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Medical behavior: an application to cesarean section delivery in Uruguay

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Resumen

En Uruguay, al igual que en todo el mundo ha aumentado sistemáticamente la tasa de nacimientos por cesáreas, llegando a ser en Montevideo en el año 2003 un 23% de los nacimientos en los hospitales públicos y un 42% en los privados. Utilizando los nacimientos registrados en el año 2003 (23.474) por el Sistema Informático Perinatal en Montevideo (Uruguay), se estima la probabilidad de tener una cesárea controlando por los principales factores de riesgo y por la endogeneidad en la elección del hospital donde se atienden. Los hospitales públicos montevideanos básicamente pagan por salario fijo y los privados por acto médico. Según predice la teoría en los primeros no hay ningún efecto del ingreso sobre la inducción y esta es cero, mientras que en los segundos es positiva, a la vez que se reduce para mujeres de menor riesgo médico. Por lo anterior, diferencias en las probabilidades irían en el sentido de confirmar la hipótesis de inducción de demanda en este acto médico en particular. Las estimaciones permiten afirmar que una mujer tiene 20% de probabilidad de tener una cesárea en un hospital público y un 39% en uno privado. A su vez, las diferencias entre los dos tipos de hospitales son mayores para mujeres de menor riesgo. Por ejemplo, aquellas mujeres que no presentaron ninguno de los riesgos médicos considerados en este estudio tienen un 11% de probabilidad de tener una cesárea en un hospital público y 25% si se atienden en un hospital privado –más del doble-.

Palabras claves: demanda inducida, cesáreas, exogeneidad

Abstract

Considering deliveries registered in 2003 (23.474) by the Prenatal Information System (PIS) in Montevideo (Uruguay), the probability of having a cesarean section delivery is estimated, controlled by risk factors and the endogeneity of the choice of hospital. At Montevideo private hospitals this procedure has to be paid for whereas public hospitals have fixed budget payment systems. The empirical work yields evidence to say that there is 20 per cent of probability for a woman of having a cesarean section delivery in a public hospital; while in private hospitals the probability rises to 39 per cent. At the same time, differences between the two types of hospitals get bigger for lower risk women. For example, women considered to have no medical risk have double the probability of a cesarean section in private hospitals than in public ones (25 per cent versus 11 per cent).

Keywords: induced demand, cesarean section delivery, exogeneity

JEL-Classification: I11, I18, C35

1. Introduction

Health care can be seen as an input in the individual health production function. In this sense, it is a derived demand, that many times, because of information asymmetries between the physician and the patient; it is originated by the physician, who indicates what and how to demand.

Health economics literature has emphatically studied the impact of these information asymmetries on the agent's decision taking process. It was particularly studied the use of the physicians main position to obtain an economic benefit, like the incentive to change consumption demand in order to maximize their utility (demand induction). Evidence is found against neoclassical traditional theory predictions; for example in Uruguay it is observed a positive correlation between income and the amount of physicians during the nineties. Moreover, when the payment to medical attention became an important proportion of physicians' income (particularly among anesthetic-surgery private sector in Montevideo since 1993), a rise in the number of services provided was observed. There was specially a rise of non-complex surgeries such as cesarean section (Fleis y Urrestarazu, 2000).

Due to the incidence of this procedure and the differences among hospitals, in this work we intend to show different practice styles controlling by risks characteristics of population attended in different institutions. Information is taken from Prenatal Information System (SIP, CLAP-OPS/OMS, MSP) for Montevideo in 2003.

2. Cesarean sections

Birth can occur through vaginal delivery or through the abdomen, that is, through a cesarean section. This last procedure was less frequent until mid XX century. Actually, in the past times the only cesarean sections made were *post mortem* in order to save the child once the mother was dead. In the XIX century it was used in obstructed labor with the fetus alive, and its application rose in XX century (CLAP, 1989). During the forties a "cesarean section liberalization" was produced, rising from 2 to 4 percent of total births and starting a sustained and generalized increase until present. For example, in the United States it rose from 5.5 percent of total births in 1970 to 23.0 percent in 2000; in Sweden this proportion more than duplicated during the seventies, reaching in 2001 17.0 percent of total births. In Latin America, Chile appears as the country with higher rates, representing 40.0 percent of total births in 2004.

In Uruguay, annual average rate between 1985 and 1989 was 16.8 percent, while in 2003 became 27.0 percent, observing huge differences among institutions. Such as in the rest of Latin America, higher frequencies of cesarean sections were observed in private institutions.

[TABLE1]

Reasons for this development have been extendedly discussed. Development of new medical technology (hemotherapy, anesthesiology, antibiotics, chemotherapy and pre-birth diagnosis), existence of regulation and legislation related to medical capacities, change in physicians' practice style and patients personal attitudes related to cesarean section, can be pointed as the main causes. At the same time, there is empirical evidence both for and against this procedure as a way of decreasing prenatal mortality rate.

[TABLE2]

Several organizations suggest "ideal" cesarean section rates. For the World Health Organization (WHO) it is between 10 and 15 percent; for the United Nations and its program *Health for All*, it varies from 15 percent for nulliparous to 63 percent for women with previous cesarean sections. For other organizations the ideal rate is the minimum. Anyway, there is a consensus in specialized literature that cesarean rate depends on population characteristics.

