# The demand factors for cesareans in Portugal – some preliminary results

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# The demand factors for cesareans in Portugal – some preliminary results[1]

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Abstract:

The aim of this work is to determine the demand factors for cesareans in Portugal. This work is exploratory and preliminary. Data is aggregated in NUTSII[3], for the period 2002-10. The number of cesareans performed is count data which requires the estimation of this panel data by a negative binomial with fixed effects. The main result is the evidence that there may be induced demand for cesareans in Portugal. Further research is needed.

Keywords: cesareans, demand factors, induced demand, count data, negative binomial

JEL classification: C50, D12, I10

[1] This paper is preliminary and exploratory. Comments and suggestions are welcome.

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[3] Nomenclature of Units for Territorial Statistic.

## 1. Introduction

Cesareans in Portugal have followed the western trend and the number has been rising steadily over the last years. For instances, in 2010, the rate of c-sections was about 36% of the number of live births. This is an extremely high rate, in particular, when compared to the WHO reference. Accordingly, the cesarean rates should not be above the 15% (WHO, 1985), even if this value has no consensus (Chamers, 1992). However, the trade-off between cesarean birth and natural birth is clear. Cesareans have higher risk and are more expensive than natural births, while cesareans are more appropriate under some conditions (Muinelo et al., 2005).

The factors that contribute to the choice of cesarean delivery are several among which there is the induced demand by the doctors (obstetricians and gynecologists). This phenomenon is quite controversial but it is central in health economics. The asymmetric information that characterizes the relationship doctor-patient allows the doctor to use his superior knowledge to induce the patients to choose exams, treatments or other health care procedure that may not be necessary (Arrow, 1963).

The aim to fulfill a void concerning the factors that may explain the number of cesareans performed in Portugal and to test the hypothesis of induced demand of cesareans.

For this purpose, we use a count model to find the demand factors, in average terms for the Portuguese females. Data is aggregated by regions type NUTS II[4] of Portugal and for the period 2002-2010. The controls are of different types: social, economic, birth characteristics and health framework.

The main result is the evidence that demand for c-sections may be partially induced.

The contribution of this work is important insights on the factors determining the aggregated demand for cesareans in Portugal. Policy makers may be interested in this work in order to convey some policy lines to reduce the number of cesareans performed in Portugal.

The results of this work are preliminary since this is a working in progress, highly dependent on the available statistics.

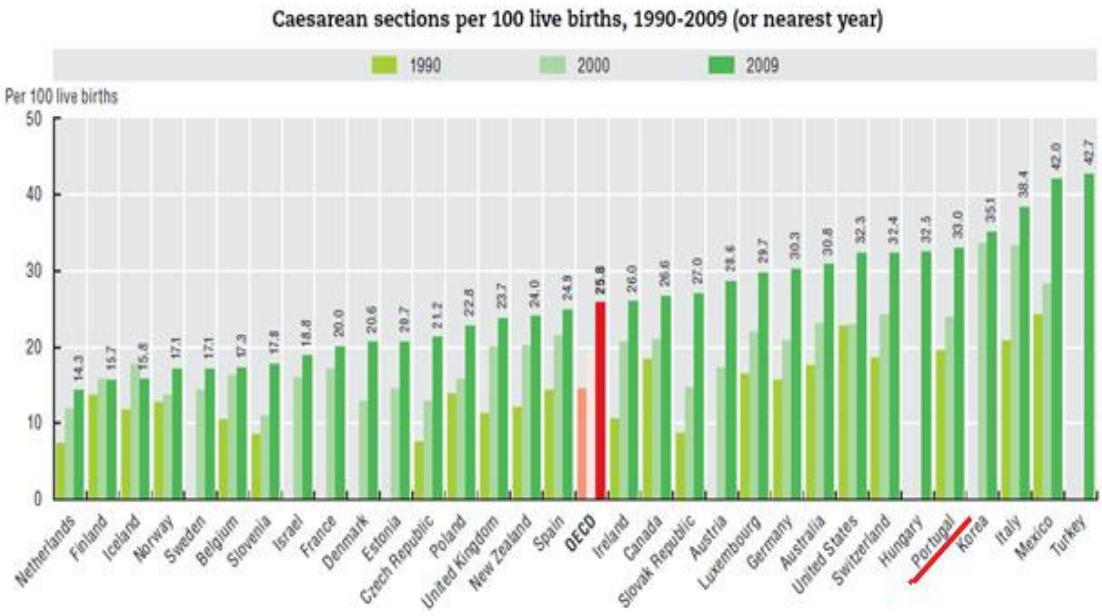
[4] Five regions NUTII: North, Center, Lisbon, Alentejo and Algarve.

