

HEDG

HEALTH, ECONOMETRICS AND DATA GROUP

WP 19/11

Competition Between Public and Private Maternity Care Providers in France: Evidence on Market Segmentation

Daniel Herrera-Araujo and Lise Rochaix

July 2019

<http://www.york.ac.uk/economics/postgrad/herc/hedg/wps/>

Competition Between Public and Private Maternity Care Providers in France: Evidence on Market Segmentation

Daniel Herrera-Araujo*, Lise Rochaix†

Abstract

The French market for hospital care is shared by public and private providers. In addition to covering a number of mandates usually not undertaken by the private sector such as training, research, and disease prevention, public hospitals are required to provide basic care across the French territory. To investigate the existence of market segmentation between public and private care providers, we focus on maternity care and first examine to what extent public and private maternity units substitute each other on an extensive margin, to then analyze how competition plays out on an intensive margin. Consistent with the public mandate, our findings indicate that, after a private unit closure, public maternity units are less likely to exit a low-populated area than a high-populated area. In addition, we find evidence of an asymmetric intensive margin substitution between private and public maternity units. Maternity users tend to substitute private units (non for-profit and for-profit) for public units more often than the reverse.

JEL Codes: D03, D12, L13, L22, L81.

Keywords: maternity units; substitution; demand estimation; public-private.

*Corresponding author (e-mail: daniel.herrera@dauphine.psl.eu), Université Paris-Dauphine, LEDA (CGEMP)

†Hospinnomics, Paris School of Economics - Université Paris 1

1 Introduction

In developed countries, hospital care is of upmost importance both because of its size relative to GDP and its impact on individuals' well-being. In France, this industry is divided into a public and a private sector, with the latter comprising both for-profit and non for-profit hospitals.¹ Generally, public provision of services is justified when market failures lead to an under provision of private services. In the hospital market, however, it is not clear to what extent market failures exist.² Hence, given the presence of the public sector, some crowding-out might be occurring depending on whether the markets are segmented or not. This paper sets out to investigate if, and to what extent, crowding-out may be at work by focusing on in the French maternity wards market.

The hospital care public-private mix (and its alleged vices and virtues) has been hotly debated in the 90s when a number of countries undertook structural reforms to enhance competition in health care financing (the Netherlands, Switzerland) or provision (the UK), with a subsequent stream of theoretical research on the optimal public-private mix of services (Brekke et al. 2006; Brekke et al. 2011; Bardey et al. 2015). However, most of the empirical literature has focused on the impact of competition on the provision of quality (Dranove et al. 1992; Kessler et al. 2000; Tay et al. 2003; Propper et al. 2004; Propper et al. 2008; Gaynor et al. 2013). To the best of our knowledge, there is only one empirical paper, by Cooper et al (2018), which specifically deals with public and private hospitals' competition. The paper focuses on private hospitals' entry in the UK market, yet only considering the intensive margin, quality, and not the extensive margin, actual entry.³ Similarly, there has been a great deal of interest in recent years in competition between private and public providers of education, but evidence is also quite thin (Epple et al, 1998; Hoxby 2000; Epple, et al., 2004). Our paper seeks to fill the gap in the literature.

With one of the largest hospital industries worldwide, and increasing expenditure in health care, the historical division between public and private providers in the

¹With more than 30% of activity in the hospital market, the private sector in France is quite large.

²Other factors calling for public provision are services whose value to the consumer cannot be entirely captured by the supplier and which are, therefore, not supplied by the private sector. For hospital care, such services include research, disease prevention, informing the public and training. These are all part of the public mandate in France, which is mandatory for all public and some of the private (non for-profit) hospitals. This public mandate also includes equal access to health care across France.

³Similarly, in the insurance literature, Cutler (1996) analyses whether public insurance crowds-out private insurance exploiting the expansion of Medicaid between 1987 and 1990. He finds that around 50% of the increase in Medicaid coverage was associated with a reduction in private insurance coverage at the expense of the public insurance.

French hospital sector offers unique insights into the competition between public-private mix of health care services. Among all services, maternity care is most representative of this public-private mix, inasmuch as users' preferences for public or private providers play an important role. Public hospitals are required to provide basic care across the French territory and exit decisions are taken at national and local level, usually for risk prevention. Private exit decisions on the other hand are taken unilaterally, usually based on profitability arguments.

We focus on French maternity markets to investigate to what extent public and private maternity units are substitutes by exploiting two sources of variation: (1) the variation over time in the number of maternity units; (2) the variation in users' choices. We are interested in assessing whether there is a substitution on the extensive margin of maternity units between sectors, and conditional on the number of units in the market, assessing whether there is a substitution on the intensive margin between the public and private providers.

On the extensive margin substitution, our results suggest that after an exit of a public unit, a near-homogeneous number of private maternity units replace the public unit, regardless of the size of the market which the public maternity exited. However, after an exit of a private unit, public units replace the private unit only in smaller markets. This approach parallels that of Berry & Waldfogel 1999, who studied the links between market size and the number of firms active in the market for radio stations in the U.S. Their results suggest that public stations crowd-out private stations only in larger markets. Unlike Berry & Waldfogel (1999), we find evidence of extensive margin substitution across all market sizes, consistent with an entry model with a constant fixed cost where firms capture all expected benefits.

On the intensive margin substitution, we provide evidence using two complementary approaches: a reduced form approach, which exploits a catchment area analysis; and a structural demand approach, which exploits user level decisions. Our reduced form results suggest that public units' market shares decrease with the number of public units in the same market but are not affected by the number of private units. Similarly, private units' market share decrease with the number of other private units but are not affected by the number of public units. Our structural demand approach reveals that the level of substitution is highly asymmetric. The public sector seems to be better placed than the private sector to capture the maternity care market. We explicitly account for the risk-tiered maternity provision of care and find evidence of asymmetric substitution between public and private maternity units even within each risk-tiered level.⁴

⁴In France, all units are risk-tiered in three levels (level 3 being the most technical), defined by the level of neonatal care provision, which conditions the gestational age and risk profiles the unit

The paper is organized as follows: section II describes the French maternity units' market; section III presents the data and some descriptive evidence on the relationship between public and private maternity units of different sizes; section IV presents the empirical strategy and the results; section V discusses and concludes.

2 Market Characteristics

The market for maternity care in France has experienced substantial changes in the past decades, with a steady reduction in the number of maternity units, from +600 in the early 2000 to +500 today. Safety regulations which were introduced in 1972, 1988 and, more recently, in 1998 may be accountable for part of this reduction. All hospitals with maternity units now have an obligation of providing 24/7 consultant-level obstetrician services, either on site, for units with more than 1,500 births, or on call, and available within 20 minutes for units with less than 1,500 births. All maternity units are required to have 24/7 midwife presence. These requirements have introduced significant fixed and variable costs, leading to a potential decrease in the profitability of maternity units.