At the same time, cost-effective studies on cesarean section have determined that a cesarean section without complications could represent an over cost between 66 and 200 percent compared to a regular delivery, depending on the country (Clark et al, 1991; Keeler y Brodie, 1993; Eckerlund y Gerdthamn, 1996, Epstein y Nicholson, 2005).

For that reason, it is relevant to study the main factors that lead to the decision of making a cesarean section, as they expose both, mother and child, to unnecessary risks and increase medical costs.

According to Schwarcz et al (1989) the rise in this kind of procedure can be explained by many factors, such as the decrease of associated risks, new indications based on better prenatal results and a low probability of the physician of getting practice in

vaginal deliveries. However, abusing of cesarean sections is concerning when extra-health factors that go against mother and child interest prevail, such as economic factors, health team comfort, among others.

Taking all explanations into account, reasons for cesarean section can be grouped in three:

a) Obstetric indications

   i. Maternal: previous cesarean sections, previous tumors, uterine fracture, severe chronic hypertension, and failure of induction.

   ii. Fetal: abnormal fetus presentation (cross, podalic, etc.), fetal macrosomy, compromised living of the fetus, multiple pregnancy, and fetus suffering.

   iii. Maternal-fetal: fetopelvic disproportion, obstructed labor.

   iv. Ovularian: previous placenta, etc.

b) Non-medical patient conditions: age, socio-economic situation, experience in malpractice lawsuits, etc.

c) Non-medical professional conditions: economic incentives, professional discretion, technology availability, etc.

3. Antecedents

Gruber and Owings (1996), using information on births in the United States between 1970 and 1982, study the existence of induced demand on cesarean sections, given the income variation of obstetricians during that period. The authors outline that in this period, there was a decrease in fertility rate of 13.5 percent, making physicians adjust by quantity, thus increasing the number of births by cesarean section. In presence of changes in medical remunerations, it was not possible to identify supply responses, due to the fact

that, at the same time, there existed changes in demand as a response to change in prices, which could be real or induced. With a database of approximately 256 thousand of births obtained from the National Hospital Discharge Survey, the authors estimate *logit* models with the purpose of determining the probability of a birth concluding in a cesarean section. Controlling by state and year of birth, they find that the probability depends on demographic characteristics of the mother, on having a previous cesarean section, on the hospital characteristics, the number of obstetricians by birth occurred in the state and the number of births related to state population. Results show that a 10 percent increase of obstetrician density increases a 0.6 percent the probability of a cesarean section. At the same time, there exists a monotonic increase with the age of the mother. The probability of cesarean section increases for married and white women; in big hospitals, and in private ones. They also point out that previous cesarean section is a good predictor of repeating the procedure. Finally, control variables such as risks factors of pregnancy, better explain the incidence of cesarean delivery.

Eckerlund and Gerdthamn (1996) using data from the medical register of 59 obstetric departments in Sweden in 1991 (98 percent of total births in the country), carry out a research of cross section data in order to explain the variation in the cesarean section rate among the different obstetric departments. The authors identify near 20 determinants of cesarean section rate, mainly: age of mother, multiple pregnancies, size of obstetric department, being or not a university hospital, variables related to medical practice style, etc. On one side, they find that university hospitals have a higher cesarean section rate than other hospitals, and on the other side, that there existed a high variation among and inside

six regions of Sweden. At the same time, cesarean section rate increases with age of mother, mostly for primiparous mothers.

Fabbri and Monfardini (2001), based on a natural experiment of reduction of physicians' honoraries that took place in the Italian region of Emilia-Romana between 1997 and 1998, estimate a model of induced demand of births by cesarean section. They develop an extended version of the model of demand induction introduced by Newhouse (1970) and Evans (1974), pointing out that the major limitation to these models is supposing that patients are homogeneous. They try to mend this restriction considering a distribution of patients in five classes according to different risk levels. Estimating a *probit* model of simultaneous equations, in which the probability of cesarean section depends on the type of hospital chosen, they explain the probability of cesarean section related to two types of hospitals (public and private hospitals), controlling by patient characteristics and risk factors. The vector of individual risks includes variables related with the number of previous cesarean section, presentation of the fetus, age of the mother and recent admission to hospital. Among the variables that determine the choice of the hospital, they include: distance to hospital and some characteristics of the woman residence locality (availability of cars, height, etc). In this study, they cannot reject the exogeneity of the choice of hospital, and therefore the patient's election of a provider is exogenously determined with regard to the inductive behavior and the hospital treatment. As a consequence of this result, the model is reduced to a single equation, focalizing the attention on the evaluation of the impact in the probability of cesarean section according to risk factors, type of hospital and changes in schedules. With regard to the induced demand, they provide robust evidence of the presence and magnitude of this behavior. The authors find that the probability of

cesarean section, after a reduction of 20 percent in honoraries, for any type of risk, is systematically and significantly higher in private hospitals (financed with tariffs) than in public hospitals (with fixed budget). At the same time, results suggest that a marginal increment in the probability of cesarean section due to a reduction of physicians' honoraries is significantly lower among high risk women compared to women with lower risk. In response to the income shock, cesarean sections increases 65 percent for women with low risk what represents more than 50 percent of the sample. However, if women with higher risk are analyzed, which represent no more than 3 percent of the sample, cesarean section probability increases only 4 percent points.

