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## THE DETERMINANTS OF CARE HOME CLOSURE

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### SUMMARY

This study investigates the causes of full closure of care homes in the English care home/nursing home market. We develop theoretical arguments about two causes for closure that are triggered by errors or external shocks: poor economic sustainability and regulatory action. Homes aiming to operate with lower quality in the market are argued for a number of reasons to be more susceptible to errors/shocks in setting quality, especially negative errors, leading to an empirical hypothesis that observed quality should negatively affect closure chance. In addition, given quality, homes facing relatively high levels of local competition should also have an increased chance of closure. We use a panel of care homes from 2008 and 2010 to examine factors affecting their closure status in subsequent years. We allow for the potential endogeneity of home quality and use multiple imputation to replace missing data. Results suggest that homes with comparatively higher quality and/or lower levels of competition have less chance of closure than other homes. We discuss that the results provide some support for the policy of regulators providing quality information to potential purchasers in the market. © 2015 The Authors. *Health Economics* published by John Wiley & Sons Ltd.

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### 1. INTRODUCTION

Care homes for frail older people close for a number of reasons. In this paper, we consider the question of whether low-quality homes are more likely to exit the market than high-quality homes, making this assessment using data on closure in the English care homes market between 2008 and 2010.

For many, the purchase of a care home place is a ‘distressed’ purchase given the circumstances under which most prospective clients have to make their decision (Lievesley *et al.*, 2011; Laing & Buisson 2012). In addition, the choice of a care home place is usually made once, and not many clients will move to other care homes thereafter (Bebington *et al.*, 2001). As such, it can be difficult for consumers to make an informed decision (Netten *et al.*, 2001; Office of Fair Trading 2005). Given the ‘experience good’ nature of care home placements, and the costs of moving to other care homes once admitted, we are particularly interested in the impact that the quality rating (QR) system had on care home performance.

There is a small literature examining the impact of quality on care home closures. Castle (2005) found that greater levels of deficiency citations and lower levels of registered and licenced practice nurses employed significantly increased the likelihood of closure for a nursing home. Castle (2006), Castle *et al.* (2009) and Angelelli *et al.* (2003) also found a significant positive relationship between the number of deficiency citations and the likelihood of care home closure. Most of the small literature on the impact of competition on closure finds that closure rates are positively associated with competitiveness (Angelelli *et al.*, 2003; Darton 2004; Kitchener *et al.*, 2004; Castle 2005; Castle 2006; Castle *et al.*, 2009; Li *et al.*, 2010; Bowblis 2011).

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There is also descriptive evidence. Feng *et al.* (2011) found high levels of geographic concentration in nursing home closures across the USA when analysing all closures across the USA from 1999 and 2008 at the zipcode level. For England, a key (descriptive) study of the causes of care home closures comes from Netten and colleagues (2003; 2005) who found that (low) price was seen as an important contributory factor on closure rate, but not the quality of the home.

In this paper, we investigate the hypothesis that the observed quality of a care home is inversely related to its chance of closure. Closures are likely to be triggered by exogenous shocks or errors in business choices. We make two main arguments in relation to quality. First, that homes operating with low quality risk a greater chance of regulatory action that leads to closure following a shock or error. Second, that on average, economic sustainability is lower for homes with low quality—for example, because competition is greater in the low-quality end of the market which is dominated by public purchasers—and therefore given shocks or errors have more chance to lead to closure. We use a two-period panel of care homes data to investigate the impact of quality and competition on closure chance.

Section 1.1 follows with a brief overview of the English care homes market and its regulation, Section 1.2 outlines relevant theory and section 1.3 develops the hypotheses to be examined. Section 2 presents the data and empirical specification. Section 3 has the results. A discussion follows in Section 4.

### 1.1. The English care homes market and regulation

The English care homes market is highly competitive (Forder and Allan 2014). In 2010, there were almost 10 000 mostly privately-operated care homes with a resident population of 300 000 older people. Care homes have two distinct demand streams: individual self-payers and public authorities purchasing care on behalf of (low-income) residents.

In 2010, 40% of placements were self-funded by the individual or their family, with the remainder at least partially publicly-funded, and with the placement decision brokered by the public commissioner (mostly local government). Most care homes will take residents from either funding source.

Prior to October 2010, care homes were assessed by either the Commission for Social Care Inspection, the social care regulator until March 2009, or subsequently the Care Quality Commission (CQC), the new health and social care regulator, as to whether they complied with the National Care Standards Commission (Registration) Regulations 2001, the Care Standards Act 2000 and the Care Homes Regulations 2001. From April 2008, quality ('star') ratings were published following inspections by the regulator, being underpinned by the Key Lines of Regulatory Assessment guidelines, which linked ratings to outcomes and National Minimum Standards (see Forder and Allan 2014 for details).

Under this system, a care home with a poor quality rating (QR) would need to provide an improvement plan. The regulator would monitor the care home, and if standards were not improved, a robust inspection plan would be implemented, followed by enforcement action, which could ultimately lead to prosecution and/or deregistration.

The legislation was subsequently adapted so that from October 2010, the CQC has had to assess whether care homes complied or not to essential standards.

