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The revision of the Relative Needs Formulae for adult social care funding and new allocation formulae for funding Care Act reforms

Final report

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Corrections

This version of the report includes the following corrections to the previous (i.e. March 2018) version:

Page 7 (young adults formula), page 27 (Table 1), page 28 (Table 2), page 31 (Table 4), and page 55 (Table 18): "Living arrangements: share of people living in one-family households" instead of "Living arrangements: one-family household per all households".

Page 50 (third bullet point): "The share of people living in one-family households – Table ID QS112EW" instead of "The share of people living in one-family households in all Census 2011 households – Table ID QS112EW".

Contents

Summary

Background

Local authorities in England have responsibility for securing adult social care for their local populations. Historically, social care support has included services such as home care, residential care, personal budgets and direct payments, equipment, as well as some professional support such as social work.

Social care funding is allocated to local authorities using a formula to help account for differences in local funding requirements. The principle behind these formulae is that each local authority should have, after their financial allocation, sufficient money so that they can provide an appropriate level of services and support to any person in their local populations who is eligible for publicly-funded services. This means, for example, that in two local authorities with the same total population but with different numbers of people in need, the one with more people in need would get more funding.

Broadly, social care eligibility is dependent on recipients meeting all three of: (i) a sufficient level of impairment according to national eligibility criteria; (ii) insufficient informal care support; and (iii) limited income/wealth so that they meet the means test. Social care need therefore reflects all of these factors. Differences in this social care need between local authorities are incorporated into the Local Government Finance Settlement by using formulae. Some additional grants are also distributed between local authorities via the same formulae.

These formulae used to allocate funding to local authorities are (currently) called the ***Adult Social Care Relative Needs Formulae (ASC RNF)***. Although the exact form of these allocation formulae has varied somewhat over the years, the basic principle has been the same. They are periodically updated to account for changes in the mix of services local authorities provide to their residents with care needs, and also to reflect improvements in data collection and statistical methods which are used to estimate RNFs. This revision aims to improve the modelling of the social care needs distribution between local authorities by:

- using data at much smaller area level, i.e. Lower Layer Super Output Area (LSOA), compared to ward level in the 2005/06 analysis;
- using a much higher number of observations, i.e. more than 13,000 compared to 775 in 2005/06;
- using newer data, e.g. Census 2011 and DWP 2013 compared to the Census 2001 data used for developing of the current (2005/06) ASC RNF;
- using additional variables to capture need by taking advantage of the Census 2011, i.e. the share of people with limiting (significant) conditions;
- using additional variables to capture the distribution of wealth, i.e. interaction terms between the share of home ownership and the share of properties in various council tax bands.

Recent (planned) reforms of Government policy (as laid out in the Care Act 2014) mean that local authorities will take on two new responsibilities regarding social care. These reforms are to the financial eligibility rules that govern who is entitled to publicly-funded social care. They are the ***cap on lifetime care costs*** and the new ***extended financial means*** test. Because they are new responsibilities, they each need additional allocation formulae.

Under the current (pre-reform) rules, people with savings and assets worth more than £23,250 – an amount called the *upper capital limit* – generally do not qualify for means tested financial support

for their care. Where a person is living alone, the definition of assets for this rule also includes the property in which they live, if owned. People who do not qualify – called *self-funders* – must pay for care themselves (although there are some benefits that they can claim to help) and these costs can be significant, e.g. more than £36,000 per year in a care home.

Where people qualify for some publicly-funded support under the current financial means test by virtue of having assets of less than the upper capital limit (i.e. £23,250), they may still have to cover part of the costs themselves, with the local authority meeting the difference. These charging rules are complex, with the amount people have to pay dependent on their income and the amount of their assets above £14,250 (i.e. the *lower capital limit*). Assets under £14,250 are not considered for charging purposes.

In order to help self-funders limit what can be high care costs over their lifetime, a key reform of the Care Act 2014 was for self-funders to receive a publicly-funded contribution from their local authority to cover their eligible care costs once these exceed a running total of £72,000.