In the case of Uruguay, the only study that intends to give hints on the induced demand hypothesis for medical acts was carried out by Fleis y Urrestarazu (2000). The authors underline the change of the medical remuneration system in 1993 in Uruguay that priories the payment of medical and surgical act, finding an increase on the average real monthly income of physicians along the nineties, especially in the private sector in Montevideo. At the same time, there was a rise in the number of surgery procedures, especially non-complex ones. In general, they find a positive correlation between remuneration and the physician supply of 0.8 for the period considered, suggesting, like Reinhardt test, the existence of an induced demand. However, they cannot prove the hypothesis of induction of demand, because they fail in identifying unnecessary acts in the increase of the quantity of services provided.

4. Induced demand

4.1. A theoretical model

In health, differences between patient and physician in terms of knowledge, suggest the possibility that physicians may take advantage of that asymmetry for their own economic benefit. This threatens the economic market paradigm, gradually destroying the normative implications underlying economic recommendations about market policy.

Since the seventies health economics have centered its attention on the demand side. But if physicians are capable of inducing demand, superstructure constructed on consumer theory is threaten, and this is not correct for this type of market structure (Culyer y Newhouse, 2003).

Induced demand by physicians exists when the physician influence the patient's demand for health services against what the physician itself considers is the best for patient's well being. It is important to take into account two sides of the previous definition. First, there is a difference between agency's good use and induction. In fact, when the physician influences in order to take the patient to the optimum, it would not be induction, but the good use of agency relation (Culyer y Newhouse, 2003). The other side to look at relates to the difference among use and demand. A physician could influence use level but not influence demand.

In terms of economic vision of induced demand, there are theoretical reasons to believe that it always exists at some level. If we consider a physician that gives the optimal quantity of information, the patient will be using the optimal quantity of health services. Envelope theorem argues that, around this point, a small increase or decrease of quantity

will have a small effect on consumer welfare. On the contrary, physician can earn more money when inducing a patient to demand more. No matter which theoretical model is used to argue physician motivation, trade off presented (to earn more affecting the patient or not to) implies that the physician, at least in some way, will end up inducing demand.

Information asymmetries between physician and patient are not a sufficient condition for demand induction. There must exist incentives to do it. For example, when the supply of physicians rise, they might not be supplying the quantities they would like, and therefore have an incentive to induce demand (Fleis y Urrestarazu, 2000). However, there might exist obstacles to demand induction, which can be ethical (Hippocratic Oath), legal (medical licenses, sanctions to hospitals) or socioeconomic (reputation loss, time spent in convincing patients, etc.).

Existence of induced demand on the supply side of health services was originally introduced by Evans (1974) and Fuchs (1978). The main idea arises from the fact that in geographical areas with hospitals with higher beds supply there was a higher use of services as well (Roemer, 1961).

Evans (1974) suggested a model in which physicians maximize their utility function with arguments as income or induction. Besides, it takes into account the disutility of induction that limits income generation. On the other side, Fuchs (1978) presented induction as the ability of the physicians of changing the demand curve in the market.

However, there are alternative explanations among literature on how positive association between supply and demand can be sustained by itself in a competitive structure. For example, more physicians (through density increase) decrease time costs of patients, increasing therefore the demand.

As for limits to induction, some authors find them as a “target income” for physicians (Newhouse, 1970; Evans, 1974); others as a moral limit for themselves (Sloan y Feldman, 1978; Gruber y Owings, 1996); while others find that there might be limits imposed by patient precaution (Dranove, 1994).

At the same time, in literature there is a clear distinction among models that limit induction in a context of benefit maximization (Dranove, 1994; Stano, 1987), and models that incorporate disutility of acting against the best interest of the patient (Evans, 1974; Fuchs, 1978; McGuire y Pauly, 1991; Gruber y Owings, 1996; Zweifel y Breyer, 1997; Carlsen y Griten, 1998; Fabbri y Monfardini, 2001).

McGuire y Pauly (1991) formalized the ideas of Evans and Fuchs in the context of a model that intends to explain the induction produced by physicians that respond to changes in income, incorporating as a limit to induction the disutility of induction.

Next, taking these works as a basis, we develop the theoretical model used in this work.

It is assumed that different obstetric departments attend women with different risks, which are distributed among a discrete number of risk types (r), with $r = 1,...,s,...,R$, where if risk types are ordered and $R > s$, women in *R* type present more risk than women in *s* type. At the same time, each hospital or obstetric department has a utility function in the way:

$$U = U(Y, I_1,..., I_R)$$

$$U_Y^{'} > 0, U_r^{'} < 0 \qquad (1)$$

$$U_{YY}^{''}, U_{rr}^{''} < 0$$

Where Y represents obstetric department income, and I_r is the induction level of women with risk type r.

When assuming that $U_r^{'} < 0$, it is implied that professionals respect an ethical code, and physicians have disutility when exploiting their agency relation in inducing demand, which is bigger when the patient risk is lower:

$U_s^{'} < U_R^{'}$, with $R > s$.

There can exist two types of payments: for procedure or medical act, p, or fixed salaries, f.

In the first case and assuming separable additive preferences, we obtain:

$$U^p = U_Y(Y^p) + \sum_{r=1}^{R} U_r(I_r^p) \qquad (2)$$

$$Y^p = Y_N N^p + Y_C C^p \qquad (3)$$

Where N is natural births, C is Cesarean section, and Y_N, Y_C are income from each intervention. At the same time, $Y_C - Y_N > 0$, that is, the reimbursement premium for practicing cesarean section is high enough to compensate the obstetric department for any loss of time spent in it.