### 1.2. Theoretical considerations

Two reasons for why a care home might close—by which we mean ceases to trade in this paper—are the following. First, the care home might become economically unsustainable such that an alternative (non-care) use of the assets is more profitable. Second, as a result of regulatory action whereby the home consistently fails to meet minimum standards for registration.

Accordingly, the probability of home survival is

$$\text{prob}(S_i = 1) = \text{prob}(\pi_i \geq 0) \times \text{prob}(A_i = 0) = \pi_i^0 (1 - r_i) \quad (1)$$

where  $S_i = 0$  if the home closes and  $S_i = 1$  if the home survives. Here,  $\pi_i$  is (long-term) profitability and  $r_i$  is the chance of direct regulatory action ( $A_i$ ), leading to home closure.

Profitability will depend on revenue,  $R_i$  (price and demand) and the cost of provision,  $C_i$ . Revenue will be a function of *observed* quality,  $\tilde{q}_i$ , which is actual quality  $q_i$  measured with error, and also of competition,  $N_i$ . The probability of regulatory action,  $r_i(\tilde{q}_i)$  is a direct function of observed quality, such that  $r_{\tilde{q}} < 0$ .

Purchasers (including public authorities) will care about quality so that  $R_{\tilde{q}} > 0$ . Costs will increase with quality  $C_q > 0$ . As such, the relationship between profit and quality will not be straightforward in most cases. The literature shows that general results for optimal quality choice  $q_i^*$  are unlikely, instead requiring specific assumptions (Tirole 1988). Nonetheless, in many specifications, markets become (vertically) differentiated with different levels of optimal quality (and profit) in different market segments (Shaked and Sutton 1982; Sutton 1986).

We can conjecture that providers select (actual) quality with error:  $q_i = q_i^*(p_i^*) + q_i^e$ , given optimal prices. Errors,  $q_i^e$ , are assumed to be external, with providers unable to anticipate their size. Through the action of errors, we can speculate that expected profits—and so survival rates—will be positively related to observed quality for a number of reasons, notwithstanding the complexity of vertical differentiation models.

A first potential reason is that a provider's expected revenue is more sensitive to errors at low levels of optimal quality than at high levels due to the chance of regulatory action, that is,  $r_{\tilde{q}\tilde{q}} > 0$ . Where homes have previously chosen low quality and are relatively close to the minimum quality standard threshold enforced by the regulator, (negative) errors have a (greater) chance of triggering a regulatory intervention that might lead to closure.

A second reason, similar to the first, is that even without regulatory action, a provider's demand is sensitive to their level of quality and in particular might show greater elasticity with respect to quality around lower quality levels than around higher quality levels:  $R_{\tilde{q}\tilde{q}} < 0$ . Again, for homes intending to operate (optimally) at low quality-low price levels, errors (especially negative errors) can lead to large changes in profit. The risk of non-sustainability will be higher as compared with levels aiming for moderate or higher-quality levels (given competitiveness).<sup>1</sup>

A third reason stems from the possibility that profits can differ between (optimally) quality-differentiated market segments (even with perfect information). In segments where competition is higher and profits are lower, quality choice errors are more likely to lead to closure than market segments with higher profits. Although we cannot generalise, we might expect the lower-quality segment of the care homes market to operate with lower profits/higher levels of competition compared with higher-quality market segments (Forder and Allan 2014). A main reason is that monopsonistic local authority (public) purchasers operate in the lower quality segment where also, respectively, the size of demand relative to optimal home size is greater, and barriers to entry lower than the higher quality segment. In this case, closure rates would appear to be higher for homes operating in market segments with lower optimal quality than those with higher optimal quality following errors. This might be described as a market quality-composition effect.

We have argued that these effects result from errors about quality setting, because without errors and shocks, markets should be in steady states with only random home turnover/closure. However, in the context of imperfect observation of quality, optimal quality levels without error might in some cases be below those levels that would be optimal with full information, that is, some providers accept a small risk of regulatory action, balancing profitability if regulatory action is avoided (a form of moral hazard). Imperfect information considerations would tend to strengthen our expectation of a negative impact of observed quality on closure rates.

There may be reasons why higher quality market segments show greater closure risk, other things equal, for example, more discerning customers, but on balance we expect the above reasons to dominate.

<sup>1</sup>Positive errors will also adversely affect profits as they are made given prices, that is providers will have set quality (and costs) higher than their prices can support.

This framework also allows us to consider the welfare implications of QR activities/policies. We might reasonably assume given the experienced nature of care home services that *ex ante* quality observations, absent QR, will be difficult and imprecise. In this case, homes that might otherwise have closed under QR through lack of demand or regulatory action will continue to operate with low actual quality. The experienced nature of quality, and the costs of moving home, would mean that residents in such homes would suffer lower quality than they would otherwise want to pay for. Because these homes would have otherwise closed with full (or at least better) information, imperfect information about quality is likely to be welfare reducing overall. In other words, unless the transaction costs of QR are very high, QR should have net positive welfare implications.

Some necessary conditions for us to draw this conclusion are (i) that the closure rate is negatively related to observed quality; (ii) that this effect arises through demand or regulatory responses to observed quality (i.e. not a market quality-composition effect); and (iii) without QR, *ex-ante* quality observation is poor.

We can test the first two conditions empirically with a structural closures model that includes both observed quality and competition, as outlined in the succeeding text. The last condition we assume to hold, based on the characteristics of the ‘product’ and the circumstances in which purchases are made.

