THE IMPACT OF HOSPITAL COMPETITION ON MATERNITY CARE IN THE ENGLISH HOSPITAL MARKET[1*]

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Abstract

The policies focusing on the improvements in the quality of health care services have become very popular in recent years. One of the main government policies which can improve quality in health care can be considered as hospital competition. In this paper, I examine whether, hospital competition can improve the quality indicators for maternity care. I investigate whether increasing competition among NHS (National Health Service) hospitals can lead to any improvements in the rate of 28 days of emergency readmissions, baby's mortality, rate of elective c-sections and rates of birth complications at hospital level after 2010 for England by exploiting a suitable econometric setting (difference in differences design). According to the weighted fixed effects regressions, 1 unit increase in market concentration measure (less competition) reduces emergency readmission rate within 28 days of discharge by almost 0.0004 admissions (per 1000 admissions).

Keywords: Analysis of Health Care Markets, Market Concentration, Hospital Competition, Hospital Quality, Applied Econometrics, Weighted Fixed Effects Regression Model

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Öz

Sağlık hizmetlerinin kalitesini iyileştirmeye yönelik politikalar son yıllarda oldukça popüler hale gelmiştir. Sağlık hizmetlerinde kaliteyi artırabilecek temel politikalardan biri, hastaneler arası rekabet olarak düşünülebilir. Bu çalışmada, hastane rekabetinin anne ve çocuk sağlığı sektörü için kalite göstergelerini geliştirip geliştiremeyeceği incelenmektedir. İngiltere'deki Ulusal Sağlık Servisi (NHS) hastaneleri arasında 2010 yılından sonra artan rekabet bebek ölümlerinde, taburcu edildikten sonraki 28 gün içinde gerçekleşen acil kabul oranlarında, sezeryan oranlarında ve doğum sırasında gerçekleşen komplikasyonlarda iyileşmelere yol açıp açmadığı uygun ekonometrik yöntemler kullanılarak araştırılmıştır. Ağırlıklı sabit etki modeli (weighted fixed effects model), piyasa yoğunluğunda meydana gelen 1 birimlik artışın (hastaneler arası rekabette azalma) taburcu edildikten sonraki 28 gün içinde gerçekleşen acil kabul oranlarında yaklaşık olarak 0.0004 oranında azalmaya sebep olduğuna dair kanıtlar sunmaktadır.

Anahtar Kelimeler : *Sağlık Sektörünün Analizi, Piyasa Yoğunluğu, Hastane Rekabeti, Hastane Kalitesi, Uygulamalı Ekonometri, Ağırlıklı Sabit Etki Modeli*

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1. INTRODUCTION

The policies focusing on the improvements in the quality of health care services have become very popular in recent years. One of the main policies which can improve quality in health care can be considered as hospital competition. The market structure where hospital competition is introduced under fixed price payments systems are known as pro-competition market structures. Under pro-competition market structures if choice becomes available to patients, hospitals are expected to increase the quality of services to be able to attract more patients (Gaynor, Moreno-Serra & Propper, 2013). Nevertheless, from the perspective of both the empirical and theoretical literature, the evidence for such an impact on quality is limited for health care markets (Burgess, Gossage & Propper, 2008; Cooper et al., 2010; Gaynor, 2006). Therefore, this issue has remained a big debate for health care researchers and policy makers although the basic microeconomic theory suggests that competition improves social welfare (Gaynor, Moreno-Serra & Propper, 2013; Kessler and McClellan, 2000).

The existing empirical work suggests that the intensity of competition is determined by market structure which is related to the geographical location of service providers and receivers (patients) i.e. distance from patient location to hospital where patient is treated (Burgess, Gossage & Propper, 2008; Cooper et. al., 2010; Kessler and McClellan, 2000; Gaynor, Moreno-Serra & Propper, 2013). In addition to the geographical factors, endogeneity of market structure is a well-known problem in the evaluation of market oriented reforms in health economics. To identify the causal relation between quality and competition, one therefore has to take into account all channels affecting this association.

The English government introduced a choice policy under a fixed price payment system known as Payment by Results for pregnant women and their partners by the end of 2009. The policy requires pregnant woman to be given a choice in all stages of pregnancy (i.e. choice of place of birth such as home births, midwifery clinics, and consultant led clinics at hospital). I study this choice policy.

Similar to previous studies, this study examines the relation between competition and the level of quality in maternity care by using an exogenous variation in the levels of concentration in the maternity market among public hospitals in the English National Health Service (NHS) (Burgess, Gossage & Propper, 2008; Kessler & McClellan, 2000; Gaynor, Moreno-Serra & Propper, 2013). I exploit the pre-policy market structure which varies by the geographical location of NHS hospital providers and patients (mothers). Some previous studies report that geographical locations with high population intensity would induce a high level of competition (low level of market concentration) whereas locations with low population intensity would lead to a high level of market concentration (low level of competition) with only a few opponents (Burgess, Gossage & Propper, 2008; Kessler & McClellan, 2000; Gaynor, Moreno-Serra & Propper, 2013). This is the key to my identification strategy.

The Department of Health introduced Payment by Results (known as PbR), an activity based fixed price payment system) into the maternity care in 2004/2005 (only among

Foundation Trusts) and extended it to all NHS maternity care providers in 2006/2007. In 2006/2007 PbR covered only actual birth events at hospitals, so that home births and outpatient admissions in midwifery clinics were excluded. Home births were then included into the scope of Payment by Results in 2008/2009. At that time, the choice available to pregnant women was limited. So prior to 2009 many aspects of maternity care remained outside the scope of PbR and choice was limited.

