboy" doctors who consistently recommend intensive care beyond the current medical guidelines (Cutler et al. (2019)). As far as the general habit is place-specific, its effect can be absorbed by health market fixed effects. In our setup, these coincide with γ_{lha} and are defined as the time-invariant characteristics of the LHA (lha) responsible for the mother's municipality. LHAs do not simply represent the patient's health markets, they also play a significant role in the actual provision of care. In fact, LHAs are responsible for the territorial management of health services and pay for the treatments received by their reference population. In addition, they monitor providers' activity and release periodical guidelines targeted to both providers and patients. Therefore, we provide additional estimations where we also account for their time trends using η_{lhat}.

$$Csection_{iht} = \delta Exposure_{mt^*} + \beta X1'_{iht} + \beta X2'_{imt} + \pi_t + \rho_q + \sigma_d + \omega_h + \gamma_{lha} + \epsilon_{iht} \tag{1}$$

Our coefficient of interest is δ and it captures the network effect: the delivery method experienced by women whom the mother has potentially been in contact with (i.e., share of c-sections in the relevant time and spatial dimension). Since we are not able to reconstruct the group with whom the mother has interacted during her pregnancy or her exchanges with the inner circle of her relatives, friends or coworkers, we approximate her network by focusing on her municipality of residence. The median size of a municipality is about 13,800 inhabitants when the sample includes the city of Milan and about 10,000 inhabitants when Milan is dropped, with an approximately 20% average incidence of fertile (15-49 years) women. Figure A.3 plots the distribution of the municipalities in our sample based on their size.[8]

To capture the network effects, we rely on two time (t^*) dimensions: the year of the delivery and the 12 months preceding the delivery date. Overall, using the municipality of

[8]Our intuition is confirmed by the survey on the health conditions of Italians run by ISTAT in three waves ISTAT (2000, 2005, 2013). They explicitly ask questions on the use of preventive care (i.e., cholesterol, glycemia and blood pressure screenings) and the reasons for using it. In particular, respondents were asked whether they used preventive care because of medical recommendations or the advice of acquaintances. Municipalities are distinguished into three classes according to their population dimensions (i.e., *small* up to 10,000 inhabitants, *medium* between 10,000 and 50,000 inhabitants, and *large* above 50,000 inhabitants). Controlling for several demographics and time trends, we observe that living in smaller municipalities is positively correlated with the adoption of health practices not driven by physician initiatives, with no significant difference between men and women. Coefficients are plotted in Figure A.5.

residence m as the geographical unit of reference, *Exposure* can take one of the following meanings:

- $Exposure_{mt}$: Share of c-sections during the same calendar year of delivery i^{th}, excluding the i^{th} mother;
- $Exposure_{mt\text{-12m}}$: Share of c-sections during the 12 months preceding the delivery of the i^{th} mother.

Imagine two mothers with the same municipality of residence m: *Mother A* having a delivery in March 2008 and *Mother B* delivering in November 2008. They share the same $Exposure_{mt}$ (i.e., share of c-sections in 2008), but they differ on $Exposure_{mt\text{-12m}}$. Indeed, $Exposure_{mt\text{-12m}}$ is equal to the share of c-sections from March 2007 to February 2008 for *Mother A* and from November 2007 to October 2008 for *Mother B*. Figure A.6 shows the positive correlation between the levels of exposure and the probability of undergoing a c-section.

Personal experience obviously matters. We do not have information on previous deliveries, due to data limitations but we can reduce the concerns about the relevance of previous deliveries in several ways. First, we drop mothers who already experienced a c-section. Undergoing a c-section significantly increases the probability of a c-section for future pregnancies. According to the reports published by the Ministry of Health, only about 10% of mothers who have previously had a c-section deliver naturally (*Ministero della Salute*).[9] Since the information on previous c-sections is registered on the chart, we drop mothers with a previous c-section from the sample, increasing the probability that those who undergo a c-section in our sample are first-delivery mothers.

Mothers could be affected by previous vaginal deliveries, but this would bias our results upward only if previous natural births always coincide with a negative experience for mothers. This does not look to be the case: only 4% of mothers observed in the sample who had a vaginal delivery experienced major complications that in some cases prevented future childbirth (e.g., hysterectomy, retained placenta), while 12% reported minor complications

[9] The Ministry of Health produces yearly reports on delivery events (Ministero della Salute (2009, 2010, 2011, 2012, 2013, 2014, 2016)).

(e.g. uterus trauma).[10] Additionally, previous experience should be more relevant the higher the fertility rates. We test this hypothesis by estimating Equation 1 with a control for the average fertility rate at the provincial level (12 provinces).[11] Clearly, we cannot completely eliminate the effect of previous vaginal deliveries because, for instance, mothers could be affected by the emotional stress related to their previous experience with a vaginal delivery. However, the stronger this element is, the more our results represent a lower bound of the true effect of exposure.

Since patients have full discretion in the choice of provider, mothers cannot be expected to randomly end up in a hospital. A driver in the selection of the delivery hospital could be the desire to give birth by c-section. If all mothers would perfectly self-select into hospitals based on their willingness to have a c-section, δ in Equation 1 would not be different from zero. Indeed, due to this self-selection, hospital fixed effects, ω_h, would capture individual willingness to have a c-section.

This possible sorting can be examined by looking at the difference between $Exposure_{mt^*}$ and the c-section incidence at the delivery hospital in the 12 months preceding the delivery for each mother in our sample: a self-selection motivated by demand for a c-section would imply a difference equal to zero (i.e., a perfect match between individual preferences formed through exposure and provider practice style). We plot the distribution of this difference in Figure 1, where we also distinguish between mothers who do and do not give birth at the closest hospital. As a matter of fact, the selection might not necessarily be captured by the traveled distance: even the choice of the nearest hospital could be motivated by the willingness to have a c-section. As apparent from Figure 1, variation exists between maternal exposure and hospital practice. This confirms that other drivers might be at work when choosing the hospital, such as flexible visiting hours, distance to relatives, child rooming-in policy, availability of psychological support, or availability of single rooms.

Overall, we cannot rule out that for a portion of our sample, the mother-hospital match

[10] Moreover, if previous natural births always coincide with a negative experience for mothers, we would expect higher rates of elective c-sections due to mother's choice for not-first-birth mothers. However, based on the 2012 survey (ISTAT (2012)) of new mothers, elective c-sections due to mother's choice are 13% for first births and 8% for not first births.

[11] Trends in fertility rates presented in Table A.3.

results from the preference for c-sections. Still, this only means that the mothers who are perfectly matched with hospitals do not contribute to the identification of the effect of $Exposure_{mt^*}$. To prove our point, we perform a robustness check by replicating the analysis after dropping perfectly matched patients.

5 Results

5.1 Baseline Specification

We estimate Equation 1 on six samples. In the first sample, we keep all the observations. Then, we drop those mothers whose municipality of residence is Milan since, given the size of the city, the network effect is less likely to be proxied by their municipality. In the third sample, we drop weekend deliveries, when c-sections are less likely to be scheduled; then, in the fourth sample, we drop mothers coming from outside Lombardy to check how they are driving the main effect. The fifth sample considers only low-risk mothers as they should be less likely to have a c-section and the sixth sample includes only mothers who do not give birth at the closest hospital. Figure 2 graphically shows the estimated effects by sample and measures of $Exposure_{mt^*}$, while detailed coefficients are reported in Tables A.4 and A.5.[12]

The effect of $Exposure_m$ is significant across all samples and specifications, with the specification t-12m capturing the strongest impact. This is the first important result: if unobservable characteristics were driving our results, then the simultaneous index, $Exposure_{mt}$, should be robust across specifications, while it is not. We select $Exposure_{mt\text{-}12\text{m}}$ as our best proxy for a network effect. Indeed, it is the only index that captures differences in the pool of mothers who had a delivery in the same calendar year and municipality of residence but with a different month of the delivery. According to our baseline estimate, a one standard deviation increase in the $Exposure_{mt\text{-}12\text{m}}$ in the overall sample (Table A.5 - Column (3)) translates into a 3% higher probability that the i^{th} mother undergoes a c-section. As expected, the magnitude and significance of the coefficients is not affected by the exclusion of "perfect-match patients" (i.e., patients reporting exposure levels equal to the c-section rate

[12] All specifications are robust to the inclusion of the additional control for the yearly fertility rates at the LHA level: results are available in Table A.6.

of the selected provider). The results, presented in Table A.7, confirm the hypothesis that those individuals do not contribute to the estimation of the effect.

The level of exposure matters. This result is obtained by estimating the baseline model using deciles of exposure in place of the continuous index. Figure 3 highlights a cubic relationship between exposure levels and patient preferences: the highest the exposure, the strongest its effect on patient behaviors and vice versa. This means that the response to exposure is heterogeneous, with mothers at the top of the exposure distribution being the most affected and those at the bottom being the least affected. This implies a strong transmission of both positive and negative spillovers derived from the appropriate or inappropriate use of health care procedures.

5.2 Complementary Information

If the *primary information* is clearly the choice between delivery methods, the *complementary information* could be related to the incidence of c-section complications or the incidence of c-sections on low-risk mothers, which we define as less appropriate.[13] They both require a deeper knowledge/observation of the others' experience. While sharing information about the delivery method is quite common, women might be less willing to share detailed information about their personal health conditions before and after delivery. Hence, we still expect *complementary information* to have a significant effect on the likelihood of receiving a c-section, but with smaller magnitude than *primary information* (i.e., $Exposure_{mt_{-12m}}$).

We modify our baseline model by adding a control for complementary information that may influence the individual attitude toward the use of c-sections (Equation 2). The variable $Complementary_{mt\text{-12m}}$ is alternatively equal to the incidence of delivery complications due to a c-section and the incidence of c-sections on low-risk mothers in the 12 months before

[13] According to medical literature, c-section complications include fever, postpartum hemorragia, complications related to anesthesia, retained placenta, surgical wounds, infections, postpartum anemia, postpartum cardiovascular diseases, embolism, and hysterectomy. The risk factors considered as controls in the regression are also used to compute the *individual risk level of the pregnancy* by applying a logit model to the probability of having a c-section. Mothers are considered low-risk if they score 0.4 or less (Currie and MacLeod (2008) and Bertoli and Grembi (2019)).

delivery in the mother's municipality of residence.

$$
\begin{aligned}
Csection_{iht} = {} & \delta_1 Exposure_{mt\text{-}12\mathrm{m}} + \delta_2 Complementary_{mt\text{-}12\mathrm{m}} \\
& + \beta X1'_{iht} + \beta X2'_{imt} + \pi_t + \rho_q + \sigma_d + \omega_h + \gamma_{lha} + \epsilon_{iht}
\end{aligned} \tag{2}
$$

Figure 4 graphically presents the results. It shows stable results for exposure to the use of c-sections ($Exposure_{mt\text{-}12\mathrm{m}}$), while complementary information plays a significant but minor role in the expected direction. The results are robust through the different samples. In terms of magnitude, the primary information produces the same estimations as those presented in Section 5.1, while a one standard deviation increase in the indexes for complementary information reduces by 1% and increases by 0.8% the likelihood of receiving a c-section, respectively. This means that the effect of exposure to the use of c-sections is partially updated according to the type of complementary information available. This behavior can result from two mechanisms. On the one hand, observing a higher incidence of c-section complications may reduce the willingness to receive a c-section, with other factors being equal. On the other hand, the higher use of c-sections even when not appropriate may reinforce the belief that it is a safe choice.

