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Does a hospital's quality depend on the quality of other hospitals? A spatial econometrics approach

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ABSTRACT

We examine whether a hospital's quality is affected by the quality provided by other hospitals in the same market. We first sketch a theoretical model with regulated prices and derive conditions on demand and cost functions which determine whether a hospital will increase its quality if its rivals increase their quality. We then apply spatial econometric methods to a sample of English hospitals in 2009–10 and a set of 16 quality measures including mortality rates, readmission, revision and redo rates, and three patient reported indicators, to examine the relationship between the quality of hospitals. We find that a hospital's quality is positively associated with the quality of its rivals for seven out of the sixteen quality measures. There are no statistically significant negative associations. In those cases where there is a significant positive association, an increase in rivals' quality by 10% increases a hospital's quality by 1.7% to 2.9%. The finding suggests that for some quality measures a policy which improves the quality in one hospital will have positive spillover effects on the quality in other hospitals.

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1. Introduction

Quality is a key concern for patients and policymakers in health care markets. It is often argued that encouraging competition amongst health care providers will improve quality, especially when prices are fixed as higher quality is then the only way in which hospitals can attract more patients.¹ There is a large empirical literature on the relationship between quality and hospital competition (Gaynor and Town, 2011; Gravelle et al., 2012). The bulk of the literature has been about the US experience but some recent contributions are on the UK and other European countries. The evidence is mixed. Kessler and McClellan (2000) and Kessler and Geppert (2005) find a positive effect of competition on quality, and Gowrisankaran and Town (2003) a negative effect. Shen (2003) reports mixed results, and Shortell and Hughes (1988) and Mukamel et al. (2001) find no effect. Research on the English National Health Service (NHS) for the 1990s finds that

competition was associated with lower quality (Propper et al., 2004, 2008) whereas studies of the more recent NHS experience find that more competition increased quality (Cooper et al., 2011; Gaynor et al., 2010; Bloom et al., 2011).

The usual way to test whether competition affects hospital quality is to examine the relationship between quality (often measured by hospital mortality) and measures of competition such as the Herfindahl index or the number of rival hospitals.² In this study we test whether a hospital's quality responds to the quality of its rivals. In industrial organisation terms, we test whether qualities are strategic complements, i.e. whether a provider responds to an increase in quality from rival providers by increasing quality. The traditional approach tests for an effect of competition on quality by estimating a reduced form relating quality to a measure of market structure. Our approach is to estimate a reaction function to test if a provider's decisions on quality depend on the quality decisions of rival providers. This is of interest for health care policy to improve quality, whether by changing the structure of the market in which hospitals operate, improving information available to patients,

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E-mail addresses: hugh.gravelle@york.ac.uk (H. Gravelle), rita.santos@york.ac.uk (R. Santos), luigi.siciliani@york.ac.uk (L. Siciliani).¹ Prospective payment systems under which hospitals are paid a fixed price dependent on the type of case are used in the US for Medicare and Medicaid patients, in 13 European countries including the UK, Australia, and in Korea, and New Zealand (Cyclus and Irwin, 2010; Paris et al., 2010).² English studies have also been able to exploit changes in policy which encouraged hospitals to compete (e.g. Propper et al., 2008) or gave patients the right to choose from a larger set of hospitals (Cooper et al., 2011; Gaynor et al., 2010).

giving them greater choice, or pay for performance schemes, since the effect of these policies will depend on the extent to which a hospital's own quality varies with the qualities of its rivals.

We first outline a theoretical model of hospital quality competition under regulated (fixed) prices. The model builds on the existing literature on quality competition with regulated prices (Ma and Burgess, 1993; Gaynor, 2006; Gravelle and Sivey, 2010; Brekke et al., 2011) which models quality competition within the simple Hotelling or Vickrey–Salop spatial frameworks. We derive conditions under which providers respond to an increase in rivals' quality by also increasing quality, so that qualities are strategic complements. We show that, if rivals' qualities do not affect the number of patients gained by a hospital when its quality increases, then qualities are complements (substitutes) if the marginal cost of treatment is increasing (decreasing) or the demand responsiveness increases (decreases) when rivals' quality is higher.

We then test whether qualities are strategic complements using cross-section data on English hospitals in 2009–10 and a set of 16 quality measures including mortality rates, readmission, revision and redo rates and indicators of patients' experience. Most previous work has used a single measure of quality (often mortality from acute myocardial infarction) on the assumption that different quality measures are highly correlated. We use 16 measures to see if the results are sensitive to the choice of quality measure. We take a spatial econometric approach: since hospitals and patients are geographically dispersed, patients must incur travel costs to receive treatment and so hospital location affects demand. Distance between hospitals hence also influences the extent to which decisions by one hospital affects decisions by other hospitals.