By 2009/2010, four national choice guarantees under Payment by Results is introduced for pregnant women and their partners and the policy requires pregnant woman to be given a choice in all stages of pregnancy (i.e. choice of place of birth such as home births, midwifery clinics, and consultant led clinics at hospital). Therefore, these policy changes induce competition across NHS hospitals and are motivated by increases in the volume of hospital activity and reductions in unit costs. 2004/2005 financial year is treated as the pre-policy year. Although the maternity choice policy was not introduced until 2009/2010, Payment by Results was introduced for maternity care among a limited number of hospitals (known as Foundation Trusts) in 2005/2006. The use of 2004/2005 is thus before any other pro-competitive policies in maternity care. The 2010/2011 financial year was a transition period for the maternity choice policy. Therefore 2011/2012 is used as the post-policy year as the maternity choice policy had more time to roll out across NHS providers.

2. LİTERATÜR

Most research in applied economics into the impact of hospital competition under fixed price payment systems comes from the UK and the US. These studies suggest that the impact of competition on quality is ambiguous for health care markets. This is in contrast to the majority of theoretical papers where competition is found to be an efficient way of improving clinical outcomes in health care markets consisting of multiple buyers and sellers under regulated prices (Brekke, Siciliani & Straume, 2011; Kessler & McClellan, 2000; Nuscheler, 2003). There are a handful of papers suggesting that there is a positive causal relationship between competition and hospital outcomes (Gaynor, Moreno-Serra & Propper, 2013; Kessler and Geppert, 2005; Tay, 2003). whereas others conclude that competition worsens clinical outcomes and is socially wasteful or does not have any substantial impact on quality (Burgess, Gossage & Propper, 2008; Kessler & McClellan, 2000; Mukamel, Zwanziger & Tomaszewski, 2001).

The focus of interest in the UK based studies is competition introduced by the NHS internal market (prior to 2000s) and the Choose and Book reform (January 2006). During the 1990s internal market, health care providers were given the incentive to compute over price to attract commissioners (Primary Care Trusts). As a result, the extent of competition was very limited in a way which allowed providers to compete mostly on price but not explicitly on quality. Burgess et al. (2008) examine the impact of competition during the 1990s NHS internal market (Burgess, Gossage & Propper, 2008).Their identification is based on the hypothesis that competition is affected by the geographical location of health care providers and receivers. The impact of competition is identified by the differences in hospital locations (i.e. hospitals located in markets where competition was

possible vs. markets for which competition was not possible) and differences in years (i.e. years when competition was promoted vs. years when competition was not possible). Using 1991 to 1999 financial years, they examine the impact of competition on waiting times and mortality following an emergency admission for acute myocardial infraction (AMI). They find that competition increased mortality which was unmeasured and unobserved but reduced waiting times in elective care.

There are other studies investigating the impact of competition introduced through English patient choice reform commenced for elective care in January 2006 (the Choose and Book reform) (Cooper et al., 2010; Gaynor, Moreno-Serra & Propper, 2013). These studies look at the impact of competition on AMI mortality using a similar identification strategy which has been frequently used by recent studies. The identification is driven by the predicted pre-policy market intensity based on predicted patient flows which is exogenous to patient and hospital characteristics. Gaynor et al. (2013) use two years (2003 for pre-policy and 2007 for post-policy) within a difference in differences (DiD) setting for which the policy impact is estimated by the coefficient on the interaction between the predicted pre-policy market measure (based on patient flows) and an indicator for post policy period (Gaynor, Moreno-Serra & Propper, 2013). They provide robustness tests for the actual market concentration measured by the Herfindhal-Hirschman (HHI) index. They find that actual HHIs tend to be higher than the predicted HHIs suggesting that there are potentially endogenous factors affecting patient flows. Following these studies, I use the same identification strategy.

In the US, a study examines how patient level hospital choice based on predicted patient flows in patient's choice set affects social welfare measured by clinical outcomes (Kessler & McClellan, 2000). The focus of the study is on the non-rural elderly Medicare patients admitted with AMI condition for years 1985, 1988, 1991 and 1994. The study shows that competition in less populated areas decreased AMI mortality for post 1990. In contrast competition was socially wasteful and worsened clinical outcomes prior to 1990.

My study complements the previous literature by investigating the impact of competition induced by patient choice in maternity care in England. To my knowledge, there have been no other studies investigating the impact of competition on maternity services in the UK. The nature of maternity admissions is different to both elective and emergency admissions. For the former, the timing of admission is pre-determined, therefore the patient knows when and where he/she will be treated. For the latter, the timing of admission is random and patients are usually admitted to the closest hospital with capacity in England (Gaynor, Moreno-Serra & Propper, 2013).

Pregnancy is a long lasting process (9 months on average). The Maternity Matters agenda allows pregnant women and their partners to decide on the type of place of birth with the inclusion of home births, birth centres and consultant led units at hospitals. Therefore, there is plenty of time to choose for maternity patients with plenty of available delivery places. With regards to the nature of maternity admissions, they are similar to elective admissions as there is scope for women and their partners to make a choice of place of birth based on hospital quality during the pregnancy. They are also similar to

emergency admissions since the actual timing of maternity admissions for birth is random (with the exclusion of elective c-sections).

3. MATERNITY MATTERS AGENDA

In 2003/2004, the English government introduced a regulated fixed price payment system in England. In addition to regulated prices, from 2006 onwards the Blair government introduced a market oriented reform for elective care services for which patients were given a choice of a hospital at the point of referral (known as Choose and Book reform) (Dixon et al., 2010).The scope of Choose and Book reform was initially limited to elective care and certain services such as mental health, emergency, cancer and maternity care were outside the scope of the policy (Department of Health, Maternity Matters: Choice, access and continuity of care in a safe service, 2007).

A national commitment was then announced in the 2007 policy document "Maternity Matters; Choice, access and continuity" indicating that, by the end of 2009, all women in England would be offered a choice over how to access maternity care, type of antenatal care, place of birth and place of postnatal care and the agenda guarantees maternity patients to decide not only the type of place of birth (3 options are offered: home birth, midwifery led units and consultant led units depending on woman's and her baby's condition) but also allows patients to make a choice of place of birth outside their local area (Department of Health, Maternity Matters: choice, access and continuity of care in a safe service, 2007).