If B_r represents deliveries for women of risk type r, we have:

$$C^p = \sum_{r=1}^{R} \phi_r(i_r^p) B_r \qquad (4)$$

$$N^p = \sum_{r=1}^{R} (1 - \phi_r(i_r^p)) B_r \qquad (5)$$

$$I_r^p = i_r^p B_r \qquad \forall r = 1,...,R \qquad (6)$$

Where i_r represents the "induction by birth" for risk type r, representing an effort without cost that the physician makes to induce cesarean section demand for a given birth. $\phi_r(i_r)$ Is an induction function that determines the cesarean rate for risk type r for each level of effort in induction made by physicians. It is supposed that cesarean section rate rises with the induction effort, $\phi_r^{'}(.) > 0$, that $\phi_r^{''}(.) = 0$, y $\phi_r(o) > 0$ (a fraction of births are correctly diagnosed, requiring a cesarean section). Moreover, due to the fact that cesarean sections are more frequently performed to risky women, we conclude that $\phi_r(0) > \phi_s(0)$, given $r > s$.

Physicians maximize U^p (equation 2) with respect to i_r, subject to restrictions (3)-(6).

First order conditions let us affirm that there is a trade off between the net disutility of inducing, and the net utility of the income rise. Taking these results it is possible to make a comparative static exercise, for example, a decrease in the number of births – ceteris paribus- will make induction rise, and therefore there will be a rise of births by cesarean section. We can also make an analysis of the effect of controlling medical payments for the amount of interventions made. For example, Yip (1998, cited in Culyer y Newhouse, 2003) applying this model to thorax surgeries in New York and Washington, analyze the impact of controlling prices in the public system *(Medicare).* The author finds evidence that this price control raised the amount of surgeries in the public and private systems through an income effect. In particular, the estimations of Yip find that thorax surgeries recovered a 70 percent of loss income via prices, through a rise in volume (Culyer y Newhouse, 2003).

Under this payment system, economic incentives to induce demand are higher than if the payment is made by a third party instead of the demander of medical services itself, making unpredictable the amount destined to cover the expenses. At the same time, even though the payment for act promotes a model based on healing instead of prevention, we must emphasize that it raises physician productivity, rewards personal effort and personal responsibility, and improves the quality of the service (Fleis y Urrestarazu, 2000).

In the case of fixed payment, the physician income depends basically on the amount of working hours, where the hour-value will depend on the activity, grade and specialty. In the optimum, there is no effect of income on induction, thus it is zero. Therefore, this payment modality generates incentives to eliminate superfluous practice that would only provoke a decrease of physicians' utility. However, it may generate incentives to an insufficient quantity of medical services supply.

4.2.Empirical model and information

Following Fabbri and Monfardini (2001) in this study we estimated the probability of a cesarean delivery in Montevideo, controlling for different patient's risks. The type of the hospital could affect this probability, because there are two payment systems: for act (private hospitals) and fixed salary (public hospitals). At the same time, given that the risk type of patients reduces induction, it is important to estimate the differences for women with lower relative risk. As it was mentioned before, theory predicts that in the second group the induced demand is zero, but it is positive in the first group and decreases with the risk level of patients.

It is important to briefly systematize the payment system in Uruguay. Around 60 percent of operative expenses in hospitals are remunerations, and physicians work basically in a dependence relation. In health sector there are two sub sectors with different contracting rules. On one side, there is the public sub sector where payment modality is mainly thorough fixed salary; and on other side, there is the private sub sector where it is necessary to distinguish between the capital city and the rest of the country. In 1993, a collective bargain agreement established that physicians from private sector in Montevideo would be remunerated by medical and surgical act, reducing the weight of base salary in total income, while in the rest of the country the payment modality is still based on fixed salary (Fleis y Urrestarazu, 2000). Even though payment by act already existed, the agreement of 1993 increased considerably in real terms the price of anesthetic-surgical acts.

Real income of physicians showed a marked increasing trend during the nineties, being an important part of this increase the rise in 1993 (Fleis y Urrestarazu, 2000). At the same time, if we compare the average real income of physicians from public and private sector, we observe that remuneration to physicians in public sector is approximately a third of remuneration to physicians in private sector.

As we do not count with data for before and after the change of 1993, in this work we decided to compare the medical behavior regarding births in two types of institutions in Montevideo. It is important to underline that there are other differences than the payment systems in both types of hospitals, such as the available capacity of surgical emergency, medical practice styles[2] and socioeconomic level of patients. Due to the fact that this last

[2] In Uruguay, public hospitals are mostly university hospitals, particularly in Montevideo. For example, Centro Hospitalario Pereira Rossell, the most important maternity in the country, is a practice hospital, and in 2003 concentrated 40 percent of total deliveries in Montevideo.

characteristic is controlled for in estimations, that a high proportion of physicians have both public and private jobs and that the surgery is non complex, is that we understand that if there are differences, they are because of the payment system[3].

It is possible to argue that variables such as type of hospital are determined endogenously, due to the fact that the probability of cesarean section depends on non-observable variables that are correlated with non-observed characteristics that undermine the choice of the hospital. This could lead to inconsistent estimations. In fact there could exist selection bias, for example hospitals with high-risk population, etc[4].

The above makes necessary to find out whether it is convenient or not to jointly estimate both phenomena.