6 Robustness Checks

6.1 Average Practice Style for Delivery

In our model, we control for the general level of invasiveness– or *Practice style*– of the health care market using LHA fixed effects and their time trend. However, the general practice style with reference to delivery might be slightly different. We address this issue following two alternative strategies. First, we estimate the baseline model imposing hospital-year time trends (estimations are shown in Column (4) - Tables A.4, A.5, A.6, A.7). These trends would absorb any change in the average practice style at the hospital level (e.g., a gynecologist with a high use of c-sections who retires at a certain point). Second, we define a measure for the average practice style to which each mother is exposed on the basis of her municipality of residence. Since mothers from the same municipality end up delivering in different hospitals, we construct an index of the average practice style to which each municipality is exposed as a function of the mobility of the mothers. The intuition is to check if it is this kind of exposure that explains the increase in the probability of receiving a c-section. We define this measure as the weighted average of the c-section rates among the hospitals serving the mother's municipality of residence. Specifically, the hospitals serving municipality m are those hospitals where at least one mother registered in m delivered a baby in the period of interest.[14] Defining N as the overall number of these hospitals, $Practice\ style_{mt^*}$ is equal to:

$$Practice\ style_{mt^*} = \sum_{j=1}^{N} \lambda_{jt^*} X_{jt^*} \tag{3}$$

where X_{jt^*} is the c-section rate in hospital j and λ_{jt^*} is the share of mothers registered in m who gave birth in j during the relevant time period.[15] We estimate the baseline model by adding the measure of $Practice\ style_m$ as a control. The estimations are not significantly affected (Column (5) - Tables A.4, A.5, A.6, A.7).

The results obtained confirm that our index for exposure is not just the result of practice styles in the health care market where the mother resides.

6.2 Subgroup Analysis

To prove that the estimated effects are driven by information sharing and to study the network effect in depth, we split mothers into two homogeneous groups: Italian and foreign mothers.[16] First, we run the baseline estimation on the subgroup of foreign mothers. The results, presented in Table 2, are robust to the selection, even when controlling for the nationality (λ_{nat}) and the c-section rate in the country of origin ($Country_{it}$).[17] The two additional specifications allow us to control for language proximity, fertility trends, and the general

[14] During the period considered, 2006-2014, the median number of hospitals serving each municipality is 3.

[15] For example, assume a hypothetical municipality where 30% of mothers gave birth in hospital A, 25% in hospital B and the remaining 45% in hospital C. Then, given a c-section incidence of 16% in hospital A, 30% in hospital B and 25% in hospital C, we compute *Exposure* as 0.16*0.3+0.3*0.25+0.25*0.45=0.048+0.075+0.113=0.236.

[16] The most represented nationalities among foreign mothers are Moroccan, Romanian, and Albanian.

[17] Information on c-section rates in the country of origin in the relevant year are derived from official sources such as Eurostat, OECD, DHS Program, WHO, UNICEF.

approach to the health care system in the spirit of Fernandez and Fogli (2009). However, we cannot state *ex ante* if this specific subgroup is subjected to the same mechanisms in the transmission of behaviors at the local level. Indeed, beliefs and preferences related to the country of origin (i.e., culture) may be of particular relevance to this group of individuals (Fernandez and Fogli (2009)). We address this point by differentiating the exposure by subgroup (i.e., Italians vs. foreigners), performing deeper analyses on the impacts of the two indexes and studying possible heterogeneous effects.

Following Aizer and Currie (2004), we rely on the assumption that the information is more likely to be shared within the same group to disentangle information sharing from potential neighborhood effects based on unobservable characteristics of the residential areas.[18] We therefore compute two measures for exposure, considering the c-section use at the municipality of residence for Italian and foreign mothers separately. We associate each mother to the exposure to c-section use of her own group (i.e., $Exposure\_own_{mt\text{-}12\text{m}}$: Italian mother-Italian exposure, foreign mother-foreign exposure) and the other group (i.e., $Exposure\_other_{mt\text{-}12\text{m}}$: for Italian mothers, foreign exposure; for foreign mothers, Italian exposure). Foreign mothers are defined on the basis of nationality and they constitute a large portion of the sample (about 25% of observed mothers).[19]

We then reproduce the baseline analysis on the two groups of mothers separately, using $Exposure\_own_{mt\text{-}12\text{m}}$ and $Exposure\_other_{mt\text{-}12\text{m}}$ and the two together in place of the standard measure for exposure $Exposure_{mt\text{-}12\text{m}}$ as described by Equations 4-6.

$$\begin{aligned} Csection_{iht} = {} & \delta_{own} Exposure\_own_{mt\text{-}12\text{m}} \\ & + \beta X1'_{iht} + \beta X2'_{imt} + \pi_t + \rho_q + \sigma_d + \omega_h + \gamma_{lha} + \epsilon_{iht} \end{aligned} \tag{4}$$

$$\begin{aligned} Csection_{iht} = {} & \delta_{other} Exposure\_other_{mt\text{-}12\text{m}} \\ & + \beta X1'_{iht} + \beta X2'_{imt} + \pi_t + \rho_q + \sigma_d + \omega_h + \gamma_{lha} + \epsilon_{iht} \end{aligned} \tag{5}$$

[18]In their study related to the analysis of network effects in the use of publicly funded prenatal care, Aizer and Currie (2004) stress that correlations in observed behaviors within groups may arise both from information sharing (i.e., network effects) and unmeasured characteristics of the group or neighborhood (i.e., neighborhood effects). The latter reflect time-varying characteristics that simultaneously affect all women located in the local area (e.g., opening of a new local clinic).

[19]The most represented foreign nationalities are Moroccan, Romanian, and Albanian.

$$
\begin{aligned}
Csection_{iht} = {} & \delta_{own} Exposure\_own_{mt\text{-}12\mathrm{m}} + \delta_{other} Exposure\_other_{mt\text{-}12\mathrm{m}} \\
& + \beta X1'_{iht} + \beta X2'_{imt} + \pi_t + \rho_q + \sigma_d + \omega_h + \gamma_{lha} + \epsilon_{iht}
\end{aligned}
\tag{6}
$$

Following Aizer and Currie (2004), we interpret $Exposure\_own_{mt\text{-}12\mathrm{m}}$ as a proxy for within-group information sharing, while $Exposure\_other_{mt\text{-}12\mathrm{m}}$ is a place-specific feature changing over time that affects all women in the area of residence.

The results presented in Table 3 confirm the existence of a network effect for both groups. Indeed, we observe δ_{own} to be significant in Models 4 and 6. The magnitude of the effect increases in Model 6 for both Italian and foreign mothers, reinforcing the relevance of information sharing within groups. In Models 5 and 6 δ_{other}, the neighborhood effect is never significant for Italian mothers, while it is relevant for the group of foreign mothers. This indicates, as in Aizer and Currie (2004), that the characteristics of the place where the individual is located significantly affect the use of health care for the specific group of foreign mothers. Hence, there are features at the municipality level that are specific to foreigners and are not part of the local health care system. From this perspective, the role of immigrant associations and nonprofit organizations that target foreigners is crucial. Over time, the number of these associations/organizations has been growing, and they play a relevant role in helping foreigners deal with the health care system. According to a 2006 survey by the Italian Volunteering Foundation (FIVOL), almost 60% of immigrant associations in the country operate in the area of social assistance providing medical and psychological support services Frisanco (2007). The services provided to foreign pregnant women range, for example, from translation to informational material on pregnancy and the health care system, meetings with healthcare professionals, introductory courses to the health care system, and antenatal classes. Still, δ_{other} can partially capture a network effect, but only in the case of well-integrated foreigners who can then rely on both foreign and Italian mothers. In the complete model (Model 6), the magnitude of the effect in the Italian and foreign subgroups is, respectively, a 4.5% and 2% increase in the probability of having a c-section if the exposure to c-sections in the own group increases by one standard deviation. The magnitude associated with an increase of one standard deviation in the exposure of the other group is not significant and 4.3%.

The adjustments due to complementary information are confirmed (Table 4). A one standard deviation increase in the incidence of c-section complications reduces the probability of having a c-section by 1.4% and 1%, respectively, for Italian and foreign mothers, while a one standard deviation increase in the incidence of unnecessary c-sections increases the likelihood of having a c-section by 0.9% and 1.1%, respectively. In the first situation, the Italian response is much higher than that of foreign mothers. This may be due to the possibility of accessing richer information, together with a higher ability to correctly interpret that information and to include it in the decision process. Conversely, if we look at the information related to appropriateness, foreign mothers show a stronger response; however, the two are fairly similar. It is likely to mean that foreign mothers are more subject to exposure to inappropriate use of health care and are more likely to consider a procedure as appropriate if it is widely used within their group.

7 Drivers of the Network Effect

As a last step in the analysis, we focus on the predominant mechanisms of information transmission, that is, network effects, and study their drivers. The specific characteristics of each subgroup may determine different responses due to external characteristics. We therefore analyze how the role of $Exposure\_own_{mt\text{-}12\text{m}}$ changes under several dimensions on the patient or provider side, while controlling for the exposure of the other group. The results presented refer to the estimation of the model defined by Equation 7

$$\begin{aligned} Csection_{iht} = {} & \delta_1 Exposure\_own_{mt\text{-}12\text{m}} + \lambda D_x * Exposure\_own_{mt\text{-}12\text{m}} \\ & + \delta_{other} Exposure\_other_{mt\text{-}12\text{m}} + \nu D_x + \beta X1'_{iht} \\ & + \beta X2'_{imt} + \pi_t + \rho_q + \sigma_d + \omega_h + \gamma_{lha} + \epsilon_{iht} \end{aligned} \tag{7}$$

D_x is a dummy equal to 1 when the values of the variable capturing the driver (x) are above the median. For patients, we consider marital status, generally associated with higher income, the day of delivery, since we assume less discretion on weekends, access to care as proxied by the distance between the municipality of the mother and the nearest hospital or the hospital where the delivery took place, the presence of at least one family care center in the municipality, and the availability of specialists.[20] For providers, we consider two proxies for hospital capacity constraints, two proxies for hospital quality (hospitals' fixed effects and readmission rates), and three measures of the characteristics of the medical team working in the maternity ward (i.e., specialization, attractiveness, and graduation year).

7.1 Patient Side

The analysis on the patient side has a strong limitation because individuals can freely choose where to be treated. Patients with similar underlying characteristics (e.g., education, income, preferences) may choose the same hospital. We therefore expect heterogeneous effects driven by patient characteristics to be partially mitigated by hospital fixed effects.

First, we focus on the marital status of the mother because it is considered a proxy for the economic stability of the household and, therefore, for higher socioeconomic status (Tables 5 and 6 - Column (1)). Married mothers are 61% of the sample of Italian mothers and 62% of the overall sample. Not-married mothers are generally younger, with the median age for not-married and married mothers being 32 and 33, respectively (31 and 32 in the overall sample).[21] In Italy cohabitation is quite common and accepted. Accordingly, even if the effect of being married goes in the right direction for Italian mothers (i.e., married women are less affected by exposure), the difference with the effect for not-married mothers is not statistically significant.