The choice of a woman with high risk pregnancy (for which an emergency or an elective c-section is required by a gynecologist) is limited to a certain degree. The Department of Health suggests that choice for c-sections should be organized in tandem with the National Institute for Health and Clinical Excellence (NICE) recommendations on c-sections (Department of Health, Maternity Matters: Choice, access and continuity of care in a safe service, 2007; National Institute for Health and Care Excellence website, Caesarean section, 2011).

4. EMPIRICAL APPROACH

The aim of this study is to provide an assessment of the impact of the choice policy (pro-competition policy) in maternity care in England. In the context of the Maternity Matters agenda, being able to choose over type of place of birth outside the patient local area implies that women have a choice set of maternity units (either midwife led or consultant led). Following earlier works, I use an exogenous policy shift to examine the variation in market structure across hospitals and test whether quality of maternity services is higher at hospitals located in low concentrated markets (Burgess, Gossage & Propper, 2008; Gaynor, Moreno-Serra & Propper, 2013).

I estimate the impact of the Maternity Matters agenda using predicted patient flows to derive a predicted Herfindahl-Hirschman Index (Kessler & McClellan, 2000; Gaynor,

Moreno-Serra & Propper, 2013). I predict flows from a patient choice model. The actual HHI is not used due to the concerns over endogeneity of the market structure as explained earlier. I use a difference in differences approach where the identification is provided by the interaction between the pre-agenda market concentration and an indicator for post policy year (in the model below).

This set up is very similar to the one used by Gaynor, Moreno-Serra & Propper (2013: p.141):

$$y_{it} = \alpha_0 + \alpha_1 T(t=2011) + \alpha_2 T(t=2011) \times HHI_{i,2004} + \alpha_3 X_{it} + \Theta_i + e_{it}$$

y_{it} is the maternal outcomes for hospital at time T(.) is an indicator function for the post policy period and is equal to 1 if year 2011/2012 and 0 otherwise. $HHI_{i,2004}$ is the predicted Herfindahl-Hirschman Index for 2004/2005 and it is my preferred measure of market concentration. X_{it} represents hospital averages of mother's and babies' characteristics such as mother's age, ethnicity, weeks of gestation, number of previous pregnancies, socioeconomic status of mothers and birth weight. θ_i are unobserved hospital fixed effects. e_{it} is error term. The model is estimated via OLS (Ordinary Least Squares) with a full set of hospital dummies.

The government expressed the need to increase choice to women in the UK in 2005 and committed to expand choice to all women accessing maternity services by the end of 2009 (Department of Health, 'Maternity Matters: Choice, access and continuity of care in a safe service', 2007). Between 2005/2006 and 2010/2011 was a transition period for the policy; therefore 2004/2005 is considered as the pre-policy year and 2011/2012 is treated as the post-policy.

5. DATA

The data are from the Hospital Episode Statistics Database for two financial years (2004/2005 and 2011/2012). The data for these two financial years are anonymised from the Hospital Episode Statistics (HES) database and "ethical approval over and above that required for access to anonymised HES records was not sought" (Ertok, 2015, p. 98).

The focus of the study is on NHS acute trusts in England. The Hospital Episode Statistics database provides patient level data with a wide range of information on maternal and birth records from the first point of admission till the end of a hospital stay (Ertok, 2015). I use hospital level data where I aggregate all individual patient information to the NHS trust level for 2004/2005 and 2011/2012 respectively. Geographical data on the approximate geographical location of patients and NHS trusts are obtained through the Office for National Statistics and UK Data Service Census Support. The study population consists of 278 hospitals, giving 139 hospital-year observations in total. The data for Market Forces Factor are obtained from the National Health Service (NHS) and Department of Health databases.

For the rest of the paper, I refer to the hospital trust level as the hospital level and to the Maternity Matters agenda as the choice policy. For hospital quality, I focus on medical

quality measures and use emergency readmission rates within 28 days of discharge, rate of elective c-sections, length of stay (days), most common maternal complications (fetal stress and long labour) and all cause baby's mortality up to 12 months. Babies' mortality is constructed and merged to the aggregate maternal data at hospital level for each year from birth records. This is because baby's mortality is not recorded in maternal records and there is no direct link between maternal and birth records.

6.METHODS OF DEFINING HOSPITAL MARKET STRUCTURE

Previous literature defines hospital market areas with a wide range of methods (i.e. fixed radius, variable radius, actual patient flows and Kessler & McClellan predicted patient flows methods). In addition, the economics literature commonly uses two methods to calculate the level of hospital competition in the market: Herfindahl-Hirschman Index (HHI) and number of alternative competitors in a market area (Feng, Pistollato & Propper et al., 2015; Wong, Zhan & Mutter, 2005). The former is the preferred measure of the level of hospital competition in this study since it allows the use of a wide range of providers with different sizes and is used frequently by recent studies examining hospital market competition in a difference in differences setting (Feng, Pistollato & Propper et al., 2015; Gaynor, Moreno-Serra & Propper, 2013).

6.1 Patient Flow Vs. Kessler & McClellan Methods

6.1.1 Patient flow method (actual patient flows)

The patient flow method is a patient oriented approach which does not restrict the size of hospital market and is based on patient flows from all geographical areas to hospitals such that the market area for a given hospital is defined as the collection of those geographical areas which send patients to the hospital (Gaynor, Moreno-Serra & Propper, 2013).