The 1998 regulation divided the French maternity units into a three level risk-tiered system: level 1 maternity units handle pregnancies with no particular risk factors, which represent the largest number of births; level 2 maternity units offer neonatal intensive care and treatment for premature infants from the 33rd week of pregnancy; maternity units of level 3 specialize in births with severe complications, including extreme premature births, high risk pregnancies and provide newborn resuscitation. All units are organized in networks centered on level 3 units, with clear transfer protocols and network arrangements in case of unforeseen complications. Hence, French maternity units are not only differentiated by their ownership status but also their respective responsibilities, with transfers organized according to severity within the network.⁵

However, most of the recent exits of private for-profit maternity units might be explained by a more recent reform: the adoption in 2004 of a Diagnosis Related Group (DRG) hospital funding scheme. Since then, every hospital, public or private, is funded according to a nationally fixed rate, set for each DRG. Before 2004, the private sector was mainly funded through regionally negotiated tariffs, while the public sector was funded by a global budget. As additional patients now represent additional revenues, the DRG system introduces high-powered activity incentives

may admit.

⁵Unfortunately, we are not able to observe these transfers across maternity units.

for public hospitals. By 2008, all public hospitals in France were under this DRG payment scheme (Choné, 2017).

Finally, users can freely choose between public or private maternity units. As child birth costs are mostly covered by the national health insurance, price differences play a minor role in the maternity unit choice. Extra billing for a particular physician or a single room will be refunded by supplementary health insurance.⁶ This implies that non-price attributes, such as proximity, perceived safety or staff responsiveness play a prominent role in the maternity unit choice.

3 Data

To consistently estimate the competitive effects of public versus private maternity units, we require detailed information on the number, location, level and activity of each unit. We construct a merged database on obstetric services offered by public and private hospitals in France. The following section describes the different data sources linked to construct this unique database.

3.1 Data sources

Our main source of information is an extraction from the *Programme de médicalisation des systèmes d'information*, PMSI, a publicly available administrative database providing an exhaustive and nationwide record on hospital activity. ScanSanté is based on a DRG-classification of activities, covering all public and private hospitals. It provides data on all claims paid by the national health insurance to hospitals and is therefore the main source of information on hospital activity and associated expenditure. We use information on the total number of clinical procedures filed from 2009 until 2014. We supplement our data with the number of patients' standardized discharge records per unit-DRG pair and their residence zip-code.

For information at maternity unit level, we use Hospidiag, a publicly available meta-database gathering detailed hospital-level information on activity, financial status, heavy equipment, labor force, among other relevant variables. As hospital characteristics vary over time (i.e., the number of mid-wives per obstetrician or C-section rates may change over the course of a couple of years), controlling for such time-varying characteristics is necessary to avoid potential confounding effects.

⁶Almost 90% of men and women in working age are covered by a voluntary private health insurance, in addition to the coverage provided by the national health insurance system. Out-of-pocket payments are quite low.

We supplement our main data source with variables from *Fichier National des Etablissements Sanitaires et Sociaux* (FINESS) database, which is a national directory of health and social establishments maintained by the Regional Department of Health and Social Affairs (fr. *Direction régionale des affaires sanitaires et sociales*) and the Departmental Directorate for Health and Social Affairs (*Direction Départementale des Affaires Sanitaires et Sociales*). Each FINESS identifier is paired with data on the hospital’s geographic location, legal status, field of activity, date of opening and closure (if any), and other hospital level characteristics.

3.2 Summary statistics

To capture general tendencies, table 1 reports summary statistics for maternity units in France from 2009 to 2014. There is substantial variation in the number of births across departments, with an average number of births per department of around 13000 births, ranging from 500 births to 56000 births. On a department level, we see that maternity unit market shares also display substantial variation.

On average, the length of stay in a maternity unit follows clinical guidelines. The ratio between the number of days spent on a maternity unit and the number of days recommended by clinical guideline is 1. Users have a 20% probability of having a C-section and a 75% probability of having an epidural. There are around 50 births per obstetrician, while there are 4 mid-wives per obstetrician. The bed utilization ratio is close to 60% (a rate higher than 100% implying that beds assigned to the obstetric department are used for other conditions), and the average number of beds is close to 42. Regarding technical equipment, hospitals and clinics that include a maternity unit service have on average a number of scanners and MRIs of 1.8 and 1.9, respectively.

The public sector has, on average, the largest number of maternity units per department (4.4), compared to the for-profit sector (2.6) and the non for-profit sector (0.5). Most of the public units are of level 2, while most of the for-profit and non for-profit units are of level 1. Changes over time in the number of maternity units and in their level are reported in Table 2. We observe an overall decrease in the number of level 1 units across all sectors, with a stronger effect for the private sector. This results from either unit closures or, to a lesser extent, changes in unit level for the for-profit sector (No level changes occur for non for-profit units over the study period).

An analysis of the distribution pattern of private and public maternity units across departments in France allows to assess the extent to which the number of units correlate with the demand for maternity care. We expect that in smaller markets,

Table 1: Maternity Units Summary Statistics

Variables	Mean	Std dev.	Min	Max
# of births per department	12825	9301	651	36,703
Hospital characteristics				
Relative length of stay	0.994	0.0736	0.452	1.390
C-section rate (in %)	19.98	4.238	6.260	46.45
Epidural rate (in %)	74.07	14.46	0.130	98.90
Births per obstetrician	49.55	90.32	1	4,840
Mid-wife per obstetrician	3.786	1.792	0.200	21.30
Bed utilization rate	59.08	15.47	0.200	319.4
Number of beds	42.01	50.28	3	1,077
Number of scanners	1.786	1.987	0	43
Number of IRM	1.894	1.644	0	34
Certification level 2	0.0287	0.167	0	1
Certification level 3	0.172	0.378	0	1
Certification level 4	0.131	0.337	0	1
Certification level 5	0.279	0.449	0	1
# of for-profit maternity units				
Level 1	1.805	1.717	0	6
Level 2	0.816	0.976	0	4
All	2.622	2.224	0	8
# of non for-profit maternity units				
Level 1	0.369	0.756	0	3
Level 2	0.161	0.426	0	2
All	0.531	0.898	0	4
# of public maternity units				
Level 1	1.564	1.399	0	6
Level 2	1.991	1.504	0	7
Level 3	0.795	0.735	0	3
All	4.349	2.592	1	14
Patients characteristic				
Driving time to maternity unit (mins)	21.91	20.98	2.06	130.37

Table 2: Number of Public and Private Maternity Units (2009 - 2014)

Panel A: Public				
	All	Level 1	Level 2	Level 3
Year				
2009	340	128	149	63
2010	334	123	148	63
2011	332	121	148	63
2012	329	118	148	63
2013	328	114	151	63
2014	327	113	151	63

Panel B: Private for-profit				
	All	Level 1	Level 2	Level 3
Year				
2009	165	117	48	0
2010	154	108	46	0
2011	149	103	46	0
2012	144	98	46	0
2013	142	95	47	0
2014	140	90	50	0

