Impact of private health insurance on a public healthcare system: the case of cesarean deliveries

Carine Milcent, Saad Zbiri

PARIS SCHOOL OF ECONOMICS
ECOLE D'ECONOMIE DE PARIS

WORKING PAPER N° 2018 – 52

Impact of supplementary private health insurance on medical practice: the case of cesarean deliveries

Carine Milcent
Saad Zbiri

JEL Codes:
Keywords:

Funded by a French government subsidy managed by the ANR under the framework of the Investissements d'avenir programme reference ANR-17-EURE-001

Impact of supplementary private health insurance on medical practice: the case of cesarean deliveries

Carine MILCENT[‡] and Saad ZBIRI[§]

Abstract

In the French DRG-based payment system, both private and public hospitals are financed by a single public payer. Public hospitals are overcrowded and have no direct financial incentives to choose one procedure over another. If a patient has a strong preference, they can switch to a private hospital. In private hospitals, the preference does matter, but the patient has to pay for additional costs, for which they are reimbursed if they have supplementary private health insurance. Do financial incentives drive the physician's behavior? Using exhaustive delivery data from a French administrative district (*département*) over a 7-year period (2008-2014), we controlled for factors that are known to influence obstetric practices. Restricting the sample to the women with low clinical risk, we found that private hospitals perform significantly more cesarean deliveries than public hospitals. However, for patients without private health insurance coverage, the two sectors differed much less in terms of cesareans performed. We determined the impact of the financial incentive for patients who can afford the additional cost. Affordability is mainly ensured by the reimbursement of costs by private health insurance. The responsibility of the public welfare system is to provide healthcare for normal births, but not for discretionary cesareans. We here show the two sides of the supplementary private health insurance; 1) because 95% of the French population is covered, people's health preferences are generally not based on affordability; 2) in a market-driven public healthcare delivery system, it distorts public policies developed by policy-makers for the benefit of society.

JEL classification: I11, I13, I18

Keywords: Private supplementary health insurance; Public healthcare system; DGR-based payment; Cesarean delivery

1. Introduction

Activity-based payment using diagnosis-related groups (DRGs) has become commonplace in most developed countries. All French hospitals, whether public or private, are publicly funded through a DRG-based[1] prospective payment system that became broadly implemented in 2008. Here, we investigated the impact of private health insurance on a hospital healthcare system in which both the public and the private sectors are publicly funded in what appears to be a similar manner. We focused on women with low clinical risk. In a first step, we determined the extent to which private and public hospitals differ in terms of the rates of cesareans performed. We then show that this difference decreased as the financial affordability decreased, ultimately vanishing entirely for women with the lowest economic status.

Most of the literature to date, both theoretical and empirical, has examined the overall effect of activity-based payment on cost efficiency and hospital performance (Hafsteinsdottir and Siciliani, 2010). Although convincing theoretical arguments lead to expectations of hospital cost reductions and improved efficiency, the empirical evidence is inconclusive. The introduction of the DRG system has been associated with positive effects on hospital efficiency in Finland (Linna, 1999), Portugal (Dismuke and Sena, 1999), Norway (Biørn *et al.*, 2003; Biørn *et al.*, 2010), and Switzerland (Widmer, 2015), while no such effects have been found for Germany (Herwartz and Strumann, 2014), Italy (Barbetta *et al.*, 2007), Austria (Sommersguter-Reichmann, 2000), and the United States (Borden, 1988; Chern and Wan, 2000).

For public hospitals, France has a model whereby the hospitals are in competition with each other, but the physicians are salaried. For private hospitals, both the hospitals themselves as well as the physicians are paid according to their level of activity, but they also receive additional payments when patients have private health insurance coverage. For obstetric activity, performing a cesarean delivery is associated with a substantial additional payment. This raises the question of doctors′ profit-oriented practices. Baker *et al.* (2014) examined the consequences of contractual or ownership relationships between hospitals and physician

[1] A specific DRG classification was set up in France. For simplicity's sake, the term "DRG" will be used as a generic term that includes the French classification.

practices, which is often described as vertical integration. They found that "an increase in the market share of hospitals with the tightest vertically integrated relationship with physicians — ownership of physician's practices — is associated with higher hospital prices and spending". A systematic review examining the factors explaining the diversity of findings regarding hospital ownership and quality (Eggleston *et al.*, 2008) reported that the diverse results in the hospital ownership literature can largely be explained by differences in the institutional context, including differences across regions and markets, and over time.

Most of the empirical work to date on the effect of reimbursement rules on healthcare production has used USA data (see Sloan, 2000, for a review). However, the structure of the USA healthcare market makes it hard to disentangle the pure effect of hospital ownership from other institutional features such as the segmentation of insurance or payers and payment types (Lien *et al*., 2008). In France, the national health insurance system (*Sécurité Sociale*) is a single-payer system that covers the entire population. Studying the French context effectively eliminates any concern about different reimbursement schemes for different payers, negotiation between providers and payers, and cost-shifting behavior by providers on the supply side and financial access to hospitals on the demand side.

Controlling for the relevant patient- and hospital-level characteristics, we found that private hospitals perform more cesarean deliveries than public sector hospitals. This result was robust to restrict the sample to the women with low clinical risk, and it may be explained by the context. Both sectors are publicly funded, but in the private sector, both the institutions and the doctors receive additional payments from private health insurance for fees that public hospitals are not allowed to charge.[2] Moreover, women who choose a private hospital also choose their physician and they can have a say in how they give birth. In the public sector, the pregnancy is monitored by a team instead of by a specific doctor. In addition, in the absence of complications, the woman is monitored by midwives, including the D-day. The midwife is the person who decides whether the doctor needs to be called during the pregnancy as well as during the delivery period. In this study, women admitted to public hospitals were used as a "control" group in the first step. In the second step, women with a low socioeconomic status admitted in public hospitals were used as a "control" group.

[2] More details are presented in Section 2.2.

For women with a low probability of private health insurance coverage, there was almost no difference between sectors in terms of the number of cesareans performed. Here, we determined the impact of private health insurance. Therefore, if a mother cannot afford to pay for a cesarean, irrespective of her preference, she will give birth by a normal delivery (except in case of clinical reasons). This means that higher-income individuals have a choice that is unaffordable for lower-income individuals.

In the following section, we briefly outline the factors that determine the use of cesarean delivery and, after providing an overview of the characteristics of French hospitals, their incentives to provide obstetric services. The third section describes the data used for this study and it provides some preliminary statistics. The econometric strategy is presented in the fourth section, and the results and robustness checks are reported in the fifth section. In the sixth section, we discuss the results and we provide a conclusion regarding our findings.

2. Cesarean delivery and incentives for cesarean delivery in the French healthcare system

2.1. Use of cesarean deliveries

Cesarean delivery is one of the most common surgical procedures performed worldwide (Gibbons *et al.*, 2012). Epidemiologic studies have revealed a negative association between cesarean rates and maternal, neonatal, and infant morbidity and mortality (Althabe *et al.*, 2006; Villar *et al.*, 2007). Although cesarean delivery can provide a degree of psychological and social well-being (Mazzoni *et al.*, 2011), it can also cause significant and sometimes permanent complications, disability, or death (Hyde and Modi, 2012; Souza *et al.*, 2010). It is also associated with a higher cost (Allen *et al.*, 2005; Rogers *et al.*, 2017). Cesarean delivery should, therefore, only be undertaken when medically necessary. The research literature has identified many interrelated factors that influence the number of cesarean deliveries. These are related to the characteristics of the women who are pregnant, the medical staff, and the hospitals.

The characteristics of the women in part explain the use of cesarean deliveries. Older women and those having their first child have a higher probability of cesarean delivery (Cleary *et al.*,1996; Ecker *et al.*, 2001). The presence of certain medical risk factors for the woman and/or her fetus, which may arise from conditions that existed before the pregnancy (e.g., a

chronic disease), or that develop during the pregnancy (e.g., eclampsia), or labor (e.g., dystocia), are associated with a higher rate of cesarean births (Menacker *et al.*, 2006; Penn and Ghaem-Maghami, 2001). Furthermore, women with a lower socioeconomic status have a higher probability of cesarean delivery than their more socioeconomically advantaged counterparts, at least in high-income countries (Linton *et al.*, 2004; Milcent and Zbiri, 2018); while the woman's preference may also be a factor (Mazzoni *et al.*, 2011).

The apparent increased use of "defensive medicine" in obstetrics is likely to be a contributing factor in the increase in cesarean deliveries. Many studies have found a positive correlation between higher cesarean rates and the increase in obstetricians' perceived risk of complaints and litigation (Fuglenes *et al.*, 2009) or in their malpractice insurance premiums (Dubay *et al.*, 1999; Yang *et al.*, 2009).

The time required to perform a cesarean is relatively uniform for a planned cesarean, while the time required for a vaginal delivery is unpredictable. Managing the medical equipment and the facilities as well as the physician's time is, therefore, easier with a cesarean delivery. The probability of a cesarean delivery has been shown to increase sharply on Friday evenings and it decreases during weekends as physicians factor their time off into their medical practices (Brown, 1996; Fabbri, 2008).

The heterogeneity of delivery practices may also be explained in part by hospital characteristics. An increased likelihood of cesarean deliveries has been reported for well-equipped hospitals (Le Ray *et al.*, 2006), as well as for teaching hospitals (Hammond, 2015). Hospital organization also plays a role. For example, the probability of cesarean delivery is lower in hospitals in which the obstetricians are more available (Yee *et al*., 2017). The size of the maternity ward also affects the probability of cesarean delivery in various ways (Roman *et al*., 2008; David *et al*., 2001). Staff organization in hospitals also has an impact (Zbiri *et al*., 2018).

Finally, reimbursement rules affect the cesarean delivery rate. Gruber and Owings (1996) reported that, after a drop in the birth rate in some states in the USA, the number of cesarean deliveries increased. Gruber *et al.* (1999) showed that a significant pay gap between a cesarean and a vaginal delivery accounts for half of the differences in practices in the USA. Using the data from Gruber *et al.*, Grant (2009) confirmed the effect of physicians' financial incentives on cesarean rates. Recently, Allin *et al.* (2015) reported that increasing the fee

differential between cesarean and normal delivery in Canada led physicians to perform more cesareans. In France, Milcent and Rochut (2009), using data from before the implementation of the activity-based payment system, showed that private for-profit hospitals performed substantially more cesarean deliveries than public-sector hospitals. This disparity was attributed to the difference in hospital payment systems. This context has changed, however, as all French hospitals are now governed by the same reimbursement rules for all acute care stays, including for childbirth.