Given quality, we would expect turnover (closure) of providers to be greater in more competitive/contestable markets for standard (low profitability) reasons (Forder *et al.*, 1996). The welfare implications in this case are for competition policy and beyond the remit of this paper.

### 1.3. Home closure hypotheses

Suppose the term  $s_i$  is the latent probability of home  $i$  continuing to operate:  $s_i = \text{prob}(S_i = 1)$ , being a function of expected profit as given in (1). A partial reduced-form for the expected profits of each provider, solving for competition  $N_i$ , is

$$s_i = s_i(q_i^*(N_i, z_i, m_i), N_i(q_i^*, z_i, m_i), z_i, m_i) \quad (2)$$

In this function,  $m_i$  are exogenous demand and cost factors (e.g. local input costs) and  $z_i$  are inherent and unobservable exogenous factors, such as productivity rates, the propensity to make errors or the impact of external shocks. At optimal quality (with no errors,  $q_i^e = 0$ ),  $\frac{\partial s_i}{\partial q_i} \Big|_{q^e=0} = 0$ . As argued earlier, we speculate that quality choice errors will have a direct effect through (i) the chance of regulatory action and (ii) greater demand responsiveness at low quality. In both cases, errors reduce survival chance, particularly negative errors (denoted  $q_i^{-e}$ ), that is,  $\frac{\partial s_i(N_i)}{\partial |q_i^{-e}|} < \frac{\partial s_i(N_i)}{\partial |q_i^{+e}|} < 0$ . Moreover, the impact of errors is greater at lower optimal quality:  $\frac{\partial^2 s_i(N_i)}{\partial |q_i^e| \partial q_i^*} > 0$ . As such, we would expect to see survival being positively correlated with actual quality and, in turn, observed quality:  $\frac{\partial s_i(N_i)}{\partial q_i} > 0$ .<sup>2</sup> Competition will negatively affect profits, given optimal quality choice  $\frac{\partial s_i(q_i^*)}{\partial N_i} < 0$ .

An indirect market-composition effect involves the negative impact of errors being exacerbated for high competition compared with lower levels, that is,  $\frac{\partial^2 s_i(q_i^*)}{\partial |q_i^e| \partial N_i} < 0$ . If levels of competition are negatively related to optimal quality choice, as we expect, then the market composition effect would produce the same results as a direct quality effect (i.e.  $\frac{\partial^2 s_i}{\partial |q_i^e| \partial q_i} > 0$  and in turn  $\frac{\partial s_i}{\partial q_i} > 0$ ), but is actually due to differences in competition between market segments. This market-composition effect should disappear if we hold competition constant in our empirical analysis.

The welfare implications as regards QR policy are as follows. In the absence of a QR policy, the (direct) effect of quality errors,  $\frac{\partial s_i(N_i)}{\partial |q_i^e|}$ , will be less adverse on providers compared with the situation under QR. So

<sup>2</sup>Assuming that observations are non-biased.

consumers would experience suboptimal quality from providers that would otherwise close and be replaced by lower-error, higher quality providers. Replacement should occur if the cause of closures is errors, that is, deviation from optimal quality. If the error had not occurred, the provider would have been sustainable.

In summary, we hypothesise that home survival (not closing) is positively correlated with observed quality overall, that is,  $\frac{\partial s_i}{\partial q_i} > 0$  (hypothesis H1) and also when holding competition constant  $\frac{\partial s_i(N_i)}{\partial q_i} > 0$  (hypothesis H1a).

Furthermore, given quality, competition should reduce survival chance:  $\frac{\partial s_i(\tilde{q}_i)}{\partial N_i} < 0$  (hypothesis H2).

## 2. DATA AND EMPIRICAL SPECIFICATION

### 2.1. Empirical specification

The stochastic counterpart to (2) in linear form, and being explicit about time  $t$ , is

$$s_{it}^* = x_{it}'\beta + \epsilon_{it} = \beta_0 + \beta_1 q_{it}(N_{it}, z_{it}) + \beta_2 N_{it}(z_{it}, q_{it}) + \beta_3 m_{it} + \epsilon_{it}(z_{it}) \quad (3)$$

where  $\epsilon_{it}$  is an error term. Only the *ex-post* status of the care home is known at time  $t+1$  (i.e. at the next observation) in the following way:

$$S_{it+1} = 1 \text{ if } s_{it+1}^* > 0$$

$$S_{it+1} = 0 \text{ if } s_{it+1}^* \leq 0$$

The variable,  $S_{it+1}$ , is the status of the care home at time  $t+1$ , a discrete 0/1 variable, which takes the value of 1 if the care home remained open between waves of the panel (i.e. between 2008 and 2010 and between 2010 and 2012) and 0 if the care home closed within the same period.

Because we could only observe the characteristics of surviving homes at time  $t+1$ , we used time  $t$  data as explanatory variables and therefore modelled  $s_{it+1}^* = s_{it+1}^*(x_{it})$ . As we have observed between  $t=1$  and  $t+1$  and also between  $t+1$  and  $t+2$ , we can simplify the notation by considering two waves,  $w=1, 2$ , and writing (3) as

$$s_{iw}^* = x_{iw}'\beta + \epsilon_{iw} \quad (4)$$

and assuming

$$\text{Prob}(S_{iw} = 1 | x_{iw}) = F(x_{iw}'\beta) \quad (5)$$

where  $S_{iw} = 1$  or 0 if  $S_{it+w} = 1$  or 0.