Panel C: Private non for-profit				
	All	Level 1	Level 2	Level 3
Year				
2009	32	24	8	0
2010	31	23	8	0
2011	31	23	8	0
2012	30	22	8	0
2013	29	21	8	0
2014	29	21	8	0

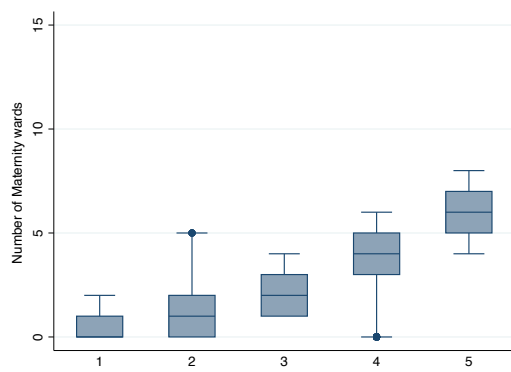
public units are the main providers of maternity care because private maternity units cannot profitably sustain activity. In larger markets, public and private maternity units are likely to be rivals. Figure 1 depicts the relationship between market size per birth quantile, as measured by the number of births by department, and number of private, non for-profit and public units, using a box-and-whiskers plot. This plots give a simple descriptive and "non-parametric" fit to the distribution of maternity units. As figure 1 shows, the number of for-profit, non for-profit and public maternity units increases with the size of the market. The fact that the number of maternity units is positively related to market size is not surprising. As users care about how distant maternity units are from their home, this naturally creates geographically separated markets. As the cities/departments grow in population size, say by adding new neighborhoods, maternity units too far away from a mother's home will not be part of the consideration set. Hence, we expect that the number of maternity units will have a linear relationship to the market size. Finally, the average driving time between the centroid of a zip-code and a maternity is 22 minutes.

Figure 2 depicts the relationship between market size per birth quantile and the number of units per 1000 births. In line with the idea of geographically segmented markets, we observe a nearly constant number of maternity units across all market size per birth quantiles for the private sector. A maternity unit in the private for-profit sector seems to require around 3000 births for sustainability. Nevertheless, we observe a negative relationship between the birth quantiles and the number of public maternity units. The implied number of births needed to sustain a public maternity unit is equal to 1000 births in the first birth quantile, and it converges to the private sector number of births in the fifth birth quantile. The fact that public maternity units can operate with a lower number of births than the private sector suggests that they might be incurring financial losses.⁷ Moreover, the locations where public units are operating at loss correspond to departments where under-provision is more likely to occur.

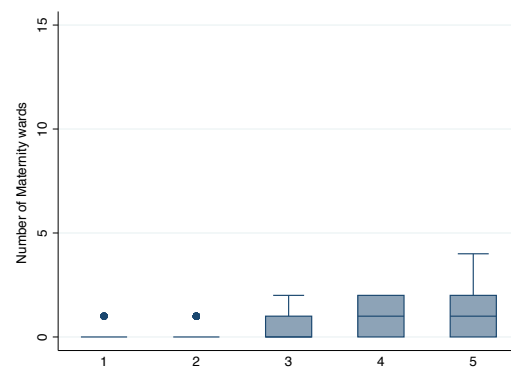
4 Empirical Strategy

In order to investigate the structure of the French market for maternity units, we first analyze the extent to which private maternity units compete with other private units (for-profit and non for-profit) or with public maternity units on an extensive margin in the same market, using a reduced form approach. Next, we analyze the

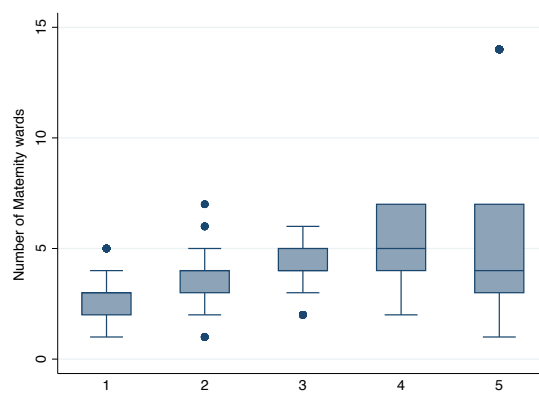
⁷It might also be the case that publicly operated maternity units are less expensive than private units, although this seems unlikely.



(a) Private for-profit maternity units

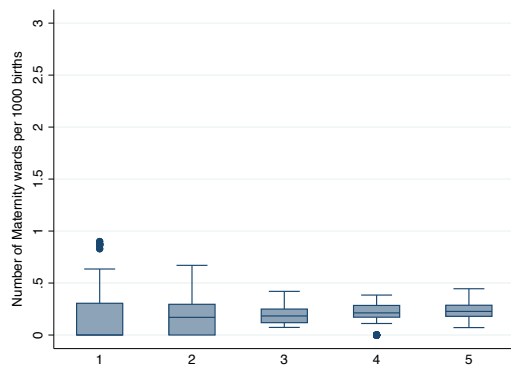


(b) Private non for-profit maternity units

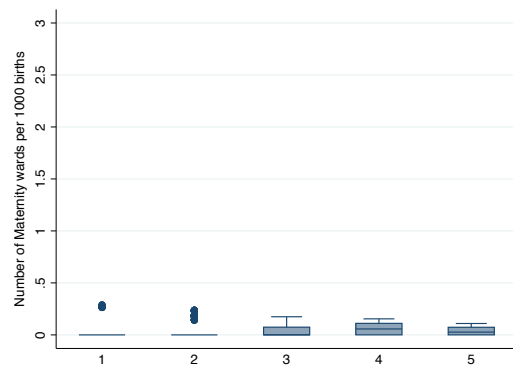


(c) Public maternity units

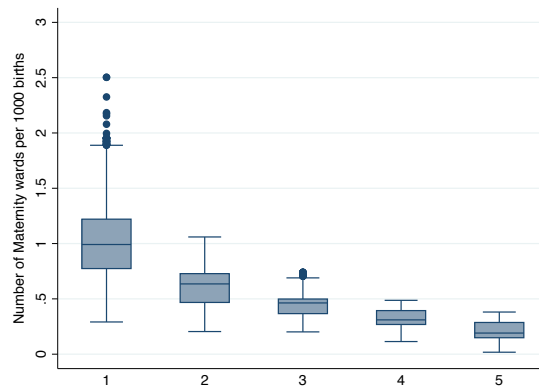
Figure 1: Number of maternity units, by birth quantile



(a) Private for-profit maternity units



(b) Private non for-profit (PSPH) maternity units



(c) Public maternity units

Figure 2: Number of maternity units per 1000 births, by birth quantile

intensive margin using two complementary approaches: (1) a reduced-form analysis to assess the substitutability between maternity units; (2) a structural model of demand to assess the substitutability between competing maternity units from the users' point of view.