The model structure is based on a reduced equation for the potentially endogenous variable (hospital) and a second structural equation for the outcome of interest (cesarean section)

(7) $$y_{1i}^{*} = \beta_1^{'} x_{1i} + u_{1i}$$

$$y_{2i}^{*} = \beta_2^{'} x_{2i} + u_{2i} = \delta_1 y_{1i} + \delta_2^{'} z_{2i} + u_{2i}$$

Where y_{1i}^{*} is the latent variable for hospital choice, and y_{2i}^{*} is the latent variable for the identification of a cesarean section delivery. Both variables are observed as binaries of the form:

[3] Double job is less probable in the main maternity hospital in Montevideo and Uruguay: Centro Hospitalario Pereira Rossell. It is a public, university hospital that works mainly with residents, and as they have not finished their career, they are not allowed to work in private hospitals.

[4] In Uruguay, the characteristics of the health system make the woman to choose between a private or public hospital in her place of residence. The choice among different private institutions is only possible in the capital city of the country.

$$y_{1i} = \begin{cases} 1 & if\ y_{1i}^{*} > 0 \\ 0 & if\ y_{1i}^{*} \leq 0 \end{cases} \quad (hospital)$$

(8)

$$y_{2i} = \begin{cases} 1 & if\ y_{2i}^{*} > 0 \\ 0 & if\ y_{2i}^{*} \leq 0 \end{cases} \quad (c.s)$$

x_{1i} and z_{2i} are vectors of the exogenous variables in both equations, including the first vector of instruments to be used for controlling endogeneity; β_1 , δ_2 are the parameter vectors and δ_1 is a scalar.

The error terms are assumed to be independent and identically distributed as a bivariated normal with zero mean and unitary variance, with $\rho = corr(u_1, u_2)$. The exogeneity condition could be put in terms of ρ, which could be interpreted as the correlation between the unobserved explanatory variables of both equations. The Wald test for ρ, implies that, in case of not rejecting the null hypothesis, y_{1i} y u_{2i} are not correlated, so y_{1i} is exogenous in the second equation. In the literature on these topics it is possible to find many alternative exogeneity tests (Wooldridge, 2002; Fabbri et al, 2004; Baum et al, 2003).

In the case of the first specification (equation 8), the estimation can be done by maximum likelihood, using *bivariate probit o seemingly unrelated bivariate probit (SURE probit)*, where the equations are related solely by the perturbations. In order to control for the potential endogeneity of the hospital choice, one must include y_{1i} as an endogenous regressor, making it possible to study it effect on the cesarean section delivery. At the same time, x_{1i} must include the instruments to be used to control the endogeneity.

Another possibility is to use instrumental variables and estimate two–stage models, which are a particular case of simultaneous equation models. In this sense it is possible to specify a linear probability model (LPM-IV 2SLS), with the disadvantage of fixed partial effects –but good for values around the poblational mean of the regressor- and heteroskedastic by construction, this is why robust standard errors are presented (Wooldridge, 2002; Baum et al, 2003)[5]. Finally, estimations can be done trough *two stage probit least squares* models (2SPLS), maintaining the specification presented in equation 2[6].

As exogenous variables individual risk factors are included, such as previous cesarean sections, fetus presentation, eclampsy, preclampsy, hypertension, multiple pregnancies and fetopelvic disproportion.

The literature usually uses insurance prices as instrumental variables for the hospital choice as they are correlated to this, but not with the fact of having or not a cesarean section delivery. However, in Uruguay price of public hospitals is basically zero, and price of private hospitals is regulated, existing low variation among private institutions. At the same time, as we are working with cross section data, there is no temporal variation in prices. For these reasons, in the present work we consider that there is no price constraint.

As constraints in the hospital choice we use education and marital status of the mother, because, as theory predicts, women more educated and married (or in stable union) are more likely to plan pregnancy and to invest on health, but these variables themselves do not affect the probability of having a cesarean section (Culyer and Newhouse, 2003). If we

[5] Stata 9 (StataCorp, 2005) software is used to estimate 2SLS with the command *ivreg2*, which gives the exogeneity tests as well as the ones for relevance and validity of instruments.
[6]The *ivprobit* command is used (2SPLS). As the endogenous regressor (hospital) is binary, it is chosen to work in two stages, where the values predicted in the first stage are used as instruments in the second one.

find that h is exogenously determined, the model could be reduced to an equation of the probability of a cesarean section conditional to the hospital choice.

We used data from the Prenatal Information System (SIP, CLAP, OPS/OMS) for the year 2003 provided by the Public Health Ministry (*Ministerio de Salud Pública*). Registered births by this system were 39,937 all over the country. This represents 70 percent of the registered births by the Born Alive Certificate that counts with a universal coverage of the country. In the capital city, Montevideo, where in general SIP coverage is wider, 23,474 births were registered.

In what follows, variables considered as risk factors are defined, without considering actual medical pregnancy problems diagnosed.

Age of the mother, measured by four binary variables that: take each one the value of 1 in case of the mother being younger than 16, between 17 and 19 years old, between 35 and 39 years old, and older than 40 years. This specification instead of a continuous one is used in ordered to capture differences among specific stages of woman's life. Omitted age range in estimations is between 20 and 34 years old, because this is the ideal age in social and reproductive terms.