I use lower super output areas (LSOAs) to define hospital market areas for maternity care. LSOAs are homogenous geographical boundaries consisting of a minimum population of 1000 with 1500 population on average and there were 32482 lower super output areas in England in 2001 (Office for National Statistics website, 2001 Census).[3] The maternity market is assumed to be the whole of England and all NHS acute hospitals are taken into account. Following earlier work by Gaynor, Moreno-Serra & Propper (2013), actual patient flows are calculated in two steps. In the first step, the sum of squared shares of patients is calculated across all English NHS acute hospitals for each LSOA sending its residents for a birth event; secondly, the weighted average of the HHI for LSOAs for which the hospital provides maternity services is calculated (Gaynor, Moreno-Serra & Propper, 2013: p.144). Weights used in the study are the shares of hospital patients living in each LSOA. The travel distance to the hospital is 30 km within each LSOA assuming

3 Office for National Statistics. Super Output Areas. 2001 Census, [Accessed 1st October 2014], available from:

http://www.ons.gov.uk/ons/guide-method/geography/beginner-s-guide/census/super-output-areas--soas-/index.html.

that a pregnant woman is less likely to travel long distances to deliver her baby. Actual patient flows are calculated for 2004/2005 and 2011/2012 respectively (Table 1.1, Panel D).

6.1.2 Kessler and McClellan method (predicted patient flows)

This method was developed to overcome the limitations of the previous methods suffering from the endogeneity of hospital market structure (i.e. Actual HHI, fixed radius method, variable radius method). It is developed by Kessler and McClellan (2000) and employs exogenous patient and hospital characteristics (exogenous to market competition) to predict patient flows to each hospital (Kessler & McClellan, 2000). Likewise, this is derived in two steps. I first estimate patient level multinomial logit hospital choice models using individual patient level data and calculate probabilities of a patient choosing a particular hospital to give birth; in the second step, predicted HHIs for each hospital are derived using the probabilities estimated from the first step (Gaynor, Moreno-Serra & Propper, 2013: p.146). This is the preferred method to define hospital market areas for maternity care in the study. This method is based only on exogenous patient and hospital characteristics and does suffer less from the endogeneity of market structure compared to other measures. Every patient choice set includes the hospital actually attended, the two nearest hospitals regardless of the distance travelled and any other hospitals within 30 kilometers of the LSOA (Table 1.1, Panel D).

7. RESULTS

7.1 Actual Patient Flows Vs. Predicted Patient Flows

Column (1) in Table A.1 (Appendix) shows that the correlation between actual patient flows and predicted patient flows is positive and has a significantly large magnitude (79.8%). This suggests that these two measures capture almost something similar (as also shown by Gaynor, Moreno-Serra & Propper, 2013). However, I follow the earlier works by Kessler and McClellan (2000) and Gaynor, Moreno-Serra & Propper (2013) and use predicted patient flows which are less likely to suffer from the endogeneity of the hospital market structure. The choice model I exploit to estimate patient level hospital choice model is based on exogenous patient characteristics (i.e. mother's age, number of previous pregnancies, rural residence indicator, and severity of mother's condition).[4] Table 1.1 also suggests that the predicted HHI is fairly small compared to the actual HHI.

7.2 Patterns In The Data

I use two years of data (2004/2005 and 2011/2012) where there is a seven year gap between "before and "after" policy periods. As this is a long period I provide tests for whether there are any changes occurred between the "before" and "after" policy periods. I present descriptive statistics for the outcome variables and controls used in the main regression in Table 1.1 for each year.

4 The patient level hospital choice model is available upon request from the author.

For outcomes, readmission and mortality rates are reported as means per 1000 admissions. The table suggests that there are changes in rates of emergency readmissions and elective c-sections between 2004/2005 and 2011/2012 (Panels A and C respectively). Both outcomes increased over the seven year period. There is no change in average mortality of babies during this period (Panel B).

For the measure of competition, the actual patient flow method in Panel D indicates the existence of monopolies in the maternity market. However, as noted above the predicted patient flow method suggests less concentrated markets. It predicts that there are no monopolies in the market but there are hospitals with high market concentration. Figure 1.1 presents kernel density estimations of the distribution of the Herfindahl-Hirschman Index based on actual patient flows for 2004/2005 and 2011/2012 respectively. The figure shows a shift to the left suggesting that the competition has increased over the 7 year period. Nevertheless, there is no statistically significant change in the levels of market measures (both predicted and actual patient flows) between "before" and "after" policy years in maternity market (Panel D, Table 1.1). 2011/2012 is associated with a higher number of maternity admissions and shorter length of stay (Panel E and F respectively).

For the controls, i.e. with respect to maternal complications and demographics, 2011/2012 is associated with a higher proportion of fetal stress and higher birth weight (Panels G and H respectively). Therefore, I control for changes in patient characteristics (controls for maternal age, weeks of gestation, number of previous pregnancies, index of multiple deprivation (socio economic status of mothers), birth weight and ethnicity) in the main regression. To control for time invariant hospital heterogeneity, I include hospital fixed effects. In a separate analysis, I also control for an additional covariate (the market forces factor) to capture the regional differences in hospital costs (Gaynor, Moreno-Serra & Propper, 2013).

7.3 Impact Of The Policy On Maternal Outcomes

Table 1.2 presents results for all NHS maternity admissions using the predicted pre-policy HHI measure regardless of place of birth. The columns labelled "B" refer to baseline model where no patient characteristics are included. "B+C" are estimates from models including mother's age, number of previous pregnancies, weeks of gestation, ethnicity, socio economic status of mothers and birth weight. All variables are aggregated at hospital year level. Therefore, hospital year averages are reported for emergency readmissions, baby's mortality, elective c-sections, length of stay (days), fetal stress, long labour and patient characteristics. The Herfindahl-Hirschman Index is divided by 10000. Both independent and dependent variables are expressed in levels.

With respect to the impact of the policy, my findings suggest that there is no statistically significant association between maternal outcomes and competition introduced by the choice policy. Models with controls do not make considerable changes to the estimated impact of competition (Columns labelled as (B+C)) in Panel A of Table 1.2). Panel B in the same table shows results with an additional control; Market Forces Factor (MFF). The inclusion of MFF does not make any significant change on the impact of compe-

tition on maternity care. It slightly increases the magnitude of the estimated impact of competition on emergency readmission rate within 28 days of discharge (Column (2), 1 unit increase in HHI (less competition) decreases emergency readmission rate by almost 0.0003 readmissions (per 1000 maternity admissions).[5] For other outcomes, the inclusion of MFF hardly changes the estimated impact of the HHI measure based on predicted patient flows.