### 2.2. Data

To construct our panel of care homes, we used the social care regulator's register of care homes from three points in time: 8th May 2008, 30th September 2010, and 30th December 2012.

The care homes sector can be classified by the following: registration type (with or without registered nurses); primary client group (for example, homes catering for people with mental health problems, learning disability, dementia, and other old age); and organisational type (public, private, or voluntary sector). There were 18 486 care homes of *all* classifications on the CQC register in 2008, 18 040 in 2010 and 17 527 in 2012.

The CQC register was augmented with data from a commercially-available dataset from care home market specialists, Laing and Buisson (LB). In particular, the LB data include a variable indicating the primary client group served by the care home and care home organisational type, these variables being used in the selection of the care homes population for the study.

We matched between the CQC register and the LB dataset using a hierarchical process, matching on post-code (full initially, then shortened), care home name, address, telephone number and number of registered

places. Using this process, we were able to match the LB data to 98.75% of *all* classifications of care homes on the CQC register for 2008, 99.39% for 2010, and 99.29% for 2012. There were 231 homes in 2008 and 110 homes in 2010 for which we lacked a primary client group designation.

For the analysis, we selected care homes in the CQC registers for the two baseline years that (i) had a primary client group classification of either old age or dementia; and (ii) operated in the independent sector, that is, private or voluntary. As a result, we had 9324 homes in 2008 and 9330 homes in 2010. Note that any care home that changed client group or sector so that it ceased to meet the selection criteria in subsequent waves was dropped from that subsequent wave.

Having selected the care home population in any given year, the determination of closure status was made by identifying whether each care home remained on the register at the subsequent time point. In principle, any home not on the register in the subsequent period could be regarded as closed, because registration with the CQC is a legal requirement to providing care. The focus was homes that had entirely ceased to operate. Consequently, we ignored any change in ownership/organisation for this purpose, regarding these homes as still open.

In adopting this approach, it was important to determine as far as possible whether a home remained on the register, recognising the potential for miscoding between periods in the data. Consequently, we used multiple data items in a hierarchical fashion to match between years. The starting point was to attempt to match across periods using the CQC identifier. If homes could not be matched between years on this basis, we then used the LB identifier. If homes were then not showing a match, we continued the process using name, address, and so on (as with the LB matching). Only when a home in the baseline year could not be matched to a home in the subsequent period's register on any of these criteria did we conclude that the home had closed.

On this basis, 320 (3.43%) of those care homes (in the selected population of 9324) that were open in 2008 had closed by 2010. Also, by 2012, a further 302 (3.24%) care homes that were operating in 2010 had closed.

*2.2.1. Variables.* Quality was measured using the CQC star rating measure, which can be either zero stars (poor), one star (adequate), two stars (good) or three stars (excellent). The Office of National Statistics in England commissioned research that showed both a reasonable degree of inter-rater reliability in the assessment of ratings and a significant positive relationship between QRs and the social care-related quality of life for a sample of care home residents (Netten *et al.*, 2010). Due to the small number of 0 star ratings (1.92%), we combined this with a one star (adequate) rating. We used either a dummy variable: 0/1 stars and 2/3 stars, or a three-way categorical variable.

Competition was measured using a distance-time and travel-time-weighted Herfindahl-Hirschman Index (HHI) with a market radius of 20 km around each care home. For more information on this measure, see Forder and Allan (2014). The HHI takes values between 0 and 1 with higher values indicating more concentration (lower competition) in the market.

Various home-level characteristics were included in the analysis as control factors: age (number of years since first registration), if the home was a nursing or residential home, whether it was purpose-built, size (number of beds), voluntary sector, primary client (older people or those with dementia) and the number of homes in the organisational group.

We also included local market characteristics as controls by mapping the home to its standard-classification small geographical area, specifically its lower-layer super output area (LSOA).<sup>3</sup> The LSOA-level control factors were the following: percentage of females claiming job seekers' allowance (JSA) (a proxy for unemployment rates), the proportion of the population 65 and over, and rank of the area's Multiple Deprivation Scale score. This scale is a national index ranking small areas of England from most deprived (rank of 1) to least deprived (rank of 32 482). We also controlled in all estimations for the region where the care home

<sup>3</sup>See <http://www.ons.gov.uk/ons/guide-method/geography/beginner-s-guide/census/super-output-areas--soas-/index.html>

was located (East of England, East Midlands, London, North East, North West, South East, South West, West Midlands and Yorkshire or Humberside).

**2.2.3. Missing data and imputation.** The QR system in operation over the period was first introduced in 2008. As a result, a number of care homes on the register had not been rated in 2008; specifically 6598 independent sector care homes (70.77%) had been rated by May 2008. In 2010, 9049 (96.99%) homes had been rated, with virtually all of those homes that were not inspected at this time being newly opened.

There were also some missing data amongst the control variables in the two-wave population (of 18 654 homes): registration year (18 homes); purpose-built (80 homes); and organisational group (26 homes).