## 2. Descriptive statistics and short literature review

The cesarean rate has been increasing in the OECD countries in the last decades (OECD, 2011). On average, this rate has increased from 14%, in 1990, to about 26%, in 2009.

On the graph 1 below, it is presented the cesarean rate per OECD country for 1990, 2000 and 2009. It is clear that Portugal has one of the highest rate from the listed countries.

Graph 1

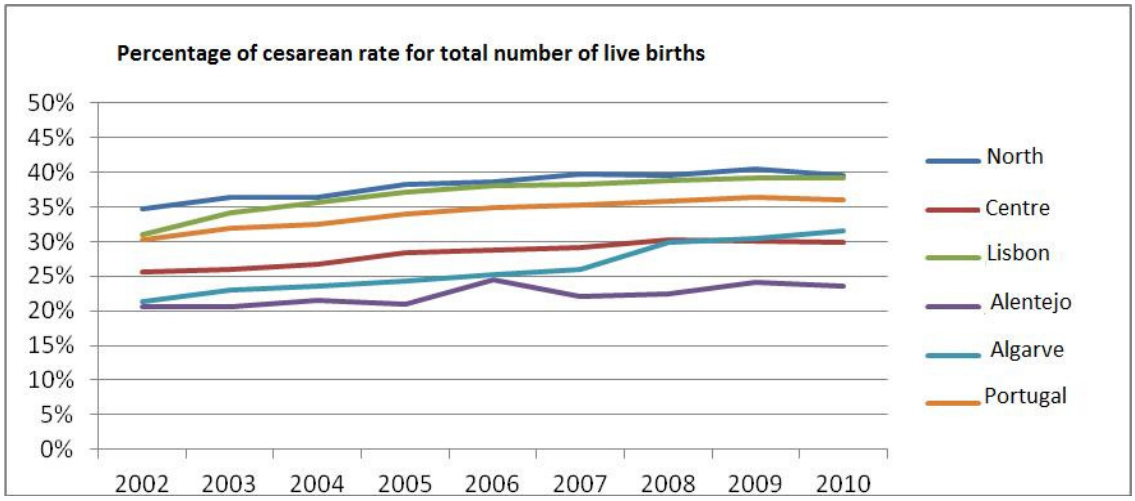



Source: OECD Health Data 2011.

In Portugal, the performance of c-sections is not highly different across regions. Although there are more deliveries by cesarean on the north of the country – graph 2. For our analysis, we take the aggregated number of cesareans in Portugal and disregard the regional disparities.

Some more descriptive numbers in Portugal: the number of public hospitals (57%) is similar to the number of private hospitals; the number of obstetricians and gynecologists has increased by nearly 9% in 7 years: there were 1344 doctors in 2003, and 1461 in 2010. Graph 2 shows the differences of the cesarean rate among the Portuguese regions. The differences are not extreme and are maintained over time. The higher percentage of cesarean rate is to be found in the north and in Lisbon while the south (Alentejo) presents the lowest rate.

Graph 2




The factors that explain the choice of a cesarean birth are several. Ecker and Frigoletto (2007) group these factors in three classes: technological changes, women preferences changes and doctors' behavior changes.

