Specification of financial incentives for quality in NHS health care contracts: an empirical investigation[*]

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Preliminary Version

Abstract

Until recently contracts between purchasers and providers of NHS hospital services concentrated on costs and volumes, with no explicit consideration of quality. Recent improvements in information now make it possible to include measures of quality in hospital contracts. From 2009 onwards purchasers of NHS hospital services have been required to incorporate incentives for quality in contracts with hospitals with upper and lower limits on the proportion of the total payment which can be linked to locally chosen measures of quality Using data extracted from 153 of the 169 contracts for acute hospital services in England in 2010/11, we consider how the complexity of the negotiated contracts depended on purchaser and provider characteristics. We find that the complexity of the quality element of the contract is determined by the financial position of the payer, whether negotiation was passed to an agency, and whether the provider had teaching status.

Keywords: *quality of health care; contracts; financial incentives*

JEL classification: I11, I18, L51, C35

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1. Introduction

Since 1991 the National Health Service in England has been organised as an internal market in which local purchasers negotiate contracts with separate provider organisations. The composition of the purchaser and provider organisations has been reformed repeatedly but the content of the contracts between the parties has evolved more slowly. Until 1997, purchasers and providers had considerable freedom to determine the contractual arrangements that governed their relationship but the principal differentiation of contracts was whether or not payments were dependent on volume (Chalkley and McVicar, 2008). From 2003/04, volume-based financing (called *Payment by Results*) was gradually introduced and providers were reimbursed on a casemix-adjusted tariff determined by the Department of Health and based on the average costs of procedures across all hospitals (Street and Maynard ref). Although there was no evidence that quality was adversely affected (Farrar et al, 2009), the Department of health became concerned that providers might reduce quality to keep costs below the tariff (Department of Health, 2008). The *Commissioning for Quality and Innovation* (CQUIN) payment framework was introduced in 2009 requiring commissioners to link payment to measures of quality. By 2011 local purchasers had to make 2.5% of the contract value conditional on the fulfilment of locally negotiated quality indicators. Purchasers were given considerable autonomy in choosing which aspects of quality to incentivise, which quality indicators to use, and how they were to be linked to payment.

In this paper we examine more than 150 contracts for acute providers in England (about 91% of providers) from the second year of the CQUIN schem to determine how the content of local CQUIN schemes varies with the characteristics of provider and purchasers, including the size of the purchaser and providers, the type of provider, their financial positions, the extent to which any provider quality improvements would benefit other purchasers.

Only three papers [Berthiaume et al., 2004; Reiter et al., 2006; Roski et al., 2003] have looked at the link between organisational characteristics and adoption of financial incentives for hospital quality improvement. They focus on the U.S. and use a much smaller sample of hospitals than in this paper. They also do not provide any theoretical analysis to support the empirical tests performed. In the U.K., Csaba and Fenn (1997) and Chalkley and McVicar (2008) have focused on the relation between contract form and provider/purchaser characteristics between 1990 and 1997. They examined contracts relating payment to volume of activity and

do not consider quality incentives. We also have richer information on the characteristics of providers and purchasers.

This paper contributes to the literatures on contract form and financial incentives for quality improvement in health care. First, we present a simple model of contract choice and use it motivate the empirical analysis. We test the empirical implications of this model using count data models to determine how the choice of an incentive scheme is related to provider and purchaser characteristics. We find that the degree of concern for quality and financial efficiency of the purchaser, and the efficiency and size of the provider increase the complexity of the locally-negotiated agreement.

In the next section we explain the contractual arrangements in the NHS and the specific characteristics of the CQUIN scheme. In section 3 we describe the empirical and theoretical literature on contract choice in health care and in other fields of economics. Our theoretical model is derived in section 4. Section 5 describes our data sets. The empirical approach is developed in section 6. Section 7 outlines the results and section 8 concludes.

2. Contractual arrangements in the NHS

2.1. The contracting parties

The organisational structure of the NHS in England has changed repeatedly over the last 60 years. A major change in the last 20 years has been the creation of an internal market, in which the purchaser role has been separated from the provider role. In 2002 the Labour government outlined the new market-based reforms in the document *Delivering the NHS Plan: next steps on investment, next steps on reforms* [DH, 2002]. The plan included two major reforms: patient choice of provider for elective care and the purchasing of healthcare services by a new group of purchasers called Primary Care Trusts (PCTs).

Under the new market reform, secondary and specialist care providers were encouraged to compete to attract individual patients for elective treatment and for acute contracts. The introduction of Foundation Trust (FT) status was intended further to stimulate competitive quality improvement amongst providers. Upon meeting certain clinical quality and financial standards, hospital trusts could apply to become FTs. As FTs, hospitals would become independent, not-for-profit benefit organisations; they would reinvest their profits in services rather than distributing them to shareholders and could access private capital.

PCTs are local health authorities that are primarily responsible for planning, purchasing and securing health services for their local population. They receive a budget based on a weighted capitation formula which reflects the demographic structure, measures of need, and input prices.

2.2 The NHS Standard Contract and the CQUIN scheme

The process of contracting is the focal point of the split between purchasers and providers. An NHS Standard Contract was introduced in 2007 for acute services to be used for all providers offering services to the NHS. These contracts were legally binding documents between purchasers and providers [see Petsoulas et al. (2011)].

The 2008 DH Report, *High Quality Care for All*, highlighted a new focus on quality improvement and proposed new arrangements where a proportion of each provider's income was to be linked to quality improvement. This Commissioning for Quality and Innovation (CQUIN) Framework was intended "*to support and reinforce other elements of the approach on quality and existing work in the NHS by embedding the focus on improved quality of care in commissioning and contract discussions*" [Department of Health, 2008].