4.1 Extensive margin substitution analysis

In this subsection, we introduce the reduced-form analysis on extensive margin substitution between private and public hospitals at an aggregate level. We first define the relevant market, we then provide the empirical strategy followed by the results.

4.1.1 Market definition

As the extensive margin analysis examines the correlation between the number of public and private units, it requires the markets to be fixed. For this, we define the relevant markets of maternity unit using department borders, which results in 95 markets that vary in population size. The departments are further divided into quantiles according to their population size to examine differences between market sizes. Within each department, we aggregate activity between private and public sectors.

A general concern related to market definition is the size of the market. Too large market definitions will include too many competitors and hence, the effect of competition will be underestimated. Too small market definitions, on the other hand, will overestimate the relation, because less direct competitors are excluded. French departments are relatively large and hence, there is the possibility of relatively high differences between travel times to different maternity unit. Considering this, we assume that our strategy is more likely to identify too many units as potential competitors and therefore underestimate the substitutability between units that are effectively competing for users. Furthermore, using department boundaries as markets may introduce a bias through competitors that are located close to a unit, but in a different department.

4.1.2 Empirical strategy

We wish to assess whether there is substitution on the extensive margin between public and private activity. For the private sector to enter and stay in the market, the demand for maternity services must be high enough so that the revenue covers the fixed costs of providing care. However, the public sector might operate incurring

losses primarily to fulfill its public mandate regarding its public health service to the community.

To investigate whether substitution on the extensive margin is occurring between private and public units, we regress the number of maternity units in a market on its market determinants along with the number of competitors from a different sector in the same market. We interact the number of competing units from a different sector with birth quantiles dummies to assess the competitive impact on varying market sizes. We use the following specifications:

$$FP_{mt} = \kappa_1 + \sum_{k=1}^5 \beta_{1k} * PU_{mt} * BQ_{mt}^k + \sum_{k=1}^5 \beta_{2k} * NFP_{mt} * BQ_{mt}^k + \gamma_m + \gamma_t + \epsilon_{mt}^1, \quad (1)$$

$$PU_{mt} = \kappa_2 + \sum_{k=1}^5 \beta_{3k} * NFP_{mt} * BQ_{mt}^k + \sum_{k=1}^5 \beta_{4k} * NFP_{mt} * BQ_{mt}^k + \gamma_m + \gamma_t + \epsilon_{mt}^2, \quad (2)$$

where FP_{mt} and PU_{mt} represent the number of maternity units in the market m , at period t , respectively for for-profit units and public units; BQ_{mt}^k are dummy variables equal to 1 when market m at period t is among the j 's quantile in terms of number of births per market across all markets in France; γ_m and γ_t are department and time fixed effects, respectively.

As we control for department fixed effects in these regressions, our identifying variation comes from two different sources: (1) the exit of maternity units of different types across the different birth quantiles; (2) the variation in the number of births, which shifts the birth quantile ranking across the markets. As the ranking across birth quantiles is fairly constant across departments, the most important source of variation comes from the variation in the number of units. To the extent that assuming that unobservable characteristics (for example, tastes for public/private maternity wards) do not change over time might be a strong assumption, our results are intended to present correlations rather than a causal impact.⁸

4.1.3 Results on extensive margin substitution

In Table 3, we report the estimated coefficients for the extensive margin substitution analysis, estimated separately for private maternity units (columns (1)), and for public maternity units (columns (2)). An observation is a department in one year. The dependent variable in all regressions is the number of maternity units per

⁸Although not reported, we performed robustness checks using one-year lags for the explanatory variables. The results are robust to this alternative specification.

sector in the department. Independent variables are the number of units, interacted with birth quantile dummies. The number of private units is used in columns (1), while the number of public units is used in columns (2). Although not reported for simplicity's sake, the number of private non for-profit units, interacted with birth quantile dummies, is used in both regressions. Department-fixed effects, time-fixed effects and the number of births per department are also included in the regressions.

Table 3: Extensive Margin Substitution Between Maternity Units

	Replacement of	
	private by public	public by private
Birth quintile 1 x # maternity unit	-0.191** (0.0861)	-0.261** (0.116)
Birth quintile 2 x # maternity unit	-0.259** (0.104)	-0.372*** (0.112)
Birth quintile 3 x # maternity unit	-0.263** (0.102)	-0.0901** (0.0416)
Birth quintile 4 x # maternity unit	-0.281*** (0.101)	-0.0637** (0.0244)
Birth quintile 5 x # maternity unit	-0.187* (0.106)	-0.0568*** (0.0181)
Observations	564	564
R-squared	0.97	0.97
Number of departments	94	94
Department FE	YES	YES
Year FE	YES	YES

Notes: Dependent variable is the number of maternity units per department. Each column represents a different regression focusing on a subset of maternity units. The subset for each column is indicated by the column header. Standard errors are clustered at the department level.

Looking at the number of all private maternity units per department (column (1)), our results indicate that there is evidence of replacement between public and private units in departments across all birth quantiles. If we view the number of public units as exogenous, 10 less public units are associated to not more than 1.8 fewer private units in markets of birth quantile 1 and 5, and to no more than 2.5 fewer private units in markets of birth quantile 2, 3 and 4. The correlation across departments is consistent with the hypothesis that the number of births required to sustain a private unit is constant across markets and that an additional public maternity unit captures enough births to displace an almost constant number of private units across departments.

As reported in column (2) of Table 3, we find some evidence of replacement from the private sector to the public sector. The number of public units is negatively correlated with the number of private units across all market sizes. However, the effect is not homogeneous. One less private unit is associated with a higher replacement of public maternity units in a low-birth department than in a high-birth department.

Moreover, the replacement is quite small in high-birth departments, which might indicate a one-way replacement between public and private units. As the number of units is small in less populated departments, as opposed to more populated departments, this pattern is consistent with the observation that public units are required to comply with a public health service national coverage, while the private units are not.

4.2 Reduced-form analysis on intensive margin substitution

In this subsection we introduce the reduced-form analysis of substitution between private and public hospitals. As the analysis is carried out from the hospitals' point of view, we first illustrate how we defined each hospital's competitor, we then provide the empirical strategy followed by the results.

4.2.1 Maternity units market definition

To define a market, two main elements are required: product definition and geographic definition. As we are dealing only with maternity units, the product definition is trivial. However, as patients are assumed to minimize their travel distances, a geographic market definition is required. We expect patient to be heterogeneous in their travelling preferences, leading to markedly different geographical markets across regions (Capps et al 2001; Varkevisser et al., 2007; Cooper, 2010).

We use a catchment area analysis to define geographical markets. We do so by computing the driving time required from the user's to the clinic's location, as defined by the centroids of the postal codes. The geographical market around a hospital is defined by the traveling distance times around the hospital (from now on, the focal unit) from which 80% of patients originate.⁹ That is, the hospital's catchment area can be understood as the distance (in traveling time) that the majority (80%) are willing to travel. Any public or private hospital within this traveling distance is considered to exert a competitive constraint on the focal unit. Using driving time, rather than a fixed radius, reduces the likelihood of having distorted geographical markets due to population density (Cooper et al., 2010).¹⁰ To construct the mater-

⁹We vary the size of the threshold from 75%, 95% and 99%. Our findings are robust to the choice of the threshold.