2.2. Incentives for cesarean delivery

In the French hospital healthcare system, there is a single-payer: the national health insurance funds (*Sécurité Sociale*). The public system sets its own fee schedule. Computation of its fees includes some costs, such as doctors' salaries, that are absent in the private sector.[3] As a result, there are two fee scales according to the sector. These are presumably nearly equivalent once the private obstetrician has billed the patient separately for their services. Table A1 presents the fee as a function of the hospital sector for the first and the last year of the study period. It can be seen that the mean DRG fee for delivery is around 2,500 Euros. This fee is approximately 40% higher for a cesarean delivery than for a vaginal delivery, and the difference in these fees is quite similar irrespective of the sector. Hence, based on the DRG fee, the differences between a delivery with or without a cesarean provide the same incentive in both sectors for the organization, but the incentives are different for the obstetricians, as they can charge above and beyond the reimbursed fee schedule.

Hence, the situation is somewhat more complex. Only in private hospitals can patients be charged additional fees for (1) room and board, and (2) physicians' fees.[4] The room and board fees can be substantial in private hospitals. They are typically between 100 and 250 Euros for a one-night stay and may hence encourage medical practices that optimize the length of stay. Cesareans require longer hospitalizations than vaginal deliveries. A private hospital, therefore, has an additional incentive to perform more cesarean deliveries.

The hospital sector also affects the physician’s income. In France, physicians, including obstetricians, can split their time between activities in the private and in the public sector. In

[3] In the public sector, the doctor's wages are based on the civil servant grid, while in the private sector, independent physicians work on a fee-for-service basis, charging their patients directly.
[4] At present, public hospitals are allowed to charge an additional fee for a room, provided it is a single room. Note that these amounts are usually quite low compared what private hospitals charge (usually an average of 50 Euros).

the public sector, hospitals compete both within and across sectors. On the other hand, the medical staff and the doctors are salaried. Their volume of work activity does not affect their income. As a result, the doctor's choice of procedure is not influenced by income considerations. The doctor is a limiting factor in the push for greater volumes. In the private sector, physicians charge mainly on a fee-for-service basis. They submit their fees directly to the health fund and to the patient, which is sometimes managed for them by the hospital. Moreover, they pay back a portion of their fees to the private hospital to pay for access to beds and operating/delivery rooms as well as other hospital facilities. All these aspects are specified in the contract between the physician and the private hospital. These payment practices are not subject to strict official regulations. For obstetric activity, most of the additional payment is for cesarean delivery, and only when the physician is physically present during the delivery process. The supplementary fees earned directly by the practitioner vary from 150 to 2,700 Euros, with a mean of 900 Euros. For anesthetists, the regular fee is approximately 300 Euros.[5] As in the USA, both the doctor and the hospital administration in the French private sector have incentives to increase the volume of cesareans.

In addition to the financial incentive, cesarean deliveries allow obstetricians to better schedule their work commitments, thereby potentially increase volumes as well as allowing deliveries to be carried at different facilities.

Obstetricians at private hospitals are also more likely to practice defensive medicine, and cesarean deliveries may reduce their exposure to malpractice liability because they reduce the risk of complications during delivery. More importantly, physicians at public hospitals are covered by the hospital’s malpractice liability insurance, while independent physicians in private hospitals have to purchase their own malpractice insurance, which costs about 30,000 Euros per year for a full-time private-sector obstetrician. This may be an incentive to perform more planned cesarean deliveries, as the medical risk for these is lower. Moreover, in case of complications in labor, they have greater incentives to avoid these by undertaking a cesarean procedure.

What about the patient’s choice of hospital sector? In public hospitals, patients generally do not choose their physician. They are assigned according to the catchment area for a specific hospital but not to a specific obstetrician. During pregnancy, a woman may be under the care

[5] Unpublished health insurance data from 2011 and on the Ministry of Health website from 2014: https://www.scansante.fr/accueil

of different physicians or even only or mainly midwives for her prenatal care visits. In a private hospital, however, she can choose a specific obstetrician, who then generally provides all of her prenatal care in addition to performing the delivery. During the prenatal period, a woman has time to develop a high level of trust in her obstetrician. When she does not feel confident with her initial choice, she has enough time to switch to another obstetrician. The patient-physician relationship is hence closer, which increases the likelihood that the obstetrician will be able to satisfy the woman's requests in regard to the delivery. If the woman has a preference for a cesarean delivery, the obstetrician will give due consideration to her preference. On the other hand, the obstetrician may prefer a cesarean rather than a vaginal delivery based on factors such as those presented in Figure 1, which may or may not include clinical factors. Their close relationship with their patients, established during the prenatal period, can help them steer their patients to what they consider to be the most appropriate medical treatment for and approach to the pregnancy and the delivery. In a public hospital, women generally do not see the same physician throughout their pregnancy. When a planned cesarean delivery is scheduled, this decision is made as a collective decision by the medical team. When a normal delivery is scheduled, the midwife is the person who decides whether to call the obstetrician for an urgent cesarean delivery. Whether or not a cesarean delivery is performed may also be influenced by the sector, especially in case of a planned cesarean delivery.

[Insert Figure 1]

What is the impact on the patient's access to healthcare? On the patient side, all households in France have compulsory public health insurance, which is financed by deductions (or for the self-employed, mandatory contributions) as a percentage of their income. In-patient obstetric services (delivery) are fully reimbursed, irrespective of the hospital sector. For the small proportion of people who are not covered by the public health insurance system because no one in the household is employed, a special fund of the public health insurance system provides the equivalent of 100% coverage for childbirth. Therefore, the healthcare reimbursement for admissions in either a public or in a private hospital comes from this single public health insurer. However, this reimbursement does not include reimbursement for the additional fees. This is where supplementary private insurance plays an important role. Depending on the level of insurance, these fees will be fully covered, partially covered, or not covered.

Although 95% of the French population has this type of supplementary private health insurance (Ministry of Health, 2016), the level of reimbursement for these additional fees depends on the private supplementary health insurance premium. For patients with a low level of private insurance, these additional fees are often not or poorly reimbursed. For very financially disadvantaged women (covered by the so-called CMU-C), there is no additional fee at for-profit hospitals. Most of the time, these patients go directly to a public hospital, mainly when a cesarean is scheduled. However, defined by law as a right to healthcare access, the private sector has to admit a certain percentage of these very financially disadvantaged women. The direct referral of low-income women to a private hospital is mainly driven by local supply, i.e., when the public sector does not have the capacity to cater to the local demand. In any case, for these individuals, there are no additional fees when a cesarean is performed.

3. Data and preliminary statistics

We exclusively used French data that allowed us to consider the factors that influence cesarean deliveries, including *i)* the woman's age and medical risk factors, *ii)* her household's socioeconomic situation, and *iii)* hospital characteristics, including the sector and the organization of the maternity unit.

3.1. Exhaustive delivery data

We used data from deliveries in 2008 through 2014 from two databases. One of these databases contains information regarding all deliveries in the Yvelines department. The Yvelines department is one of the four administrative districts of the outer suburbs of the greater Paris region. The Yvelines administrative district has a population (1.5 million inhabitants) comparable to that of the state of New Hampshire in the USA. The second database contains information about all French hospitals.

The first database is a compilation of the information provided in the first health certificate (*Premier Certificat de Santé*, PCS) of infants born in the district. In France, the PCS certificate is completed for each newborn before discharge from the maternity ward. In the Yvelines department, it is supplemented by additional data regarding topics such as household deprivation, severe morbidity, and delivery trauma. The PCS database contains the following

demographic information about each woman: age and parity;[6] detailed information about her socioeconomic level and that of her partner: status of the couple, level of education, type of job, employment/labor force status, and location; information about the pregnancy: medical follow-up, hospital stays; information about the delivery: hospital, date, mode of delivery, and delivery procedures performed; and full information about maternal, fetal, and neonatal health: diagnoses and co-morbidities. The study included all births in the Yvelines department during the complete calendar years from 2008 through 2014, but excluded deliveries that were stillbirths, medically indicated terminations of pregnancies, and births that did not take place in a maternity ward. Thus, the study sample comprised 102,236 deliveries. For 58,645 of these, full socioeconomic data were available. As this information regarding socioeconomic characteristics is quite important, we analyzed all of the observations for which there was complete socioeconomic data. However, as a robustness check, we also re-estimated our results with the full sample of all observations.[7] The similarity of the results ruled out the possibility of an omitted observations effect. The PCS database is managed by the general council of Yvelines (*Conseil départemental des Yvelines*) in collaboration with the regional public health administration agency (*Agence Régionale de Santé de l'Ile-de-France*) and the local perinatal network (*Réseau Périnatal Maternités en Yvelines et Périnatalité Active,* MYPA). All data used are reported to the French data protection authority (*Commission Nationale de l'Informatique et des Libertés*, CNIL, number 1295794). The PCS certificate is completed, almost prospectively from birth, by midwives and physicians. The contents of the certificates are also double-checked to correct inaccurate or missing information. The information extracted is hence of high quality.

The second database is based on the French annual statistics for hospitals (*Statistique Annuelle des Etablissements de santé*, SAE). This survey, conducted by the Ministry of Health, provides information on all hospitals including their status, equipment level, volume of activity, medical staff composition, and location. The information on hospitals with obstetric care in the Yvelines department was located, checked, and supplemented through data from the local perinatal network MYPA.

3.2. Descriptive statistics

3.2.1. The Yvelines department

[6] Here, parity is the number of previous deliveries; nulliparous women are those having their first child.
[7] Robustness checks based on Tables 2 & 3. More details available upon request

Yvelines is the eighth largest administrative district in France in terms of population (French national institute of statistics (*Institut National de la Statistique et des Etudes Economiques*, INSEE), 2008-2014 data). Table A2 presents the summary statistics for the patient- and hospital-level characteristics of the women giving birth in the Yvelines department between 2008 and 2014. Their mean age was 30.7 years, and 43.1% of them were nulliparous. The most frequent medical risk factors for cesarean delivery were induced labor, a previous cesarean, and other obstetric pathology,[8] which accounted for 21.6%, 10.3%, and 7.1%, respectively, of all women.

The Yvelines department has a degree of geographic disparity in terms of socioeconomic status. The eastern portion of the Yvelines department comprises middle-class and upper-class areas. The rest comprises an extensive rural zone with sparsely distributed high-income areas, as well as some areas with quite low incomes (INSEE, 2008-2014 data). In our model, we controlled for the rural/urban location of the residents as well as the level of education and the type of job.

All of the hospitals are located in urban areas: There are hospitals (public as private) in well-off areas and hospitals located in economically disadvantaged areas, as well as one private hospital in a municipality with a median income of 16,000 Euros per year (compared to 20,000 Euros for France as a whole (INSEE, 2008-2014 data)). As shown in Table A2, only a small proportion of the women did not have a partner (2%). The majority of the women (61.4%) had a post-secondary education.[9] Most of the women and their partners were employed, at 69.6% and 89.8%, respectively, versus 6.7% and 4.4%, respectively, who were unemployed, and 23.7% and 5.8%, respectively, who were not in the labor force.[10] There were also differences in the types of job. Both the women and their partners most often had office, sales, or service sector jobs (55.2% and 40.1%, respectively) followed by managerial and higher intellectual positions (31% and 36.7%, respectively).