Under the CQUIN framework, purchasers and providers are required to contractually link payment to quality improvements. In 2009/10, 0.5% of contract values were required to be linked to quality improvement. This was mandatory for contracts for acute hospital services and optional for community, mental health and ambulance services. In this first year it was expected that many organisations would choose to use the framework to focus on data collection, supporting the wider emphasis on measuring for improvement. This involved collecting data to establish the level of baseline performance in areas of care where the purchaser and provider agreed that quality improvement was needed. CQUIN schemes were also used to encourage improvement in the quality of data collected, or help develop metrics for innovation. Where organisations felt they already had good quality data, they could choose to focus on quality improvement from the start.

From 2010/2011, all NHS contracts had to include a CQUIN scheme. The proportion of the contract value linked to quality improvement increased to 1.5%. Each CQUIN scheme in the acute sector had to include two nationally-mandated elements on (i) reducing the impact of Venous Thromboembolism (VTE) and (ii) improving Patient Experience. To achieve the VTE national goal, providers had to undertake a VTE risk assessment on at least 90% of adult

inpatients. To achieve the Patient Experience national goal, the proportion of patients reporting that the service was responsive to their needs had to exceed a locally-negotiated threshold. The proportion of contract value linked to these national goals was set nationally by the DH at 0.3% for both goals, leaving 1.2% of revenue to be linked to other quality indicators.

Strategic Health Authorities (SHAs), the regional organisations responsible for managing PCTs, could also specify regional elements for CQUIN schemes. Thus, some purchasers could be more constrained in negotiating local quality elements than others.

Within these constraints, the local elements of the CQUIN scheme were completely flexible and could vary across providers depending on the negotiation process with the purchasers. Unlike the first year, in the second year PCTs were instructed not to pay for data collection. They were advised that outcome measures were preferable, but process indicators could be used if there was a direct link to better outcomes.

For each provider, a single organisation is designated as the negotiating purchaser on behalf of the NHS. This was the Lead or Coordinating PCT or an agency negotiating on behalf of the Lead PCT. The content of the CQUIN scheme was negotiated between the provider and the negotiating purchaser, but achievement of the quality indicators was measured on the activity undertaken by the provider for all purchasers. Guidance on the NHS Standard Contract set out the expectation that the purchaser and the provider would co-operate to reach agreement on the CQUIN scheme.

In summary, the negotiating purchaser and provider had to decide a number of elements of the CQUIN scheme:

- the local topics to be included;
- the indicators to be used to measure performance on these local topics;
- the target levels of quality that would represent achievement on the national (for patient experience), regional (where appropriate) and local indicators;
- the proportion of the up to 1.2% of revenue (left after the 0.3% stipulated for the national goals and any proportion required by the region) to be attached to achievement of each of the local indicators.

3. Literature review

Contractual choice has been the focus of the empirical literature in numerous areas. For instance, Ackerberg and Botticini (2002) examine the relation between the characteristics of landlords and tenants and the type of agricultural contracts in Renaissance Tuscany. They find significant evidence of matching between contractual arrangements and type of crop. In particular, risk-sharing and multitasking are observed for perennial crops. In labour contracts, Lazear (2000) finds a relation between worker productivity and contract type. He finds that switching from an hourly-wage to a piece rate system led to a 44-percent increase in productivity for the Safelite Glass Company. In procurement contracts, Crocker and Reynolds (1993) provide evidence for the endogenous choice of the degree of contractual completeness and the incentives facing agents to enter such agreements. They find that the degree of contractual incompleteness reflects the parties' desire to minimise the costs of designing a contractual arrangement. In the context of the offshore drilling industry, Corts and Singh (2004) find that repeated interactions can mitigate the trade-off between low contracting costs (as in day-rate contracts) and high-powered incentives (as in fixed-price contracts). Their empirical analysis shows that more frequent interactions lead to greater adoption of day-rate contracts mitigating incentive problems. This result is even larger when endogenous matching between drillers and project is taken into account with instrumental variables. Shepard (1993) finds that contractual arrangements between gas stations and oil companies are related to the gas stations characteristics in eastern Massachusetts. He finds that oil companies trade off incentive power for more direct control when observable effort is relatively more important, but choose strong incentives and less direct control when unobservable effort in gas stations is more important. Using data for 277 coal contracts, Joskow (1990) finds that contract duration between buyer and sellers depends on relationship-specific investments as predicted by Williamson (1983).

The analysis of contractual choice in healthcare is not as developed as in other fields. The local flexibility in contract setting given by the NHS reform in 1990-1997 offered the opportunity of testing the theory relating to contracting in the healthcare sector. The first contribution is by Csaba and Fenn (1997) who analyse the percentage share of the fixed element in total contracted income for 71 major district acute units representing about a third of acute units in England in the financial year 1992-1993. They show that contractual risk-sharing arrangements depend on purchaser and provider characteristics. More specifically,

they find that capacity constraints and the stochastic nature of patient demand result in purchasers wanting to transfer some risk to local providers by choosing block or cost-volume contracts. The second more recent contribution is by Chalkley and McVicar (2008) who consider whether the choice between block contracts, cost-dependent or volume dependent contracts is related to provider and purchaser characteristics. They use two independent datasets. The first contains 236 contracts from 52 purchasers in 1991-1992. The second one contains 464 contracts from 106 purchasers. They show that the choice of contract form was related to provider and purchaser characteristics in ways that were consistent with predictions from contract theory.

This paper too focuses on the relation between contractual choice and provider and purchaser characteristics in a period of large reforms within the NHS. However, the focus is on the characteristics that affect contractual negotiation based on quality rather than volume.

Principal/Agent models consider the use of incentives by an imperfectly informed principal who tries to induce an agent to provide an efficient level of effort/quality. Quality is usually assumed to be one-dimensional. However, especially in health care, quality is a multi-dimensional variable [see Chalkley and Malcomson (2000)]. In Hölmstrom and Milgrom (1991) a principal has to fine-tune the use of multiple incentives to induce an agent to apply the right level of multidimensional effort. A well known problem in this type of models is that, depending on the substitutatibility or complementarity between the tasks, increasing the incentive for one task might have a negative effect on the level of effort on the other tasks [see Eggleston (2005), and Kaarboe and Siciliani (2011) for applications of the multitasking framework to healthcare markets].