The degree of patient discretion, proxied by the day of the week, is strongly significant for Italian mothers. Consistent with the findings by Finkelstein et al. (2016), significant effects only arise when patients have more discretion in the decision process, which in our case means during weekdays. Foreign mothers report the same, but not significant, effect of patient discretion (Tables 5 and 6 - Column (2)). This might be due to the relevance of the

[20] Family care centers (i.e., *Consultori familiari*) are local centers offering medical, psychological and social support to individuals and families. During pregnancy, women can have prenatal screenings and ask professionals for counseling. The availability of specialists is computed as the number of specialists available in the patients' district per 10,000 inhabitants. We provide two measures: overall number of specialists and female specialists.

[21] Only 49% of those younger than 25 are married, and the percentage increases to 63% of those between 25 and 32 and 64% of those over 32.

neighborhood effect in the case of foreigners who are strongly affected by the characteristics of the local system they live in.

Following Gowrisankaran et al. (2015), we assume that access to care decreases as the distance between the mother's municipality and the hospital increases.[22] There are not statistically different effects driven by access to care as proxied by the distance to the nearest hospital or the distance to the hospital chosen for the delivery (Tables 5 and 6 - Columns (3)-(4)). However, in the subgroup of foreign mothers, we observe that the effect of exposure is significant only when the distance is larger.

For both groups, the absence of family care centers in the mothers' municipality largely increases the significance of the exposure (Tables 5 and 6 - Column (5)). This holds in particular for foreign mothers who may have less information about the services offered in other municipalities.

The availability of specialists in the LHA of the patient seems to reduce the significance of the exposure. (Tables 5 and 6 - Columns (6) (7)). This may be related to the higher possibility of accessing information through the more formal and safer medical channel. Moreover, mothers may have greater confidence in a female physician.

Regarding the patients' perspective, we can therefore confirm the findings by Finkelstein et al. (2016) that the patients' discretion in the decision process is a key element that must be taken into account when studying the use of health care. Moreover, we show some evidence that information transmission between patients can be seen as a substitute of the *official medical channel* when individuals have limited access to care.

7.2 Provider Side

We explore the role of providers by looking at the characteristics of the hospitals and the medical team operating in the specific maternity ward.

Regarding hospital characteristics, no subgroup shows any significantly different effect due to capacity constraints, on personnel or beds (Tables 7 and 8 - Columns (1)-(2)). We define capacity constraints *on personnel* as the ratio between the number of employees and

[22]The distance is computed as kilometers between the centroid of the mother's municipality of residence and that of the municipality where the hospital is located.

the beds in use, while constraints *on the beds* is the ratio between available beds and used beds. The rationale for checking the role of capacity constraints is related to the longer duration of hospitalization and the higher number of personnel involved in a c-section, because it is a surgical intervention. The lack of significance is likely to be due to the fact that capacity constrains are not subject to much variation over time, and their effect of capacity constraints might be partially captured by the inclusion of hospital fixed effects. Hence, it is not surprising that the observed effects are not statistically significant.

We then consider the estimated hospital fixed effects from Equation 1 (Tables 7 and 8 - Column (3)). The hospital fixed effects capture the time-invariant characteristics at the hospital level, which predict a higher incidence of c-sections, after controlling for risk factors, seasonal, yearly and environmental elements. This means that the higher the fixed effects are, the higher the hospital's weight in explaining the incidence of c-sections. Column (3) shows how the effect of $Exposure\_own_{mt\text{-12m}}$ is decreasing with higher the fixed effects, with the difference being statistically significant for both groups. This confirms the hypothesis that the potential sorting of a subset of individuals into high fixed-effects hospitals leads to a lesser role for exposure. Indeed, even if patients may have had specific preferences for selecting a provider, the higher use of a treatment at the provider level is entirely absorbed by time-invariant hospital characteristics.

Hospital quality is proxied by the readmission rates during the 42 days following the delivery (Tables 7 and 8 - Column (4)).[23] Quality has a strong heterogeneous effect among foreign mothers: the higher the quality is, the lower the role played by individual exposure. The effect goes in the same direction, although it is not statistically significant, for Italian mothers. Higher quality hospitals may therefore be more able to cope with patient fear and misinformation, reducing the relevance of individual preferences in the adoption of medical procedures. This seems to be particularly relevant for foreigner mothers who might be more likely to suffer from misinformation, to lack information or to be uneasy with the health care system.

[23]The readmission rates during the 42 days following the delivery are standard measures used by the Ministry of Health to monitor the quality of providers, but they are unfortunately available only for a subset of hospitals.

Moving to the characteristics of the medical team working in the maternity ward, we explore the role of physicians' demographics and professional experience.[24] The effect is driven by less specialized medical teams (Tables 7 and 8 - Column (5)). The degree of specialization is computed as the average number of medical specializations obtained by the physicians in the medical team.[25] This result is consistent with previous findings (Currie et al. (2016)) that more skilled physicians can better match the patient with the appropriate treatment. It is also reinforced by the results in Column (6), where the degree of attractiveness of the ward is considered. We assume that hospitals with a high rate of physicians born outside the region are more attractive and, consequently, are the hospitals where the best and most motivated physicians self-select. Public hospitals are subject to national agreements on salary and contract conditions, and the process of hiring is made through public calls. However, given equal employment conditions, providers may differ in terms of career perspectives, research environment and other unmeasured benefits. Overall, this translates into different levels of attractiveness. Considering the geographic composition of the group of physicians, we observe lower effects with higher attractiveness and, ideally, higher quality of the team. These results are confirmed for the pool of Italian mothers.

We additionally prove that $Exposure\_own_{mt\text{-}12\mathrm{m}}$ plays a stronger role in the case of younger physicians (Tables 7 and 8 - Column (7)) and this is driven by foreign mothers.[26] The main explanation could be that younger (i.e., less experienced) physicians might more frequently opt for a c-section for foreign mothers given the difficulties in communication with these patients and given also the recent developments in cases of malpractice by the Italian jurisprudence. In 1992 the Supreme Court for civil and criminal law ruled murder in the second degree rather than manslaughter for the case of a doctor who did not obtain the full consent from the patient before a clinical intervention (*Decision 5639/92 Caso Massimo*).

[24]Due to data limitations, we cannot match the mother with the physician. We therefore perform the analysis by aggregating the individual information on the physicians at the ward level. This analysis implicitly takes into account potential spillovers between physicians working on the same medical team.

[25]In our sample, physicians have a maximum of 4 different specializations.

[26]We report the results for the classification based on the year of specialization. The medical team is defined as *young* if the average year of specialization is above the median, 1992. Analogous results can be found considering the year of birth or the year of graduation.

This decision is considered a turning point in addressing the importance of patient-informed consent in the Italian health care system and it is a benchmark case for medical malpractice claims. Accordingly, it is a topic widely discussed during the university training of physicians. It is not surprising that its effect is stronger for foreign mothers than for Italians: if more emphasis is given to the role of the patient, the most disadvantaged categories are those who benefit the most.

8 Conclusion

We investigate the role of information sharing between patients in shaping the choice of delivery methods. The informal channel is proxied by the variable for the exposure on mother i, which is the incidence of c-sections among the mothers residing in the same municipality in the 12 months preceding the delivery of mother i. We find that the experiences of other people with whom the patient may interact affect her health care consumption, increasing the incidence of c-sections by approximately 3%. Our results are robust to multiple specifications, and support to the fact that patients can obtain information in many informal ways. While the case that we examine can be considered an example of spillover effects from inaccurate health care treatments, the diffusion of information through informal channels can also apply to beneficial practices, as in the case of preventive care.

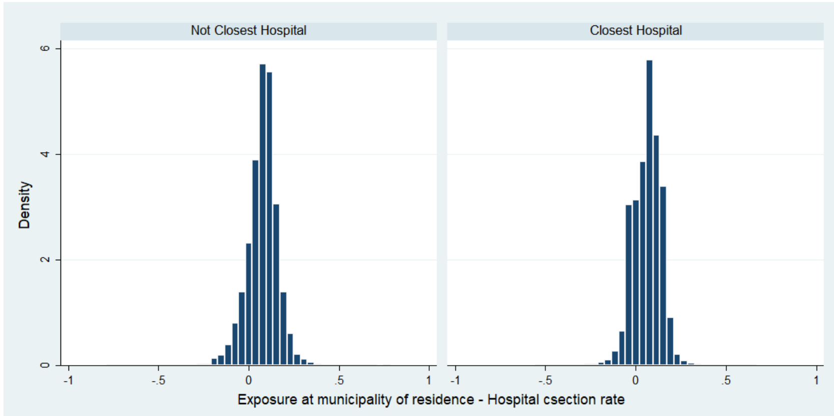
9 Tables and Figures

Table 1: **Controls**

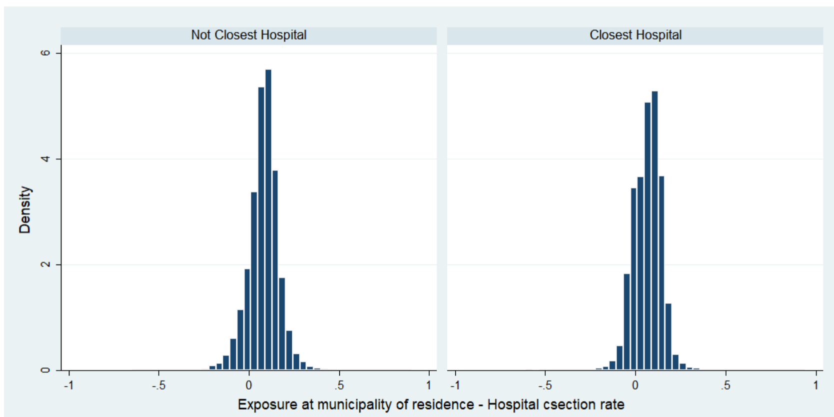
X1			X2
Age	Anemia	Multiple delivery	Urbanization
Italian	Hypertension	Abnormal fetus heart rate	Population density
Married	Cardiovascular problems	Placenta previa	Average income
	Diabetes	Precipitous labor	Average education
	Sexually transmitted diseases	Uterus traumas	
	Drug addiction	Problems of the amniotic cavity	
	Renal failure	Fetus rhesus isoimmunization	
	Thyroid dysfunction	Fetus abnormality	
	Obesity	Breech	
	Pelvic abnormality	Eclampsia	

Notes: $X1$ are controls at the mother level. $X2$ are controls at the municipality of residence of the mother level. Maternal risk factors are consistent with those used in Dubay et al. (1999), Dubay et al. (2001), Currie and MacLeod (2008), Dranove and Watanabe (2009), Dranove et al. (2011), Shurtz (2013, 2014) and Bertoli and Grembi (2019).