As a part of the reform package, the upper capital limit of the means test was proposed to increase to £118,000 if a person receives care in a care home and all their assets are taken into account in their financial assessment. However, if a person is receiving care in any other setting (e.g. home care in their own home) or if a person is receiving care in a care home but their home is disregarded in the financial assessment, then the upper capital limit would be £27,000. The lower capital limit of the means test was also recommended to increase, from £14,250 to £17,000.

As a result of these reforms, local authorities will need to provide both higher levels of support to currently eligible people (i.e. due to the increase of the lower capital limit) and support to newly eligible people (i.e. both due to the cap on lifetime care costs and the increase of the upper capital limit). The allocation of the new funds to support LAs in meeting these new responsibilities will need to fairly reflect the new burden on the LA's budget. Some local authorities will be affected more than others by the new policies (i.e. on one hand those with more self-funders in residential care and on the other those with more people of low to middling wealth).

Aims

The aim of this work is to develop needs-based formulae that will determine funding allocations to local authorities to cover:

(a) the funding of existing responsibilities of local authorities for adult social care;
(b) the additional expenditure requirements as a result of the cap on lifetime care costs; and
(c) the additional expenditure requirements as a result of the extension of the means test.

Methods

There are broadly two alternative approaches to determining resource allocation formulae: the *utilisation-based* approach, and the *normative* (or *epidemiological*) approach. An essential difference in the approaches concerns how the concept of 'need' is defined and determined. In social care, people are helped by the public (local authority) system because they have issues with personal (physical or mental) impairment, suffer risks to safety (which include environmental factors) and lack sufficient informal care. As noted, there are also financial-means-testing rules that determine a person's eligibility. In other words, these factors give rise to a 'need' for publicly-funded care services and support. Local authorities assess people's need and determine the amount of public funding needed to pay for their care.

The central premise of the *utilisation-based* approach is that the effect of need is reflected in observed patterns of use of services in a local population. This approach does not require definition

of some absolute level of need, but rather the *relative* patterns between individuals. Total need for social care in a population will vary according to the needs-related characteristics of that population e.g. levels of impairment, environmental factors (such as those that affect people's safety), the availability of family care etc. In theory, there should be a close connection between these characteristics and the services actually used. By using suitable indicators of these characteristics, we can use statistical models to estimate what drives differences in need.

In practice, total need is not the only factor that determines what services are actually used. First, local authorities can interpret need factors differently. Second, constraints on service capacity or supply in a local area will also affect what is actually used. Finally, publicly-funded care services are also financially means tested as well as needs-tested. Consequently, we need a set of indicator variables that approximates the influence of these factors, as together they give rise to a level of publicly-funded social care being used by people with care needs. Statistical techniques (generally regression analysis) can be used to isolate the contribution of the different factors. Differences in the scale of need effects between local authorities are the basis for a relative needs formula.

In the *normative* approach a measure of need in a local population is inferred directly from the criteria (ideally best-practice) that local authorities use to define need. For example, we could measure the number of people with impairment. The relative scale of this indicator of need between local authority populations is then used to generate a relative needs formula.

These different approaches have their theoretical strengths and weaknesses. However, there are practical limitations in using the normative approach in social care. First, no national set of criteria exists to define need (specifically enough). Second, there is no basis for how the different elements of need (impairment, safety, informal care availability) can be combined into a single indicator of relative need. A particular problem is to specify rules for how much need can be met by informal care. This issue has proved to be extremely difficult and controversial and, therefore, care systems in some countries simply disregard informal care (with the range of policy consequences this brings). Third, eligibility for care also depends on people's financial situation, and these eligibility rules would also have to be taken into account.

Therefore, the pure normative approach was not used in this study. Nonetheless, a conventional utilisation-based approach could be used only for the revision of the Relative Needs Formulae. As far as the Care Act reforms were concerned, the aim was to estimate formulae for the new eligible people. As there are not specific service utilisation data for people not yet receiving these new forms of local authority support, a pure utilisation approach was not applicable in these cases.

Instead, the analysis for the cap on lifetime care costs is based on a *mixed-utilisation-based* approach, which uses data on care home service use by self-funders. People's service utilisation in this case is neither the result of an LA assessment process nor determined by normative criteria but rather by self-assessment. Therefore, we had to assume that self-funders in residential care have eligible needs according to LA assessment criteria. That may be a reasonable assumption, as care home residents (including self-funders) have on average a relative high level of care needs.