As maternal risk factors we considered *deliveries, previous cesarean sections, high blood pressure (eclampsy, preclampsy, previous hypertension),* being in all cases binary variables that take value 1 if the characteristic is present[7].

As maternal-fetus risk factor we considered the fetopelvic disproportion, measured by the variable *disproportion*, which is binary and takes the value of 1 if it is present.

[7] We did not considered medical indications of having cesarean section.

Finally, as fetal risk factors we considered abnormal presentation of the fetus (pelvic or cross) through *presentation*, binary variable that takes the value of 1 if it is present; and *multiple*, binary variable that takes the value of 1 if it is a multiple pregnancy.

As non-medical conditions we considered the type of institution where the physician works, using *public* as a binary variable that takes the value of 1 if the birth occurred in a public institution and zero otherwise.

With the purpose of controlling endogeneity in the choice of the hospital, we included in equation 8 *education*, continuous variable from 1 to 4 (1 no education, 2 primary education, 3 secondary education and 4 university); and *stable union*, binary variable that takes value 1 if the woman is married or in a stable union.

In Table 3 we present descriptive statistics of the variables.

[TABLE3]

5. Results

The probability of a cesarean section delivery either in a pubic or private hospital is estimated for Montevideo in the year 2003, controlling by the potential endogeneity of the hospital choice.

The different Wald tests for exogeneity in each estimation procedure makes it possible to state that the hospital choice is endogenously determined with the probability of a cesarean section delivery[8]. At the same time it is possible not to reject education and marital status as appropriate instruments.

[8] Smith-Blundell test for 2SLS; Wald test for ρ in the *SURE probit* and 2SPLS. At the same time, the test for the instruments confirms the appropriateness of their use (2SLS: Partial R2=Shea=0.1836 in the case of 2

As observed in Table 4 in the hospital choice the main determinants are: age, education and marital status, and some medical risk factor previously known by the mother as hypertension and previous cesarean sections. In this way, the probability of choosing a public hospital is higher for: least educated, single and young women. The significant and positive risk factors are hypertension, preclampsy and previous deliveries of the woman. The last variable can be seen as a proxy of income, considering the fact that poorer women have higher fecundity rates, rising the probability of choosing a public hospital.

On the other hand, having had a previous cesarean section negatively impacts on the probability of choosing a public hospital, meaning that women assume that future pregnancies would have the same ending what takes them to invest in private insurance.

[TABLE4]

In Table 5 we present the second stage results for the different estimation procedures also with the results of the classic *probit* model (without controlling for endogeneity) in order to show the differences.

[TABLE 5]

Just looking at the coefficient sings, it is possible to say that the probability of having a cesarean section rises with the age of the mother, for private hospitals and the different risks, excluding, as expected, deliveries that have a negative sign.

Given the non-linearity of probit models, in Table 6 we present the corresponding marginal effects, replying at the same time the coefficients of the linear model in order to make the comparison possible.

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instruments, F(2, 17618); SURE probit: Chi2(1)). Tests, as well as complete outcomes are available upon request to the authors.

In this sense similar results are observed. While the average probability of having a cesarean section is approximately 25 percent, women in private hospitals have between 17 and 19 more percentage points of probability o having a cesarean section, between 10 and 14 more if they are 40 or more years old; 61-70 if fetopelvic disproportion is present; 44-52 if they had previous cesarean sections, etc.

[TABLE 6]

When the estimation proceeds without controlling for endogeneity and focusing on the hospital type, the results show an underestimation given the marginal effect of 13%.

Controlling by the risk factors for people treated in the different hospitals, results let us affirm that the probability of having a cesarean section is always grater in a private institution. At the same time, this difference is even greater for low-risk women. As it can be seen in Table 7, the probability for a women without any risk factor of having a cesarean section is: 11% in a public hospital and 25%in a private one –more than twice-. If we analyze multiparous women without any risk factor the difference between public and private, almost triplicate, 7% in public hospitals and 18% in private ones, and double for nulliparous without risk factors (20% and 39% respectively).[9]

[TABLE 7]

Differences found can be explained by non-observable factors such as medical indications and risk factors not registered in SIP, medical style practice, hospital technology, patients' attitudes, etc. According to previous studies, in Montevideo there is a high proportion of physicians that combine public and private jobs, due to low remunerations in the public sector. For that reason, it is possible to affirm that there are no

[9] 60 percent of the women in this data do not have any of the risk factors considered, while 16 percent of them had a cesarean section delivery.

substantial differences in medical staff in both types of hospitals (Bucheli, 2000). On the other hand, the act analyzed is a low complexity surgery, so no big differences are expected among institutions' technology. In this sense, it is considered that different remuneration systems explain much of the different probabilities estimated, leading to the hypothesis of induced demand.

6. Conclusions

In Uruguay, as all over the world, the proportion of births by cesarean section has increased. Reasons for this trend have been extensively discussed, underlining the existence of laws and rules related to medical practice, development of new technologies, changes in medical practice styles, as well as attitudes of patients towards cesarean section.

Basing on the deliveries occurred in Montevideo (capital city of Uruguay) and registered in the Prenatal Information System (SIP, CLAP-OPS/OMS, MSP) in the year 2003, this rate was 23 percent in public hospitals and 42 percent in private ones.

Although there is no agreement on the "ideal rate" for cesarean sections, there is a concern about the procedures made without clear medical justification, because they expose both mother and baby to unnecessary risks, and they rise medical attention costs.