We do not expect that QRs were missing *entirely* at random. Moreover, because the QR system was new at the time, we may assume that inspectors did *not* target inspections on homes with poor QR. If they did, this would mean that data were missing not at random. Instead, we assumed that any targeting used other indicators available to inspectors, which are, in the main, available in the dataset. As such, we could use multiple imputation (MI), ignoring the exact process that led to the data being missing. Specifically, a chained imputation method was implemented with logit and predictive mean matching models to generate 20 imputations. The data were imputed across the two waves, with a wave dummy included in the imputation model.<sup>4</sup>

### 2.3. Estimation methods

There are a number of features of the data with implications for our empirical modelling approach. First, the missing data, and the use of an imputed dataset as noted. Second, the dependent variable in the model was a binary dummy:  $S_{iw}$ . Third, the data were in panel form with two transitions: wave 1 from 2008 to 2010 and wave 2 from 2010 to 2012. This design allowed us to model home-level effects.

A fourth issue was the potential for endogeneity. In the estimation—see (3)—there was likely simultaneity and also correlation of the unobserved factors  $z_{iw}$  with quality and competition. The lagged nature of the endogenous variables may help to reduce the significance of this problem, but because we might expect the unobserved factors to persist over time, that is,  $z_{it+1} = z_{it+1}(z_{it})$ , this problem may still arise. An instrumental variables (IV) approach could address this problem.

Given these features of the data, we used three main empirical modelling approaches. First, we estimated IV probit models on the pooled data with errors clustered on  $i$ . Second, to explicitly recognise the dependence over time in the panel data, we estimated population-averaged probit models with manually instrumented endogenous variables (also with robust standard errors). Third, a random effects probit model was also estimated. This estimation was mainly for comparison given that PA models may be inconsistent if there are home-level random effects: that is, where the marginal probability density function for each home-wave pair is  $f(S_{iw}|\hat{x}_{iw}) = f(\hat{x}_{iw}'\beta + \alpha_i)$  (where  $\alpha_i$  is an unobserved random variable for the latter) rather than  $f(S_{iw}|\hat{x}_{iw}) = f(\hat{x}_{iw}'\beta + \alpha)$ . Our strategy for testing for endogeneity, weak instruments and over-identification within the MI framework is outlined in the Appendix (Supporting Information). We were not able to test directly for the significance of random effects in MI regressions other than to use the standard likelihood-ratio (chi squared) test on each imputation. More pragmatically, we were able to compare the results with those from the pooled regression. Nonlinear fixed effects models are problematic—conditional MLE can be used but the conditioning means that observations are dropped when outcomes are unchanged through time (Cameron and Trivedi 2010).

<sup>4</sup>We did not impute for the 231 homes in 2008 and 110 homes in 2010 on the register missing the relevant LB data for selection criteria, believing this to be missing completely at random.



Following Forder and Allan (2014), the instruments used for competition were selected to reflect demand and supply factors applying at market level: specifically medium-layer super output area (MSOA) level deprivation rank and the proportion of the population 65 and over (excluding the LSOA that the care home was located in). The argument for their exogeneity was that any effects on closure status of the older population rate variable and deprivation rank variable will be captured at the lower LSOA level, and these LSOA variables are included as independent variables. Rather, the MSOA-level factors will largely affect *competitor's* behaviour and in turn, the level of competition facing the home in question.

For quality, a similar approach was adopted, but in this case using the average level of quality at the district council ( $n=352$ ) level (excluding each respective home's star rating) and MSOA-level deprivation rank. The effect of quality on a home's status was directly measured by the inclusion of the home's own QR. However, the choice of quality is to some degree affected by the quality choices of competitors in the local market, and these 'market-level' choices are reflected in the district council level variable. Similar spill-over arguments were made by Hirth (1999) and Grabowski and Hirth (2003) where quality is driven by the number of voluntary care homes in a market.

### 3. RESULTS

Descriptive statistics for the initial and MI datasets are presented in Tables I and II, the former with the waves pooled and the latter separately.

Results of the closure status models are presented in the following tables. Table III reports the main models 1 and 2. Table IV reports two comparison models 3 and 4. Initially, we estimated with both endogenous quality and competition. The data suggested that the main competition variable (HHI 20 km travel time adjusted) was endogenous but quality was not. These results are given in Model 3 for comparison. Consequently, the other models were estimated with just endogenous competition.

Model 4 estimated a random effect probit model with manually instrumented competition. Likelihood ratio tests were recorded for each imputation and showed mixed significance of panel-level effects (in 13 out of 20 imputations, the LR test was significant at the 5% level). Adopting the more parsimonious approach, we instead focused on the pooled/PA-average models.

Model 1 explicitly allows for the endogeneity of the competition variable, but with pooled data across the waves (albeit with errors clustered on homes between the waves). The PA-model (Model 2) recognises the panel nature of the data, but does not allow for the stochastic nature of the predicted value of competition. Nonetheless, the results between these models are very similar.

All models satisfied tests for weak instruments and over-identification (as outlined in the Appendix). We also implemented a specification test in the PA-model by including squared predicted values of the dependent variable. This variable was insignificant.

In all models, (exogenous) quality and (endogenous) competition were significant. Good/excellent QR was associated with a reduced probability of closure as hypothesised (hypothesis H1a). Concentration (HHI) was negatively associated with closure rate, which supports hypothesis H2. Excluding competition from Model 1 did not alter the quality effect found, supporting hypothesis H1. Interactions between quality and wave were not found to be significant where tested in Model 1, nor were interactions between quality and competition (HHI), suggesting little or no indirect market composition effects.