For the extension to the financial means test, we adopted a *hybrid* approach. It primarily uses utilisation data and methods, but predicts the additional expenditure requirement following an increase in the upper capital limit on the artificial simulation of the number of additionally eligible people based on their financial situation (which is more akin to a *normative* approach). This approach is more practical in this case because the financial-means-test rules are well defined.

Empirical analysis and results

In this analysis we used a small area approach whereby the relationship between per capita expenditure (or the count of service users) and per capita need is estimated across small areas of our sample LAs. In particular, we used the ONS standard geographical unit of the Lower Layer Super Output Area (LSOA) (of which there are 32,844 in England, each with a population of around 1,500 people). LSOAs boundaries are chosen so that the characteristics of their population do not vary much. This allowed us to link in a wide range of potentially relevant need, wealth and supply data. We used data on chronic illness, age, sex, household composition, uptake of both income-related and disability-related benefits and also indicators of the supply of services in each area.

As LAs do have powers to directly provide services and are able to manage local markets to some extent, we have not considered supply to be externally determined. Therefore, supply effects were cleaned by including various indicators of supply in the regression analyses, and then removed by setting the corresponding supply variable(s) to a constant for all LAs. Similarly, the effect of LA practices on utilisation were estimated and removed by using LA fixed effects (i.e. LA dummy variables).

The Relative Needs Formulae for adult social care

Four distinct statistical analyses were used to estimate the factors determining service provision: 1) care home services for young adults aged 18 to 64; 2) community-based services for young adults aged 18 to 64; 3) care home services for older people aged 65 and over; and 4) community-based services for older people aged 65 and over. We used LSOA-level data on LA-supported service use collected from a sample of around 60 local authorities that agreed to participate in the research.

The final formula predicting the relative (weekly) cost of (all) social care services for young adults in a local authority, expressed in rates per capita 18 to 64, is:

RNF value (for younger adults)	=		
Limiting (significantly) condition 16-64 per capita 16-64	x	22.71	+
Living arrangements: share of people living in one-family households	x	-3.82	+
Population 16-24 per capita 16-64	x	-4.40	+
Income Benefits Claimants 16+ (i.e. IS, ESA, and JSA) per capita 16-59	x	3.77	+
(Constant)		5.58	

while the final formula for predicting the relative (weekly) cost of social care services for older people in a local authority, expressed in rates per capita 65 and over, is:

RNF value (for older adults)	=		
Attendance Allowance claimants 65+ per capita 65+	x	29.53	+
Limiting (significantly) condition 85+ per capita 65+	x	27.89	+
Living arrangements: couple households per household 65+	x	-5.35	+
Pension Credit Claimants 80+ per capita 65+	x	21.13	+
Home-owner households 65+ per households 65+ × properties in council tax band ABCDE per all properties	x	-5.95	+
Home-owner households 65+ per households 65+ × properties in council tax band FGH per all properties	x	-14.75	+
(Constant)		14.89	

Sensitivity analysis

In order to check the robustness of the formulae, we estimated alternative models from which we excluded one or more of the need indicator variables not included in the 2005/2006 version of the RNF; a further model was estimated by jointly modelling care home and community-based services

(as in the previous RNF version). Simulated per capita allocations according to alternative models were rather similar, with all coefficients above 0.92 (see Figure 2, p. 32 and Table 20, p. 57).[1]

Comparison to 2005/06 RNF

When using the new and old RNF formulae to calculate per capita funding allocations to local authorities, we found a high degree of similarity (a correlation coefficient of 0.91). Due to improvements to the empirical analysis (i.e. analysis at much smaller area level, a considerably higher number of observations, and additional variables that capture more accurately the distribution of need and wealth), the new RNF are expected to better approximate the distribution of need between local authorities.

The cap on lifetime care cost

The analysis for the cap on lifetime care cost was performed in two stages. The first stage aimed to estimate the numbers of self-funders in care homes for each small-area locality in England. These numbers are not routinely recorded. Therefore, we conducted a survey of care homes in England to find the number of self-funders in a representative sample of care homes and the factors that influence this number.