Figure 1: **Difference in patient exposure at municipality - hospital c-section rate**



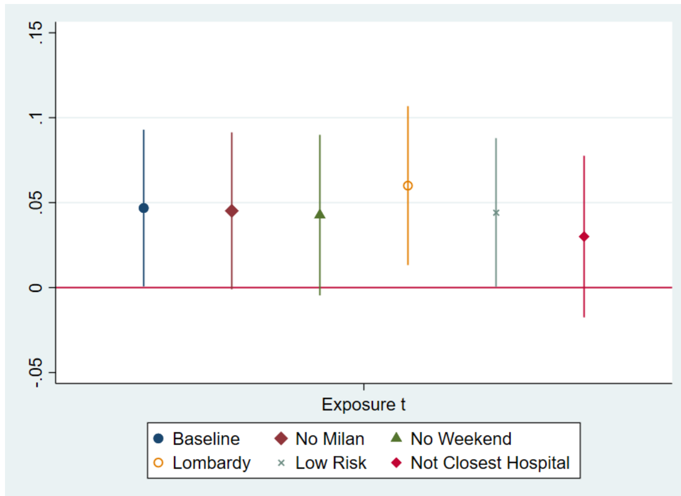
(a) $Exposure_t$



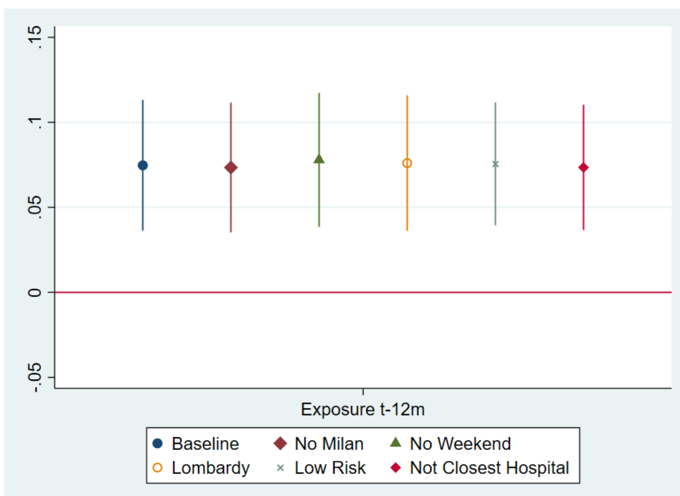
(b) $Exposure_{t-12m}$

Notes: The variation is computed as the difference between rate of incidence of c-sections at the municipality of residence and rate of incidence of c-sections at the hospital selected for the delivery for each time period. A zero means that the two measures are the same and this is what we define a "perfect match" between the patient exposure and the hospital practice.

Figure 2: **Estimations by exposure**



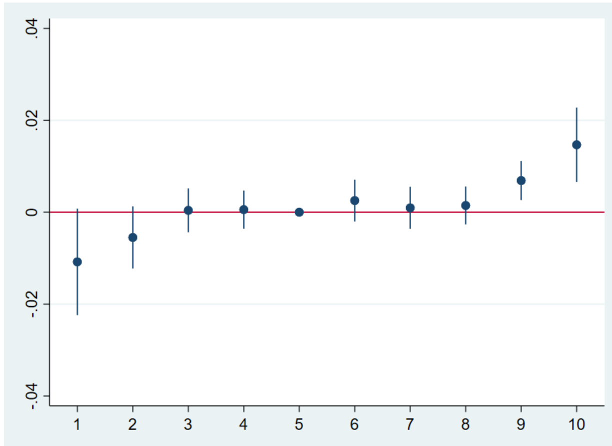
(a) $Exposure_t$



(b) $Exposure_{t-12m}$

Notes: Estimated effects for Model 1. Each coefficient estimated stands for the specific effect of the exposure to c-section use on the individual probability of undergoing a c-section. Estimation repeated over alternative samples: baseline (i.e. all observations), exclusion of mothers from the municipality of Milan, exclusion of deliveries occurred during the weekend, exclusion of mothers officially registered outside Lombardy, selection of low-risk mothers, selection of mothers not choosing the closest hospital. Confidence intervals at 95%.

Figure 3: **Exposure at municipality: effects by index deciles**



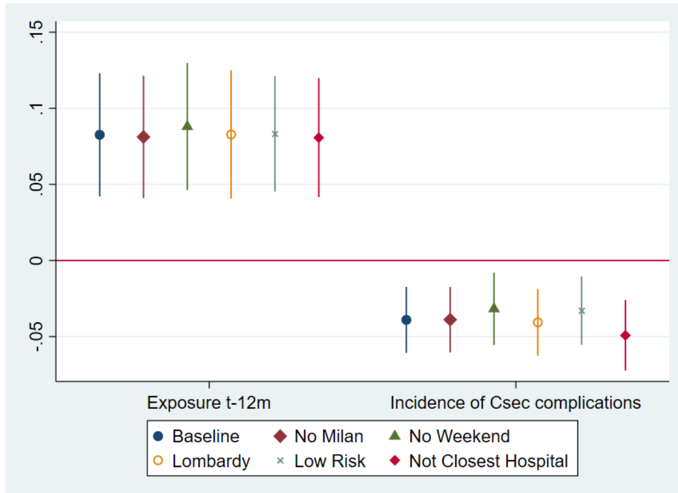
Notes: Estimated effects for Model 1, where deciles of $Exposure_{t-12m}$ are used in place of the continuous variable $Exposure_{t-12m}$. Each coefficient estimated stands for the specific effect of the exposure deciles with respect to the 5^{th} category. Results presented for the baseline specification where all observation are taken into account. Confidence intervals at 95%.

Table 2: **Subsample: foreign mothers**

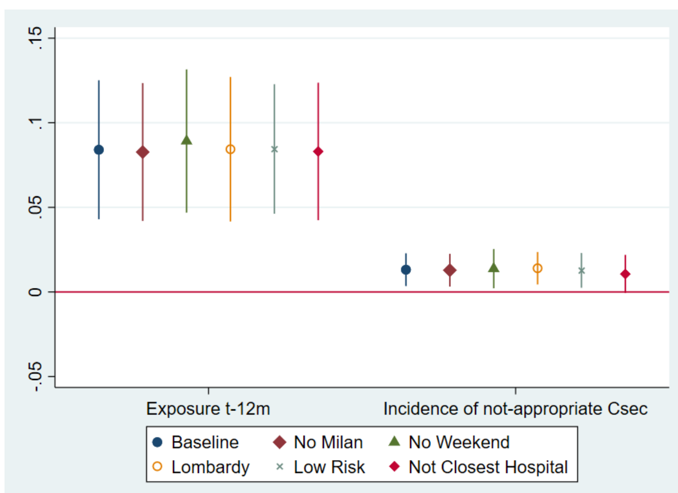
	Baseline	Specification 1	Specification 2
	(1)	(2)	(3)
δ	0.081***	0.082***	0.082***
	(0.024)	(0.025)	(0.025)
δ_{origin}			0.036*
			(0.018)
Number Obs	182,654	182,168	181,120
Controls	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Hospital FE	Yes	Yes	Yes
LHA FE	Yes	Yes	Yes
Nationality FE		Yes	Yes

Notes: Estimated coefficients for Model 1 when only foreign mothers are taken into account (i.e. mothers without Italian citizenship). *Specification 1* include mother's nationality fixed effects, while *Specification 2* additionally control for the c-section rate in the country of origin in the relevant year. Significance levels: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Figure 4: **Complementary information**



(a) *C-section complications*



(b) *Unnecessary c-sections*

Notes: Estimated coefficients for Model 2. We estimate both the effect of $Exposure_{t-12m}$ and the effect of complementary information. In the simple model we estimate only the effect of complementary information. Estimation repeated over alternative samples: baseline (i.e. all observations), exclusion of mothers from the municipality of Milan, exclusion of deliveries occurred during the weekend, exclusion of mothers officially registered outside Lombardy, selection of mothers with Italian citizenship, selection of low-risk mothers, selection of mothers not choosing the closest hospital. Confidence intervals at 95%.

Table 3: **Italian Vs foreign mothers - exposure at municipality**

	Sample: Italian Mothers					*Sample: Foreign Mothers*				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Model 4 - Exposure: own group										
δ_{own}	0.075***	0.070***	0.061***	0.064***	0.079***	0.023**	0.022**	0.020**	0.019*	0.023**
	(0.017)	(0.016)	(0.016)	(0.017)	(0.018)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Number of Obs	555535	555535	555535	555535	546726	176982	176982	176982	176982	176522
Model 5 - Exposure: other group										
δ_{other}	0.014	0.016*	0.016	0.013	0.016	0.083***	0.085***	0.079***	0.075***	0.084***
	(0.010)	(0.009)	(0.009)	(0.010)	(0.009)	(0.023)	(0.023)	(0.024)	(0.024)	(0.023)
Number of Obs	390,217	390,217	390,217	390,217	389,933	168,404	168,404	168,404	168,404	168,253
Model 6 - Exposure: both groups										
δ_{own}	0.095***	0.100***	0.086***	0.076***	0.104***	0.025**	0.025**	0.023**	0.021*	0.026**
	(0.026)	(0.024)	(0.025)	(0.028)	(0.026)	(0.011)	(0.010)	(0.011)	(0.011)	(0.011)
δ_{other}	0.007	0.010	0.011	0.008	0.009	0.075***	0.078***	0.071***	0.067***	0.076***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.022)	(0.022)	(0.023)	(0.023)	(0.021)
Number of Obs	390,205	390,205	390,205	390,205	389,923	167,777	167,777	167,777	167,777	167,645
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE, Hospital FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
LHA FE		Yes	Yes				Yes	Yes		
LHA trend			Yes					Yes		
Hospital trend				Yes					Yes	
Practice style					Yes					Yes

Notes: Subgroup analysis where Italian and Foreign mothers are considered separately (Models 4, 5, 6). *Dependent variable* binary variable assuming value 1 if the patient receives a c-section. δ_{own} is the effect of the exposure within the group to which the mother belong, δ_{other} vice-versa. *Controls* are those specified in $X1$ and $X2$ as described in Table 1. LHA= local health authorities. Significance levels: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Table 4: **Italian Vs foreign mothers - complementary information**

	Sample: Italian Mothers			*Sample: Foreign Mothers*		
	(1)	(2)	(3)	(4)	(5)	(6)
Exposure own group and Csection complications						
δ_{own}	0.100***	0.108***	0.109***	0.023**	0.023**	0.023**
	(0.027)	(0.025)	(0.027)	(0.011)	(0.011)	(0.011)
$compl_{own}$	-0.057***	-0.056***	-0.057***	-0.022*	-0.021*	-0.022*
	(0.014)	(0.013)	(0.014)	(0.012)	(0.011)	(0.012)
$compl_{other}$	-0.008	-0.008	-0.008	-0.042*	-0.038*	-0.042*
	(0.007)	(0.007)	(0.007)	(0.021)	(0.021)	(0.022)
Number of Obs	377,229	377,229	377,012	161,581	161,581	161,485
Exposure own group and Unnecessary Csections						
δ_{own}	0.103***	0.110***	0.112***	0.024**	0.023**	0.023**
	(0.028)	(0.026)	(0.028)	(0.011)	(0.011)	(0.011)
$compl_{own}$	0.012	0.014*	0.012	0.010**	0.010***	0.010**
	(0.008)	(0.007)	(0.008)	(0.004)	(0.004)	(0.004)
$compl_{other}$	0.005	0.006*	0.005	0.027***	0.028***	0.027***
	(0.003)	(0.003)	(0.003)	(0.008)	(0.008)	(0.008)
Number of Obs	377,229	377,229	377,012	161,581	161,581	161,485
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Time FE, Hospital FE	Yes	Yes	Yes	Yes	Yes	Yes
LHA FE		Yes			Yes	
Practice style			Yes			Yes