¹⁰There are several precedents of use of isochrones as proxies for geographical markets. In France, the relevant geographic markets are defined as local markets within a radius of 30min driving time. The radius may be extended up to one hour depending on the type of care, the population density, the available hospital infrastructure (Choné, 2016). In the UK, merger investigations used isochrones of 30 minutes defined by having 80% of private hospital patients come from areas within a 30-minute drive-time (Office of Fair Trading, 2008a; Office of Fair Trading, 2008b). Isochrone analysis has also been used for defining geographical markets in the NHS hospital mergers. All

nity unit j 's market share, we divide the number of births born in maternity unit j by the total number of births born in its' catchment area.¹¹

4.2.2 Empirical specification

To assess the substitutability between private and public maternity units, we regress the natural logarithm of the focal unit market share on the natural logarithm of the number of for-profit, non for-profit and public hospitals located within the market of each focal unit. To account for the competitive pressure between hospitals, we use the distance-to-hospital weighed number of competitors by applying as weights the inverse of the distance to the focal unit. This implies that the further away a competitor is located, the smaller the competitive pressure to the focal unit.¹²

We distinguish the impact of the number of public, for-profit and non for-profit units in the markets on private units' market shares and control for unit- and time-fixed effects. The specification is as follows:

$$\log(s_{jt}) = \beta_0 + \beta_1 \log(FP_{jt}) + \beta_2 \log(NP_{jt}) + \beta_3 \log(PU_{jt}) + \gamma_t + \gamma_j + \alpha_1 X_{jt} + \epsilon_{jt}^1, \quad (3)$$

where $\log(s_{jt})$ is the natural logarithm of the market share of the maternity unit j in year t ; FP_{jt} captures the distance-to-hospital weighted number of for-profit units in maternity unit j 's catchment area and in year t ; and NP_{jt} and PU_{jt} are, respectively the distance-to-hospital weighted number of non for-profit status and public maternity units in maternity unit j 's catchment area and in year t ; X_{jt} are time-varying controls specific to unit j , as reported in table 1. Finally, γ_t , γ_j , ϵ_{jt}^3 capture time-fixed effects, unit-fixed effects and unit-time idiosyncratic variation, respectively.

In addition, we also distinguish the impact of the competitive pressure depending on the population size of the department. The specification is as follows:

$$\begin{aligned} \log(s_{jt}) = \beta_0 + & \sum_{k=1}^5 \beta_{1k} \log(FP_{jt}) \times BQ_{jt}^k + \sum_{k=1}^5 \beta_{2k} \log(NP_{jt}) \times BQ_{jt}^k + \\ & \sum_{k=1}^5 \beta_{3k} \log(PU_{jt}) \times BQ_{jt}^k + \gamma_t + \gamma_j + \alpha_1 X_{jt} + \epsilon_{jt}^1, \end{aligned} \quad (4)$$

hospitals within a 30-40 minutes drive-time were considered as belonging to the same geographical market.

¹¹We are able to know the number of birth per zip-code per year. Thus, we sum the births over the zip-codes that belong to each maternity units catchment area.

¹²In a separate specification, we also control for the size and the distance to the focal unit. We measure the size of a hospital using the number of beds. Our findings are robust to this re-weighting.

where BQ_{mt}^j is a dummy variable that equals one if the market of the focal unit, m , is located within a department that is considered as belonging to the j th quantile in the French birth population distribution at year t , and zero otherwise.

Our identification strategy entails potential endogeneity issues. That is, unobserved market characteristics might influence both the maternity units' market shares and the number of competing maternity units. For example, if users strongly prefer public provision, more public units will be present and private units will have smaller market shares. The estimated relation between the number of public and private units' market shares not only captures the substitution patterns between the two types of units, but it will also encompass future users' preferences for public units, if such were to be the case. To try to correct for these potential endogeneity sources, we control for hospital fixed effects. With these fixed effects, our identifying variation is solely derived from changes in the number of competitors over time. Therefore, as long as hospital environments, including households' tastes, do not change over time, we control for these sources of endogeneity.

4.2.3 Results

In Table 4, we report the estimated coefficients for the model assessing the potential substitution between maternity units. We report separately the potential substitution for private units (columns (1), (2) and (3)), and for public units (columns (4), (5) and (6)). An observation is a combination of a given year and a given focal maternity unit. The dependent variable in all regressions is the natural logarithm of the focal unit's market share, taking the relevant market of unit. Independent variables are the natural logarithm of the number of other units in the focal unit's relevant market, as well as the focal unit's observed time-varying characteristics. Unit- and time-fixed effects are introduced in all regressions.

For the sequence of results' presentation, we consider results regarding within sector competition (private to private and public to public) and between sectors competition (private to public and public to private) successively.

Considering within private sector competition, results indicate that a focal unit's market share decreases with the number of other private units in high-birth departments. Market shares remain unaffected by the number of other private maternity units when private focal units are located in low-birth departments, indicating no between competition in the private sector in those departments.

Considering within public sector competition, results suggest that a public focal unit's market share decreases with the number of other public units, indicating a within public competition. Public units significantly affect public focal unit's market

Table 4: Reduced Analysis on Substitution Between Maternity Units

	Dependent: Logarithm of market share					
	Focal is Private			Focal is Public		
	(1)	(2)	(3)	(4)	(5)	(6)
logarithm number of FP	-0.159** (0.0609)	-0.295*** (0.0993)		-0.160*** (0.0503)	-0.0156 (0.0470)	
x birth quintile 1			0.0574 (0.273)			0.0804 (0.0546)
x birth quintile 2			-0.132 (0.183)			0.0233 (0.0528)
x birth quintile 3			-0.231*** (0.0642)			-0.0360 (0.0468)
x birth quintile 4			-0.419*** (0.130)			-0.0477 (0.0424)
x birth quintile 5			-0.586*** (0.201)			-0.0251 (0.0573)
logarithm number of PU	-0.224** (0.102)	-0.114 (0.128)		-0.503*** (0.136)	-0.296** (0.122)	
x birth quintile 1			-1.148*** (0.368)			-0.392** (0.176)
x birth quintile 2			-0.984*** (0.278)			-0.238** (0.114)
x birth quintile 3			-0.840*** (0.277)			-0.212* (0.115)
x birth quintile 4			0.205 (0.207)			-0.186 (0.118)
x birth quintile 5			0.00102 (0.0334)			-0.375** (0.177)
logarithm number of NFP	-0.182*** (0.0662)	-0.0526** (0.0256)		-0.0690 (0.0664)	-0.0697** (0.0339)	
x birth quintile 1			-0.215 (0.183)			-0.0543** (0.0267)
x birth quintile 2			-0.0993 (0.117)			-0.0796** (0.0332)
x birth quintile 3			-0.0684*** (0.0231)			-0.0628** (0.0303)
x birth quintile 4			-0.0968*** (0.0292)			-0.0811** (0.0370)
x birth quintile 5			-0.180** (0.0850)			-0.0981** (0.0378)
Observations	774	774	774	1,707	1,707	1,707
R-squared	0.67	0.97	0.97	0.531	0.94	0.94
Hospital FE	NO	YES	YES	NO	YES	YES
Department FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Number of id		145	145		293	293