Another strand of the literature (motivated in particular by applications related to the use of incentives in health care) ignores the asymmetric information at the heart of the principal/agent model, and studies how financial incentives paid by a third party payer (usually a benevolent regulator) affect quality provision of providers in imperfectly competitive markets [see Calem and Rizzo (1995), Brekke et al. (2006), (2007)]. Quality is, in general, assumed to be a one-dimensional observable but not contractible variable.

Our paper considers the strategic considerations behind the definition of the CQUIN scheme. Specifically we examine how the characteristics of healthcare providers and purchasers determine the quality content of these contracts. Unlike the scarce literature on this topic, we provide a theoretical representation of the CQUIN structure. Our game-theoretic model contains aspects in common both with the multitasking models [e.g. the payer in our

model can choose between two different incentives to induce the provider to offer quality] and the contributions with observable but not contractible quality [we will assume indeed that the payer can observe quality, but she can induce the provider to supply quality only via the use of financial incentives].

We empirically test the implications of this model with a relatively large sample of contracts in an observational dataset. As in Chalkley and McVicar (2008) we consider a period in which NHS reforms have pushed towards a more flexible contractual setting. We consider a larger variety of characteristics both on the provider and purchaser side. We also focus on the complexity of contractual choice for quality improvement rather than volume of services.

4 Theoretical analysis

The model described in this section captures some of the strategic considerations behind the definition and structure of the CQUIN scheme.

4.1 The model

The model assumes healthcare to be supplied by an acute care provider serving a representative patient who requires a given volume of service. The service is free of charge for the patient and the provider receives payment (as defined in the national contract) from a third party payer[6] (the local PCT). The PCT has an objective function which is strictly increasing in the quality chosen by the provider. Quality has two aspects. $q_0 \geq 0$ represents the dimension of quality incentivized at regional level by say the Strategic Health Authority, SHA, while n is the quality directly incentivized by the local PCT. Alternatively, leaving aside the discrete nature of the problem, n could be interpreted as the number of local quality dimensions that the PCT intends to incentivise in the contract. In line with the CQUIN scheme, qualities are incentivized according to a system of targets. Specifically, the PCT defines quality targets[7] that, if achieved, will allow the provider to receive a payment on top of the national NHS standard contract. The PCT however faces a budget constraint: the amount of money that can be offered to incentivize targeted quality is a fixed portion of the value of the national contract.

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[6] The scheme includes the possibility that contracts might be defined at different levels (e.g. DH, SHA and PCT). The PCT takes the quality indicators specified by the DH or SHA as given.

[7] The CQUIN scheme requires negotiation between the payer(s) and the provider. The model we are adopting is implicitly assuming that all the bargaining power resides with the payer.

Let us consider the following two-stage game.

Stage one

The PCT's problem is the following:

$$\max_{n} V(n; \alpha, \vartheta, x, q_0, p, R_0) = \alpha B(n; x, q_0) - px - R_0(q_0) - R(n; \vartheta, x, q_0) - m(n) \quad (1)$$

$$s.t. R_0 + R(n; \vartheta, x, q_0) \leq kpx$$

where V is strictly increasing, concave function of n. $x > 0$ is the fixed volume of output of the provider for which it is paid the nationally fixed price of p. B is the social benefit from x units of output with quality $[q_0, n]$ and $\alpha \in [0,1]$ is a parameter that measures how much the PCT is concerned with the provision of quality care[8]. $R_0(q_0)$ is the amount (strictly increasing in q_0) to be paid to the provider to be induced to produce regionally mandated quality q_0. R_0 and q_0 are defined at regional level and are therefore treated as parameters by the PCT. $m(n)$ is a (strictly increasing) function of n and represents the monitoring costs of the PCT. $R(n; \vartheta, x, q_0)$ represents the extra cost incurred by the provider to offer a strictly positive level of local quality n.

Stage two

The provider's costs to produce quality, say $\vartheta c(n; x, q_0)$, depend on the volume of output, the dimensions of quality and a cost shifter (efficiency) parameter $\vartheta > 0$. Assume that $c'_n > 0, c''_n < 0, c'_x > 0$.

Under the CQUIN scheme the provider is paid a lump sum if and only if $n \geq \bar{n}$, where $\bar{n}$ defines a target level of quality. Given that there is no uncertainty the PCT will know, incurring monitoring costs $m(n)$, whether the hospital will achieve the target. This is why in problem (1) the PCT directly chooses qualities n rather than $\bar{n}$.

In the absence of any targets set by the PCT hospital utility is

$$u^H = px - \vartheta c(0; x, q_0)$$

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[8] Notice that α weights B relative to the PCT's expenditure on hospital care and on the scheme. It cares about the financial implications because expenditure on hospitals has an opportunity cost (either in terms of less funding for managerial salaries or because the PCT has other socially useful things to spend its budget on). The weight will plausibly be lower if the PCT has a smaller overall budget from the resource allocation process.

Quality dimensions n are zero in the absence of targets since quality has a positive marginal cost and the hospital is assumed not to be altruistic.

The PCT will not wish to pay more than the cost increase of the hospital in achieving the target. In general, the incentive paid by the PCT to induce the provider to achieve target $\bar{n}$ is:

$$R\big(c(\bar{n}; x, q_0)\big) = \vartheta[c(\bar{n}; x, q_0) - c(0; x, q_0)]$$

The constraint in (1) represents the limit on the total amount that can be spent on CQUIN, where $k \in (0,1)$ is the fixed portion of the value of the national NHS standard contract.