Notes: Subgroup analysis where Italian and foreign mothers are considered separately (Model 2). *Dependent variable* binary variable assuming value 1 if the patient receives a c-section. δ_{own} is the effect of the exposure within the group to which the mother belong, δ_{other} vice-versa. The estimations include additional controls for the exposure to complementary information. *Controls* are those specified in $X1$ and $X2$ as described in Table 1. LHA= local health authorities. *Unnecessary* is defined as the incidence in the group of low risk mothers. Significance levels: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Table 5: **Heterogeneity analysis - patients - Italian (own group)**

	Patient						
	Marital Status	Day-of-the-week	Distance Closest Hosp	Distance Used Hosp	Consultorio	Spec Available	Spec F Available
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Not Married	**Weekend**	**Near**	**Near**	**No**	**Low**	**Low**
δ_{own}	0.098***	0.026	0.087***	0.099***	0.094***	0.111***	0.119***
	(0.027)	(0.029)	(0.031)	(0.031)	(0.022)	(0.032)	(0.036)
	Married	**Working days**	**Far**	**Far**	**Yes**	**High**	**High**
δ_{own}	0.102***	0.125***	0.096***	0.087***	0.112***	0.081**	0.078***
	(0.027)	(0.025)	(0.022)	(0.028)	(0.037)	(0.036)	(0.027)
$Difference$	0.004	0.099***	0.009	-0.012	0.017	-0.030	-0.040
	(0.026)	(0.026)	(0.027)	(0.040)	(0.026)	(0.049)	(0.044)
δ_{other}	0.010	0.010	0.009	0.008	0.010	0.010	0.010
	(0.008)	(0.008)	(0.007)	(0.007)	(0.008)	(0.008)	(0.008)
Number Obs	555,535	555,535	555,535	555,535	555,535	555,535	555,535
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hospital FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
LHA FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Estimated effects for model 7 on the sample of Italian mothers. The table presents the potential patient-related drivers of heterogeneity. They are the individual socioeconomic status, proxied by the marital status, the degree of discretion, and the access to care, measured as the distance between the municipality of the mother and the nearest hospital, the presence of family care centers and the availability of specialists. The degree of discretion is identified by the day when the delivery occurs (i.e., more discretion during working days compared to weekends). Significance levels: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Table 6: **Heterogeneity analysis - patients - foreign (own group)**

	Patient						
	Marital Status	Day-of-the-week	Distance Closest Hosp	Distance Used Hosp	Consultorio	Spec Available	Spec F Available
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Not Married	**Weekend**	**Near**	**Near**	**No**	**Low**	**Low**
δ_{own}	0.016	0.014	0.012	0.016	0.024**	0.030**	0.036**
	(0.017)	(0.015)	(0.021)	(0.016)	(0.010)	(0.013)	(0.015)
	Married	**Working days**	**Far**	**Far**	**Yes**	**High**	**High**
δ_{own}	0.029*	0.030**	0.027***	0.026*	0.031	0.015	0.011
	(0.012)	(0.012)	(0.010)	(0.012)	(0.024)	(0.012)	(0.010)
$Difference$	0.013	0.016	0.015	0.010	0.007	-0.015	-0.024
	(0.020)	(0.017)	(0.021)	(0.020)	(0.022)	(0.017)	(0.017)
δ_{other}	0.078***	0.078***	0.069***	0.076***	0.077***	0.078***	0.078***
	(0.022)	(0.022)	(0.021)	(0.021)	(0.021)	(0.022)	(0.022)
Number Obs	176,982	176,982	176,982	176,982	176,982	176,982	176,982
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hospital FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
LHA FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Estimated effects for model 7 on the sample of Italian mothers. The table presents the potential patient-related drivers of heterogeneity. They are the individual socioeconomic status, proxied by the marital status, the degree of discretion, and the access to care, measured as the distance between the municipality of the mother and the nearest hospital, the presence of family care centers and the availability of specialists. The degree of discretion is identified by the day when the delivery occurs (i.e., more discretion during working days compared to weekends). Significance levels: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Table 7: **Heterogeneity analysis - providers - Italian (own group)**

	Hospital				Medical Team		
	Constraint 1: beds	Constraint 2: personnel	Hospital FE	Quality: readmission	Specialization	Attractiveness	Year of Graduation
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Low	**Low**	**Low**	**Low**	**Low**	**Low**	**Before 1992**
δ_{own}	0.111***	0.086***	0.145***	0.026	0.163***	0.164***	0.080***
	(0.030)	(0.025)	(0.043)	(0.021)	(0.042)	(0.045)	(0.015)
	High	**High**	**High**	**High**	**High**	**High**	**After 1992**
δ_{own}	0.088***	0.109***	0.063***	0.006	0.058***	0.064***	0.132**
	(0.024)	(0.030)	(0.021)	(0.033)	(0.018)	(0.013)	(0.052)
$Difference$	-0.023	0.023	-0.082*	-0.020	-0.105**	-0.100**	0.052
	(0.023)	(0.028)	(0.049)	(0.038)	(0.047)	(0.046)	(0.055)
δ_{other}	0.013*	0.013*	0.010	0.003	0.015*	0.014	0.010
	(0.008)	(0.008)	(0.007)	(0.010)	(0.008)	(0.008)	(0.007)
Number Obs	491,292	491,274	555,535	171,668	428,871	428,871	428,871
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hospital FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
LHA FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Estimated effects for model 7 on the sample of Italian mothers. The table presents the potential provider-related drivers of heterogeneity, considering characteristics of the hospital or the medical team. For what concern the hospital level, they are defined as practice style (i.e., estimated fixed effects, capturing the relevance of "not-medical factor" in the medical decision process), capacity constraint (i.e,. constrained on the available beds –Constraint 1–, on the personnel – Constraint 2–), quality indicator (i.e., quality proxied by the readmission rate during the 42 days following the delivery). Observing the characteristics of the medical team working in the maternity ward, we identify the role of the degree of specialization (i.e., average number of specializations hold by the team members), attractiveness (i.e., composition of the team in terms of individuals who born or graduate in other regions), year of graduation (i.e., 1992 is a crucial year for what concern the relation between patient and physicians due to a change in medical liability rules). All the thresholds are based on the median of the variable distribution. Significance levels: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

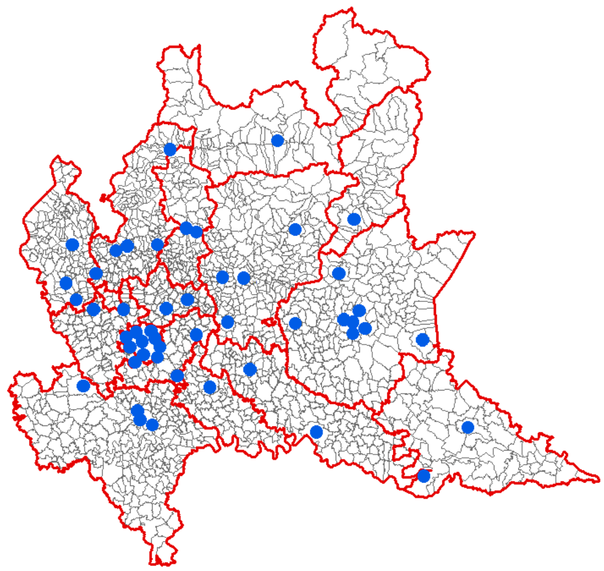
Table 8: **Heterogeneity analysis - providers - foreign (own group)**

	Hospital				Medical Team		
	Constraint 1: beds	Constraint 2: personnel	Hospital FE	Quality: readmission	Specialization	Attractiveness	Year of Graduation
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Low	**Low**	**Low**	**Low**	**Low**	**Low**	**Before 1992**
δ_{own}	0.024**	0.019	0.043***	0.031*	0.035*	0.037*	0.007
	(0.012)	(0.012)	(0.015)	(0.015)	(0.018)	(0.021)	(0.008)
	High	**High**	**High**	**High**	**High**	**High**	**After 1992**
δ_{own}	0.025*	0.029**	0.004	-0.020	0.002	0.006	0.055***
	(0.013)	(0.013)	(0.009)	(0.023)	(0.012)	(0.010)	(0.020)
$Difference$	0.001	0.009	-0.039**	-0.050*	-0.033	-0.030	0.048**
	(0.014)	(0.015)	(0.018)	(0.028)	(0.022)	(0.023)	(0.022)
δ_{other}	0.083***	0.082***	0.077***	0.060**	0.086***	0.085***	0.077***
	(0.022)	(0.022)	(0.021)	(0.028)	(0.024)	(0.023)	(0.021)
Number Obs	154,782	154,782	176,982	54,615	147,061	147,061	147,061
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hospital FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
LHA FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Estimated effects for model 7 on the sample of Italian mothers. The Table presents the potential provider-related drivers of heterogeneity, considering characteristics of the hospital or the medical team. For what concern the hospital level, they are defined as practice style (i.e. estimated fixed effects, capturing the relevance of "not-medical factor" in the medical decision process), capacity constraint (i.e. constrained on the available beds –Constraint 1–, on the personnel – Constraint 2–), quality indicator (i.e. quality proxied by the readmission rate during the 42 days following the delivery). Observing the characteristics of the medical team working in the maternity ward, we identify the role of the degree of specialization (i.e., average number of specializations hold by the team members), attractiveness (i.e., composition of the team in terms of individuals who born or graduate in other regions), year of graduation (i.e., 1992 is a crucial year for what concern the relation between patient and physicians due to a change in medical liability rules). All the thresholds are based on the median of the variable distribution. Significance levels: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

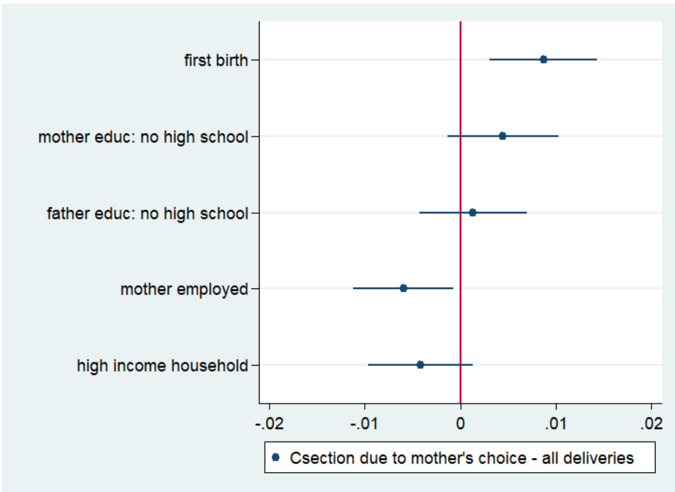
10 Appendix

Figure A.1: **Lombardy: distribution of municipalities, local health authorities, and hospitals**



Notes: The grey borders define municipalities, the red borders defined the Local Health Authorities, while the blue dots represent the hospitals.