Table 1.1: Descriptive statistics

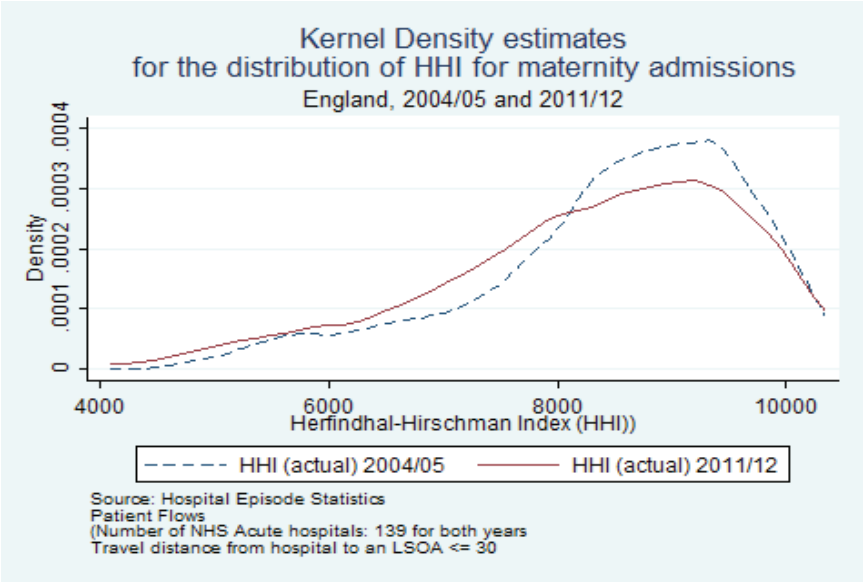
Variable	Mean	SD	Minimum	Maximum	N	p value
Panel A: Readmissions (means per 1000 admissions)						
28 days emergency readmissions	8.410	4.047	1.8934	29.070	278	
2004/05	7.9861	3.8771	2.39521	27.490	139	0.082
2011/12	8.8341	4.1826	1.8934	29.071	139	
Panel B: Mortality rate per 1000 admissions (Birth Records)						
Baby's mortality rate	4.055	14.314	0	128.0277	310	
2004/05	3.609	11.256	0	88.710	158	0.577
2011/12	4.518	16.945	0	128.027	152	
Panel C: Elective c-sections						
Rate of elective c sections	0.089	0.040	0	0.256	257	
2004/05	0.082	0.042	0	0.250	123	0.009
2011/12	0.095	0.038	0	0.256	134	
Panel D: Market concentration measures						
Herfindahl-Hirschman index (HHI)(30 km)						
Actual Patient Flows	8392	1224.833	4436.312	10000	278	
2004/05	8506	1152.362	5213.441	10000	139	0.1212
2011/12	8278	1287.336	4436.312	10000	139	
Predicted Patient Flows	6404.52	2542.829	1288.375	9842.445	278	
2004/05	6404.45	2547.459	1288.375	9842.436	139	0.999
2011/12	6404.59	2547.404	1288.700	9842.445	139	
Panel E: Admissions (per hospital)						
Maternity Admissions(number)	4171	1818	559	10878	278	
2004/05	3863	1655	592	9821	139	0.0046
2011/12	4479	1926	559	10878	139	
Panel F: Average length of stay (days)						
Length of stay	2.447	0.426	0.831	3.898	278	
2004/05	2.654	0.406	0.831	3.898	139	0.000
2011/12	2.240	0.337	0.857	3.140	139	
Panel G: Complications (means)						
Fetal Stress	0.140	0.056	0	0.317	278	
2004/05	0.122	0.051	0	0.264	139	< 0.001
2011/12	0.159	0.054	0	0.317	139	
Long Labour	0.071	0.034	0	0.226	278	
2004/05	0.072	0.0326	0	0.180	139	0.837
2011/12	0.071	0.0359	0	0.226	130	

5 For the main analysis HHI is expressed as HHI/10000. Therefore the impact on readmissions become 2.7*(1/10000) ≈ 0.0003 readmissions (per 1000 admissions). Full model specification is available upon request from the author.

Panel H: Patient characteristics (means)						
Maternal Age (years)	28.941	1.149	26.659	32.626	278	
2004/05	28.831	1.138	26.659	31.933	139	0.111
2011/12	29.050	1.154	27.081	32.626	139	
Weeks of gestation (weeks)	38.962	1.854	12.906	39.669	139	
2004/05	38.990	0.992	27.693	39.561	139	0.802
2011/12	38.934	2.432	12.906	39.669	139	
Number of previous pregnancies	0.731	0.230	0.0108	1	139	
2004/05	0.749	0.225	0.011	1	139	0.411
2010/11	0.719	0.235	0.028	1	139	
IMD (index of multiple deprivation)	24.568	9.089	7.971	47.578	278	
2004/05	24.42	9.241	7.971	47.578	139	0.789
2010/11	24.714	8.964	8.365	46.42	139	
Birth weight (gr)	3347.04	54.02	3145.85	3453.21	278	
2004/05	3331.40	52.49	3145.85	3433.41	139	0.000
2010/11	3362.67	51.08	3198.29	3453.21	139	

Total number of maternity admissions in the data over two year period is 1230908. For N = 278, this is equal to a total of 1159538 admissions. p values are calculated using mean comparison tests (ttest) or chi squared tests as appropriate.
Source: HES (Hospital Episode Statistics) database.

Figure 1.1: Kernel density estimation for the distribution of HHI (maternal admissions)



7.4 Births Associated With Only NHS Facilities

The Maternity Matters agenda provides choice to women not only for place of birth (any hospitals even outside their catchment area) but also for type of place of birth. The Hospital Episode Statistics data provide information on type of delivery unit such as midwifery ward, consultant ward or general practitioner ward. Moreover, the data provide limited information on births occurred at private hospitals or domestic addresses.