In this work we estimate the probability of having a cesarean section controlling by main risk factors of population and by the type of hospital where it is done. As the choice of hospital is endogenous, we estimate a two-stage *probit* model by maximum likelihood.

Probability of cesarean section increases with age of woman, presence of eclampsy, preclampsy, previous hypertension, previous cesarean sections, multiple pregnancy and fetopelvic disproportion, and decreases for multiparous women and women attended in a

public hospital. In fact, probability of cesarean section in a private institution is almost double than having one in a public hospital (20 percent versus 39 percent).

Focusing on women that do not present any of risk factors considered, we found that they have an 11 percent probability of having a cesarean section in a public hospital and 25 percent probability in a private one. Results are identical if we consider only women younger than 35, age in which is less probable to have a cesarean section.

Differences between the two types of institutions may be because of non-observable factors such as medical indications or risk factors not considered, medical practice styles, hospital technology, patient pressure, etc. However, as we control by the socioeconomic level of patients, as in Montevideo exists a high proportion of physicians that combine public and private work –due to low remunerations in public sector- and as cesarean section is low-complexity surgery, we consider that the remuneration system explains much of the difference found in the probabilities, leading to the existence of induced demand.

It is not the purpose of this work to foment “defensive” medicine (Danson, 2000, taken in Culyer and Newhouse, 2003). This is understood as the medicine that physicians carry out in order to prevent themselves from law suits; that is, these procedures do not benefit or involve the patient in risks but the physician recommend them for reasons of personal security. It can be expected that the physician always proceeds in benefit of the patient and in that sense, the current remuneration systems acts as an incentive. But it does not appear as the right one. It also encourages multiemployment.

From the patients’ point of view, it can be argued that the physician-patient relationship in the private sector is more personal, what can lead to pressures from the patient or its family in order to deliver by cesarean section. In this sense, education and

information given to the patient before the delivery are key factors. In the first case, there are scientific findings that should be taught in delivery didactical health, during pregnancy controls, etc. This include the rise in maternal death risk in cesarean section versus normal delivery, the correlation between the rise in the cesarean section rate and the decrease of the mortality rate, especially after a given threshold and in the last decade, etc. On the other hand, the medical and non-medical restraining of women and their families, the socialization of the process, etc., will help to lower the pressure and avoid the physicians' exposure to the "ethics of resistance" (El País, 2001).

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TABLE 1: Health of mother and newborn indicators

Country	Population (in thousands)		Life expectancy at birth (years)		Total fecundity rate		Mortality rate –less than 5 years old			Number of physicians in 10.000 habitants		Beds in hospital for habitants		Deliveries by cesarean section (percent)		Health expenses per capita (international dollars)	
								Men	Women								
Argentina	2003	38.428.	2003	74	2003	2,8	2003	19	16	1998	30,4	2000	41	2000	25,4	2002	956
Chile	2003	15.806	2003	77	2003	2,5	2003	10	9	1998	11,5	2002	26	2002	40,0	2002	642
Costa Rica	2003	4.173	2003	77	2003	2,9	2003	11	9	2000	16,0	2003	14	2002	20,8	2002	743
Spain	2003	41.060	2003	80	2003	1,3	2003	5	4	2002	30,1	2001	36		S/d	2002	1.640
United States	2003	294.043	2003	77	20003	2,1	2003	9	7	1999	27,9	2002	34	2000	23,0	2002	5.274
France	2003	60.144	2003	80	2003	1,7	2003	5	4	2003	33,5	20002	78	1999	16	2002	2.736
United Kingdom	2003	59.251	2003	79	2003	1,8	2003	7	5	2001	21,3	1997	42	1997	17	2002	2.160
Uruguay	2003	3.415	2003	75	2003	2,5	2003	17	12	2003	34,0	2003	19	1999	24,7	2002	805

Source: Elaboration with data from World Health Report 2005 by World Health Organization (WHO).
Note: Last year available.

Table 2: Cesarean sections in Uruguay

2003

	Public institutions		Private institutions		Piecework		In University		Reserve	
	Montevideo	Interior	Montevideo	Interior	Yes	No	Yes	No	Yes	No
Total births registered in SIP	14.692	7.593	8.782	8.870	8.772	30.794	12.032	27.534	17.574	21.992
Total Cesarean sections	3.346	1.307	3.644	2.546	3.644	7.199	2.521	8.322	4.420	6.423
Percentage of cesarean sections	23	17	42	29	42	23	21	30	25	29

Source: Own elaboration based on data from Prenatal Information System (CLAP, OPS-OMS-MSP).

Table 3: Descriptive statistics. Montevideo N= 23,474				
Variable	**Mean**	**Standard deviation**	**Minimum**	**Maximum**
Cesarean sections	0.301	0.459	0	1
Public	0.374	0.483	0	1
Education	2.824	0.665	1	4
Married	0.792	0.406	0	1
Multiple	0.024	0.154	0	1
Previous Cesarean sections	0.156	0.363	0	1
Presentation	0.051	0.221	0	1
Disproportion	0.050	0.073	0	1
Deliveries	0.592	0.492	0	1
Previous hypertension	0.025	0.160	0	1
Preclampsy	0.041	0.200	0	1
Eclampsy	0.001	0.041	0	1
Less than 16 years old	0.032	0.177	0	1
Between 17 and 19 years old	0.115	0.320	0	1
Between 35 and 39 years old	0.106	0.308	0	1
More than 40 years old	0.050	0.220	0	1