Figure A.2: **C-sections requested by the mother**

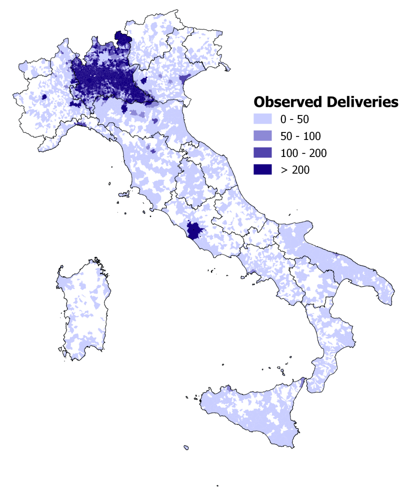


Notes: The outcome variable takes value 1 if the mother reports having explicitly asked for a csection, without medical indications. The analysis is performed on all mothers interviewed, regardless the delivery treatment adopted. *Controls* include mother and father demographics (i.e., age, citizenship, education, marital status of the mother), as well as additional information of the household (i.e., region of residence, household income, mother employment during pregnancy) and medical conditions of the mother (i.e., previous miscarriages, previous deliveries, twin pregnancy, child low weight). Confidence intervals plotted at 90%. Dataset: Indagine campionaria sulle nascite 2012. ISTAT (ISTAT (2012))

Table A.1: **Sample Coverage by Mother's municipality of residence**

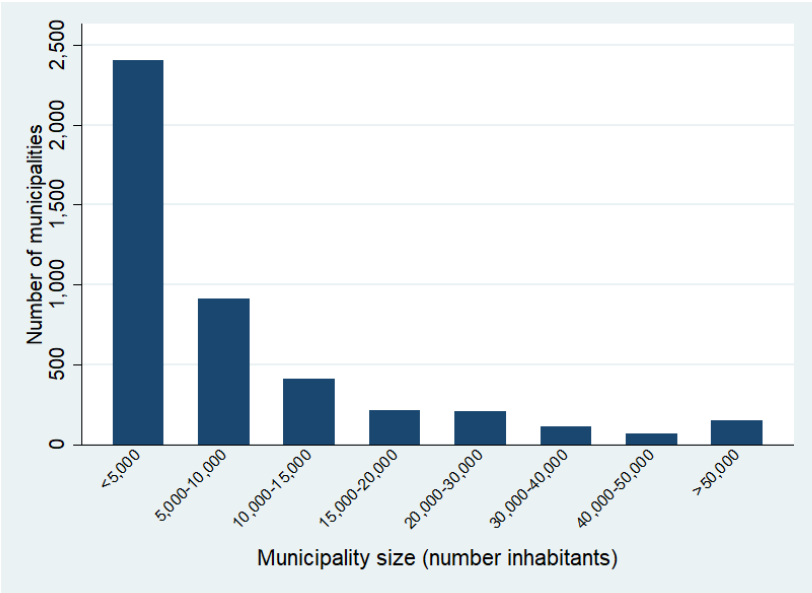
	Number of observed municipalities
Lombardy	1,543
Outside Lombardy	2,831
Overall	4,374
	Number of individual observations
Lombardy	724,695
Outside Lombardy	21,065
Overall	745,760

Notes: Number of municipalities observed at least once in the selected sample and individual observation associated. According to official statistics provided by ISTAT, the overall number of municipalities in Italy were 8,101 in 2001, reduced to 8,057 in 2014.

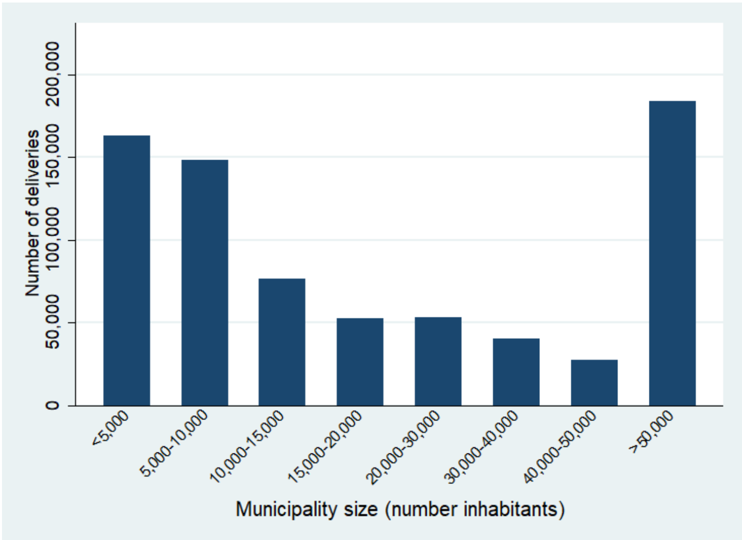


Notes: Descriptive statistics on the geographic coverage of the sample selected. The whole period of analysis is taken into account (2006-2014).

Figure A.3: **Descriptive statistics by municipality size**



(a) Frequency of municipalities in the sample per municipality size



(b) Frequency of deliveries in the sample per municipality size

Notes: Distribution of the number of different municipalities and number of deliveries by municipality dimension. Official information on the municipality dimension provided by ISTAT.

Table A.2: **Additional variables: descriptive statistics**

Variable	Description	Median	Mean	Std. Dev.
Source: ISTAT - municipality level				
High education	Ratio individuals having at least high school diploma	0.28	0.30	0.09
Population density	Population/km^2	1,042.62	2,088.19	2,299.35
Average income	Avg annual taxable income (euro)	23,929.10	25,250.67	4,903.01
Degree of urbanization	Character of the area where the municipality is located, defined following EUROSTAT standards	3	2.62	0.58
Source: Ministry of Health - hospital level				
Bed constraint	Ratio used beds over available beds	0.97	0.96	0.04
Personnel constraint	Ratio personnel over used beds	3.88	3.74	0.86
Used wards	Number of used wards	31.00	34.46	20.75
Source: National Board of Physicians - ward level				
Year of birth	Avg year of birth	1962	1962	4.12
Year of graduation	Avg year of graduation	1989	1988	4.22
Year of specialization	Avg year specialization	1993	1990	15.72
Born in Lombardy	Ratio physicians born in Lombardy	0.71	0.70	0.15
Graduated in Lombardy	Ratio physicians graduated in Lombardy	0.85	0.81	0.18
Specialities	Avg number of specializations (up to 4)	1.06	1.10	0.11

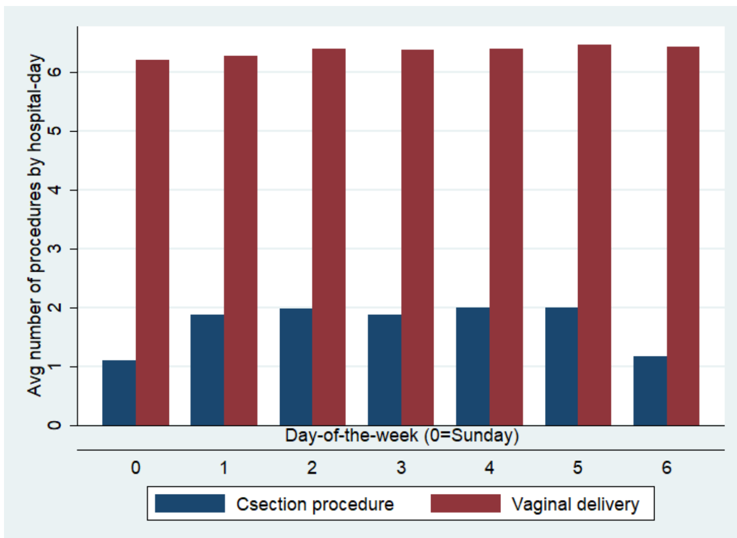
Notes: Additional variables used in the analysis. The averages for the board of physicians refer to the gynecologist and obstetrics wards active in Lombardy. The degree of urbanization is defined according to the observation of the density of population per 1 km^2 and the number of inhabitants. It assume value 1 if the density of population per 3 km^2 is at least 1,500 and the number of inhabitants is at least 50,000 units (i.e., high-density cluster); value 2 if the density is at least 300 and the population at least 5,000 (i.e., urban cluster), value 1 if none of the previous categories apply (i.e., rural grid cell).

Table A.3: **Fertility rates**

Citizenship	Sample	2006	2007	2008	2009	2010	2011	2012	2013	2014
Overall	Italy	1.37	1.40	1.45	1.45	1.46	1.44	1.42	1.39	1.37
	Lombardy	1.43	1.47	1.54	1.57	1.57	1.53	1.51	1.48	1.46
Italian	Italy	1.28	1.30	1.34	1.33	1.34	1.32	1.29	1.29	1.29
	Lombardy	1.25	1.28	1.32	1.32	1.34	1.31	1.29	1.29	1.29
Foreign	Italy	2.92	2.80	2.65	2.55	2.43	2.36	2.37	2.10	1.97
	Lombardy	3.14	3.04	2.98	3.01	2.80	2.58	2.56	2.31	2.17

Notes: Fertility rates by citizenship of the mother as reported by the national institute of statistics (ISTAT). Rates computed as the average number of children per woman aged 15 to 49 in the reference sample.

Figure A.4: **Trend in the treatments performed by day of the week**



Notes: Due to differences in the composition of the medical team, elective csections are generally scheduled during working days. Therefore, surgical interventions observed during weekends are likely to be emergency procedures.

Table A.4: **Simultaneous exposure: exposure t at municipality**

	(1)	(2)	(3)	(4)	(5)
Sample selection: All Observations (Baseline)					
δ	0.063***	0.059**	0.047**	0.049**	0.084***
	(0.023)	(0.022)	(0.023)	(0.024)	(0.025)
Number of Obs	741,154	741,154	741,154	741,154	695,289
Sample selection: Municipality of origin not Milan					
δ	0.061**	0.057**	0.045*	0.048*	0.081***
	(0.023)	(0.022)	(0.023)	(0.024)	(0.026)
Number of Obs	646,022	646,022	646,022	646,022	600,157
Sample selection: Not Weekend delivery					
δ	0.060**	0.056**	0.043*	0.045*	0.082***
	(0.024)	(0.023)	(0.024)	(0.024)	(0.026)
Number of Obs	550,813	550,813	550,813	550,813	516,525
Sample selection: Municipality of residence in Lombardy					
δ	0.069***	0.072***	0.060**	0.054**	0.084***
	(0.025)	(0.023)	(0.023)	(0.026)	(0.027)
Number of Obs	720,290	720,290	720,290	720,290	676,682
Sample selection: Italian citizenship					
δ	0.063***	0.057**	0.044*	0.048*	0.080***
	(0.023)	(0.023)	(0.024)	(0.024)	(0.026)
Number of Obs	557,994	557,994	557,994	557,994	520,811
Sample selection: Low-risk mothers					
δ	0.063***	0.056**	0.044**	0.049**	0.084***
	(0.021)	(0.021)	(0.022)	(0.022)	(0.024)
Number of Obs	654,346	654,346	654,346	654,346	614,262
Sample selection: Not Closest Hospital					
δ	0.051**	0.043*	0.030	0.038	0.071***
	(0.023)	(0.023)	(0.024)	(0.023)	(0.025)
Number of Obs	451,392	451,392	451,392	451,392	418,920
Controls	Yes	Yes	Yes	Yes	Yes
Time FE, Hospital FE	Yes	Yes	Yes	Yes	Yes
LHA FE		Yes	Yes		
LHA trend			Yes		
Hospital trend				Yes	
Practice style					Yes