We follow the approach suggested by Mobley (2003) and Mobley et al. (2009) who examine whether prices are strategic substitutes, i.e. whether each provider responds to an increase in rivals' prices by reducing its own price. They estimate models in which the effect of rivals' prices depends on spatial proximity. We adapt their approach to examine competition on quality (as opposed to competition on price) and interpret the effect of the spatial quality lag as the slope of the hospital reaction function.

We find that the quality measures are poorly correlated and that the results from regression models vary across the measures. Quality responds positively to rivals' quality for seven out of the sixteen quality indicators and does not respond for the others. When an effect is detected (for overall mortality rates, in-hospital stroke mortality, knee replacement readmissions, stroke readmission within 28 days, and three indicators on patients' experience), an increase in rivals' quality by 10% increases quality by 1.7–2.9%.

Section 2 gives a brief description of the institutional setting. Section 3 provides the theoretical model. Section 4 describes the estimation methods and data. Section 5 presents the results, and Section 6 concludes.

2. Institutional setting

The British National Health Service (NHS) provides universal access to healthcare which is funded by taxation and free to patients at point of use.³ Geographically defined local purchasers receive budgets from the central government to fund the health care for their populations. Most NHS hospital care is provided by public hospitals (Hospital Trusts) which are separate from the local purchasing body but subject to tight central financial and regulatory control by the Department of Health. Around half are Foundation Trusts, a status given only to hospitals which met certain financial and clinical requirements. Foundation Trusts have more discretion in using surpluses (they do not have to

break even) and can borrow directly from the capital market. They have more discretion in staff remuneration (they do not have to follow national pay scales), they can invest in buildings and manage their own assets (Marini et al., 2008). About 20% of the hospitals have Teaching status, undertaking teaching and research, generally providing higher quality and more specialised care, and attracting more complex patients.

Government policy has sought to encourage hospitals to compete via quality. Hospitals receive a fixed price for each patient treated, with prices varying by diagnosis or treatment under a prospective price system similar to the US Diagnosis Related Groups (DRG) scheme but based on Healthcare Resource Groups (HRGs), the local version of DRGs. The HRG system, also known as 'Payment by Results' was initially introduced in 2003 for a subset of procedures and then gradually expanded to other types of admissions, including all types of elective admissions.⁴ Money now follows the patient. Tariffs are based on national average costs of procedures (Street and Maynard, 2007) but with adjustments according to the Market Forces Factor (MFF) index which reflects exogenous geographical differences on input costs. From 2003 private sector providers have been able to enter the NHS market though they currently treat only a small proportion (2%) of NHS elective patients.

Policies to make demand more responsive to quality have been introduced. Since 2008 NHS patients have had the right to choose any qualified provider (NHS or private) for elective treatment. The Department of Health has promoted websites such as NHS Choices to provide patients with information about hospital performance on a wide range of quality measures.

There are also policies to directly influence quality. The Care Quality Commission (CQC) inspects hospitals through random audits. Hospitals that do not meet minimum national quality standards can be subject to warning notices requiring improvements, more frequent audits, sanctions or fines, prosecution, and suspension of service registration. There are also financial incentives for higher quality under the Commissioning for Quality and Innovation (CQUIN) scheme. NHS local purchasers are required to write contracts with local hospitals which link a set proportion of their revenue to quality indicators chosen by purchasers. 2009/10 (the period of our study) was the preparatory year for the CQUIN scheme during which 0.5% of NHS hospital revenue was linked to achievement of quality indicators (Fichera et al., 2013).

3. Theoretical model

Denote the quality of hospital i ($i = 1, \dots, N$) as q_i . The demand function of hospital i is

$$X_i = X(q_i, \mathbf{q}_{-i}; \delta_i) \quad (1)$$

where $\mathbf{q}_{-i} = (q_1, \dots, q_j, \dots, q_{i-1}, q_{i+1}, \dots, q_N)$ is a vector of the qualities of rival providers. We assume that the demand function of provider i is increasing in its own quality q_i and decreasing in the quality of the rivals: $\partial X_i / \partial q_i > 0$, $\partial X_i / \partial q_j < 0$. Hospitals are demand substitutes: patients switch to a hospital if its quality is increased and away from it if a rival's quality is increased. Hospitals are imperfect substitutes because of travel costs and times, and switching costs. A marginal increase in quality q_i leads some but not all patients to switch from the other hospitals to hospital i .

The vector of parameters δ_i captures other factors affecting demand, such as the location of patients and other hospitals relative to hospital i , patient preferences over distance and quality, and central policies, for example geographical constraints on patients' choice sets.

⁴ Farrar et al. (2009) investigate the effect of the introduction of the HRG system using a difference-in-difference methodology. They find that the introduction of the new system leads to a reduction in length of stay and an increase in the proportion of day cases. No effect on clinical quality was observed.

³ Around 15% of all elective (non-emergency) care is funded by private health insurance.

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