The respective effect sizes (estimated at sample means) are given in Table V. Model 1 produced slightly higher effect sizes of quality and competition on closure rate than Model 2. Nonetheless, homes with good/excellent QRs were around 4 percentage points less likely to close than poor/adequate quality rated homes (compared with an average closure rate of 3.3%). In relative terms, good/excellent rated homes are 2.5 times less likely to close.

Table I. Descriptive statistics for pooled dataset

	Non-imputed data			MI data (20 imputations)		
	All	Remained open	Closed	All	Remained open	Closed
Number of care homes	15 606	15 124	482	373 080	360 640	12 440
Status—closed	0.031 (0.173)	0 (0)	1 (0)	0.033 (0.180)	0 (0)	1 (0)
Quality						
Average star rating	2.026 (0.567)	2.035 (0.564) ***	1.749 (0.585)	2.015 (0.566)	2.025 (0.563) ***	1.738 (0.584)
Quality (2/3)	0.852 (0.355)	0.858 (0.349) ***	0.672 (0.470)	0.847 (0.360)	0.853 (0.354) ***	0.665 (0.472)
Competition						
HHI 20 km	0.016 (0.015)	0.016 (0.015) <sup>NS</sup>	0.015 (0.015)	0.016 (0.015)	0.016 (0.015) ***	0.015 (0.014)
Care home characteristics						
Age (of registration)	20.44 (6.05)	20.42 (6.08)	21.04 (4.92) **	20.35 (6.14)	20.32 (6.16)	21.19 (5.30) ***
Size	36.08 (20.82)	36.47 (20.88) ***	23.62 (13.84)	36.06 (20.93)	36.50 (20.99) ***	23.33 (13.93)
Nursing home	0.366 (0.482)	0.370 (0.483) ***	0.207 (0.406)	0.366 (0.482)	0.371 (0.483) ***	0.203 (0.402)
Voluntary sector	0.147 (0.354)	0.144 (0.351)	0.234 (0.424) ***	0.135 (0.342)	0.132 (0.339)	0.219 (0.413) ***
Dementia clients	0.153 (0.360)	0.153 (0.360) <sup>NS</sup>	0.158 (0.365)	0.156 (0.363)	0.156 (0.363) <sup>NS</sup>	0.154 (0.361)
Organisational group size	44.02 (116.35)	44.78 (117.31) ***	20.07 (76.77)	45.65 (120.32)	46.56 (121.45) ***	19.35 (76.13)
Purpose built	0.238 (0.426)	0.242 (0.429) ***	0.108 (0.311)	0.235 (0.424)	0.239 (0.427) ***	0.103 (0.304)
Local demand characteristics						
(LSOA level)						
JSA female claimants (%)	0.475 (0.421)	0.473 (0.418)	0.559 (0.503) ***	0.461 (0.413)	0.459 (0.410)	0.522 (0.478) ***
Older population (%)	24.99 (8.62)	25.05 (8.60) ***	23.24 (8.80)	24.88 (8.59)	24.94 (8.58) ***	23.12 (8.76)
Deprivation rank	16 875.7 (8795.4)	16 916.1 (8781.8) ***	15 607.0 (9131.6)	16 799.0 (8798.8)	16 837.1 (8790.8) ***	15 695.9 (8959.8)
Region	5.304 (2.413)	5.300 (2.416) <sup>NS</sup>	5.434 (2.304)	5.282 (2.432)	5.276 (2.436)	5.441 (2.317) ***
Additional instruments						
LA average star rating	2.031 (0.172)	2.031 (0.172) <sup>NS</sup>	2.025 (0.175)	2.022 (0.174)	2.022 (0.174) ***	2.015 (0.176)
MSOA older population (%)	22.07 (6.86)	22.10 (6.85) ***	21.03 (7.23)	22.00 (6.85)	22.03 (6.83) ***	20.97 (7.12)
MSOA deprivation rank	17 099.4 (7892.4)	17 130.4 (7881.4) ***	16 126.3 (8183.4)	17 023.3 (7912.6)	17 052.2 (7903.9) ***	16 185.1 (8117.96)

MI, multiple imputation; LSOA, lower-layer super output area; JSA, job seekers' allowance.

Standard deviations in parentheses. For the simple bivariate comparisons,

<sup>NS</sup> indicates no significant difference by status.

\*, \*\* and \*\*\* indicate a greater value for either remained open or closed care homes at 10%, 5% and 1% significance, respectively.

Table II. Descriptive statistics across waves

	Non-imputed data		MI data (20 imputations)	
	Wave 1	Wave 2	Wave 1	Wave 2
Number of care homes	6586	9020	186,480	186,600
Status—closed	0.028 (0.165)	0.034 (0.179)**	0.034 (0.182) <sup>NS</sup>	0.032 (0.177)
Quality (2/3)	0.837 (0.370)	0.864 (0.343)***	0.829 (0.377)	0.863 (0.344)***
Competition (HHI 20 km)	0.016 (0.015)**	0.016 (0.014)	0.016 (0.015) <sup>NS</sup>	0.016 (0.014)

MI, multiple imputation; HHI, Herfindahl-Hirschman Index.