The Yvelines administrative district is well served by healthcare facilities that provide obstetric care. There are 11 hospitals, 5 of which are public hospitals and 6 private hospitals.

[8] The "other obstetric pathology" variable included the diagnoses and co-morbidities not already considered individually (previous cesarean, diabetes, hypertension, eclampsia, and preeclampsia, intrauterine growth restriction, and placental disorder were all individual variables), such as, for example, infection, premature rupture of membranes, obesity, or amniotic fluid abnormality.

[9] In contrast to those with some secondary schooling, the women who completed secondary education reached the final year of secondary school, whether or not they obtained a baccalaureate degree.

[10] Those not in the labor force included students, apprentices, homemakers, retirees, those on parental leave, and others neither working nor looking for employment.

All of the private hospitals in the Yvelines department are private for-profit hospitals. From 2008 through 2014, the number of deliveries remained stable, accounting for 13% of the annual deliveries nationwide (SAE, 2008-2014 data). In this district, 66.4% of the deliveries took place in public hospitals and 33.6% in private hospitals. The distribution of births by sector was similar to the nationwide distribution.[11] Maternity units without special neonatal care (equipment level 1, with the least equipment) accounted for 19.1% of the deliveries, versus 39.6% and 41.3% for hospitals with special or intensive neonatal care units, respectively. Moreover, university hospitals performed 37.5% of the deliveries in the district.

The Yvelines department had an average cesarean rate of 23.9% for the study period, which is higher than the national rate of 20.3% during the same period (SAE, 2008-2014 data). The Yvelines department cesarean rate was lower in the public (22.3%) than in the private sector (27.2%). From 2008 to 2014, the overall rate was relatively stable. However, it decreased in public hospitals by 9.3%, while it increased by 13.9% in private hospitals.

3.2.2. Public versus private hospitals

The population characteristics varied considerably according to the hospital sector (Table A2). The women giving birth in private hospitals were older than those in public hospitals (31.5 versus 30.3 years, respectively). Nonetheless, the public hospitals provided care for a population considered to be at higher risk than those in private hospitals. For example, 4.3% of the women giving birth in public hospitals had diabetes versus 3.3% of those admitted to private hospitals.

Similarly, the economic level of the households affected the sector: the percentages of low-educated, low-skilled, and unemployed women were all higher in public than in private hospitals, at 42.8% versus 30.5%, 60.4% versus 49.3%, and 32.8% versus 25.5%, respectively. The same disparities were noted for the partners: in public hospitals, with 55.7% and 11.7% of the parturients' partners being low-skilled or unemployed, respectively, compared to 39.3% and 11.7%, respectively, in private hospitals.

When we compared the equipment level by sector, we observed that the majority of births in public hospitals took place in well-equipped maternity wards capable of providing neonatal

[11] In France, 66% and 34% of deliveries were performed, respectively, in public and private hospitals (SAE, 2008-2014 data).

intensive care (62.2%), while in private hospitals the women most often gave birth in maternity wards capable of providing special neonatal care (60%). Of note, all of the hospitals with neonatal intensive care units and all of the teaching hospitals were public entities.[12]

Finally, focusing on organizational factors, we found that public hospitals had a higher rate of births on non-working days including weekends and holidays than private hospitals, at 27.9% versus 23.5%, respectively.

4. Econometric strategy

The empirical analysis used panel data to assess the effect of the hospital sector on the practice of cesarean deliveries.

A simplified way of expressing the basic model that we devised is as follows:

$$P(Y) = f(T, D, X, S, V, W, e)$$

with Y equal to 1 if woman i in hospital j in year t has a cesarean.

- T_t is a linear continuous time variable (trend), starting in 2008 (trend = 0) and ending in 2014 (trend = 6);[13]

- D_{ijt} is the set of variables of demographic characteristics for patient i in hospital j in year t: age and parity;

- X_{ijt} is the set of medical risk factors of woman i in hospital j in year t such that one of them justifies or favors performing a cesarean delivery: previous cesarean, diabetes, hypertension, eclampsia or preeclampsia (including HELLP syndrome), intrauterine growth restriction, placental disorder (including placenta previa, placenta accreta, and abruptio placenta), other obstetric pathology (such as obesity, infection, premature rupture of membranes, amniotic fluid abnormality, or congenital anomaly), multiple pregnancy, preterm delivery (gestational age < 37 weeks), post-term delivery (gestational age > 41 weeks), fetal breech presentation or transverse lie, induced labor, low birth weight (< 2,500 grams), and high birth weight (> 4,000 grams);

[12] In France, the hospitals with a neonatal intensive care unit are all in the public sector. Moreover, any institution with an intensive care unit would be required to accept emergency cases, which could explain the absence of any private neonatal intensive care units.
[13] Considering a full set of time dummy variables instead of a trend variable did not change the results.

- S_{ijt} is the set of variables for the socioeconomic characteristics for patient *i* in hospital *j* in year *t*: status of the couple, the woman's level of education, type of job, employment status, (rural) location, and her partner's type of job and employment status;

- V_{ijt} is the set of variables regarding hospital organization: the 24-hour availability of obstetricians for hospital *j* in year *t*, the day of delivery for woman *i* in hospital *j* in year *t*, the size of the unit based on the volume of deliveries of hospital *j* in year *t*, and the numbers of midwives, obstetricians, and anesthetists working at hospital *j* in year *t*, as measured by full-time equivalent (FTE) employees per occupied patient bed;[14]

- W_{jt} is the set of hospital type variables for hospital *j* in year *t:* sector, equipment level, and university status;

- e_{ijt} is the error term.

We used hierarchical data: patients grouped by their hospital. We estimated multilevel logit models with the robust variance that takes the lack of independence between observations at the hospital level into account. The Hausman specification test between the specifications of the hospital fixed-effects and the hospital random-effects resulted in accepting the null hypothesis (p-value > 0.10). The hospital random-effects model thus produced consistent and efficient estimations: the hospital's characteristics not explicitly taken into account in the model were not correlated with any independent variables.[15]

Studies in the field of obstetrics face an important estimation issue, namely preferences (Figure 1). Preferences play a role in determination of the type of delivery – the preferences of the woman and of the doctor. There is a degree of heterogeneity in both sets of preferences, and this is likely to affect the type of delivery. Physician's preferences depend on various clinical characteristics of the woman and on aspects of the physician's practice characteristics, risk aversion, especially in relation to complications and malpractice as well as financial incentives. We then compared a subsample of low-risk women with a subsample of high-risk

[14] The amount of time independent private practitioners spend on their hospital practice is not known. As a result, we suggest that part-time private practice doctors work 50% of the time at the hospital, and thus represent 50% of an FTE. This standard assumption is widely used (Clark and Milcent, 2011; Zbiri *et al.*, 2018). While this is perhaps reasonable, we also checked that all our results were robust to the more extreme assumptions of 25% and 75% of an FTE (see Section 5.4).

[15] We also used the hospital fixed-effects model as a robustness check. See Section 5.4 for more details.

women. This allowed us to disentangle the clinical aspect in physician's preferences from the other aspects.

The woman's preference for the mode of delivery can also influence the physician's preferences. In the private sector, the woman's preference matters. If a woman has a preference as to how she gives birth, then it is likely that this will impact the physician's decision. According to Figure 1, from the database, we obtained the result of a combination of the physician's preferences and the woman's preference. In the French public sector, the woman's preference has no impact. Public hospitals are overcrowded and have no direct financial incentives to choose one procedure over another. Women do not choose their physician, even with a cesarean. With a normal delivery, the midwife is the individual who decides whether to call the obstetrician for an urgent cesarean delivery. The woman's preference is either not expressed or not considered. We used women admitted in public hospitals as a "control" group.

As a consequence, in this model, the private sector dummy captured not only the financial incentive to perform a cesarean but also a combination of the physician's preferences and the woman's preference.[16] However, the financial incentive is clearly linked to what the woman can afford. Supplementary private health insurance makes the additional charge for the cesarean affordable as it provides reimbursement for the additional fees charged in hospitals of the private sector. At present, very disadvantaged women (i.e., those covered by the CMU-C) do not have to pay this additional fee. Hence, for women who are very poor, the financial incentive to perform a cesarean does not depend on the additional fee. Indeed, private hospitals are not authorized to charge additional fees. For the low clinical risk subsample, we then compared the disadvantaged women between the sectors where there is no financial incentive irrespective of the sector, but where in the private sector there is a combination of the physician's preferences and the woman's preference. In the same way, we compared the better-off women between the sectors, where there is definitely a financial incentive to perform a cesarean for private hospitals and also where there is a combination between the physician's preferences and the woman's preference in the private sector.

[16] It may also capture any other effect due to the sector that is not taken into account by our extensive list of independent variables.

To capture the financial incentive, we then introduced the variable I_{ijt}, as a dummy variable for private supplementary insurance covering additional fees for obstetric procedures for woman *i* in hospital *j* in year *t*.

We did not have the individual information about private supplementary insurance enrollment. We then used the macro information from the Ministry of Health and based on the employment status (Table 1). For each employment status, we used the Ministry of Health's probability of enrollment. A high probability of enrollment was defined as a probability of enrollment for private health insurance greater than or equal to 0.8 and, inversely, a low probability of enrollment was defined as a probability of enrollment for private health insurance of less than 0.8. The woman could be covered by her partner's health insurance. Therefore, her partner's private insurance enrollment was also considered. The dummy variable for private supplementary insurance enrollment was a single indicator defined as either the woman or her partner having an 80% or greater chance of having private insurance coverage for the birth. We assumed that for a low probability of enrollment for the household, this private insurance package did not include the additional cost for admission in a private hospital for a delivery. Therefore, the dummy variable of the crossed variable for the hospital sector and the dummy for a private supplementary insurance captured the financial incentives to perform a cesarean.

[Insert Table 1]

The model is then:

$$P(Y) = f(T, D, X, S, V, W, I, I^{*}status, u)$$

In this paper, we took into account the preferences of the woman and of the doctor in order to identify financial incentives as a factor impacting the treatment decision process. A cesarean birth may cause increased and perhaps unnecessary morbidity in a woman, as it is major surgery. However, obstetricians may actively seek to protect themselves from malpractice litigation. When a woman has a clinical risk factor, a cesarean can be a defensive measure to prevent complications during the delivery. Furthermore, for a woman with a clinical risk factor, the characteristics of the physician's practices may also determine whether they are more likely to perform a cesarean or a more complicated vaginal delivery. Therefore, the characteristics of a physician's practice and their choice to use defensive medicine cannot be

disentangled. These points — defensive medicine preferences and practice characteristics — do not come into play for women who are at low risk. To do so, we used the French context and *i)* we ruled out the clinical risk determinants restricting the sample to women with low clinical risk;[17] *ii)* we compared public and private hospitals; and *iii)* we focused on how the private insurance reimbursement affects the decision to perform a cesarean.