The main analysis in Table 1.3 is based on the NHS admissions regardless of type place of birth. Therefore, some births might have occurred outside the NHS hospitals (i.e. mothers might have given birth on the way to the hospital) and then they might be admitted to an NHS hospital. As the choice policy is only introduced among NHS acute hospitals and includes the main delivery event, I now exclude births which initially did not occur at NHS hospitals to find out whether the impact of the choice policy differs among those who gave birth at NHS hospitals. Columns (3) and (4) in Table 1.3 suggest that competition introduced in health care market by the end of 2009 is associated with an increase of 0.00001 deaths among babies (per 1000 births) if they are delivered using only NHS facilities. However, this impact is very small in size and significant at 5% level. In other words, this weakly suggests that more competition worsens the quality of maternity care (regards to baby's mortality).

7.5 Weighted Regressions

As the data used in this study are also aggregated from individual patient level to the NHS hospital level, I use "average number of maternity admissions per hospital per year" as weights to account for heteroscedasticity in the error term (Wooldridge, 2009). The results are slightly different once weights are included. Panel A of Table A.2 in the Appendix suggests that once regressions are weighted, a 1 unit increase in market concentration measure reduces emergency readmission rate within 28 days of discharge by almost 0.0004 admissions (per 1000 admissions, significant at 5% level, Column (2) Panel A).

7.6 Actual Patient Flows vs. Predicted Patient Flows

Possible limitations of using actual patient flows are explained in earlier sections. However, I investigate whether the use of HHI based on actual patient flows provides similar results to those obtained via predicted HHI. In fact the correlation between predicted and actual HHI is fairly high (79.8%). Column (2), Panel B of Table A.2 in the Appendix suggests that an increase in market concentration (less competition) reduces 28 days emergency readmission rate by 0.0009 admissions per 1000 admissions (significant at 5% level) whereas it increases length of stay by 0.00006 days (significant at 10% level). However, this is in contrast with the impact of competition based on predicted patient flows (it suggests no impact on maternal outcomes).

7.7 Time Variant Predicted HHI Measure

In the study, the identification comes from cross sectional variation in pre-policy

market structure. Gaynor, Moreno-Serra & Propper (2013) suggest that existing literature from the US identifies the impact of competition using the changes in cross sectional variation in market structure over time. Similar to those studies, I therefore employ a DiD specification in which the impact of the policy is estimated from both cross sectional and time series variation in market concentration. Hospital fixed effects are also included. Panel C of Table A.2 in the Appendix presents results. The results are very similar to those obtained using the main analysis. This suggests that my results are robust to the exact specification of the DiD model in the main analysis.

8. CONCLUSION

This study provides a brief summary on the impact of the introduction of the Maternity Matters agenda on the English NHS hospital outcomes for maternity care. The policy introduced competition by offering choice of place of birth as well as type of place of birth to pregnant women and their partners all over England. Following earlier works, to identify the impact of competition in maternity market, I use predicted patient flows which are exogenous to any unobserved patient and hospital characteristics (Cooper et al., 2010; Gaynor, Moreno-Serra & Propper, 2013; Kessler & McClellan, 2000; Propper, Gaynor, Dixon et al., 2011). To my knowledge, this study provides the very first evidence on the impact of market structure on maternal outcomes after the introduction of the choice policy in maternity care under regulated prices (Payment by Results).

My findings weakly suggest that less competition is better for maternity care. The weighted fixed effects regressions provide some evidence of a reduction in emergency readmissions rates within 28 days of discharge (1 unit increase in market concentration measure reduces emergency readmission rate within 28 days of discharge by almost 0.0004 admissions (per 1000 admissions)). However, the estimated magnitude of this reduction is quite small compared to the mean value of emergency readmission rate. This is equivalent to a reduction of almost 0.003 admissions (per 1000 admissions) at the mean 28 days of emergency readmission rate of 8.4 readmissions (per 1000 admissions).[6]

My results with the actual HHI suggests that one unit increase in the actual HHI reduces emergency readmission rate within 28 days of discharge by 0.008 admissions (per 1000 admissions) at the mean 28 days of emergency readmission rate of 8.4 readmissions (per 1000 admissions) (Table A.2, Appendix, Column(2)). This estimated impact is also quite small compared to the mean value of emergency readmission rate. In contrast, one unit increase in actual market concentration measure is associated with an increase of 0.0001 days at the mean length of stay of 2.5 days (Table A.2, Appendix, and Column (8)).

My results indicate that the choice policy introduced into the English NHS maternity care by the end of 2009 has not enhanced outcomes in the market. They rather indicate that less competition is better for maternity care. However, the magnitudes of the esti-

6 A one unit increase in HHI leads to a reduction of 0.0004 admissions (per 1000 admissions) in emergency readmission rate within 28 days of discharge (per 1000 admissions). Therefore, this is equivalent to a reduction of 0.0004*8.4 roughly equals to 0.003 admissions (per 1000 admissions) at the mean 28 days of emergency readmission rate of 8.4 admissions (per 1000 admissions).

mated impacts on outcome measures are quite small compared to the mean values of all these measures. Therefore, it is essential to investigate why the policy had no big effect on maternity care. First of all, the reform is designed to offer choice to all women in England over how to access maternity care, type of antenatal care, place of birth and place of postnatal care (Department of Health, 'Maternity Matters: Choice, access and continuity of care in a safe service', 2007). As opposed to Choose and Book reform, midwives or GPs, who are usually the first person to confirm pregnancy and to provide information to pregnant women, are not given any incentives for offering choice to their patients. Secondly, policy makers should make sure that maternity patients are aware of their rights to choose over maternity services. Patients should be empowered to practice their rights. Therefore, the effective design of both choice policy and Payment by Results for maternity care is essential to enhance maternal outcomes. Thirdly, Choose and Book reform started in 2006 only among elective services. There remain concerns over the diversion of efforts from other services to elective care. It could be that some efforts have been diverted from maternity care to elective care. Therefore, a future research should focus on whether the weak negative relationship between competition and quality of maternity services are driven by the diversion of efforts (rather than competition itself) from maternity services to elective services where providers have to face relatively harsh competition since 2006.