Standard deviations in parentheses. For the simple bivariate comparisons:

<sup>NS</sup> indicates no significant difference by status.

\*, \*\* and \*\*\* indicate a greater value at either wave 1 or wave 2 at 10%, 5% and 1% significance, respectively.

The construction of the HHI means that marginal effects appear very high. In elasticity terms, the effects are still relatively large, with point estimates equivalent to a 1.2% or 1.0% reduced probability of closure for a 1% increase in HHI.

We performed a number of robustness checks. First, the models estimated on non-imputed data produced very similar results to the imputed data (see also Table V). Second, we estimated the model splitting the good

Table III. Model results—multiple imputation probit models 1 and 2

	Model 1 (IV probit)		Model 2 (Pop-averaged probit)	
	Coefficient	Z	Coefficient	Z
Quality				
Quality good/excellent	−0.489 ***	−7.21	−0.554 ***	−10.37
Competition				
HHI 20 km time (predicted) (log)	−0.643 **	−2.38	−0.685 **	−2.19
Care home characteristics				
Purpose built	−0.229 ***	−3.66	−0.247 ***	−3.62
Age (of registration)	0.030 ***	2.60	0.031 ***	2.66
Age (of registration) sqrd	−0.001 **	−2.33	−0.001 **	−2.30
Nursing home	0.058	1.21	0.059	1.15
Dementia clients	0.075	1.41	0.077	1.38
Voluntary sector	0.577 ***	10.27	0.617 ***	11.09
Organisational group size (100 s)	0.059	0.69	0.056	0.63
Organisational group size (100 s) (squared)	−0.010	−0.55	−0.009	−0.50
Size (log)	−0.598 ***	−11.49	−0.628 ***	−16.38
2010 wave	0.056	1.40	0.060	1.39
Local demand characteristics (LSOA level)				
Deprivation rank (1000 s)	−0.004	−1.42	−0.004	−1.41
Older population proportion	−0.003	−0.90	−0.003	−0.98
JSA female claimants proportion	−0.335*	−1.75	−0.352*	−1.73
JSA female claimants proportion (squared)	0.087 ***	2.04	0.092 **	2.08
Constant	−2.663 ***	−2.13	−2.844 **	−1.99
Regions	YES		YES	
<i>n</i>	18654		18654	
Imputations	20		20	
Average RVI	0.013		0.022	
Largest FMI	0.161		0.300	
	Statistic	Prob	Statistic	Prob
Weak instruments	71.980 ***	<0.001	71.980 ***	<0.001
Over-ID	0.790 <sup>NS</sup>	0.454	1.640 <sup>NS</sup>	0.195
Endogeneity	2.060 ***	0.039	2.060 **	0.039
Specification	N/A		−0.680 <sup>NS</sup>	0.494

IV, instrumental variables; HHI, Herfindahl-Hirschman Index; LSOA, lower-layer super output area; JSA, job seekers' allowance; RVI, relative variance increase; FMI, fraction of missing information.

<sup>NS</sup> indicates not significant.

\*, \*\* and \*\*\* indicate 10%, 5% and 1% significance, respectively.

Table IV. Model results—MI probit models 3 and 4

	Model 3 (PA probit with endog quality)		Model 4 (RE probit)	
	Coefficient	Z	Coefficient	Z
Quality				
Quality good/excellent			-0.718 ***	-5.82
Quality good/excellent (predicted)	-0.034	-0.06		
Competition				
HHI 20 km time (predicted) (log)	-0.683 **	-2.21	-0.946 **	-1.98
Care home characteristics				
Purpose built	-0.268 ***	-3.91	-0.331 ***	-3.11
Age (of registration)	0.029 **	2.56	0.042 **	2.43
Age (of registration) sqrd	-0.001 **	-2.30	-0.001 **	-2.17
Nursing home	0.067	1.34	0.076	1.08
Dementia clients	0.094	1.62	0.109	1.36
Voluntary sector	0.566 ***	9.17	0.842 ***	4.81
Organisational group size (100 s)	0.055	0.64	0.084	0.68
Organisational group size (100 s) (squared)	-0.009	-0.52	-0.014	-0.55
Size (log)	-0.613 ***	-16.43	-0.866 ***	-4.92
2010 wave	0.032	0.71	0.178	1.60
Local demand characteristics (LSOA level)				
Deprivation rank (1000 s)	-0.006*	-1.87	-0.006	-1.39
Older population proportion	-0.004	-1.15	-0.005	-1.03
JSA female claimants proportion	-0.385*	-1.89	-0.490*	-1.68
JSA female claimants proportion (squared)	0.101 **	2.23	0.127*	1.94
Constant	-3.208 **	-2.12	-3.840*	-1.80
Regions	Yes		Yes	
<i>n</i>	18 654		18 654	
Imputations	20		20	
Average RVI	0.0001		0.03	
Largest FMI	0.0027		0.17	
	Statistic	Prob	Statistic	Prob
Weak instruments—competition	71.980 ***	<0.001	71.980 ***	<0.001
Weak instruments—quality	69.510 ***	<0.001		
Sargan test (over ID)—competition	1.410 <sup>NS</sup>	0.243		
Sargan test (over ID)—quality	1.350 <sup>NS</sup>	0.260		
Endogeneity—competition	2.240 **	0.025		
Endogeneity—quality	-1.210 <sup>NS</sup>	0.227		
Specification	-1.640 <sup>NS</sup>	0.102		

HHI, Herfindahl-Hirschman Index; LSOA, lower-layer super output area; JSA, job seekers' allowance; RVI, relative variance increase; FMI, fraction of missing information.