5. Results

5.1. Patient and hospital factors

Table A3 in the Appendix reports the effects of the individual and hospital control variables on the probability of cesarean deliveries. Among the demographic characteristics, age and nulliparity, as expected, increased this probability. As expected, well-known obstetric risk factors also affected the mode of delivery. Cesarean delivery was most prevalent for at-risk patients compared with women who were at low risk. A non-vertex fetal presentation or transverse lie, a previous cesarean, and a placental disorder were the strongest risk factors.

The socioeconomic characteristics that increased a woman's probability of cesarean birth included not having a postsecondary education compared to more highly educated women. Similarly, women in low-skill jobs, such as manual workers, or office, sales, and service workers, or middle-skill jobs, such as workers with intermediate occupations, were more likely to have a cesarean delivery than those with high-skill jobs, such as managerial or higher intellectual professionals for instance. Unemployed women had a higher probability of a cesarean delivery. Moreover, women not living with a partner were less likely to have a cesarean than women with a partner. The same was true for the partner's socioeconomic characteristics: low-skill occupations increased the probability of cesarean delivery compared to high-skill professional positions. Accordingly, the probability of a cesarean is higher for women whose partners were not in the labor force compared with those who were employed. Moreover, we controlled for rural versus urban location in column 2 of Table A3. Women living in rural areas had a lower probability of a cesarean than those living in urban areas, at a

[17] The definition of the low-risk subsample was based on the usual obstetric literature (Coulm *et al.*, 2012).

9% significance level.[18] Of note, including this variable did not change any of the following results (available upon request).

The hospital factors checked as control variables included the neonatal equipment level; maternity units with neonatal care versus those with no special neonatal care had an increased probability of cesareans. Giving birth on a non-working day was negatively associated with cesarean delivery. Since many cesareans can be scheduled in advance, surgical deliveries were more likely to take place on workdays.[19]

Our study of medical staffing levels showed that the likelihood of delivery by cesarean decreased as the number of obstetricians available per patient bed increased.

In summary, different individual and institutional characteristics are significant indicators of cesarean deliveries. Our results are in accordance with the findings in the literature.[20]

We also tested for a linear time trend for the seven-year period to identify any patterns of incidence for cesarean deliveries over the 2008-2014 period. Taking into account all the factors, we observed a non-significant overall trend.

Table 2 presents the effects of the hospital sector on a woman's probability of a cesarean delivery. Column 1 of Table 2 shows that, after controlling for age, parity, and medical risk factors, admission to a private as opposed to a public hospital increased the probability of cesarean delivery. In addition to these epidemiologic factors, we also considered socioeconomic factors in column 2, and we found that private hospitals again had a higher rate of cesarean deliveries. In column 3, we also controlled for the hospital's type and organization, and we found that, all else being equal, giving birth in a private hospital substantially increased the probability of cesarean delivery. By computing the odds ratio, we found that the probability of cesarean delivery rose by 79% in a private versus a public hospital (odds ratio = 1.79, 95% CI = [1.29-2.49]).[21] However, this hospital sector effect may capture other determinants, as described above.

[18] Due to the number of missing values (11.5%), this variable was not included in the following regression models. Sensitivity analysis were performed. Including this variable did not change the results.
[19] When we focused only on unplanned deliveries, the effect of delivering on a non-working day was no longer significant. The results are available upon request.
[20] As shown in more detail in Section 2.1.
[21] Similar magnitudes of difference between private and public hospitals have been reported in the literature (Lutomski *et al.*, 2014; Salvador *et al.*, 2009).

[Insert Table 2]

5.2. Impact of the hospital sector

The subsample of women at low risk was defined as women without any recorded clinical risk factors during both the pregnancy and the delivery process. The clinical risk subgroup included all women with at least one recorded clinical risk factor. Table 3 presents the sector effect on the use of cesarean deliveries for both the high and the low medical risk subgroups in columns 1 & 2, respectively.

Irrespective of the other observed factors and the woman's risk level, private hospitals performed more cesarean deliveries than public hospitals. This result was obtained on each of the subsamples. For the high clinical risk sample, this can be explained by clinical factors, the risk aversion for malpractice liability, physician practice characteristics, medical recommendations, as well as the physicians' financial incentives. For the low clinical risk sample, it is not clear how to interpret this result. This finding confirms that, in addition to clinical aspects, the physician's preference — potentially in association with the woman's preference — plays a role in the disparity we observed in the mode of delivery between the two sectors.

[Insert Table 3]

In the subsamples considered here, the treatment was in fact the result of two different initial delivery assignments (Figure 1): by a planned cesarean delivery or by a planned vaginal delivery. With a planned cesarean delivery, the additional payment requiring the presence of the physician and the least hazardous delivery process are key factors. Furthermore, with a cesarean delivery, the additional payment is much more substantial. With an initial delivery assignment by planned cesarean, physicians can be expected to be more responsive to the financial incentive, and hence the financial impact can be expected to be more substantial. Therefore, we focused on the initial delivery assignment by planned cesarean. After adjusting for all of the variables including socioeconomic, institutional, and organizational factors, for a

.

group of women with low clinical risk, we found that the hospital sector impacted the probability of planned cesarean delivery (column 3 of Table 3).[22]

What about planned vaginal delivery? Women who requested a vaginal delivery in accordance with their obstetrician's advice in a private hospital were included in this subsample. This subsample also included the situation where the physician-patient combination decision led to a planned vaginal delivery. Theoretically, a weaker effect of the hospital sector would be expected. Indeed, in the private sector, the additional payment requires the presence of the physician, but the physician cannot be sure that they will in fact be present at the time of the delivery. As before, we restricted the sample to the women with low clinical risk, i.e., women for whom defensive medicine is a marginal factor and we suppressed the planned cesarean cases. Holding all other covariates constant, we found a significant but weaker hospital sector effect, as theoretically expected (column 4 of Table 3). For women with a low medical risk, the odds ratio of the sector effect on urgent cesareans was 1.61 (95% CI = [1.37-1.90]) whereas the odds ratio of the sector impact on planned cesareans was 4.70 (95% CI = [2.69-8.19]).

5.3. Impact of supplementary private health insurance

The sector impact can be attributed to the financial incentives due to additional payment. However, it could also be due to other organizational or managerial differences between the sectors not observed by the econometricians. In such a case, this sector difference would be observed even for economically disadvantaged women. The financial incentive due to the additional payment is, however, related to whether the woman can afford it.

Having shown the impact of the hospital sector on the probability of cesarean delivery, we investigated to what extent this is influenced by supplementary health insurance. To do so, we examined how the extent to which the women could afford the cesarean impacted the financial incentive. We used the "probability of non-affordability" as a "control" group to assess the financial incentives independently of other doctor characteristic factors such as their ability to control their schedule. As pointed out previously, in a public hospital, women

[22] Here, planned cesareans were compared with both unplanned cesareans and normal deliveries. However, the planned cesareans can only be compared with the normal deliveries, suppressing the urgent cesareans. Any urgent cesarean is an obstetrician's decision based on financial incentives or the occurrence of an unexpected factor unobserved by the econometrician. When we ran the model on the subsample excluding urgent cesarean deliveries, the results were largely the same (available upon request).

are generally not treated by the same physician throughout their pregnancy. There is not a specific relationship between the woman and the obstetrician.

In private hospitals, women typically choose their obstetrician, who then provides their prenatal care and who is also present at the birth. During the prenatal period, women have time to express their preferences including the mode of delivery. During this prenatal period, women have time to switch to another obstetrician should they wish to do so. There is often a very close relationship between the patient and the obstetrician, with the patient developing a great deal of trust in her obstetrician's decisions-making. The obstetrician's close relationship with their patient allows them to realign the woman's preference with their views, irrespective of the determinants of their choice (Figure 1). Once again, women have time to switch to another obstetrician or to go in a public hospital if she is not satisfied with her obstetrician's decisions-making. The mode of delivery is then a combination of the woman's preference and obstetrician's views based on various determinants that include the medical factors. To rule out the clinical risk determinants, we restricted the sample to the women with low clinical risk.

First of all, we found that, irrespective of the probability of being covered by a private insurer, the mode of delivery did not depend on the probability of being covered by a private insurer, except for the probability of a planned cesarean (Table 4).[23] Secondly, by assessing the impact of the supplementary private insurance crossed with the hospital's sector, we found that the rate of cesarean deliveries for women with low clinical risk was significantly higher in private compared with public hospitals (column 1 of Table 4).

This impact of the supplementary private insurance crossed with the hospital's sector was obtained for women with a high probability of enrolment with supplementary private coverage but also, to a lesser extent, this was also obtained for women with a low probability of enrolment with supplementary cover. This result may be explained by the other factors (physician and patient selection, fear of malpractice, etc.) that can drive the gap between the cesarean rates in public versus private hospitals. In this paper, we were not able to explain the

[23] Explaining the probability of planned cesarean, we found that the probability of being covered by a private insurance impacts significantly and negatively on the cesarean rate (column 2 of Table 4). The supplementary private insurance variable is correlated to the employment status. As previously shown in the literature (Milcent and Zbiri, 2018), low socioeconomic women are more likely to have a cesarean, particularly because of poor prenatal follow-up.

entire difference based on the financial incentive from additional payments, but we did explore this impact on the difference in cesarean rates between statuses.

We then compared the effect of the sector on the rate of cesareans for women with a high probability of supplementary coverage and for women with a low probability of supplementary cover. By comparing the coefficient estimates between women with a high probability and those with a low probability, we found a significant difference of 10% (Chi-square test = 2.96, p-value = 0.09). This result confirms that in the private sector, women at low risk but with a high probability of supplementary coverage have a higher probability of having a cesarean delivery.

The level of significance of 10% can be considered to be low, and it is hence questionable. This sample in fact deals with two initial delivery assignments that may impact the result. With an economically disadvantaged woman, without a private insurance package that covers the additional payment, there is no financial incentive to perform a planned or an unplanned cesarean. For women who pay the additional fee, there is clearly an incentive to perform a planned cesarean and to a much lesser extent to perform an unplanned cesarean. Indeed, in this case, the women have a low clinical risk. We then considered the following two probabilities.