The Kuhn-Tucker conditions for the solution of problem 1 are:

$$\alpha B'_n - m'_n - \vartheta(1+\lambda)c'_n \leq 0 \quad \lambda \geq 0$$

and either $\lambda = 0$ and $R_0 + R < kpx$, or $\lambda > 0$ and $R_0 + R = kpx$

We focus on the solutions in which the PCT sets a positive level of local qualities $n > 0$. The CQUIN financial constraint may or may not be binding.

Simple comparative statics analysis produces the testable implications considered in the following section. Specifically, the characteristics of the payer and the provider affects the solution to problem 1 as follows.

- Suppose that in equilibrium $\lambda = 0$ (the constraint is slack), $n > 0$, then:

$$\frac{dn}{d\alpha} = -\frac{B'_n}{\alpha B''_n - m''_n - \vartheta c''_n} > 0$$

$$\frac{dn}{d\vartheta} = \frac{c'_n}{\alpha B''_n - m''_n - \vartheta c''_n} < 0$$

$$\frac{dn}{dq_0} = -\frac{\alpha B''_{nq_0} - \vartheta c''_{nq_0}}{\alpha B''_n - m''_n - \vartheta c''_n} > 0 \text{ if } \alpha B''_{nq_0} > \vartheta c''_{nq_0}$$

$$\frac{dn}{dx} = -\frac{\alpha B''_{nx} - m''_{nx} - \vartheta c''_{nx}}{\alpha B''_n - m''_n - \vartheta c''_n} > 0 \text{ if } \alpha B''_{nx} > m''_{nx} + \vartheta c''_{nx}$$

$$\frac{dn}{dp} = \frac{dn}{dk} = 0$$

- Suppose that in equilibrium $\lambda > 0$ (the constraint is binding), $n > 0$, then:

$$\frac{dn}{d\alpha} = 0$$

$$\frac{dn}{d\vartheta} = \frac{c'_n R}{-(\vartheta c'_n)^2} < 0$$

$$\frac{dn}{dq_0} = \frac{c'_n(R'_0 + \vartheta c'_{q_0})}{-(\vartheta c'_n)^2} > 0 \text{ if } R'_0 + \vartheta c'_{q_0} < 0$$

$$\frac{dn}{dx} = \frac{c'_n(-kp + R'_x)}{-(\vartheta c'_n)^2} > 0 \text{ if } kp > R'_x$$

$$\frac{dn}{dp} = \frac{c'_n kx}{(\vartheta c'_n)^2} > 0$$

$$\frac{dn}{dk} = \frac{c'_n px}{(\vartheta c'_n)^2} > 0$$

When the solution has $\lambda = 0$ (the constraint is slack), n increases with α (the marginal benefit of local quality increases with α) and decreases with ϑ (the marginal cost of incentivising n increases with ϑ). A higher regionally mandated quality has a positive effect on the optimal level of n if the increase in the marginal benefit of n is larger than the increase in the marginal costs of provision[9]. A similar reasoning can be applied on the effects of an increase in the level of negotiated care x on the optimal level of n. Since the constraint is not binding, parameters p and k do not affect the optimal level of n.

When the solution has $\lambda > 0$ (the constraint is binding), n is defined by the constraint. Therefore an increases is α has not effect on the solution. n decreases again with ϑ (an increase in ϑ makes the constraint tougher). A higher regionally mandated quality or a higher level of output have a positive effect on the optimal level of n if they produce budget-expanding effects. Since the constraint is now binding, parameters p and k have a clear budget-expanding effect and produce an increase of the optimal level of n.

4.4 Testable implications

There are four main testable implications from our theoretical model:

- The effect of a variation of the PCT concern about the locally negotiated quality contracts (i.e. $\frac{dn}{d\alpha}$); the theoretical model indicates that α has a positive effect on locally negotiated qualities when the CQUIN constraint is not binding.
- The effect of a variation in the provider's efficiency on the locally negotiated quality contracts (i.e. $\frac{dn}{d\vartheta}$); the theoretical model indicates that lower provider efficiency will make it more expensive for the PCT to incentivise a certain level of quality n and that an increase of ϑ would reduce n.
- The effect of a variation in the provider's size on the locally negotiated quality contracts (i.e. $\frac{dn}{dx}$); an increase in output has a positive effect on local qualities if increase in the marginal benefit for the PCT (measured by $\alpha B''_{nx}$ when the

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[9] Notice again that c'_{q_0} might be negative is q_0 has some form of complementarity with the production of n.

constraint is slack and by kp when the constraint is binding) is larger than the increase in provider's costs to produce a certain level of n.

- The effect of a variation in the quality contracts mandated by the SHA on the locally negotiated quality contracts (i.e. $\frac{dn}{dq_0}$). The analysis above indicates that the quality mandated by the SHA has a positive effect on the qualities specified by the PCT if it is complementary in production with the local qualities and if it has sufficiently small CQUIN budget reducing effects.

5. Data sources and descriptive statistics

5.1 Data sources

Information on the CQUIN schemes specified for each provider in 2010/11 was obtained from the NHS Innovation and Improvement website. We analyse data on the second year of the CQUIN and focus on NHS acute providers because only the contracts for these providers have been required to link quality to payments since the start of the CQUIN scheme.

The dataset contains a free-text description of the topics and indicators, the weight attached to each indicator, whether the payment was for outcome or process improvement, and whether the indicator was nationally-mandated, regionally-mandated or locally-negotiated.

We analyse two proxies for complexity (q_i) of the CQUIN contract. First, the number of locally negotiated topics and second the number of indicators measuring outcome improvement. The free-text nature of the dataset precludes analysis of complexity beyond the number of indicators that are required to be monitored and the proportion of indicators that are for outcome rather than process measures of quality. Outcome is a measure of complexity as it is more risky for the provider and more costly for the purchaser to monitor.