Some limitations of the study should be noted. Firstly, my study excludes home births. Home births are one of the delivery places NHS providers offer to their patients if no future complications are expected with the pregnancy. However, the coverage of the HES data for home deliveries is limited. My study exploits more clinical outcomes rather than more consumer-orientated measures such as the rate of home deliveries. Therefore, these more consumer-orientated maternity specific indicators could be exploited in future work.

Table 1.2: Impact of Maternity Matters agenda on hospital quality (Predicted HHI)

Panel A: Impact of Maternity Matters agenda on hospital quality w and w/o controls

	28 days emergency Readmissions		Baby's mortality		Rate of elective c-sections		Length of stay (days)		Fetal stress		Long labour	
	B	B+C	B	B+C	B	B+C	B	B+C	B		B	B+C
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)		(11)	(12)
Year = 2011/12	1.095	1.944	-0.405	1.081	0.018*	0.002	-0.324***	-0.598***	0.048***	0.023	-0.004	-0.007
	(1.041)	(1.846)	(0.513)	(0.683)	(0.010)	(0.015)	(0.078)	(0.133)	(0.013)	(0.020)	(0.011)	(0.017)
$HHI_{2004/05}$ x (Year = 2011/12)	-0.386	-2.692	0.545	-1.095	-0.005	-0.006	-0.142	0.127	-0.016		0.005	-0.006
	(1.423)	(1.924)	(0.680)	(0.862)	(0.016)	(0.017)	(0.117)	(0.152)	(0.018)		(0.016)	(0.021)
N	278	278	278	278	257	257	278	278	278		278	278
R^2	0.034	0.216	0.008	0.325	0.109	0.375	0.595	0.672	0.368		0.001	0.218

Panel B: Inclusion of Market forces Factor

	C	C+MFF	C	C+MFF	C	C+MFF	C	C+MFF	C		C	C+MFF
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)		(11)	(12)
Year = 2011/12	1.944	1.873	1.081	1.083	0.002	0.003	-0.598***	-0.599***	0.023		-0.007	-0.006
	(1.846)	(1.856)	(0.683)	(0.681)	(0.015)	(0.014)	(0.133)	(0.132)	(0.020)		(0.017)	(0.016)
$HHI_{2004/05}$ x (Year = 2011/12)	-2.692	-2.722	-1.095	-1.094	-0.006	-0.008	0.127	0.127	0.007		-0.006	-0.006
	(1.924)	(1.944)	(0.862)	(0.865)	(0.017)	(0.017)	(0.152)	(0.152)	(0.023)		(0.021)	(0.021)
N	278	278	278	278	257	257	278	278	278		278	278
R^2	0.216	0.236	0.325	0.325	0.375	0.393	0.672	0.672	0.502		0.218	0.229

Robust standard errors are in parentheses. Models are estimated via OLS with a full set of hospital dummies. HHI is Herfindahl Hirschman Index measured by predicted patient flows. For Panel A, B is Baseline model without any controls. Patient characteristics are added in model B+C. For panel B, Baseline model is C where all patient characteristics are added. C+MFF included Market forces factor (MFF) along with patient characteristics. All outcome measures are means at hospital level. HHI index is divided by 10000. 28 days emergency readmissions and baby's mortality are expressed as "per 1000 admissions * p<0.1, ** p<0.05, *** p<0.01. *Year* is defined as the fiscal year (1st April-31st March in the following year for 2004/2005 and 2011/2012). Policy on = year (2011/2012 HES financial year). Hospital fixed effects are included. Patient case-mix includes number of previous pregnancies, mother's age, ethnicity, socio economic deprivation of mothers measured by index of multiple deprivation), birth weight. Baby's mortality excludes stillbirths as the cause of stillbirths is usually due to the congenital anomalies or unknown.

Table 1.3: Impact of Maternity Matters agenda on hospital quality among only NHS deliveries (Predicted HHI): inclusion of market forces factor (MFF)

	NHS deliveries only (MFF included)											
	28 days emergency Readmissions		Baby's mortality		Rate of elective c-sections		Length of stay (days)		Fetal stress		Long labour	
	C	C+MFF	C	C+MFF	C	C+MFF	C	C+MFF	C	C+MFF	C	C+MFF
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Year = 2011/12	-0.720	-0.441	0.114**	0.110**	-0.009	-0.010	-0.607***	-0.604***	0.014	0.017	-0.016	-0.018
	(2.587)	(2.572)	(0.048)	(0.049)	(0.014)	(0.015)	(0.155)	(0.154)	(0.025)	(0.025)	(0.019)	(0.020)
$HHI_{2004/05}$ x (Year = 2011/12)	-0.392	-0.812	-0.144**	-0.138**	0.020	0.022	0.167	0.161	0.005	0.002	0.013	0.016
	(2.795)	(2.741)	(0.062)	(0.064)	(0.017)	(0.017)	(0.187)	(0.187)	(0.031)	(0.030)	(0.023)	(0.023)
N	206	206	206	206	206	206	206	206	206	206	206	206
R^2	0.273	0.301	0.448	0.459	0.460	0.468	0.789	0.789	0.553	0.561	0.258	0.275

All outcome measures are means at hospital level. Models are estimated via OLS with a full set of hospital dummies HHI index is divided by 10000. 28 days emergency readmissions and baby's mortality are expressed as "per 1000 admissions". Baseline model is C where all patient characteristics are added. C+MFF included Market forces factor (MFF) along with patient characteristics. Robust standard errors are in parentheses. HHI is Herfindahl Hirschman Index measured by predicted patient flows. * p<0.1, ** p<0.05, *** p<0.01. *Year* is defined as the fiscal year (1st April-31st March in the following year for 2004/2005 and 2011/2012). Policy on = year (2011/2012 HES financial year). Hospital fixed effects are included. Patient case-mix includes number of previous pregnancies, mother's age, ethnicity, socio economic deprivation of mothers measured by index of multiple deprivation), birth weight. Baby's mortality excludes stillbirths as the cause of stillbirths is usually due to the congenital anomalies or unknown.