[Insert Table 4]

Probability of a planned cesarean delivery

For a number of reasons, a planned cesarean delivery is likely to be influenced by the hospital sector. As pointed out previously, in private hospitals, women typically choose their obstetrician, who then provides their prenatal care and who is also present at the child's birth. During the prenatal period, women have time to express their preferences including the mode of delivery. During this prenatal period, women have time to switch to another obstetrician should they wish to do so. There is often a very close relationship between the patient and the obstetrician. The patient trusts their obstetrician’s decisions. The obstetrician’s close relationship with their patient allows them to realign the woman’s preference with their own, irrespective of the determinants of their choice (Figure 1). Scheduling a planned cesarean delivery is then a combination of the woman’s preference and obstetrician’s views based on various determinants including the medical factors. In a public hospital, women are generally

not treated by the same physician throughout their pregnancy. There is not a specific relationship between the woman and the obstetrician. To rule out the clinical risk determinants, we restricted the sample to the women with low clinical risk.

For women with a low probability of supplementary private insurance, the impact of the hospital sector was significantly lower than for those with a high probability of supplementary insurance (column 2 of Table 4, Chi-square test = 4.76, p-value = 0.03). At a significance level of 5%, compared to women or their partner having a high probability of private supplementary insurance (odds ratio = 4.73, 95% CI = [2.72-8.22]), there was a gap in the difference in the cesarean rates between sectors for the women who could barely afford to pay for a cesarean delivery and those who lacked insurance for it — and only for them (odds ratio = 2.28, 95% CI = [0.95-5.47]) (see column 2 of Table 4).

For low-risk women, the financial incentive played a role in whether or not they had a cesarean delivery, particularly when the woman had supplementary health insurance. These findings show that, aside from the effect of the other potential factors, the compensation scheme matters greatly in the choice of medical procedure. The findings also show that when a woman cannot afford the additional fees in a private hospital, her preference carries as much weight as it would in a public hospital.

Probability of a planned vaginal delivery

In this situation, the patient and the doctor together opt for a planned vaginal delivery. This context includes the situation in which women schedule their vaginal delivery in concordance with the physician.

After removing planned cesarean deliveries, we explored the effect of the affordability of a cesarean for low-risk women for whom a vaginal delivery was planned initially (column 3 of Table 4). We observed no difference in the probability of having a cesarean between women with a high versus those with a low probability of supplementary private health insurance (Chi-square test = 0.16, p-value = 0.69). We conclude that medical recommendation was an overriding factor. The physician's spur of the moment preference, which could affect the decision, was also not significantly impacted by whether or not a woman has private insurance coverage. Additionally, having private insurance does not affect a woman's preference when it comes to deciding on an urgent cesarean.

Thus, these findings confirm that, potentially in association with the woman's preference, the additional fees in the private sector (based on the additional room and board payment and the physicians' additional fees) only play a role in the disparity we observed in the mode of delivery between the two sectors when the affordability is ensured and when clinical aspects are not an overriding factor.

5.4. Robustness checks

In this paper, we controlled for unobservable hospital heterogeneity by using hospital random-effects. As previously explained, the Hausman test validated this econometric approach. As a sensitivity analysis, we used hospital fixed-effects for the results shown in Tables 2 & 3. There was strict collinearity between the hospital fixed-effects and the sector variable. We then compared the hospital fixed-effect coefficients for public-sector hospitals with those for private-sector hospitals. For each model, the sector difference was significant at 5% (results available upon request).[24]

As a sensitivity analysis, we also assessed the sector's crossed with the private insurance enrollment effect (variables of interest), when using a hospital fixed-effects (11 hospital dummies) crossed with the probability of private insurance enrollment.[25] There was a strict collinearity between the hospital fixed-effects and the explanatory variables at the hospital level. We, therefore, used a two-step fixed-effects model. Clustered standard errors of the second stage were estimated by bootstrap due to the use of an estimated dependent variable. The results using the hospital fixed-effects specification were very similar to the previous findings based on hospital random-effects specification (Table A4 for results of Tables 4).

One limitation of this paper is that we did not have the individual information on the private health insurance coverage for the additional cost of a cesarean. Overall, 95% of the population was covered by supplementary private health insurance. Private insurance coverage was standard for 95% of the population and a "no private insurance coverage" designation was the exception. However, being covered by private health insurance does not mean that the private insurance package fully reimburses the additional cost for a cesarean in the private sector. A certain number of non-advantaged and disadvantaged women are not covered or have poor

[24] We also considered hospital fixed effects crossed with time dummies. Clustered standard errors of the second stage were estimated by bootstrap due to the use of an estimated dependent variable. The results were unchanged (available upon request).

[25] As done previously, we also used the employment status of the woman and of her partner as a proxy for private insurance enrollment (Table 1).

cover for this additional cost. Most of the time, they enter into a special financial agreement with the private hospital that then receives less than the regular additional cost. Furthermore, the poorest CMU-C women are not covered for the additional cost of a cesarean. In France, a woman employed with a long-term contract has to enroll with the private health insurance company proscribed by their employer, which usually covers common additional costs such as those for a cesarean. We imposed a no private health insurance package to women in these three groups of employment status ("unemployed", "homemakers", and "not in the workforce") with a cut-off of 0.8 in the model (Table4). The definition used so far (Table 4) could be a too restrictive definition of the "high probability of supplementary private insurance" group, thereby leading to some births associated with a financial incentive (albeit only a small number) to be included in the "low probability of supplementary private insurance group". Running the model with a cut-off of 0.7 imposed a no coverage for the additional cost of a cesarean only for those who were unemployed, which amounts to the most disadvantaged group of women with the lowest probability of being covered for the additional costs of a cesarean. The results are shown in Table A5. We found that for the "low probability of being covered for cesarean extra-cost" group, the sector had no effect on the probability of a cesarean being undertaken. However, the non-significant result might be due to the small number of women without private insurance coverage considered here. It is possible that the lack of statistical significance in column 2 of Table A5 for the coefficient on the variable "private * low prob. of suppl. private ins." is due to no overall effect or to a lack of statistical power to detect an effect given the small number of observations corresponding to that group.

6. Conclusion

We explored the effect of a financial incentive to perform cesarean deliveries as a factor that could explain part of the disparity we observed in the mode of delivery between the two sectors. We found that the financial incentive plays a role in the cesarean delivery, more so than all the other factors, for low-risk women; and this was all the more so when the patient had supplementary health insurance.

In terms of the extent of the effect, controlling for all factors, the probability of a cesarean delivery increased by 79% in private versus public hospitals. This result is in accordance with the previous literature. Furthermore, based on enrollment in private health insurance, this

probability rose to 97% for women with a high probability of supplementary private coverage, but it rose to only 62% for women with a low probability of supplementary private coverage.

Different characteristics of the healthcare market may drive costly health behaviors. One of these is the hospitals' mode of financing. Payments to hospitals can result in financial incentives that may encourage healthcare providers, including hospitals and the physicians they employ, to perform some medical interventions over others. Most developed countries have recently adopted activity-based payment systems for the purpose of improving hospital efficiency as well as the quality and effectiveness of care. However, empirical evidence is scarce, except from the USA.

Cesarean deliveries are among the most common surgical procedures and they account for a large proportion of the healthcare resources. They are also one of the medical practices studied most by economists because they are potentially responsive to a variety of economic forces including the payment source and financial incentives.

This study used previously unexplored delivery data from a French administrative department to examine the effect of the hospital sector — private versus public — on the rate of cesarean deliveries, in the context of a single-payer healthcare finance system. The empirical analysis revealed that, after controlling for a large number of determinants for individual- and hospital-level factors that may affect obstetric practices, the probability of a cesarean birth was higher in private hospitals than in public hospitals.

Despite the apparent similarity of funding for the private and public hospital sectors under a single-payer system, only private hospitals receive an additional payment from their patients for room and board, which are costs that are not reimbursed by the single-payer public health insurance system. These fees are, however, covered by private supplementary health insurers that help make care affordable for all patients irrespective of whether it is public or private and whether the delivery is cesarean or vaginal. As a result, a woman's preference for the mode of delivery is not dictated by financial accessibility. However, private supplementary health insurers disturb the public regulation set up by the reimbursement system of the single-payer public health insurance system. Specifically, the availability of private health insurance affects medical practices in a market-driven public healthcare delivery system, including the creation of incentives for harmful practices. These private health insurance policies and

choices may affect or prevent the implementation of public policies developed by policymakers for the benefit of society as a whole.

This result may be applicable to other healthcare systems such as, for instance, the development of private medical insurance in addition to the National Health Service as well as Medigap policies in addition to conventional Medicare. These forms of public healthcare funding, whether they are intended for widespread use (e.g., France, the UK, etc.) or more restricted use (e.g., Medicare in the USA), have been devised with the objective of addressing inequity in access to healthcare. However, the development of the portion of medical care supported by supplementary private health insurance may impair this social goal of equity.

7. Bibliographic references

Allin, S., Baker, M., Isabelle, M., Stabile, M. (2015). Physician Incentives and the Rise in C-sections: Evidence from Canada. *National Bureau of Economic Research*.

Allen, V. M., O'connell, C. M., Farrell, S. A., Baskett, T. F. (2005). Economic implications of method of delivery. *American Journal of Obstetrics & Gynecology*, 193(1), 192-197.

Althabe, F., Sosa, C., Belizán, J. M., Gibbons, L., Jacquerioz, F., Bergel, E. (2006). Cesarean section rates and maternal and neonatal mortality in low-, medium-, and high-income countries: an ecological study. *Birth*, 33(4), 270-277.

Baker, L. C., Bundorf, M. K., Kessler, D. P. (2014). Vertical integration: hospital ownership of physician practices is associated with higher prices and spending. *Health Affairs*, 33(5), 756-763.

Barbetta, G. P., Turati, G., Zago, A. M. (2007). Behavioral differences between public and private not-for-profit hospitals in the Italian national health service. *Health Economics*, 16(1), 75-96.

Biørn, E., Hagen, T. P., Iversen, T., Magnussen, J. (2003). The effect of activity-based financing on hospital efficiency: a panel data analysis of DEA efficiency scores 1992–2000. *Health Care Management Science*, 6(4), 271-283.

Biørn, E., Hagen, T. P., Iversen, T., Magnussen, J. (2010). How different are hospitals' responses to a financial reform? The impact on efficiency of activity-based financing. *Health Care Management Science*, 13(1), 1-16.

Borden, J. P. (1988). An assessment of the impact of diagnosis-related group (DRG)-based reimbursement on the technical efficiency of New Jersey hospitals using data envelopment analysis. *Journal of Accounting and Public Policy*, 7(2), 77-96.

Brown, H. S. (1996). Physician demand for leisure: implications for cesarean section rates. *Journal of Health Economics*, 15(2), 233-242.

Chern, J. Y., Wan, T. T. (2000). The impact of the prospective payment system on the technical efficiency of hospitals. *Journal of Medical Systems*, 24(3), 159-172.

Clark, A. E., Milcent, C. (2011). Public employment and political pressure: The case of French hospitals. *Journal of Health Economics*, 30(5), 1103-1112.