Notes: *Dependent variable* binary variable assuming value 1 if the patient receives a csection. *Controls* are those specified in $X1$ and $X2$ as described in Table 1. *LHA*= local health authorities. *LHA trend* refer to the local health authorities annual trends. Significance levels: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Table A.5: **Previous exposure: exposure t-12m at municipality**

	(1)	(2)	(3)	(4)	(5)
Sample selection: All Observations (Baseline)					
δ	0.087***	0.084***	0.075***	0.076***	0.109***
	(0.020)	(0.019)	(0.019)	(0.020)	(0.023)
Number of Obs	737,412	737,412	737,412	737,412	693,759
Sample selection: Municipality of origin not Milan					
δ	0.086***	0.083***	0.073***	0.075***	0.107***
	(0.020)	(0.018)	(0.019)	(0.020)	(0.023)
Number of Obs	642,280	642,280	642,280	642,280	598,627
Sample selection: Not Weekend delivery					
δ	0.090***	0.088***	0.078***	0.080***	0.112***
	(0.020)	(0.019)	(0.020)	(0.021)	(0.024)
Number of Obs	547,914	547,914	547,914	547,914	515,369
Sample selection: Municipality of residence in Lombardy					
δ	0.083***	0.085***	0.076***	0.071***	0.106***
	(0.021)	(0.019)	(0.020)	(0.022)	(0.025)
Number of Obs	718,042	718,042	718,042	718,042	675,791
Sample selection: Italian citizenship					
δ	0.089***	0.085***	0.075***	0.078***	0.108***
	(0.019)	(0.019)	(0.019)	(0.020)	(0.023)
Number of Obs	554,760	554,760	554,760	554,760	519,505
Sample selection: Low-risk mothers					
δ	0.089***	0.085***	0.076***	0.078***	0.112***
	(0.018)	(0.018)	(0.018)	(0.018)	(0.021)
Number of Obs	651,413	651,413	651,413	651,413	613,056
Sample selection: Not Closest Hospital					
δ	0.088***	0.083***	0.073***	0.078***	0.104***
	(0.019)	(0.018)	(0.018)	(0.020)	(0.021)
Number of Obs	447,786	447,786	447,786	447,786	417,400
Controls	Yes	Yes	Yes	Yes	Yes
Time FE, Hospital FE	Yes	Yes	Yes	Yes	Yes
LHA FE		Yes	Yes		
LHA trend			Yes		
Hospital trend				Yes	
Practice style					Yes

Notes: *Dependent variable* binary variable assuming value 1 if the patient receives a csection. *Controls* are those specified in $X1$ and $X2$ as described in Table 1. LHA= local health authorities. *LHA trend* refer to the local health authorities annual trends. Significance levels: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Table A.6: **Robustness check (1): controlling for fertility rates**

	(1)	(2)	(3)	(4)	(5)
Sample selection: All Observations (Baseline)					
δ	0.086***	0.083***	0.075***	0.076***	0.108***
	(0.020)	(0.019)	(0.019)	(0.020)	(0.023)
Number of Obs	737,312	737,312	737,312	737,312	693,663
Sample selection: Municipality of origin not Milan					
δ	0.084***	0.082***	0.073***	0.075***	0.106***
	(0.020)	(0.018)	(0.019)	(0.020)	(0.023)
Number of Obs	642,180	642,180	642,180	642,180	598,531
Sample selection: Not Weekend delivery					
δ	0.089***	0.087***	0.078***	0.079***	0.110***
	(0.021)	(0.019)	(0.020)	(0.021)	(0.024)
Number of Obs	547,836	547,836	547,836	547,836	515,295
Sample selection: Municipality of residence in Lombardy					
δ	0.083***	0.084***	0.076***	0.072***	0.106***
	(0.021)	(0.019)	(0.020)	(0.022)	(0.025)
Number of Obs	718,042	718,042	718,042	718,042	675,791
Sample selection: Italian citizenship					
δ	0.087***	0.084***	0.075***	0.077***	0.106***
	(0.020)	(0.018)	(0.019)	(0.020)	(0.024)
Number of Obs	554,672	554,672	554,672	554,672	519,420
Sample selection: Low-risk mothers					
δ	0.087***	0.083***	0.075***	0.078***	0.110***
	(0.018)	(0.018)	(0.018)	(0.019)	(0.021)
Number of Obs	651,331	651,331	651,331	651,331	612,977
Sample selection: Not Closest Hospital					
δ	0.086***	0.082***	0.073***	0.078***	0.102***
	(0.020)	(0.018)	(0.018)	(0.020)	(0.022)
Number of Obs	447,686	447,686	447,686	447,686	417,304
Controls	Yes	Yes	Yes	Yes	Yes
Time FE, Hospital FE	Yes	Yes	Yes	Yes	Yes
LHA FE		Yes	Yes		
LHA trend			Yes		
Hospital trend				Yes	
Practice style					Yes

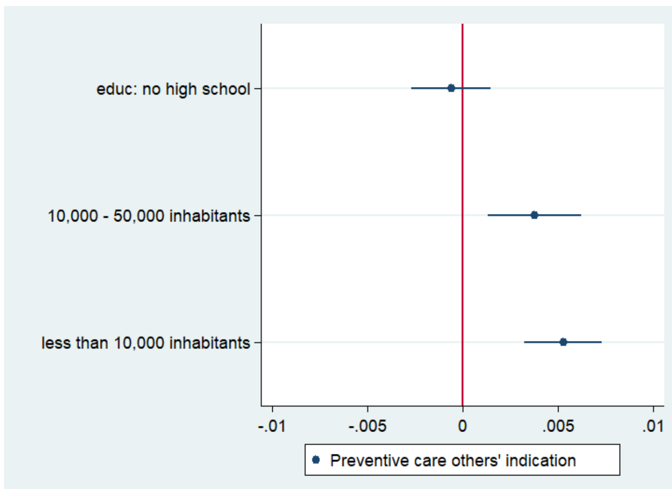
Notes: *Dependent variable* binary variable assuming value 1 if the patient receives a csection. *Controls* are those specified in $X1$ and $X2$ as described in Table 1. LHA= local health authorities. LHA *trend* refer to the local health authorities annual trends. Significance levels: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Table A.7: **Robustness check (2): dropping perfect-match patients**

	(1)	(2)	(3)	(4)	(5)
Sample selection: All Observations (Baseline)					
δ	0.086***	0.084***	0.076***	0.077***	0.109***
	(0.020)	(0.019)	(0.019)	(0.020)	(0.023)
Number of Obs	661,063	661,063	661,063	661,063	620,442
Sample selection: Municipality of origin not Milan					
δ	0.085***	0.083***	0.075***	0.077***	0.108***
	(0.020)	(0.019)	(0.019)	(0.020)	(0.023)
Number of Obs	568,805	568,805	568,805	568,805	528,184
Sample selection: Not Weekend delivery					
δ	0.090***	0.088***	0.079***	0.080***	0.112***
	(0.020)	(0.019)	(0.020)	(0.021)	(0.024)
Number of Obs	491,667	491,667	491,667	491,667	461,373
Sample selection: Municipality of residence in Lombardy					
δ	0.082***	0.085***	0.077***	0.072***	0.106***
	(0.021)	(0.020)	(0.020)	(0.022)	(0.025)
Number of Obs	643,102	643,102	643,102	643,102	603,803
Sample selection: Italian citizenship					
δ	0.088***	0.085***	0.076***	0.079***	0.108***
	(0.019)	(0.018)	(0.019)	(0.020)	(0.023)
Number of Obs	498,569	498,569	498,569	498,569	465,731
Sample selection: Low-risk mothers					
δ	0.088***	0.084***	0.076***	0.078***	0.111***
	(0.018)	(0.018)	(0.018)	(0.018)	(0.021)
Number of Obs	583,445	583,445	583,445	583,445	547,785
Sample selection: Not Closest Hospital					
δ	0.087***	0.083***	0.075***	0.080***	0.105***
	(0.019)	(0.018)	(0.018)	(0.019)	(0.021)
Number of Obs	399,492	399,492	399,492	399,492	371,275
Controls	Yes	Yes	Yes	Yes	Yes
Time FE, Hospital FE	Yes	Yes	Yes	Yes	Yes
LHA FE		Yes	Yes		
LHA trend			Yes		
Hospital trend				Yes	
Practice style					Yes

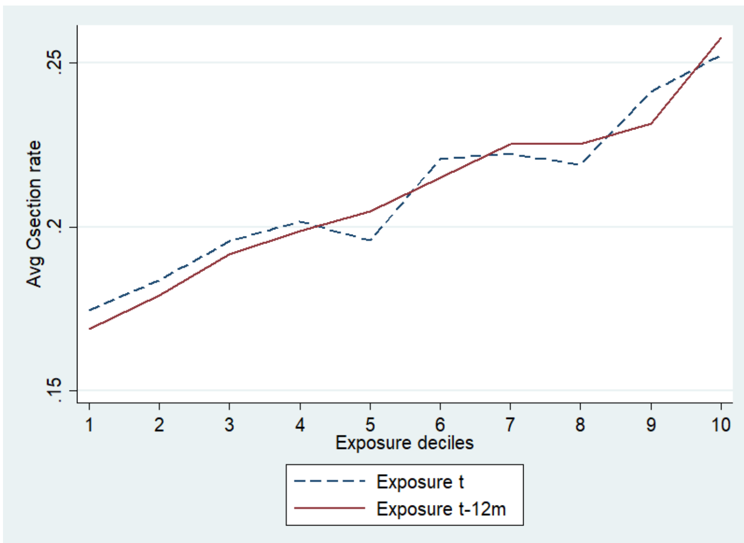
Notes: *Dependent variable* binary variable assuming value 1 if the patient receives a csection. *Controls* are those specified in $X1$ and $X2$ as described in Table 1. LHA= local health authorities. *LHA trend* refer to the local health authorities annual trends. Perfect matched patients are defining according to the difference between $Exposure_{t-12m}$ and the incidence of csection at the delivery hospital. When this difference is zero, we define it a perfect match. Significance levels: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Figure A.5: **Preventive care use in the absence of medical indications**



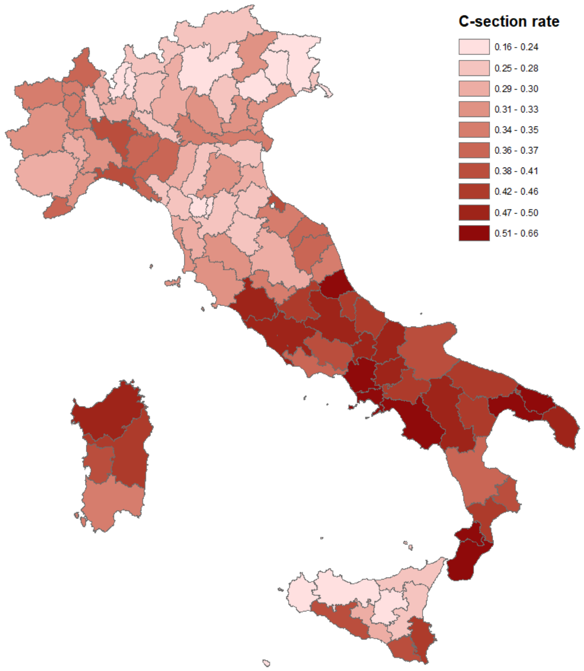
Notes: The outcome variable takes value 1 if the individual reports using preventive care without medical prescription (preventive care in the form of cholesterol, glycemia or blood pressure checks). The size of the municipality appears to eb strongly related to an informal transmission of health information. *Controls* include individual demographics (i.e., gender, age, citizenship, education, marital status), as well as additional information of the household (i.e., geographic area of residence, household income, employment status) and temporal controls (i.e., month of interview, wave). Confidence intervals plotted at 90%. Dataset: *Indagine sulle Condizioni di Salute ed il Ricorso ai Servizi Sanitari; waves: 1999-2000, 2004-2005, 2012-2013* ISTAT (2000, 2005, 2013).