Notes: Dependent variable is the logarithm of hospitals' market share as defined by their catchment area. The logarithm # of FP, PU and NFP are all weighted by their corresponding distance to the focal unit. Hospitals with only one competitor in either category are not considered in this analysis. Standard errors are clustered at the department level.

shares, with an increase of 10% in the number of public units estimated to decrease a public focal unit market share by 2.96%. This effect seems to be consistent across markets of different sizes. Although the effects are only statistically significant in departments with birth quantiles 1, 2, 3 and 5, the point estimates are quite consistent across birth quantiles.

Regarding between sector competition, we first consider the impact of public units on private market shares. We find that, on average, the market shares of private units do not statistically decrease with the number of public units. The point estimate suggests that an increase of 10% in the number of public units decreases the market shares by 1.14%, but it is not precisely estimated. However, the effect is statistically significant for market shares of private focal units located in low-birth departments. An increase by 10% of the number of public units in these markets decreases private market shares by up to 11.5%. Turning to the impact of private units on public market shares, we find that public market shares are not affected by the number of private units. These results suggests that competition occurs within sectors, and to a lesser extent, in an asymmetric way, across sectors.

4.3 Structural-form analysis of substitution

In this subsection we introduce the structural-form analysis of substitution between private and public hospitals. The analysis focuses on the users' point of view. We first present our theoretical model of demand for maternity units, next we provide the empirical specification, followed by the results.

A model for maternity unit demand

Let user's i indirect utility of choosing maternity j at period t be denoted by U_{ijt} . We assume that patients choose a unit that yields the highest utility. We model utility as:

$$U_{ijt} = \beta x_{ijt} - \alpha dist_{ij} + \xi_{ijt} + \bar{\epsilon}_{ijt}, \quad (5)$$

$$i = 1, \dots, I, \quad j = 1, \dots, J \quad t = 1, \dots, T$$

where x_{ijt} is a K -dimensional (row) vector of observable characteristics; $dist_{ij}$ corresponds to the distance between the unit l and the geographical center of the patient's zip-code; ξ_{ijt} is the user's i (unobserved) perceived quality of the maternity unit j .

The users valuations for the maternity unit j , $\bar{\epsilon}_{ijt}$, follows the distributional assumptions of the nested logit model, which allows valuations to be correlated across products in the same group. More specifically, each maternity can be assigned

to one of 4 collectively exhaustive and mutually exclusive groups, $g = 0, \dots, 3$ where group 0 is reserved for the outside good 0. The three remaining groups are, private for-profit, private non for-profit and public. Let,

$$\bar{\epsilon}_{ijt} = \zeta_{igt} + (1 - \sigma)\epsilon_{ijt}, \quad (6)$$

where ϵ_{ijt} is i.i.d extreme value and ζ_{igt} follows the distribution such that $\bar{\epsilon}_{ijt}$ is extreme value. The nesting parameter σ , with $0 \leq \sigma \leq 1$, proxies for the degree of preference correlation between products of the same group. As σ goes to 1, the within-group correlation of utilities goes to 1, and consumers perceive products of the same group as perfect substitutes. As σ goes to 0, the within-group correlation goes to 0, and the model reduces to the simple logit. Idiosyncratic shocks are assumed to be known by users but neither by maternity units nor by the researcher. To complete the demand model, we consider maternity units as "outside" units if they are further away than the median unit from the users' location and "inside" units otherwise.¹³ Users' indirect utility from the outside option is:

$$U_{oit} = \xi_{oit} + \epsilon_{ot}.$$

Given this, the probability that user i chooses maternity unit j at period t takes the nested logit form:

$$\pi_{ijt} = \frac{\exp((\beta x_{ijt} - \alpha dist_{ij} + \xi_{ijt})/(1 - \sigma)) \exp I_{ig}}{\exp(I_{ig}/(1 - \sigma)) \exp I_i},$$

where I_{ig} and I_i are defined by:

$$I_{ig} = (1 - \sigma) \ln \sum_{k=1}^{J_g} \exp((\beta x_{ikt} - \alpha dist_{ik} + \xi_{ikt})/(1 - \sigma)),$$

$$I_i = \ln \left(1 + \sum_{g=1}^3 \exp I_{ig} \right).$$

Following Berry (1994), it is possible to derive a simple analytic expression for the mean utility levels,

$$\ln(\pi_{ijt}) - \ln(\pi_{iot}) = \beta x_{ijt} - \alpha dist_{ij} + \sigma \ln(\pi_{ijt/g}) + \xi_{ijt}, \quad (7)$$

¹³Although not reported, we consider several specifications in which we varied the threshold. Our findings are robust to this threshold.

where $\pi_{ijt/g}$ is the within group share for unit j conditional on the group g .

Estimating equation 7 requires the following steps. First, due to lack of individual level data, we define the level of the individual at the zip-code level. That is, for each zip-code, we consider that there is a representative user i that chooses across different units. For each zip-code, we define which maternity units are considered as inside units, and which are considered as outside units. Next, to estimate β , α , and σ , we use a linear instrumental variable regression. We do so introducing of zip-code level fixed-effects, which seek to control for unobserved but constant individual-level preferences towards inside units. The endogeneity comes from the correlation between the within share group with the unobservable characteristics. We use competitors characteristics as instrumental variables.

Results

Table 5 reports on the demand estimates from equation 7. An observation corresponds to a combination between a zip-code and a maternity unit considered as an inside option, for each year in our sample. The dependent variable is the difference between the log-share of inside maternity units and the log-share of the outside option for each zip-code. Independent variables are the distance between the centroid of each zip-code and each maternity unit, the unit's observed characteristics, and time and zip-code fixed effects.

The first three columns correspond to specifications under the assumption that the demand behaves as a multinomial Logit, which assumes that σ is equal to zero. Column (1) reports on the least comprehensive model, which controls for distance and the sector of the hospital (where the omitted category is the public sector). Results suggest that users prefer units that are closer to their location. This finding is consistent across all specifications in table 5. Private hospitals are less preferred than public hospitals, while non for-profit hospitals are as preferred as public hospitals. However, as reported in column (2), once the levels of the maternity units are controlled for, both for profit and non for-profit maternity units have a higher mean utility than public units. Finally, the specification in column (3) controls for maternity units characteristics. As expected, individuals prefer maternity units with a higher level of certification, with lower lengths of stay, lower rates of C-sections, with higher rates of epidural and with larger capacity and utilization of such capacity. Also, individuals prefer units that specialize in maternity care, as captured by a lower number of MRI's in the hospital. The results reported in the next three columns (column (4), (5) and (6)) are derived from a nested Logit specification that uses as nests the hospital's sector status (public, for profit or non for profit). The results

are qualitatively the same as those reported in the multinomial Logit.