Cleary, R., Beard, R. W., Chapple, J., Coles, J., Griffin, M., Joffe, M., Welch, A. (1996). The standard primipara as a basis for inter-unit comparisons of maternity care. *BJOG: An International Journal of Obstetrics & Gynaecology*, 103(3), 223-229.

Coulm, B., Le Ray, C., Lelong, N., Drewniak, N., Zeitlin, J., Blondel, B. (2012). Obstetric interventions for low-risk pregnant women in France: do maternity unit characteristics make a difference? *Birth*, 39(3), 183-191.

David, S., Mamelle, N., Rivière, O. (2001). Estimation of an expected caesarean section rate taking into account the case mix of a maternity hospital. Analysis from the AUDIPOG Sentinelle Network (France). *BJOG: An International Journal of Obstetrics & Gynaecology*, 108(9), 919-926.

Dismuke, C. E., Sena, V. (1999). Has DRG payment influenced the technical efficiency and productivity of diagnostic technologies in Portuguese public hospitals? An empirical analysis using parametric and non-parametric methods. *Health Care Management Science*, 2(2), 107-116.

Dubay, L., Kaestner, R., Waidmann, T. (1999). The impact of malpractice fears on cesarean section rates. *Journal of Health Economics*, 18(4), 491-522.

Ecker, J. L., Chen, K. T., Cohen, A. P., Riley, L. E., Lieberman, E. S. (2001). Increased risk of cesarean delivery with advancing maternal age: indications and associated factors in nulliparous women. *American Journal of Obstetrics & Gynecology*, 185(4), 883-887.

Eggleston, K., Shen, Y. C., Lau, J., Schmid, C. H., Chan, J. (2008). Hospital ownership and quality of care: what explains the different results in the literature? *Health Economics*, 17(12), 1345-1362.

Fabbri, D., Monfardini, C. (2008). Style of practice and assortative mating: a recursive probit analysis of Caesarean section scheduling in Italy. *Applied Economics*, 40(11), 1411-1423.

Fuglenes, D., Øian, P., Kristiansen, I. S. (2009). Obstetricians' choice of cesarean delivery in ambiguous cases: is it influenced by risk attitude or fear of complaints and litigation? *American Journal of Obstetrics & Gynecology*, 200(1), 48-e1.

Gibbons, L., Belizan, J. M., Lauer, J. A., Betran, A. P., Merialdi, M., Althabe, F. (2012). Inequities in the use of cesarean section deliveries in the world. *American Journal of Obstetrics & Gynecology*, 206(4), 331-e1.

Grant, D. (2009). Physician financial incentives and cesarean delivery: new conclusions from the healthcare cost and utilization project. *Journal of Health Economics*, 28(1), 244-250.

Gruber, J., Owings, M. (1996). Physician financial incentives and cesarean section delivery. *The Rand Journal of Economics*, 27(1), 99-123.

Gruber, J., Kim, J., Mayzlin, D. (1999). Physician fees and procedure intensity: the case of cesarean delivery. *Journal of Health Economics*, 18(4), 473-490.

Hafsteinsdottir, E. J. G., Siciliani, L. (2010). DRG prospective payment systems: refine or not refine? *Health Economics*, 19(10), 1226-1239.

Hammond, J. A. (2015). Does the presence of learners affect family medicine obstetric outcomes? *Canadian Family Physician*, 61(11), e504-e508.

Herwartz, H., Strumann, C. (2014). Hospital efficiency under prospective reimbursement schemes: an empirical assessment for the case of Germany. *The European Journal of Health Economics*, 15(2), 175-186.

Hyde, M. J., Modi, N. (2012). The long-term effects of birth by caesarean section: the case for a randomised controlled trial. *Early Human Development*, 88(12), 943-949.

Le Ray, C., Carayol, M., Zeitlin, J., Breart, G., Goffinet, F., PREMODA Study Group. (2006). Level of perinatal care of the maternity unit and rate of cesarean in low-risk nulliparas. *Obstetrics & Gynecology*, 107(6), 1269-1277.

Linna, M. (1999). Health care financing reform and the productivity change in Finnish hospitals. *Journal of Health Care Finance*, 26(3), 83-100.

Linton, A., Peterson, M. R., Williams, T. V. (2004). Effects of maternal characteristics on cesarean delivery rates among US Department of Defense healthcare beneficiaries, 1996–2002. *Birth*, 31(1), 3-11.

Lutomski, J. E., Murphy, M., Devane, D., Meaney, S., Greene, R. A. (2014). Private health care coverage and increased risk of obstetric intervention. *BMC Pregnancy and Childbirth*, 14(1), 13.

Mazzoni, A., Althabe, F., Liu, N. H., Bonotti, A. M., Gibbons, L., Sánchez, A. J., Belizán, J. M. (2011). Women's preference for caesarean section: a systematic review and meta-analysis of observational studies. *BJOG: an International Journal of Obstetrics & Gynaecology*, 118(4), 391-399.

Menacker, F., Declercq, E., Macdorman, M. F. (2006). Cesarean delivery: background, trends, and epidemiology. *Seminars in Perinatology*, 30(5), 235-241.

Milcent, C., Rochut, J. (2009). Hospital Payment System and Medical Practice. *Revue Economique*, 60(2), 489-506.

Milcent, C., Zbiri, S. (2018). Prenatal care and socioeconomic status: effect on cesarean delivery. *Health Economics Review*, 8(1), 7.

Ministry of Health (2016). La complémentaire santé: acteurs, bénéficiaires, garanties. *Panoramas de la DREES-Santé*, 102.

Penn, Z., Ghaem-Maghami, S. (2001). Indications for caesarean section. *Best Practice & Research: Clinical Obstetrics & Gynaecology*, 15(1), 1-15.

Rogers, A. J., Rogers, N. G., Kilgore, M. L., Subramaniam, A., Harper, L. M. (2017). Economic Evaluations Comparing a Trial of Labor with an Elective Repeat Cesarean Delivery: A Systematic Review. *Value in Health*, 20(1), 163-173.

Roman, H., Blondel, B., Bréart, G., Goffinet, F. (2008). Do risk factors for elective cesarean section differ from those of cesarean section during labor in low risk pregnancies? *Journal of Perinatal Medicine*, 36(4), 297-305.

Salvador, J., Cano-Serral, G., Rodriguez-Sanz, M., Lladonosa, A., Borrell, C. (2009). Inequalities in caesarean section: influence of the type of maternity care and social class in an

area with a national health system. *Journal of Epidemiology and Community Health*, 63(3), 259-261.

Sloan, F. A. (2000). Not-for-profit ownership and hospital behavior. *Handbook of Health Economics*, 1, 1141-1174.

Sommersguter-Reichmann, M. (2000). The impact of the Austrian hospital financing reform on hospital productivity: empirical evidence on efficiency and technology changes using a non-parametric input-based Malmquist approach. *Health Care Management Science*, 3(4), 309-321.

Souza, J. P., Gülmezoglu, A. M., Lumbiganon, P., Laopaiboon, M., Carroli, G., Fawole, B., Ruyan, P. (2010). Caesarean section without medical indications is associated with an increased risk of adverse short-term maternal outcomes: the 2004-2008 WHO Global Survey on Maternal and Perinatal Health. *BMC Medicine*, 8(1), 71.

Villar, J., Carroli, G., Zavaleta, N., Donner, A., Wojdyla, D., Faundes, A., Velazco, A., Bataglia, V., Langer, A., Narváez, A., Valladares, E., Shah, A., Campodónico, L., Romero, M., Reynoso, S., de Pádua, K. S., Giordano, D., Kublickas, M. (2007). Maternal and neonatal individual risks and benefits associated with caesarean delivery: multicentre prospective study. *British Medical Journal*, 335(7628), 1025.

Widmer, P. K. (2015). Does prospective payment increase hospital (in) efficiency? Evidence from the Swiss hospital sector. *The European Journal of Health Economics*, 16(4), 407-419.

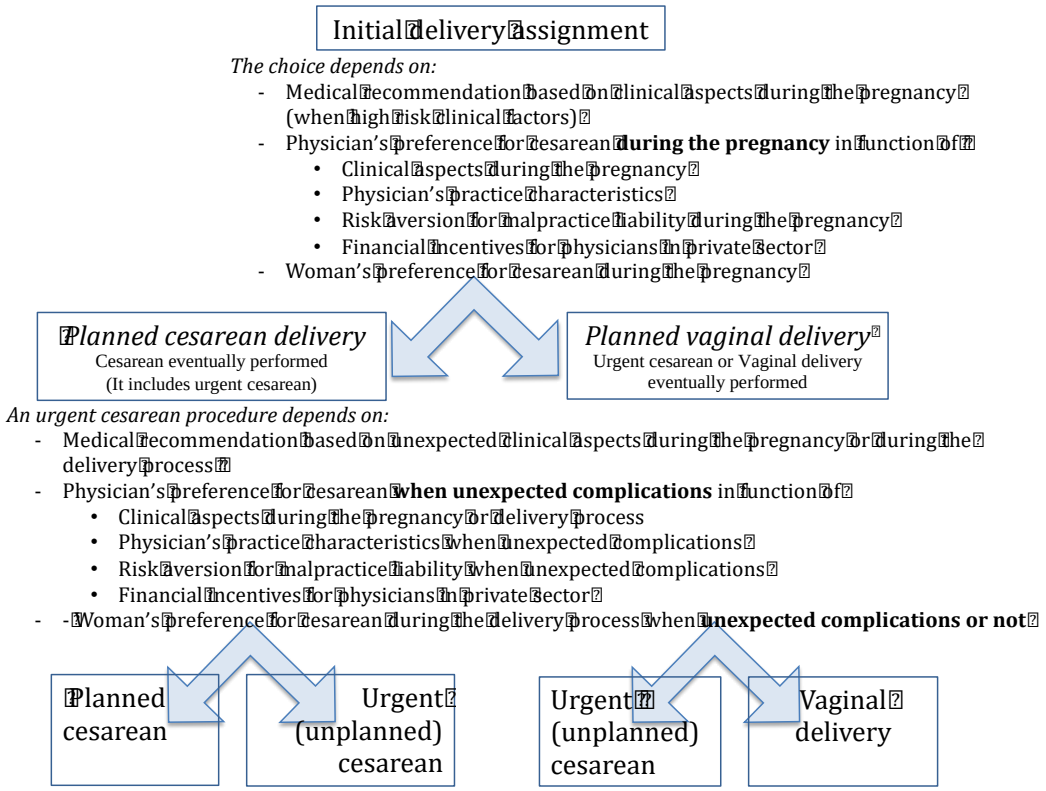
Yang, Y. T., Mello, M. M., Subramanian, S. V., Studdert, D. M. (2009). Relationship between malpractice litigation pressure and rates of cesarean section and vaginal birth after cesarean section. *Medical Care*, 47(2), 234.