We link these data sets to characteristics of the purchaser and the provider. On the purchaser side, we use ratings from the World Class Commissioning (WCC) process. The World Class Commissioning programme was a commissioning assurance system launched in 2007 which contained an annual review of each PCT's progress towards achieving better health outcomes, competencies and governance. The regional SHAs managed this assurance system. Eleven competencies were specified for an organisation to become world class. The finance score is part of the total governance measure of the PCT. We use this score to measure the

financial stability of the Lead PCT. Intuitively, a more cash-strapped commissioner might prefer a more complex quality contract to increase their chances to save money or they might prefer a simple scheme to reduce their monitoring costs.

On the provider side, we merged in information on the size of the provider and on the Care Quality Commission's (CQC) rating of the provider from their "Annual Health Check". The CQC classifies providers by their quality of care and financial management. The financial regime under which NHS Foundation Trusts operate is different from other NHS organisations in that they are not required to break-even in the year or to comply with the three-year break-even criterion. For all Trusts that became Foundation Trusts before the 31st of March 2008, the assessment of the quality of their financial management is based on the financial risk rating compiled by Monitor. The financial component of the risk rating is then translated into a quality of financial management score using rules devised by the Healthcare Commission and agreed with Monitor. We consider the size of an acute provider (i.e. the parameter x in the theoretical model) to proxy for the scope of health services it is able to deliver. It is likely that purchasers will negotiate negotiate more topics with larger providers to reflect the breadth of their activity. The efficiency of the provider (i.e. the parameter ☐ in the theoretical model) is proxied by the CQC rating and by the FT status.

We also describe the financial relationship between the purchaser and the provider. We used the Purchaser-Provider Matrix available from the DH Exposition Book 2009/10 to calculate the proportion of the purchaser's total expenditure on acute services that was paid to this provider. We proxy the altruism of the PCT (i.e. the parameter α in the theoretical model) with two variables: the proportion of the purchaser's expenditure that is provided by this provider; and an indicator as to whether the Lead/Coordinating PCT commissioner is part of a cluster or agency. Agencies are more competent at negotiation but less sensitive to the payer's preferences. PCTs will care more about the contents of a scheme if more of their expenditure goes to the provider with whom they are negotiating a contract.

Finally, some providers will be more constrained than others if their CQUIN scheme has to include a number of topics mandated by the SHA (i.e. q_0 in the theoretical model).

5.3 Descriptive statistics

5.3.1 General characteristics of the providers and PCTs

There are 169 acute providers in England [Care Quality Commission, 2005-2009]. We analyse data for 153 acute providers, representing 91% of all acute providers in England.

Table 1 shows that on average the number of mandated topics and outcome/process indicators is about three. About 15% of acute providers in our sample are led by an agency.

Table 1. Description of the variables in the models

Variable	Obs	Mean	Std. Dev.	Min	Max
CQUIN content					
Number of local topics	153	5.46	3.89	0.00	18.00
Number of local outcome indicators	153	2.75	4.25	0.00	24.00
Number of local process indicators	153	5.42	5.74	0.00	27.00
Number of region topics	153	3.73	3.13	0.00	13.00
Number of region process indicators	153	2.87	3.27	0.00	18.00
Number of region outcome indicators	153	2.31	3.83	0.00	15.00
Proportion of local indicators that are outcome indicators	153	0.29	0.31	0.00	1.00
Independent variables					
Specialist Trust	153	0.12	0.33	0.00	1.00
Teaching Trust	153	0.15	0.36	0.00	1.00
Finished consultant episodes in 2009/10 (100,000s)	153	0.98	0.54	0.04	2.79
Share of PCT expenditure at this provider	153	0.46	0.30	0.00	0.98
Contract negotiated by an agency for the PCT	153	0.15	0.36	0.00	1.00
Rating of PCT's financial governance	153	0.71	0.21	0.00	1.00

6. Econometric methods

We analyse the number of locally negotiated topics and of outcome indicators with count data models. The standard Poisson regression assumes that q, the number of topics or indicators, given a set of covariates $x \equiv (x_1, \dots, x_n)$ has a Poisson distribution [see El Sayyad (1973); Maddala (1983)]. The density of q given x is determined by the conditional mean $\mu \equiv E(q|x)$:

$$f(q|x) = \frac{\exp[-\mu(x)]\,[\mu(x)]^q}{q!} \quad q = 0,1,\dots,N$$

where maximum likelihood estimation is possible given a parameterisation of the conditional mean such as $\mu = \exp(x\beta)$ and a random sample.

Since the basic assumption of variance-mean equality in the Poisson model is rejected for all our dependent variables, we use the following assumption:

$$\mathrm{Var}(q|x) = \sigma^2 E(q|x)$$

where $\sigma^2 > 0$ is the variance-mean ratio. This is used in the generalised linear models (GLM) and is called the *Poisson GLM variance assumption* [Wooldridge (2010)]. Over-dispersion occurs whenever $\sigma^2 > 1$ as in the case of our analysis.

We adjust the standard errors for over -dispersion using the square root of Pearson and we show that the results are not dissimilar from the negative binomial ones.

The negative binomial is a popular alternative to the Poisson in case of over-dispersion because it defines $\mathrm{Var}(q|x) = E(q|x) + \alpha[E(q|x)]^2$ with $\alpha \geq 0$ so that under-dispersion is ruled out.

The coefficients of the model are expressed in terms of incidence rate ratios. The parameter estimate of the count models can be expressed as:

$$\beta = \log(\mu_{x+1}) - \log(\mu_x) = \log\left(\frac{\mu_{x+1}}{\mu_x}\right)$$

where β is the regression coefficient that can be written as the ratio of the expected count , μ, and the subscripts represent the predictor variable evaluated at *x* and *x+1*.

The likelihood ratio test for over-dispersion is a test of the parameter α. Under the null hypothesis, the Poisson and the negative binomial are the same, that is:

$$H_0: \alpha = 0$$

and the alternative hypothesis:

$$H_1: \alpha > 0$$

implies over-dispersion [Cameron and Trivedi, 1998].

7. Results

The regression results are shown in Table 2. We provide results for the number of local topics, the number of local indicators, the number of local outcome indicators, the number of local process indicators and the proportion of local indicators that are outcome indicators.