To assess the substitution between public, for-profit and non for-profit units, we report in table 6 and table 7 the own- and cross semi-elasticities between different units for the multinomial Logit and the nested Logit, respectively. Computing semi-elasticities rather than elasticities allows a within and across columns comparison. As expected from the demand estimates, the own- and cross-distance semi-elasticities are of the correct sign. As reported in the first column of table 6 and 7, the magnitude of substitution effects between different sectors differ. An similar increase of 1km in distance from the users' location makes them substitute more a for-profit and non for-profit than a public maternity unit. Given that maternity units might be considers as a bundle of characteristics, this is consistent with the results from columns (1) and (4) of our demand estimations. However, the substitution is highly asymmetric. Users are more like to substitute from a public maternity unit to another public maternity unit, than from public to for-profit or non for-profit. Yet, users are more likely to substitute from a for-profit maternity unit to a public maternity unit, than from a for-profit maternity unit to another for-profit maternity unit or a non for-profit maternity unit.

Next, we allow substitution patterns to depend on the units' risk levels. More competition is to be expected between units of the same level, as they might offer similar services (close substitutes). Thus, we report the distance own and cross semi-elasticity separately for public, for-profit and non for-profit maternity units, distinguishing the effects of other units according to status and risk levels. We do so by separating the status of for-profit units in the same zip-code, $FP_{mt} = (FP_{mt}^1, FP_{mt}^2)$, as a matrix containing the status of for-profit unit of level 1, FP_{mt}^1 and the status for-profit unit of level 2, FP_{mt}^2 . Analogously, we separate the status of non for-profit units and public units into levels as $NFP_{mt} = (NFP_{mt}^1, NFP_{mt}^2)$ and $PU_{mt} = (PU_{mt}^1, PU_{mt}^2, PU_{mt}^3)$.

The risk-tiered semi-elasticities for the multinomial and nested Logit are reported in tables 8 and 9, respectively. The results are robust to the demand specification. Own-distance semi-elasticities are lower for the public sector, regardless of the level. The cross-distance substitution from the public sector suggests that there is, overall, more substitution from public-to-public than public-to-private. At a finer level, however, substitution from level 2 public units to level 3 public units is as high as level 2 public units to level 2 private for-profit units and non for-profits. However, the opposite does not occur. There is always more substitution from private-to-public than to private-to-private, regardless of the risk level.

Table 5: Estimation for Demand for Maternity Units

	Multinomial Logit			Nested Logit		
	(1)	(2)	(3)	(4)	(5)	(6)
Distance to hospital	-0.0959*** (0.00383)	-0.105*** (0.00367)	-0.108*** (0.00373)	-0.0788*** (0.00324)	-0.0927*** (0.00327)	-0.0993*** (0.00386)
Hospital is FP	-0.167*** (0.0546)	0.361*** (0.0554)	0.307*** (0.0418)	-0.341*** (0.0503)	0.179*** (0.0623)	0.193*** (0.0514)
Hospital is NFP	-0.201 (0.145)	0.365*** (0.115)	0.199** (0.0973)	-0.539*** (0.140)	0.0720 (0.135)	0.0134 (0.105)
Maternity of Level 1		-1.401*** (0.0746)	-0.684*** (0.0998)		-1.212*** (0.0722)	-0.619*** (0.0862)
Maternity of Level 2		-0.600*** (0.0558)	-0.242*** (0.0588)		-0.501*** (0.0505)	-0.208*** (0.0526)
Certification Level 2			0.123 (0.0815)			0.0995 (0.0780)
Certification Level 3			0.179** (0.0712)			0.158** (0.0677)
Certification Level 4			0.199*** (0.0715)			0.178*** (0.0667)
Certification Level 5			0.171** (0.0691)			0.154** (0.0649)
Number of MRI			-0.0957*** (0.0243)			-0.0862*** (0.0228)
Relative length of stay			-0.827*** (0.183)			-0.784*** (0.170)
C-section rate			-0.0148*** (0.00481)			-0.0140*** (0.00423)
Epidural rate			0.00435*** (0.00163)			0.00383*** (0.00149)
Births per obstetrician			0.000127 (0.000109)			0.000119 (9.91e-05)
Mid-wife per obstetrician			-0.00118 (0.00960)			0.000575 (0.00852)
Number of beds			0.0105*** (0.00121)			0.00971*** (0.00124)
Number of scanners			0.0153 (0.0224)			0.00902 (0.0206)
Bed utilisation rates			0.00925*** (0.00296)			0.00844*** (0.00284)
logarithm nest shares ratio				0.225*** (0.0244)	0.146*** (0.0310)	0.101*** (0.0286)
Constant	0.00262 (0.0114)	0.00293 (0.0106)	-0.0123 (0.0101)	0.00269 (0.00915)	0.00294 (0.00934)	-0.0104 (0.00923)
Observations	101,355	101,355	101,355	101,355	101,355	101,355
R-squared	0.369	0.439	0.463	0.523	0.529	0.524

Notes: Dependent variable is the logarithm of units' market shares as defined by their catchment area. The logarithm # of FP, PU and NFP are all weighted by their corresponding distance to the focal unit. Standard errors are clustered at the department level.

5 Discussion and conclusion

In recent years, governments have increasingly opened up health care markets to private for-profit providers. For example, in Norway the health care market for psychiatric care and substance abuse treatment was opened up to private for-profit providers in November 2015. Hence, understanding the impact of privatization is increasingly important. However, even though, the theoretical literature is large, the empirical evidence is rather thin. Our paper exploits the private-public mix in the French maternity care market to provide policy relevant insights. Our empirical assessment of the maternity units market in France supports the hypothesis of a market segmentation.

Our extensive margin results suggests that public maternity units are prone to replace private maternity units in smaller markets, but not in larger markets. Moreover, private units are prone to replace public units across all market sizes. These findings supports: (1) the hypothesis that there is a minimum threshold of demand that private maternity units require in order to operate profitably and stay in the market; (2) given that larger markets can support a larger number of maternity units, users might be more able to select their maternity unit according with their preferences. Taken together, these two points suggest that there is an asymmetric influence between sectors.