Yee, L. M., Liu, L. Y., Grobman, W. A. (2017). Obstetrician call schedule and obstetric outcomes among women eligible for a trial of labor after cesarean. *American Journal of Obstetrics & Gynecology*, 216(1), 75-e1.

Zbiri, S., Rozenberg, P., Goffinet, F., Milcent, C. (2018). Cesarean delivery rate and staffing levels of the maternity unit. *PloS One*, 13(11), e0207379.

Figures

Figure 1. Identification process from the initial delivery assignment to the actual mode of delivery.



Tables

Table 1. Rates of enrollment by supplementary private insurance according to the employment status.

	Overall rate	**Rate excluding CMU-C**
High probability of enrollment		
Working people (including those on parental leave)	96%	94%
Retirees	95%	94%
Students and apprentices	95%	92%
Low probability of enrollment		
Homemakers	91%	71%
Unemployed people (on the labor market)	86%	61%
Not in the labor force (including housewives)	86%	73%

Note: The economically disadvantaged people are eligible for a public supplementary insurance playing an equivalent role as a private supplementary insurance, named CMU-C. However, this public supplementary insurance does not cover extra-cost defined here for cesarean in a private hospital. Therefore, we use the coverage's rate excluding CMU-C to create the private supplementary insurance variable (I_{ijt}).
Data source: French Ministry of Health (the *Ministère de la Santé*, DREES), 2012.

Table 2. Effects of hospital sector on cesarean deliveries. Multilevel logit models (coefficient estimates).

Sample:	All women	All women	All women
Dependent variable:	Pr (Cesarean)	Pr (Cesarean)	Pr (Cesarean)
	1	2	3
Time			
Trend	0.003	0.002	0.001
	(0.014)	(0.015)	(0.013)
Hospital sector			
Private	0.418***	0.460***	0.582***
	(0.117)	(0.120)	(0.168)
Demographic control variables	Yes	Yes	Yes
Medical control variables	Yes	Yes	Yes
Socioeconomic control variables	No	Yes	Yes
Hospital control variables	No	No	Yes
Observations (*N*)	58,645	58,645	58,645

Data source: PCS, SAE, Yvelines district (France), 2008-2014.
Note: Robust standard errors clustered at the hospital level in parentheses. *** = 1% significance level, ** = 5%, * = 10%. All regressions use the main sample with complete socioeconomic data. Control variables include intercept; for demographics: age and parity; for medical risk factors: previous cesarean, diabetes, hypertension, eclampsia or preeclampsia, fetal growth restriction, placental disorder, other obstetric pathology, plurality, term at delivery, fetal presentation, induced labor, and birth weight; for socioeconomic status: woman's status of the couple, education, job, and employment status, and her partner's job and employment status; and for hospital characteristics: equipment level, teaching status, obstetrician availability, day of delivery, size, and numbers of full-time midwives, obstetricians, and anesthetists per occupied bed.

Table 3. Effects of hospital sector on cesarean deliveries, for different subgroups of women. Multilevel logit models (coefficient estimates).

Sample:	High medical risk	Low medical risk	Low medical risk	Low medical risk & planned cesareans deleted
Dependent variable:	Pr (Cesarean)	Pr (Cesarean)	Pr (Planned cesarean)	Pr (Unplanned cesarean)
	1	2	3	4
Time				
Trend	-0.001	0.006	0.041**	-0.011
	(0.016)	(0.012)	(0.019)	(0.013)
Hospital sector				
Private	0.633***	0.677***	1.547***	0.477***
	(0.167)	(0.145)	(0.284)	(0.084)
Demographic control variables	Yes	Yes	Yes	Yes
Medical control variables	Yes	Yes	Yes	Yes
Socioeconomic control variables	Yes	Yes	Yes	Yes
Hospital control variables	Yes	Yes	Yes	Yes
Observations (*N*)	28,312	30,333	30,333	29,088

Data source: PCS, SAE, Yvelines district (France), 2008-2014.
Note: Robust standard errors clustered at the hospital level in parentheses. *** = 1% significance level, ** = 5%, * = 10%. All regressions use the main sample with complete socioeconomic data. Control variables include intercept; for demographics: age and parity; for medical risk factors: previous cesarean, diabetes, hypertension, eclampsia or preeclampsia, fetal growth restriction, placental disorder, other obstetric pathology, plurality, term at delivery, fetal presentation, induced labor, and birth weight; for socioeconomic status: woman's status of the couple, education, job, and employment status, and her partner's job and employment status; and for hospital characteristics: equipment level, teaching status, obstetrician availability, day of delivery, size, and numbers of full-time midwives, obstetricians, and anesthetists per occupied bed.

Table 4. Effects of supplementary private health insurance on cesarean deliveries. Multilevel logit models (coefficient estimates).

Sample:	Low medical risk	Low medical risk	Low medical risk & planned cesareans deleted
Dependent variable:	Pr (Cesarean)	Pr (Planned cesarean)	Pr (Unplanned cesarean)
	1	2	3
Time			
Trend	0.006	0.041**	-0.011
	(0.012)	(0.019)	(0.013)
Supplementary private health insurance			
High prob. of suppl. private ins. (woman or her partner)	Reference	Reference	Reference
Low prob. of suppl. private ins. (woman and her partner)	0.043	0.412**	-0.073
	(0.100)	(0.199)	(0.098)
Crossed variables for hospital sector and supplementary private health insurance			
Public * High prob. of suppl. private ins. (woman or her partner)	Reference	Reference	Reference
Private * High prob. of suppl. private ins. (woman or her partner)	0.679***	1.554***	0.476***
	(0.145)	(0.282)	(0.084)
Public * Low prob. of suppl. private ins. (woman and her partner)	Reference	Reference	Reference
Private * Low prob. of suppl. private ins. (woman and her partner)	0.481**	0.824*	0.536***
	(0.201)	(0.447)	(0.147)
Demographic control variables	Yes	Yes	Yes
Medical control variables	Yes	Yes	Yes
Socioeconomic control variables	Yes	Yes	Yes
Hospital control variables	Yes	Yes	Yes
Observations (*N*)	30,333	30,333	29,088

Data source: PCS, SAE, Yvelines district (France), 2008-2014.
Note: Robust standard errors clustered at the hospital level in parentheses. *** = 1% significance level, ** = 5%, * = 10%. All regressions use the main sample with complete socioeconomic data. Control variables include intercept; for demographics: age and parity; for medical risk factors: previous cesarean, diabetes, hypertension, eclampsia or preeclampsia, fetal growth restriction, placental disorder, other obstetric pathology, plurality, term at delivery, fetal presentation, induced labor, and birth weight; for socioeconomic status: woman's status of the couple, education, job, and employment status, and her partner's job and employment status; and for hospital characteristics: equipment level, teaching status, obstetrician availability, day of delivery, size, and numbers of full-time midwives, obstetricians, and anesthetists per occupied bed.

Supporting Information

Table A1. DRG fees for stays including childbirth by hospital sector.

	2008		**2014**	
	Public	Private	Public	Private
No complication				
Vaginal delivery (Euros)	2,164	1,450	2,439/2,054	1,490/1,282
Cesarean delivery (Euros)	2,983	1,789	2,812	1,759
Difference (%)	**+38%**	**+23%**	**+15%/+36 %**	**+15%/+37%**
Minor complication				
Vaginal delivery (Euros)	2,615	1,631	2,900/2,336	1,669/1,435
Cesarean delivery (Euros)	4,208	2,202	4,153	2,891
Difference (%)	**+61%**	**+35%**	**+43%/+77%**	**+73%/+101%**
Major complication				
Vaginal delivery (Euros)	3,347	1,803	3,071/2,615	1,803/1,617
Cesarean delivery (Euros)	4,900	2,346	4,383	2,967
Difference (%)	**+46%**	**+30%**	**+43%/+67%**	**+65%/+83%**

Note: Stays presented are those for singleton deliveries. For 2014, fees vary between nulliparous and multiparous women who deliver vaginally and are reported in that order.
Data source: French technical agency for hospital information (the *Agence Technique de l'Information sur l'Hospitalisation*, ATIH), 2008-2014.

Table A2. Descriptive statistics.

	Full sample		**Public**	**Private**
	n	Percent	Percent	Percent
Outcome variable				
Cesarean delivery	102,236	23.93	22.28	27.20
Woman's demographics				
Age (years)	102,236	30.73 (5.14)	30.34 (5.22)	31.52 (4.87)
Nulliparous	102,236	43.09	42.98	43.31
Woman's medical risk factors				
Previous cesarean	102,236	10.33	10.19	10.61
Diabetes	102,236	3.96	4.28	3.31
Hypertension	102,236	1.12	1.09	1.19
Eclampsia or preeclampsia	102,236	0.81	1.01	0.41
Fetal growth restriction	102,236	1.24	1.51	0.72
Placental disorder	102,236	0.24	0.25	0.22
Other obstetric pathology	102,236	7.13	7.99	5.44
Multiple pregnancy	102,236	1.46	1.68	1.04
Preterm delivery	102,236	5.04	5.81	3.51
Post-term delivery	102,236	0.12	0.13	0.11
Breech presentation or transversal lie	102,236	4.09	4.10	4.08
Induced labor	102,236	21.58	21.86	21.03
Low birth weight	102,236	5.48	6.43	3.62
High birth weight	102,236	7.07	7.04	7.12
Woman's socioeconomic level				
No partner	100,411	2.03	2.44	1.24
Education				
Primary school	79,428	2.66	3.23	1.55
Some secondary school	79,428	13.99	16.03	10.06
Completed secondary school	79,428	21.96	23.54	18.93
College or university	79,428	61.39	57.19	69.46
Job				
Manual worker	70,201	1.35	1.69	0.72
Office, sales, or service staff	70,201	55.17	58.73	48.62
Farmer	70,201	0.32	0.34	0.28
Craft/trades worker or entrepreneur	70,201	2.94	2.60	3.57
Intermediate (technical)	70,201	9.22	10.57	6.74
Managerial or higher intellectual	70,201	31.00	26.07	40.07
Employment status				
Working	83,351	69.64	67.21	74.58
Unemployed	83,351	6.65	7.05	5.86
Not in labor force	83,351	23.71	25.75	19.57
Partner's socioeconomic level				
Job				
Manual worker	78,712	9.29	11.50	5.01
Office, sales, or service staff	78,712	40.12	43.16	34.25
Farmer	78,712	0.37	0.39	.32
Craft/trades worker or entrepreneur	78,712	7.33	7.10	.25
Intermediate (technical)	78,712	6.20	6.94	4.77
Managerial or higher intellectual	78,712	36.69	30.92	47.86
Employment status				
Working	79,154	89.77	88.30	92.70
Unemployed	79,154	4.41	5.03	3.17
Not in labor force	79,154	5.82	6.67	4.12
Supplementary private health insurance				
High prob. (woman or her partner)	77,845	96.55	95.79	98.03
Low prob. (woman and her partner)	77,845	3.45	4.21	1.97
Woman's location				
Rural	90,482	8.63	10.27	5.23
Hospital type				
Private	102,236	33.64	-	100
Level of equipment				