This last factor is quite relevant because it includes the induced demand of cesareans. There are several studies on this topic, in particular, on the induced demand of cesareans. Moreover, the results are not consensual. On the one hand, some works find the evidence of induced demand for c-sections such as Gruber and Owings (1996), Fabbri and Monfardini (2001), Muinelo, Rossi and Triunfo (2005), and also Kim (2009). On the other hand, the research by Das (2002) does not find significant statistical evidence of induced cesareans in a cross country analysis.

The induced demand can be explained and captured in different ways. Shain and Roemer (1959) and Roemer (1961) showed that the after an increase in the supply of hospital beds, there was a very strong correlation between beds availability and its utilization. Another way is proposed by Rice (1983). His argument is that doctors have a target-income and they promote their own services up to that target-income. The limit to the induced demand comes from ethical factors, as referred by McGuire and Pauly (1991).

**3. Variables and econometric model**

The variable to be explained is the number of cesareans performed in Portugal, between 2002 and 2010. Because this variable is a natural number, the type of econometric analysis used is the count data model. The reason we use count data comes from the fact that we aim at determining the average behavior of the women choosing cesareans in Portugal, given the aggregated controls we have considered (Wooldridge, 2009).

The control variables are grouped in those explaining the social characteristics of mothers – age, education and occupation, hospital characteristics – private and public, and others – number of doctors (obstetricians and gynecologists), number of multiple births and income per capita.

A comment on the hospital characteristics is worth. The national statistics do not provide the number of bed in public hospital and the number of beds in private hospitals. To capture the hospital characteristics of each region we construct a proxy. The total number of beds and the number of private and public hospitals are available. So we did two ratios that provide the average number of beds per hospital, either private or public (the ratios are computed as total number of hospital beds to number of private or public hospitals in each region).

In table 1 – control variables description

| | | |
|---|---|---|
| mother characteristics | <20 | Number of live births for mothers under 20 y.o. |
| | 2034 | Number of live births for mothers aged 20-34 y.o. |
| | >34 | Number of live births for mothers aged >34 y.o. |
| | nouniv | Number of live births for mothers with no university degree |
| | univ | Number of live births for mothers with university degree |
| | emp | Number of live births for employed mothers |
| | unemp | Number of live births for unemployed or inactive mothers |
| hospital characteristics | bedpubl | Beds per public hospital |
| | bedpriv | Beds per private hospital |
| other | nrdoc | Number of obstetricians and gynecologists doctors |
| | multibirth | Number of live births for twin/multiple births |
| | incomepc | Per capita income (constant prices, base 2000, thousand €) |

The estimation of count models can be done using Poisson model or Negative Binomial.

Poisson estimation assumes that the conditional variance and mean of the dependent variable are equal. However, analyzing the data for the number of cesareans, it is clear that the variance is significantly larger than the mean, which means that data is overdispersed. Thus, the estimation of our model has to be with Negative Binomial.

Table 2 – Dependent variable statistics

| Variable | | Mean | Std. Dev. | Min | Max | Observations | |
|---|---|---|---|---|---|---|---|
| cesari~a | overall | 6861.933 | 5273.16 | 956 | 14542 | N = | 45 |
| | between | | 5807.5 | 1257.222 | 13840.11 | n = | 5 |
| | within | | 459.7376 | 5032.489 | 7844.489 | T = | 9 |

Since our data is a panel of 9 years, Hausman test[5] allows checking if data presents fixed or random effects.

Before finishing this section, it is worth to mention that the estimated coefficients under Negative Binomial are interpreted as incidence rate ratio[6], where $\beta = \log \frac{(\mu_{x_0+1})}{(u_{x_0})}$. Since the dependent variable can be reinterpreted as a rate itself, meaning the number of cesareans per region, then the estimated coefficient gives the change (increase or decrease) of the dependent variable equal to the factor provided by the estimated coefficient, when the control variable X is increased by 1 unit.

[5] The Hausman test. The hypothesis are the following.
$H_0$: random effects ($\beta^{FE} = \beta^{RE}$) vs $H_1$: fixed effects ($\beta^{FE} \neq \beta^{RE}$).