Our intensive margins results suggest that public units' market shares decrease with the number of public units in the same market. Similarly, private units' market share decrease with the number of other private units. We do not find evidence on substitution across sectors. To better understand these reduced form results, we estimate a structural demand model. The results from this approach reveals that the level of substitution is highly asymmetric. We find evidence of asymmetric substitution between public and private maternity units even within each risk-tiered level. Also, our results suggest that patients prefer maternity units of higher risk levels, signaling the risk of an inappropriate use of highly technical facilities.¹⁴

Some degree of substitution could also be expected from units of different risk levels. Yet, in case of complications, a fast transfer to a higher level unit is an advantage for a lower level unit, which dampens the substitution effect to be expected between maternity units of different risk levels. Lower level units may therefore benefit from the presence of a closely located higher level unit, through patients' transfers to and from the higher level unit, which reduces the substitution effects to be expected from units of different risk levels. Unfortunately, our data does not

¹⁴Although we do not have the data to test this, anecdotal evidence suggests that users tend to associate higher level maternity units with safer care.

allow us to test these effects.

The strengths of our approach are threefold: First, the choice of a rather unique and under-researched institutional context, i.e. French maternity units, where competition between public and private units is sufficiently developed for substitution analyses to be meaningful; Second, the quality of our merged data set, which enables us to control for risk and quality heterogeneity, in order to compare public and private maternity units; Third, the econometric specification with controls at both local or national level and allows us to focus on comparable activity sub-segments, singling out high level care which is only provided by level 3 public maternity units.

Our study has limitations. Our analysis, like most of the international research that exploits catchment areas, relies on a simple definition of the maternity units catchment area (Wong et al. 2005). Even if robustness checks on the definition of the catchment does not significantly affect our findings, we could still not be capturing the true catchment area of each maternity unit. Another limitation is potential endogeneity issues, as unobserved market characteristics might influence both maternity units' numbers and market shares and the number of competing maternity units. Units fixed effects partly control for this but we must still rely on the hypothesis that units' environments do not change in a different way over time for different units. Our reduced-form results are likely to be underestimating the effects on the intensive and extensive margins of substitution.

Table 6: Mean Own and Cross-Distance Semi-Elasticities – Logit Model

	Own-distance semi-elasticity	Public	Cross semi-distance	
			Private NFP	Private FP
Public	-0.066	0.032	0.030	0.036
Private NFP	-0.088	0.019	0.009	0.016
Private FP	-0.084	0.023	0.016	0.016

Notes: Each entry i, j , where i indexes rows and j columns, gives the percentage change of demand for product category i with respect to change in distance of 1km of j .

Table 7: Mean own and cross-distance semi-elasticities – Nested Logit model

	Own-distance semi-elasticity	Public	Cross semi-elasticity	
			Private NFP	Private FP
Public	-0.065	0.034	0.028	0.033
Private NFP	-0.082	0.018	0.014	0.015
Private FP	-0.080	0.021	0.015	0.019

Notes: Each entry i, j , where i indexes rows and j columns, gives the percentage change of demand for product category i with respect to change in distance of 1km of j .

Table 8: Mean Own and Cross-Distance Semi-Elasticities by Level – Logit Model

	Maternity level	Own-distance semi-elasticity	Cross-distance semi-elasticity			Private FP	
			Public	Private NFP		1	2
				1	2		
Public	1	-0.076	0.026	0.027	0.024	0.022	0.019
	2	-0.064	0.036	0.030	0.032	0.031	0.022
	3	-0.075	0.027	0.021	0.020	0.024	0.031
Private NFP	1	-0.089	0.015	0.016	0.013	0.008	0.009
	2	-0.087	0.016	0.010	0.020	0.012	0.008
Private FP	1	-0.087	0.016	0.020	0.017	0.013	0.007
	2	-0.084	0.019	0.016	0.025	0.018	0.016

Notes: Each entry i, j , where i indexes rows and j columns, gives the percentage change of demand for product category i with respect to change in distance of 1km of j .

Table 9: Mean own and cross-distance semi-elasticities by level – Nested Logit model

	Maternity level	Own-distance semi-elasticity	Cross-distance semi-elasticity					
			Public		Private NFP		Private FP	
			1	2	1	2	1	2
Public	1	-0.076	0.028	0.028	0.020	0.018	0.022	0.022
	2	-0.064	0.038	0.032	0.028	0.020	0.033	0.030
	3	-0.074	0.029	0.022	0.022	0.028	0.027	0.028
Private NFP	1	-0.083	0.014	0.015	0.012	0.013	0.014	0.011
	2	-0.082	0.015	0.009	0.016	0.012	0.012	0.012
Private FP	1	-0.083	0.015	0.018	0.016	0.006	0.016	0.014
	2	-0.080	0.017	0.015	0.023	0.015	0.021	0.017

Notes: Each entry i, j , where i indexes rows and j columns, gives the percentage change of demand for product category i with respect to change in distance of 1km of j .

References

- Berry, S. T. & Waldfogel, J. (1999), ‘Public radio in the United States: does it correct market failure or cannibalize commercial stations?’, *Journal of Public Economics* **71**(2), 189–211.
- Brekke, K. R., Nuscheler, R. & Rune Straume, O. (2006), ‘Quality and location choices under price regulation’, *Journal of Economics & Management Strategy* **15**(1), 207–227.
- Choné, P. (2017), ‘Competition policy for health care provision in France’, *Health Policy* **121**(2), 111–118.
- Cooper, Z., Gibbons, S. & Skellern, M. (2018), ‘Does competition from private surgical centres improve public hospitals’ performance? evidence from the english national health service’, *Journal of Public Economics* **166**, 63–80.
- Cutler, D. M. & Gruber, J. (1996), ‘Does public insurance crowd out private insurance?’, *The Quarterly Journal of Economics* **111**(2), 391–430.
- Dranove, D., Shanley, M. & Simon, C. (1992), ‘Is hospital competition wasteful?’, *The Rand journal of economics* pp. 247–262.
- Gaynor, M., Moreno-Serra, R. & Propper, C. (2013), ‘Death by market power: reform, competition, and patient outcomes in the national health service’, *American Economic Journal: Economic Policy* **5**(4), 134–166.
- Keeler, E. B., Melnick, G. & Zwanziger, J. (1999), ‘The changing effects of competition on non-profit and for-profit hospital pricing behavior’, *Journal of health economics* **18**(1), 69–86.
- Kessler, D. & McClellan, M. (2000), ‘Is hospital competition socially wasteful?’, *The Quarterly Journal of Economics* **115**(2), 577–615.
- Melnick, G., Keeler, E. & Zwanziger, J. (1999), ‘Market power and hospital pricing: Are nonprofits different?’, *Health Affairs* **18**(3), 167–173.
- Propper, C., Burgess, S. & Green, K. (2004), ‘Does competition between hospitals improve the quality of care?: Hospital death rates and the nhs internal market’, *Journal of Public Economics* **88**(7-8), 1247–1272.
- Tay, A. (2003), ‘Assessing competition in hospital care markets: the importance of accounting for quality differentiation’, *RAND Journal of Economics* pp. 786–814.

Wong, H. S., Zhan, C. & Mutter, R. (2005), ‘Do different measures of hospital competition matter in empirical investigations of hospital behavior’, *Review of Industrial Organization* **26**(1), 27–60.