CQUIN contracts that are negotiated by agencies for the PCT rather than the PCT itself contain fewer topics and indicators. PCTs with better finances negotiate CQUIN contracts with more topics and indicators. CQUIN contracts for teaching hospital Trusts also contain more topics and indicators.

Local PCTs did not respond to the amount of constraint placed on them by regional mandation of CQUIN content. The number of locally-negotiated topics and indicators did not respond to the number of regionally-mandated topics or indicators and thus the amount of contract value available for local negotiation.

However, local negotiators did respond to regional leadership in the type of quality improvement included in the contract. PCTs in regions with more regionally-mandated outcome indicators negotiated local contracts containing more outcome indicators. Agencies for PCTs negotiated substantially fewer process indicators but the same number of outcome indicators. PCTs with better finances specified more outcome and more process indicators. Teaching Trusts faced more process indicators. Specialist Trusts faced more outcome indicators.

Table 2. Regression results

	Number of local topics		Number of local indicators		Number of local outcome indicators		Number of local process indicators		Outcomes as proportion of indicators	
	IRR	z	IRR	z	IRR	z	IRR	z	b	t
Regional content	1.003	0.16	0.991	-0.59	1.105	3.27	1.014	0.68		
Contract negotiated by an agency for PCT	0.644	-2.17	0.668	-1.53	1.032	0.09	0.300	-3.67	0.264	3.43
Share of PCT expenditure at this provider	0.824	-0.73	0.869	-0.42	1.258	0.41	0.816	-0.59	0.088	0.76
Rating of PCT's financial governance	1.796	2.00	3.540	3.21	3.739	2.14	3.010	2.76	-0.110	-0.92
Finished consultant episodes in 2009/10 (100,000s)	1.052	0.36	1.234	1.22	1.045	0.15	1.258	1.28	-0.018	-0.29
Teaching Trust	1.430	2.15	1.597	2.36	0.773	-0.71	1.770	2.81	-0.044	-0.56
Specialist Trust	0.936	-0.29	1.559	1.72	2.569	2.32	1.376	1.13	0.130	1.40

Note: Models of numbers of topics and indicators are estimated as generalised linear models. Std. errors in count data models corrected for over-dispersion using square root of Pearson. Model of outcome proportion is estimated as a linear model. IRR = Incidence Rate Ratios.

8. Conclusions

Since its foundation in 1948, the British National Health Service has been subject of repeated reforms. Before 1990 Health Authorities had the responsibility for planning, financing and delivering hospital services. With the introduction of the internal market in 1991 the purchasing and providing roles were separated. Between 1990 and 1997 purchasers (Health Authorities and GP fundholding) and providers (NHS Trusts) were free to determine contractual arrangements according to the need of their local population. In the early 2000s another wave of market based reforms maintained the split between purchasers and providers, creating PCTs with commissioning responsibility and giving greater autonomy to NHS Trusts acquiring the status of FT. Quality of healthcare services was regulated by a Care Quality Commission for all NHS Trusts and by Monitor for all FTs.

Despite the creation of a centrally determined national NHS standard contract, the new reforms in 2000s introduced some flexibility in contractual arrangements between providers and purchasers/commissioners. In addition, from the mid 2000s a greater emphasis on quality of healthcare was placed on both providers and purchasers. In 2009/10 the Commissioning for Quality and Innovation (CQUIN) framework was introduced linking 0.5% of a provider's contract value to quality improvement. This proportion increased to 1.5% in 2010/11. The purpose of this reform was to improve quality by encouraging commissioner-provider contractual discussions to focus on quality. In practice, CQUIN brought together the contractual flexibility of the reform period 1990-1997 with a new focus on quality in the mid 2000s.

In this paper we analyse the second year of the CQUIN in which quality contracts could be designed around nationally mandated, regionally mandated or locally agreed goals. We determine whether and which provider/purchaser characteristics are related to the choice of contract form for quality improvement. We focus on two dimensions of such contracts, as according to the DH, a good CQUIN scheme should be simple, include few topics within the goals set in the World Class Commissioning framework and focus on outcome measures.

Whilst there is a relatively large literature on contract choice in several areas of economics such as agricultural economics, labour economics, mining and oil industry, the health economics empirical literature on this topic is still scarce. Csaba and Fenn (1997) and Chalkley and McVicar (2008) have analysed the flexibility of contractual choice over volume of health services in the NHS between 1990 and 1997.

This paper can be placed within such literature exploiting the nature of the NHS reforms after the year 2000 and including a further dimension to contractual choice, namely quality improvement.

Very little research has looked at how payers design contracts to incentivise quality improvement [Berthiaume et al., 2004; Reiter et al., 2006; Roski et al., 2003]. No attempt has been made by these papers to provide an economic model of the adoption of a quality incentive scheme.

Within the theoretical literature, this paper can be placed in the strand of research concerned with multitasking problems and observable but not contractible quality. By designing a two-stage game with a payer and a provider we show that quality contracts depend on the degree of concern for quality of the PCT, the efficiency and size of the provider, and the number of constraints placed on a contracts, namely the number of regionally mandated topics.

We test whether purchasers behave as expected from the theoretical model in the second year of the scheme using count data models on three dimensions of the contracts: the number of locally negotiated topics and the number of outcome and process indicators. We find that there is a positive relation between the degree of concern for quality of the PCT and the number of locally negotiated topics, and of outcome and process indicators. Clusters of PCT, being less altruistic towards individual providers, reduce the number of locally negotiated topics and of process indicators. We also find that the size of the provider has a very positive and significant relation with all the three dimensions of the contracts. As predicted by our model, the more constraints are placed on the contract the higher the number of outcome indicators.

Our paper makes a number of contributions to the literature on contract choice. By exploiting the characteristics of the CQUIN scheme we are able to observe quality directly rather than volume of services. We also dispose of larger information with regard to provider/purchaser characteristics compared to the two previous studies in health economics. We develop a game-theoretic approach that considers contractual choice of quality dimensions and we directly test the empirical implications of such a model.