No neonatology unit	102,236	19.11	8.54	39.96
Neonatology unit	102,236	39.64	29.30	60.04
Neonatal intensive care unit	102,236	41.25	62.16	-
Teaching	102,236	37.49	56.50	-
Hospital organization				
On-call obstetrician outside the unit	102,236	9.09	-	27.02
Non-working day delivery	102,236	26.42	27.90	23.48
Size				
Small (< 1000 deliveries/year)	102,236	11.60	4.92	24.78
Medium (1000-1999 deliveries/year)	102,236	31.86	20.13	54.99
Large (≥ 2000 deliveries/year)	102,236	56.54	74.95	20.23
Midwives (FTEs/occupied bed)	102,236	1.10 (0.34)	1.28 (0.25)	0.74 (0.14)
Obstetricians (FTEs/occupied bed)	102,236	0.35 (0.11)	0.32 (0.10)	0.40 (0.11)
Anesthetists (FTEs/occupied bed)	102,236	0.39 (0.15)	0.41 (0.16)	0.36 (0.12)

Note: Means are given with their standard deviation in parentheses for continuous variables (age, midwives, obstetricians, and anesthetists).
Employment status is composed of three categories: "Working" including people who are employed; "Unemployed" including people who are unemployed; "Not in the labor force" including students, apprentices, homemakers, retirees, those on parental leave, and others neither working nor looking for employment.
Data source: PCS, SAE, Yvelines district (France), 2008-2014.

Table A3. Effects of patient and hospital factors on cesarean deliveries. Multilevel logit models (coefficient estimates).

Sample:	All women	All women
Dependent variable:	Pr (Cesarean)	Pr (Cesarean)
	1	2
Intercept	-4.639***	-4.704***
	(0.240)	(0.256)
Time		
Trend	0.001	0.000
	(0.013)	(0.014)
Woman's demographics		
Age (years)	0.054***	0.055***
	(0.003)	(0.002)
Nulliparous	1.200***	1.197***
	(0.074)	(0.070)
Woman's medical risk factors		
Previous cesarean	3.071***	3.049***
	(0.117)	(0.107)
Diabetes	0.235**	0.225**
	(0.106)	(0.103)
Hypertension	0.511***	0.480***
	(0.091)	(0.090)
Eclampsia or preeclampsia	1.295***	1.343***
	(0.166)	(0.154)
Fetal growth restriction	0.775***	0.789***
	(0.240)	(0.229)
Placental disorder	2.456***	2.474***
	(0.313)	(0.363)
Other obstetric pathology	0.082***	0.117***
	(0.025)	(0.033)
Multiple pregnancy	0.266	0.233
	(0.187)	(0.180)
Preterm delivery	0.337***	0.333***
	(0.095)	(0.102)
Post-term delivery	1.126***	1.182***
	(0.198)	(0.203)
Breech presentation or transversal lie	3.515***	3.529***
	(0.133)	(0.128)
Induced labor	0.136*	0.147*
	(0.081)	(0.077)
Low birth weight	0.488***	0.474***
	(0.054)	(0.061)
High birth weight	0.737***	0.744***
	(0.090)	(0.091)
Woman's socioeconomic level		
No partner	-0.246**	-0.257**
	(0.099)	(0.112)
Primary school	0.207**	0.224**
	(0.105)	(0.108)
Some secondary school	0.282***	0.275***
	(0.048)	(0.045)
Completed secondary school	0.248***	0.249***
	(0.032)	(0.034)
Manual worker	0.225***	0.207**
	(0.076)	(0.085)
Office, sales, or service staff	0.123***	0.133***
	(0.038)	(0.046)
Farmer	0.238	0.189
	(0.354)	(0.411)
Craft/trades worker or entrepreneur	0.101	0.076
	(0.070)	(0.073)
Intermediate (technical)	0.121***	0.114**

	(0.046)	(0.114)
Unemployed	0.126**	0.134**
	(0.057)	(0.067)
Not in labor force	-0.057	-0.050
	(0.044)	(0.040)
Partner's socioeconomic level		
Manual worker	0.138***	0.129***
	(0.048)	(0.044)
Office, sales, or service staff	0.126***	0.129***
	(0.029)	(0.030)
Farmer	0.034	0.121
	(0.223)	(0.284)
Craft/trades worker or entrepreneur	0.089	0.067
	(0.068)	(0.078)
Intermediate (technical)	0.066	0.066
	(0.050)	(0.057)
Unemployed	0.007	0.019
	(0.080)	(0.089)
Not in labor force	0.157***	0.156***
	(0.042)	(0.052)
Woman's location		
Rural		-0.048*
		(0.027)
Hospital type		
Private	0.582***	0.553***
	(0.168)	(0.187)
Neonatology unit	0.193**	0.223**
	(0.087)	(0.087)
Neonatal intensive care unit	0.316*	0.361**
	(0.180)	(0.183)
Teaching	0.116	0.109
	(0.119)	(0.130)
Hospital organization		
On-call obstetrician outside the unit	-0.036	-0.069
	(0.097)	(0.088)
Non-working day delivery	-0.528***	-0.520***
	(0.049)	(0.048)
Small size (< 1000 deliveries/year)	0.112	0.192
	(0.130)	(0.122)
Large size (≥ 2000 deliveries/year)	0.012	0.003
	(0.027)	(0.029)
FTEs midwives (/occupied bed)	-0.091	-0.110*
	(0.082)	(0.066)
FTEs obstetricians (/occupied bed)	-0.528***	-0.499**
	(0.201)	(0.195)
FTEs anesthetists (/occupied bed)	0.003	0.057
	(0.264)	(0.308)
Observations	58,645	52,927

Note: Robust standard errors clustered at the hospital level in parentheses. *** = 1% significance level, ** = 5%, * = 10%.
All regressions use the main sample with complete socioeconomic data
Data source: PCS, SAE, Yvelines district (France), 2008-2014.

Table A4. Effects of supplementary private health insurance on cesarean deliveries. Multilevel logit models (coefficient estimates). Hospital fixed-effects specification.

Sample:	Low medical risk	Low medical risk	Low medical risk & planned cesareans deleted
Dependent variable:	Pr (Cesarean)	Pr (Planned cesarean)	Pr (Unplanned cesarean)
	1	2	3
Supplementary private health insurance			
High prob. of suppl. private ins. (woman or her partner)	Reference	Reference	Reference
Low prob. of suppl. private ins. (woman and her partner)	0.053	0.318	0.035
Crossed variables for hospital sector and supplementary private health insurance			
Public * High prob. of suppl. private ins. (woman or her partner)	Reference	Reference	Reference
Private * High prob. of suppl. private ins. (woman or her partner)	0.561**	1.825***	0.070
Public * Low prob. of suppl. private ins. (woman and her partner)	Reference	Reference	Reference
Private * Low prob. of suppl. private ins. (woman and her partner)	0.343	1.205**	0.118
Demographic control variables (step 1)	Yes	Yes	Yes
Medical control variables (step 1)	Yes	Yes	Yes
Socioeconomic control variables (step 1)	Yes	Yes	Yes
Hospital control variables (step 2)	Yes	Yes	Yes
Observations (*N*)	30,333	30,333	29,088

Data source: PCS, SAE, Yvelines district (France), 2008-2014

Note: Robust standard errors clustered at the hospital level in parentheses. *** = 1% significance level, ** = 5%, * = 10%. All regressions used the main sample with complete socioeconomic data. The control variables included the intercept; the trend; for demographics: age and parity; for medical risk factors: previous cesarean, diabetes, hypertension, eclampsia or preeclampsia, fetal growth restriction, placental disorder, other obstetric pathology, plurality, term at delivery, fetal presentation, induced labor, and birth weight; for socioeconomic status: woman's status of the couple, education, job, and employment status, and her partner's job and employment status; and for hospital characteristics: equipment level, teaching status, obstetrician availability, day of delivery, size, and numbers of full-time midwives, obstetricians, and anesthetists per occupied bed. For model 2, the coefficient estimates between women with a high probability and those with a low probability of private insurance are statistically different (Chi-square test = 3.63, p-value = 0.05)

Table A5. Effects of supplementary private health insurance on cesarean deliveries. Multilevel logit models (coefficient estimates). Robustness check.

Sample:	Low medical risk	Low medical risk	Low medical risk & planned cesareans deleted
Dependent variable:	Pr (Cesarean)	Pr (Planned cesarean)	Pr (Unplanned cesarean)
	1	2	3
Time			
Trend	0.006	0.041**	-0.011
	(0.012)	(0.019)	(0.013)
Supplementary private health insurance			
High prob. of suppl. private ins. (woman or her partner)	Reference	Reference	Reference
Low prob. of suppl. private ins. (woman and her partner)	0.697*	1.391***	0.370
	(0.416)	(0.315)	(0.423)
Crossed variables for hospital sector and supplementary private health insurance			
Public * High prob. of suppl. private ins. (woman or her partner)	Reference	Reference	Reference
Private * High prob. of suppl. private ins. (woman or her partner)	0.679***	1.549***	0.479***
	(0.145)	(0.282)	(0.084)
Public * Low prob. of suppl. private ins. (woman and her partner)	Reference	Reference	Reference
Private * Low prob. of suppl. private ins. (woman and her partner)	-0.111	0.928	-0.532
	(0.437)	(0.705)	(0.441)
Demographic control variables	Yes	Yes	Yes
Medical control variables	Yes	Yes	Yes
Socioeconomic control variables	Yes	Yes	Yes
Hospital control variables	Yes	Yes	Yes
Observations (*N*)	30,333	30,333	29,088

Data source: PCS, SAE, Yvelines district (France), 2008-2014.

Note: Robust standard errors clustered at the hospital level in parentheses. *** = 1% significance level, ** = 5%, * = 10%. All regressions use the main sample with complete socioeconomic data. Control variables include intercept; trend; for demographics: age and parity; for medical risk factors: previous cesarean, diabetes, hypertension, eclampsia or preeclampsia, fetal growth restriction, placental disorder, other obstetric pathology, plurality, term at delivery, fetal presentation, induced labor, and birth weight; for socioeconomic status: woman's status of the couple, education, job, and employment status, her partner's job and employment; and for hospital characteristics: equipment level, teaching status, obstetrician availability, day of delivery, size, and numbers of full-time midwives, obstetricians, and anesthetists per occupied bed.