[6] The estimated coefficients can also be interpreted as the difference between logarithms:
$\beta = \log(\mu_{x_0+1}) - \log(\mu_{x_0})$ when one more unit of the explanatory variable is considered.

**4. Estimated results**

The coefficients for the Negative Binomial estimations are presented in table 2. The dependent variable is the number of cesareans.

Table 2 – Estimated results *(in brackets p-value*)

| Control variables | Negative binomial random effects | **Negative binomial fixed effects** |
|---|---|---|
| <20 | 0,9994579<br>(0,005) | 0,9995283<br>(0,030) |
| 2034 | 1,000299<br>(0,002) | 1,000241<br>(0,018) |
| >34 | 1,000553<br>(0,000) | 1,000157<br>(0,230) |
| nouniv | 0,9988748<br>(0,001) | 0,9992492<br>(0,011) |
| univ | 0,998742<br>(0,002) | 0,999207<br>(0,024) |
| emp | 1,000821<br>(0,003) | 1,000571<br>(0,023) |
| unemp | 1,001028<br>(0,002) | 1,000652<br>(0,025) |
| incomepc | 0,9864729<br>(0,336) | 1,026872<br>(0,207) |
| bedpriv | 1,000408<br>(0,028) | **0,9995902**<br>**(0,352)** |
| bedpubl | 1,00058<br>(0,025) | **1,000433**<br>**(0,151)** |
| nrdoc | 1,003374<br>(0,000) | **1,007322**<br>**(0,000)** |
| multibirth | 1,000487<br>(0,092) | 1,000005<br>(0,983) |
| nr obs | 30 | 30 |
| Wald chi2<br>Prob>chi2 | chi2(12)= 1759,90<br>Prob>chi2= 0,000 | chi2(12)= 194,58<br>Prob>chi2= 0,000 |
| Log likelihood | -197,245 | -146,048 |
| Hausman test<br>Chi2<br>Prob>chi2 | Do not accept $H_0$ so accept $H_1$: fixed effects<br>Chi2(11)= 22,33<br>Prob>chi2 = 0,0219 | |

According to the Hausman test, the panel data is of fixed effects. This makes sense because regions may have some idiosyncratic traits that are correlated with the control variables.

Moreover, a BIC test for model selection was performed. The results are in table 3. The best model is the binomial negative with fixed effects (it presents the lower BIC and Log likelihood).

Table 3 – Poisson vs NB

| Log Likelihood | BIC | |
|---|---|---|
| -235,36 | 514,93 | Poisson, robust |
| **-146,05** | **336,31** | NB, FE |
| -197,24 | 442,11 | NB, RE |

The most relevant result is the evidence that induced demand for cesareans may exist in Portugal. This comes from the positive and significant coefficient of the number of doctors. Accordingly, the increase of one doctor results in an increase of cesarean rate by the factor equal to the estimated coefficient 0,007322.

The induced demand may come from the doctors' competition and target-income that they define and not from the number of available beds since the estimated coefficients are not statistical significant.

The results can be criticized because no matter occupation, there is a positive impact on the number of cesareans. Similarly, no matter the education level, the impact is negative. A less controversial result comes from the age of women. Younger women contribute less for the number of cesareans, while older women contribute more, because of pregnancy and birth risk.

**5. Conclusion**

This work is an exploratory analysis of the factors explaining the number of cesareans in Portugal. The results are preliminary and may be subject to several criticisms. However, there is one result that brings some enthusiasm to this research which is the evidence that the number of obstetricians and gynecologists doctors may be inducing cesareans. This result is particular relevant for policy makers, who may wish to control the number of cesareans, and it

is interesting to doctors to know that competition between them may be causing a bias in their preferences about cesareans. Women should also be aware of this bias when making their decisions about the delivery form of the new born.

Count data is frequently used in health economics; however most studies on cesareans do not use the number of cesareans but the percentage of cesareans (or even a binary decision variable). The choice of a different dependent variable requires a different type of econometric modeling and so different control variables. Moreover, it may be easier to consider regional differences in this case. The future research goes in this direction. Comments are welcome.

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