Appendix: An analysis of the distribution of topics/indicators

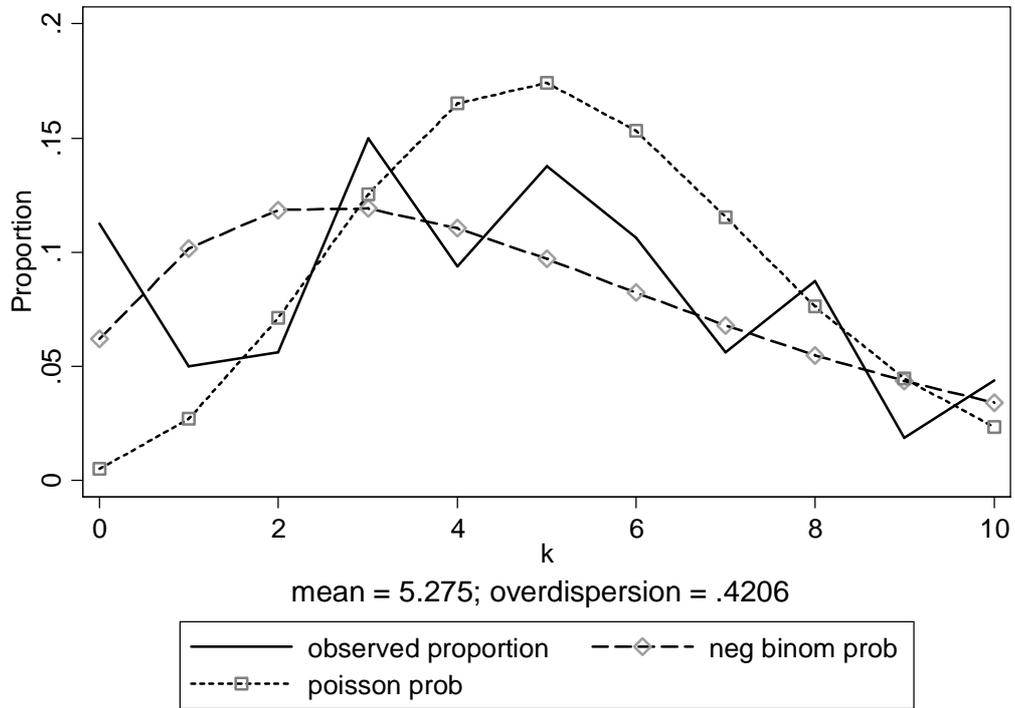**Figure A.1 Distribution of No. of local topics with Poisson and negative binomial (2010)**

mean = 5.275; overdispersion = .4206

| observed proportion | neg binom prob |
| poisson prob | |

Figure A.2 Distributions of No. of outcome local indicators with Poisson and negative binomial (2010)

mean = 2.737; overdispersion = 1.649

| observed proportion | neg binom prob |
| poisson prob | |
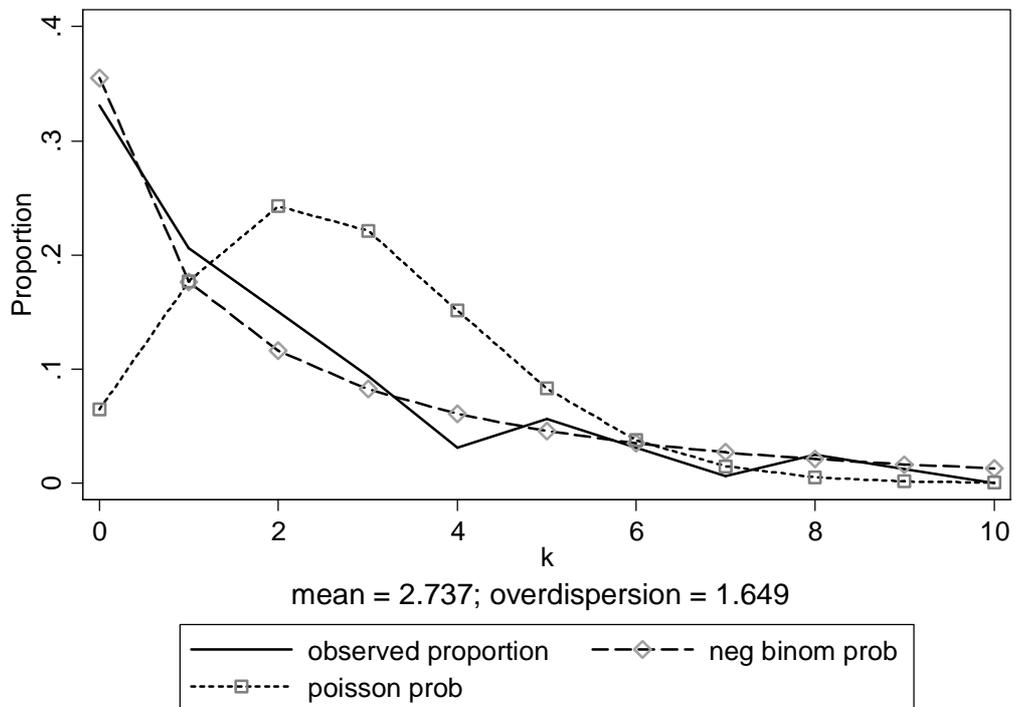
Figure A.3 Distributions of No. of process local indicators with Poisson and negative binomial (2010)