Table 4: First stage results: choice of hospital

Montevideo 2003

N=17633

Variable	**SURE probit**	**2SLS**	**2SPLS**[1]
Less than 16 years old	1.347***	0.247***	1.344***
	(0.106)	(0.158)	(0.106)
Between 17 and 19 years old	1.967***	0.246***	1.197***
	(0.054)	(0.009)	(0.054)
Between 35 and 39 years old	-0.435***	-0.127***	-0.435***
	(0.037)	(0.009)	(0.037)
More than 40 years old	-0.246***	-0.062***	-0.248***
	(0.064)	(0.163)	(0.064)
Education	-0.985***	-0.265***	-0.985***
	(0.023)	(0.004)	(0.023)
Stable union	-0.490***	-0.118***	-0.490***
	(0.036)	(0.007)	(0.036)
Deliveries	0.697***	0.194***	0.697***
	(0.027)	(0.007)	(0.027)
Preclampsy	0.288***	0.083***	0.286***
	(0.062)	(0.014)	(0.062)
Eclampsy	0.311	0.065	0.291
	(0.415)	(0.073)	(0.412)
Previous hypertension	0.293***	0.078***	0.295***
	(0.084)	(0.018)	(0.084)
Multiple	0.042	0.007	0.043
	(0.079)	(0.019)	(0.079)
Presentation	-0.009	0.001	-0.010
	(0.056)	(0.013)	(0.056)
Previous Cesarean section	-0.104***	-0.029***	-0.101***
	(0.033)	(0.008)	(0.033)
Disproportion	0.071	0.030	0.071
	(0.145)	(0.039)	(0.147)
Test Wald: exogeneity	7.69	8.94	7.53

Note: *** Significant at the 1% level, **significant at the 5% level, *significant at the 10% level. Robust standard errors between brackets.

[1] The naïve probit results are presented in this case, the predicted values were used as instruments in the second stage.

Table 5: Second stage results: cesarean section

Montevideo 2003

N=17633

Variable	SURE probit	2SLS	2SPLS	Naïve Probit
Less than 16 years old	-0.353*** 0.069	-0.091*** 0.016	-0.354*** 0.069	-0.391*** 0.067
Between 17 and 19 years old	-0.236*** 0.043	-0.062*** 0.010	-0.237*** 0.043	-0.278*** 0.039
Between 35 and 39 years old	0.187*** 0.039	0.045*** 0.010	0.188*** 0.039	0.208** 0.038
More than 40 years old	0.411*** 0.065	0.104*** 0.018	0.411*** 0.065	0.423*** 0.065
Deliveries	-0.655*** 0.031	-0.164*** 0.008	-0.657*** 0.031	-0.688*** 0.028
Preclampsy	0.921*** 0.056	0.289*** 0.018	0.921*** 0.056	0.909*** 0.056
Eclampsy	1.376** 0.389	0.451** 0.099	1.376** 0.389	1.371** 0.386
Previous hypertension	0.338*** 0.070	0.098*** 0.020	0.338*** 0.070	0.326*** 0.071
Multiple	1.221*** 0.093	0.336*** 0.023	1.221*** 0.093	1.224*** 0.093
Presentation	1.708*** 0.061	0.511*** 0.014	1.708*** 0.061	1.712*** 0.061
Previous Cesarean section	1.430*** 0.032	0.439*** 0.009	1.431*** 0.032	1.438*** 0.032
Disproportion	2.293*** 0.247	0.607*** 0.032	2.294*** 0.247	2.290*** 0.245
Public	-0.562*** 0.054	-0.167*** 0.016	-0.557*** 0.053	-0.389*** 0.029
Education				0.058** 0.020
Stable union				0.019 0.030
Log pseudo-likelihood	-15196.213		-14863.953	-7832.486

Note: *** Significant at the 1% level, ** Significant at the 5% level, * Significant at the 10%. Level.

Table 6: Marginal effects, percentage points

Montevideo 2003

N=17633

Variable	SURE probit	2SLS	2SPLS	Naïve Probit
Less than 16 years old	-9.79	-9.14	-9.81	-10.67
Between 17 and 19 years old	-6.97	-6.25	-6.99	-8.10
Between 35 and 39 years old	6.18	4.51	6.19	6.90
More than 40 years old	14.41	10.42	14.42	14.87
Deliveries	-21.33	-16.40	-21.37	-22.39
Preclampsy	34.36	28.86	34.35	33.88
Eclampsy	50.87	45.11	50.85	50.70
Previous hypertension	11.70	90.76	11.70	11.24
Multiple	45.63	33.63	45.63	45.72
Presentation	60.54	51.07	60.54	60.66
Previous Cesarean section	51.81	43.93	51.82	52.05
Disproportion	70.24	60.66	70.25	70.24
Public	-18.96	-16.72	-18.80	-12.89

Table 7: Predictions of probability of having Cesarean section, percentages

Montevideo 2003

N=17633

	2SPLS	
Groups	**Public hospitals**	**Private hospitals**
Average	20.01	38.81
Without risk factors	11.01	25.17
Less than 35 years old and without risk factors	10.42	24.16
More than 35 years old and without risk factors	25.48	45.92
Nulliparous without risk factors	20.31	39.21
Multiparous without risk factors	6.85	17.61