Figure A.6: **Trend in average c-section rate by exposure deciles**

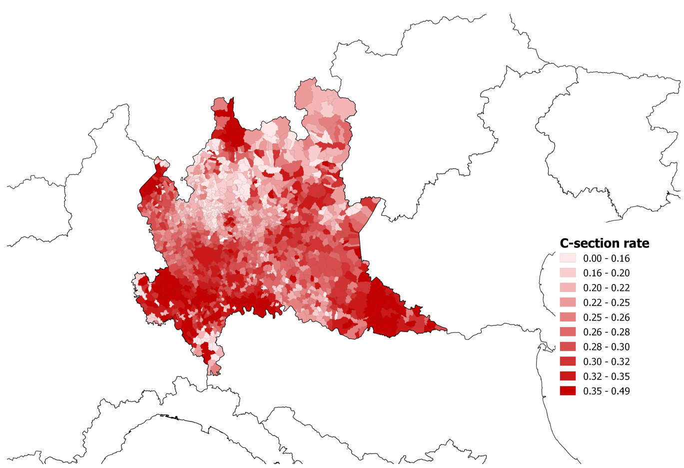


Notes: Descriptive evidence of the relation between $Exposure_m$ and probability of undergoing a c-section.

Figure A.7: **Exposure Variability: National Level vs. Lombardy**



(a) Italy - District Level



(b) Lombardy - Municipality Level

Notes: Descriptive statistics on the spatial variability in csection use in Italy. The map in Figure A.7a gives an overall picture of the country, considering districts, called *province*, as units of analysis (each region is divided in certain number of districts, they represent an intermediate administrative level and generally coincide with LHAs). The map in Figure A.7b presents a zoom on the region of Lombardy, where statistics at the municipality level are presented. The whole period of analysis is taken into account when computing the averages (2006-2014).

References

Aizer, A. and J. Currie

2004. Networks or neighborhoods? Correlations in the use of publicly-funded maternity care in California. *Journal of Public Economics*, 88(12):2573–2585.

Alexander, D. and M. Schnell

2019. The Impacts of Physician Payments on Patient Access, Use, and Health. *NBER Working Paper Series*, 26095:1–65.

Amaral-Garcia, S., M. Nardotto, C. Propper, and T. Valletti

2019. Mums Go Online : Is the Internet Changing the Demand for Healthcare ? *CEPR Discussion Paper*, (DP13625):1–48.

Barili, E., P. Bertoli, and V. Grembi

2020. Fees Equalization and Appropriate Health Care. *HEDG Working Paper series*, (20/09):1–33.

Bertoli, P. and V. Grembi

2017. The political economy of diagnosis-related groups. *Social Science and Medicine*, 190:38–47.

Bertoli, P. and V. Grembi

2019. Malpractice risk and medical treatment selection. *Journal of Public Economics*, 174:22–35.

Card, D., A. Fenizia, and D. Silver

2019. The Health Impacts of Hospital Delivery Practices. *NBER Working Paper Series*, (25986):1–32.

Clemens, J. and J. D. Gottlieb

2014. Do physicians' financial incentives affect medical treatment and patient health? *American Economic Review*, 104(4):1320–1349.

Costa-Ramón, A. M., M. Kortelainen, A. Rodríguez-González, and L. Saaksvuori
2019. The Long-Run Effects of Cesarean Sections. *VATT Working Papers*, (125):1–52.

Costa-Ramón, A. M., A. Rodríguez-González, M. Serra-Burriel, and C. Campillo-Artero
2018. It's about time: Cesarean sections and neonatal health. *Journal of Health Economics*, 59:46–59.

Currie, J. and W. B. MacLeod
2008. First do no harm? tort reform and birth outcomes. *Quarterly Journal of Economics*, 123(2):795–830.

Currie, J. and W. B. MacLeod
2017. Diagnosing expertise: Human capital, decision making, and performance among physicians. *Journal of Labor Economics*, 35(1):1–43.

Currie, J., W. B. MacLeod, and J. Van Parys
2016. Provider practice style and patient health outcomes: The case of heart attacks. *Journal of Health Economics*, 47:64–80.

Cutler, D., J. Skinner, A. D. Stern, and D. Wennberg
2019. Physician Beliefs and Patient Preferences: A New Look at Regional Variation in Health Care Spending. *American Economic Journal: Economic Policy*, 11(1):192–221.

Declercq, E. R., C. Sakala, M. P. Corry, and S. Applebaum
2007. Listening to Mothers II: Report of the Second National U.S. Survey of Women's Childbearing Experiences. *Journal of Perinatal Education*, 16(4):15–17.

Doyle, J. J., J. A. Graves, and J. Gruber
2017. Uncovering waste in US healthcare. *Journal of Health Economics*, 54:25–39.

Dranove, D., R. Subramaniam, and A. Sfekas
2011. Does the market punish aggressive experts? evidence from cesarean sections. *The BE Journal of Economic Analysis & Policy*, 11(2):1–33.

Dranove, D. and Y. Watanabe

2009. Influence and Deterrence: How Obstetricians Respond to Litigation against Themselves and Their Colleagues. *American Law and Economic Review*, 20:69–94.

Dubay, L., R. Kaestner, and T. Waidmann

1999. The Impact of Malpractice Fears on Cesarean Section Rates. *Journal of Health Economics*, 18:491–522.

Dubay, L., R. Kaestner, and T. Waidmann

2001. Medical malpractice liability and its effect on prenatal care utilization and infant health. *Journal of Health Economics*, 20:591–611.

Fernandez, R. and A. Fogli

2009. Culture: An empirical investigation of beliefs, work, and fertility. *American Economic Journal: Macroeconomics*, 1(1):146–177.

Finkelstein, A., M. Gentzkow, and H. Williams

2016. Sources of geographic variation in health care: Evidence from patient migration. *Quarterly Journal of Economics*, 131(4):1681–1726.

Frakes, M.

2013. The impact of medical liability standards on regional variations in physician behavior: Evidence from the adoption of national-standard rules. *American Economic Review*, 103(1):257–276.

Frisanco, R.

2007. Volontariato sotto la lente: lo scenario del volontariato organizzato alla luce della quarte rilevazione fivol 2006. Fondazione Europa Occupazione e Volontariato, Impresa e Solidarietá, Roma. Available at: http://www.fondazioneterzopilastrointernazionale.it/wp-content/uploads/2014/12/1-REPORTODFINALEODVITALIA2006.pdf.

Goldberg, J., M. Macis, and P. Chintagunta

2019. Incentivized Peer Referrals for Tubercolosis Screening: Evidence from India. *NBER Working Paper Series*, 25279:1–82.

Gourevitch, R. A., A. Mehrotra, G. Galvin, M. Karp, A. Plough, and N. T. Shah
2017. How do pregnant women use quality measures when choosing their obstetric provider? *Birth: Issues in Perinatal Care*, 44(2):120–127.

Gourevitch, R. A., A. Mehrotra, G. Galvin, A. Plough, and N. T. Shah
2019. Does Comparing Cesarean Delivery Rates Influence Women ' s Choice of Obstetric Hospital? *The American Journal of Managed Care*, 25(2):33–38.

Gowrisankaran, G., A. Nevo, and R. Town
2015. Mergers when prices are negotiated: Evidence from the hospital industry. *American Economic Review*, 105(1):172–203.

Ho, K. and A. Pakes
2014. Hospital choices, hospital prices, and financial incentives to physicians? *American Economic Review*, 104(12):3814–3840.

ISTAT
2000. Indagine Multiscopo sulle Famiglie. Condizioni di salute e ricorso ai servizi sanitari 1999-2000.

ISTAT
2005. Indagine Multiscopo sulle Famiglie. Condizioni di salute e ricorso ai servizi sanitari 2004-2005.

ISTAT
2012. Indagine campionaria sulle nascite e le madri - Anno 2012.

ISTAT
2013. Indagine Multiscopo sulle Famiglie. Condizioni di salute e ricorso ai servizi sanitari 2012-2013.

ISTAT

2014. Migrazioni Internazionali e Interne della Popolazione Residente. *Statistiche Report*, Pp. 1–17.

Johnson, E. M. and M. M. Rehavi

2016. Physicians treating physicians: Information and incentives in childbirth. *American Economic Journal: Economic Policy*, 8(1):115–141.

Maurer, M., k. Firminger, P. Dardess, K. Ikeler, S. Sofaer, and K. Carman

2016. Understanting consumer perceptions and awareness of hospital-based maternity care quality measures. *Health Service Research*, 51(3).

Ministero della Salute

2009. CeDAP, Analisi dell'evento nascita - Anno 2006.

Ministero della Salute

2010. CeDAP, Analisi dell'evento nascita - Anno 2007.

Ministero della Salute

2011. CeDAP, Analisi dell'evento nascita - Anno 2008.

Ministero della Salute

2012. CeDAP, Analisi dell'evento nascita - Anno 2009.

Ministero della Salute

2013. CeDAP, Analisi dell'evento nascita - Anno 2010.

Ministero della Salute

2014. CeDAP, Analisi dell'evento nascita - Anno 2011.

Ministero della Salute

2016. CeDAP, Analisi dell'evento nascita - Anno 2014.

Molitor, D.

2018. The evolution of physician practice styles: Evidence from cardiologist migration. *American Economic Journal: Economic Policy*, 10(1):326–356.

Shurtz, I.

2013. The impact of medical errors on physician behavior: Evidence from malpractice litigation. *Journal of Health Economics*, 32:331–340.

Shurtz, I.

2014. Malpractice Law, Physicians' Financial Incentives, and Medical Treatment: How Do They Interact? *The Journal of Law and Economics*, 57(1):1–29.

Skinner, J.

2011. Causes and Consequences of Regional Variations in Health Care. In *Handbook of Health Economics*, volume 2, Pp. 45–93. Elsevier.

Tonei, V.

2019. Mother's mental health after childbirth: Does the delivery method matter? *Journal of Health Economics*, 63:182–196.