<sup>NS</sup> indicates not significant.

\*, \*\* and \*\*\* indicate 10%, 5% and 1% significance, respectively.

and excellent categories of the QR. The estimated probabilities of closure were: 0.014 for excellent ( $p=0.027$ ), 0.024 for good ( $p < 0.01$ ) and 0.065 for poor/adequate ( $p < 0.01$ ).

Third, we used a categorical version of predicted competition split into quartiles. These results showed that only homes in the second most competitive quartile had a significantly reduced probability of closure compared

Table V. Marginal effects (point estimates)—multiple imputation probit models 1 and 2

	Model 1 (IV probit)	Model 2 (Pop-averaged)	Non-imputed IV probit	Unadjusted
Probability of closure (predicted)				
Quality: 0/1 stars	0.066	0.057	0.065	0.073
Quality: 2/3 stars	0.023	0.016	0.023	0.026
Diff	0.043	0.040	0.042	0.047
HHI (concentration)				
Marginal effect at mean	-2.603	-2.124	-3.914	
Elasticity at mean	-1.218	-0.994	-1.831	

IV, instrumental variables; HHI, Herfindahl-Hirschman Index

with homes in the most competitive markets ( $p=0.022$ ). Otherwise, there was no significant difference in the likelihood of closure between homes in the other two more concentrated quartiles of markets ( $p=0.154$  and  $p=0.538$ , respectively) and those in the most competitive markets. Fourth, when adding lagged quality and competition effects, we found no significant effect of lagged (2008) quality ( $p=0.521$ ) and a slightly significant negative effect of 2008 competition ( $p=0.061$ ) on the likelihood of closure in 2012. The non-lagged effects remained unchanged. Fifth, we included in both waves those care homes that only met the selection criteria in one wave. Treating these homes as closed or as remaining open did not alter the results. Finally, we estimated a model treating competition as exogenous for comparison. In this case, competition was insignificant as expected ( $p=0.205$ ) but still negatively signed.

#### 4. DISCUSSION

The analysis supported our hypotheses that care homes with (prior) poor quality were more likely to close than homes with better quality and that homes experiencing high competition would also be more likely to close than those operating in less competitive markets.

There are a number of limitations to the analysis. First, our panel data analysis assessed how current levels of quality and competition affect subsequent chances of closure. We could not look at whether a change in home status was determined by a *change* in QR, that is, a differences analysis, because home-specific data, including QRs, were only available for homes remaining open. Nonetheless, a more limited cross-sectional analysis did show that a reduction in quality between 2008 and 2010 was associated with an increased chance of a home closing between 2010 and 2012.

Another potential weakness is in identifying actual home closures. Whilst we conducted a detailed analysis and data matching process, there remains a small possibility that coding errors prevented matching across time. A third issue is that we have assumed that any systematic causes of missing quality data are reflected in our observed data, and therefore suitable for multiple imputation. A potential concern rests with the argument that regulators focused initially on poor quality homes. However, inspectors could not, at least directly, use this new quality information to assess homes. Moreover, we did not find any interaction between quality effects and wave, suggesting that the relationship between quality and closures in 2008 was the same as in 2010, where complete quality data were available.

In this analysis, we considered ‘complete’ closures: that is, where a care home at a specific address ceased to operate in any form thereafter. We have not therefore considered the impact of prior quality choices and competition on supply-side changes that fell short of complete closure (e.g. changes in ownership, sector or client type). This might include homes that may have been actually closed and then reopened following a change in ownership.

We found that closure rates were negatively associated with quality controlling for competition. This result is consistent with our hypothesis that purchasers and/or regulators were responding to quality information, avoiding and/or taking action against homes that set quality ‘too low’ (as a result of errors and/or shocks). Although we cannot rule out a market composition effect, despite not finding an interaction between quality and competition, this result has welfare implications when we assume the QR system provides better information for purchasers. In the absence of quality information provided by the QR process, some residents would end up in homes that would otherwise have closed with QR information. This is a negative welfare effect relative to full information. Clearly, closing homes has potential adverse impacts on current residents, but some recent research suggests that these negative events can be limited through orderly, timely, and personal relocation processes (Holder and Jolley, 2012).

Home closure might also arise from market structural barriers or changes in public funding levels overall that are not specifically due to the availability of quality information (Allan and Forder 2012). These causes might also have welfare implications for competition policy and public financing choices, but they are outside the remit of this paper.

Quality ratings were discontinued in June 2010 and replaced with minimum compliance measures. However, at the time of writing CQC were consulting relevant parties on a new assessment process for health and social care with the aim of launching a new ratings system for care homes in October 2014 (Care Quality Commission 2014). In this study, we are unable to comment directly on the effectiveness of minimum compliance systems compared with QR regulatory policies, but we believe the more delineated quality information provided by the latter would help purchasers in making better decisions.

#### CONFLICTS OF INTEREST

The authors have declared that there are no conflicts of interest.

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