mean = 5.206; overdispersion = 1.148

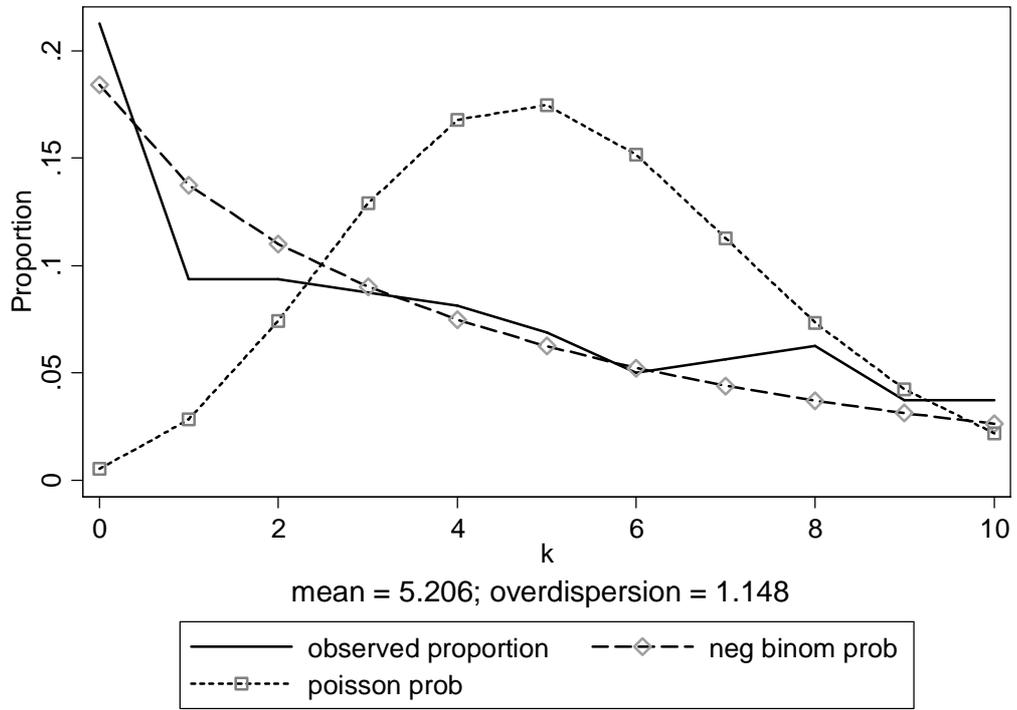|	
——— observed proportion	– –◇– – neg binom prob
----▫---- poisson prob	

Table A.1 Number of locally negotiated topics

Dependent Variable: No. of locally negotiated topics	Negative binomial model		
	Model I:	Model II:	Model III:
Provider's type and efficiency:			
Acute specialist[‡]	1.10 (0.36)	1.14 (0.36)	0.99 (0.26)
Acute teaching[‡]	1.60 (0.33)**	1.72 (0.33)***	1.67 (0.32)***
Acute large[‡]	1.24 (0.19)	1.26 (0.18)	1.17 (0.17)
Acute medium[‡]	1.17 (0.19)	1.284(0.20)	1.27 (0.21)
Foundation Trust	1.05 (0.13)	1.03 (0.12)	1.03 (0.12)
CQC finance score: Fair or weak[†]	0.99 (0.17)	1.04 (0.18)	1.12 (0.19)
Contract constraint:			
No. of SHA mandated topics	0.99 (0.02)	1.01 (0.03)	1.01 (0.03)
Market Power measures:			
Share of PCT expenditure to provider	1.09 (0.26)	0.89 (0.20)	0.75 (0.19)
Lead/coordinating PCT type and efficiency:			
Cluster of PCTs	-	0.64 (0.17)*	0.61 (0.16)*
WCC finance score	-	-	2.04 (0.78)*
No. of observations	*153*	*153*	*153*
Likelihood-ratio test of over-dispersion	*χ^2=95.59 p-value=0.000*	*χ^2=86.92 p-value=0.000*	*χ^2=80.60 p-value=0.000*

Note: Incidence Rate Ratios displayed. PCT-clustered std. errors in (). [†]Reference category: excellent or good.***p<0.01; **p<0.05.

Appendix B

Table B.1 A description of the WCC scores

World Class Commissioning scores	Description
Total governance	Summary score of the three governance scores (i.e. strategy, finance and board).
Total competency	Summary score of the 11 competencies scores.
Strategy	Contains the following categories: a) vision and goals; b) initiatives to ensure delivery of strategic goals and the PCTs programme of change; c) consistency of financial plan with the strategy; d) board challenge, ownership and monitoring of strategic plan delivery and e) achievement of milestones to date.
Finance	Contains the following categories: a) historical financial management; b) robust financial management; c) robustness of planning assumptions; d) sustainable financial position as base case; e) sustainable financial position under different financial scenarios.
Board	Contains the following categories: a) organisation; b) risk; c) information; d) performance; e) delegation; f) board interaction.
Competency 1	Recognised as the local leader of the NHS.
Competency 2	Partnership: work collaboratively with community partners to commission services that optimise health gains and reduce health inequalities and deliver increased productivity.
Competency 3	Engagement with public and patients: proactively build continuous and meaningful engagement with the public and patients to shape services and improve health.
Competency 4	Clinical engagement: lead continuous and meaningful engagement of a broad range of clinicians to inform strategy and drive quality, service design, and efficient and effective use of resources.
Competency 5	Knowledge and health need assessment: manage knowledge and undertake robust and regular needs assessments that establish a full understanding of current and future local health needs and requirements.
Competency 6	Prioritisation of investments: prioritise investment of all spend in line with different financial scenarios and according to local needs, service requirements and the values of the NHS.
Competency 7	Market management: effectively stimulate the market to meet demand and secure required clinical and health and wellbeing outcomes.
Competency 8	Quality improvement and innovation: promote and specify continuous improvements in quality (e.g., CQUIN, IQI) and outcomes through clinical

	and provider innovation and configuration.
Competency 9	Procurement skills: secure procurement skills that ensure robust and viable contracts.
Competency 10	Contract management: effectively manage systems and work in partnership with providers to ensure contract compliance and continuous improvement in quality and outcomes and value for money.
Competency 11	Efficiency and effectiveness of spend.

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