APPENDIX

Table A.1: Correlations between competition measures (Herfindhal-Hirschman Index)

Maternity Services	Actual patient flow (30 km within LSOAs)	Predicted patient flow (30 km within LSOAs)
	(1)	(2)
Actual Patient Flow (30 km within LSOAs)	1	
Predicted Patient Flow	**0.798**	
(30 km within LSOAs)		1

Herfindhal Hirschman indices for 2004/2005 and 2011/2012 are pooled. N = 278 for two years.

Table A.2: Impact of Maternity Matters agenda on hospital quality (weighted regressions and actual HHI)

Panel A: Weighted regressions

	28 days emergency Readmissions		Baby's mortality		Rate of elective c-sections		Length of stay (days)		Fetal stress		Long labour	
	C	C+MFF	C	C+MFF	C	C+MFF	C	C+MFF	C	C+MFF	C	C+MFF
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Year = 2011/12	2.812	2.707	0.124*	0.124*	0.012	0.124*	-0.491***	-0.492***	0.023	0.022	-0.009	-0.008
	(1.698)	(1.696)	(0.072)	(0.072)	(0.015)	(0.072)	(0.146)	(0.147)	(0.023)	(0.022)	(0.015)	(0.015)
$HHI_{2004/05}$ x (Year = 2011/12)	-3.527*	-3.541**	-0.121	-0.121	-0.014	-0.121	0.026	0.026	0.003	0.003	-0.002	-0.002
	(1.813)	(1.777)	(0.092)	(0.093)	(0.018)	(0.092)	(0.169)	(0.169)	(0.026)	(0.025)	(0.019)	(0.018)
N	278	278	278	278	257	257	278	278	278	278	278	278
R^2	0.784	0.793	0.622	0.622	0.845	0.854	0.868	0.868	0.852	0.854	0.75405	0.75869

Panel B: Actual HHI

	28 days emergency Readmissions		Baby's mortality		Rate of elective c-sections		Length of stay (days)		Fetal stress		Long labour	
	C	C+MFF	C	C+MFF	C	C+MFF	C	C+MFF	C	C+MFF	C	C+MFF
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Year = 2011/12	4.786	7.567**	1.355	1.413	0.019	0.001	-1.022***	-1.045***	-0.024	-0.015	0.044	0.033
	(3.501)	(3.690)	(1.338)	(1.570)	(0.034)	(0.034)	(0.293)	(0.311)	(0.040)	(0.042)	(0.060)	(0.068)
$HHI_{2004/05}$ x (Year = 2011/12)	-5.438	-8.652**	-1.236	-1.302	-0.025	-0.005	0.577*	0.603*	0.058	0.048	-0.061	-0.048
	(3.704)	(3.942)	(1.477)	(1.745)	(0.038)	(0.037)	(0.317)	(0.339)	(0.043)	(0.047)	(0.067)	(0.076)
N	278	278	278	278	257	257	278	278	278	278	278	278
R^2	0.215	0.247	0.317	0.317	0.377	0.392	0.678	0.678	0.508	0.509	0.230	0.236

Continued Table A.2:

Panel C: The impact of time variant HHI (MFF included)

	28 days emergency Readmissions		Baby's mortality		Rate of elective c-sections		Length of stay (days)		Fetal stress		Long labour	
	C	C+MFF	C	C+MFF	C	C+MFF	C	C+MFF	C	C+MFF	C	C+MFF
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Year = 2011/12	1.993	1.911	1.129	1.131	0.001	0.003	-0.603***	-0.604***	0.022	0.021	-0.008	-0.008
	(1.863)	(1.876)	(0.689)	(0.685)	(0.015)	(0.015)	(0.132)	(0.132)	(0.021)	(0.020)	(0.016)	(0.016)
HHI	-0.144	-0.110	-0.141	-0.142	0.003	0.002	0.013	0.014	0.004	0.004	0.005	0.005
	(0.599)	(0.625)	(0.115)	(0.113)	(0.005)	(0.005)	(0.036)	(0.036)	(0.006)	(0.006)	(0.006)	(0.006)
$HHI_{2004/05}$ x (Year = 2011/12)	-2.730	-2.750	-1.131	-1.130	-0.005	-0.008	0.130	0.130	0.008	0.008	-0.004	-0.004
	(1.929)	(1.951)	(0.865)	(0.867)	(0.018)	(0.018)	(0.152)	(0.152)	(0.023)	(0.022)	(0.020)	(0.020)
N	278	278	278	278	257	257	278	278	278	278	278	278
R^2	0.216	0.236	0.328	0.328	0.377	0.394	0.672	0.672	0.504	0.508	0.224	0.235

All outcome measures are means at hospital level. Models are estimated via OLS with a full set of hospital dummies. Weights are number of maternity admissions per hospital per year. HHI index is divided by 10000. 28 days emergency readmissions and baby's mortality are expressed as "per 1000 admissions". Baseline model is C where all patient characteristics are added. C+MFF included Market forces factor (MFF) along with patient characteristics. Robust standard errors are in parentheses. HHI is Herfindahl Hirschman Index measured by predicted patient flows. * p<0.1, ** p<0.05, *** p<0.01. Year is defined as the fiscal year (1st April-31st March in the following year for 2004/2005 and 2011/2012). Policy on = year (2011/2012 HES financial year). Hospital fixed effects are included. Patient case-mix includes number of previous pregnancies, weeks of gestation, mother's age, ethnicity, socio economic deprivation of mothers measured by index of multiple deprivation), birth weight. Baby's mortality excludes stillbirths as the cause of stillbirths is usually due to the congenital anomalies or unknown.

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