Using data on care-home characteristics and clients from a sample of 918 care homes in England, we modelled the self-funders' rate using various care home characteristics and socio-economic factors at LSOA/MSOA level using regression analysis (see Table 6, p. 34). The estimation results were used to predict the share of self-funders for each CQC-registered care home for older people in England. By multiplying the predicted share of self-funders in each care home with the registered number of care home beds, we obtained an estimate of the count of self-funders at small-area level. We obtained an estimated number of self-funders for 8,217 LSOAs (about 25 per cent of LSOAs); the rest had no care homes located in them and, therefore, no self-funders in residential care.

The second stage of the analysis had the aim of establishing a causal relationship between the number of self-funders and various factors indicating need, wealth and supply at small area level. We opted for an analysis at MSOA level as a strategy to deal with the large number of zero values (i.e. compared to only 25 per cent of LSOAs, about 70 per cent of MSOAs had care homes located in them). Additionally, we experimented with a range of count and censored data models.

Local care home capacity (supply) is an important factor in this analysis. Local authorities arguably have some control over supply (and can even build care homes if required). If so, the formula should not adjust for this factor (as the LA can adjust it). Self-funders do not have this control however. As there is some uncertainly as to whether the supply of care home places (to self-funders) is under the control of local authorities, we derived two alternative formulae: (1) with a coefficient for supply; and (2) with the effect of supply removed.

The decision regarding which formula to apply should ideally be based on the timing of the LA assessment application. If self-funders apply for assessment after moving into a care home – and this will be the case for the majority of self-funders applying for assessment during the first year after implementation and potentially even in subsequent years – the LA of their care home residence will become responsible for them, even if they have moved there from another LA. As the allocation formula ought to provide sufficient funding to LAs to support the eligible people with care needs in their locality, this argument suggests that supply indicators should be used in the cap formula.

[1] A correlation coefficient of 1.00 would indicate identical allocations between models.

Accounting for supply does make some difference: the correlation coefficient between per capita allocations to LAs according to the two formulae is 0.56.

We present here the preferred model, i.e. with supply included. The calculation to determine the final allocation per capita 65 and over for the cap on lifetime care costs reform in a local authority is as follows:

No. of registered care home beds for old age and dementia per capita 65+	x	0.2655	+
Attendance Allowance claimants 65+ per capita 65+	x	0.1487	+
Limiting (significantly) condition 85+ per capita 65+	x	0.0292	+
Living arrangements: couple households per household 65+	x	-0.0224	+
Pension Credit Claimants 80+ per capita 65+	x	-0.1825	+
Home-owner households 65+ per households 65+ × properties in council tax band ABCDE per all properties	x	0.0049	+
Home-owner households 65+ per households 65+ × properties in council tax band FGH per all properties	x	0.0248	+
(Constant)		-0.0005	

The extension to the financial means test

As there are no utilisation data for newly eligible people under the extended means test, their expenditure requirement (i.e. the LA contribution to care costs) needed to be estimated. Moreover, individual (or household) income and wealth data are not collected routinely at national level. Therefore, we had to simulate financial eligibility and expenditure requirement in a representative sample of older people, for which the necessary information was available. These figures were then converted at small area level for the whole of England using statistic modelling as follows:

First, we selected a sample of people with long-standing impairment/disability from the English Longitudinal Study of Ageing (ELSA). Using variables about their financial situation, we calculated their eligibility and charges for LA care according to both the current and the new means test.

Second, a statistical analysis was used to estimate for people with care needs the effect of wealth (and need) indicator variables on their financial eligibility and expenditure requirements under either the current or extended means test (as determined in step one). Sample weights were used to ensure that the ELSA sample matched the LSOA data in terms of selected need and wealth dimensions (i.e. home ownership, living arrangements, and Pension Credit claimant rates).

Third, the results of the statistical modelling from step 2 were then applied at small-area level to predict the expenditure requirement in each LSOA according to either the current or the new capital limits for people that are both financially eligible and satisfy the need test.

Fourth, we needed also to estimate the proportion of people in each small area who would satisfy the needs test for residential care. We did this by using data on the number of people who were eligible for LA-funded care home placements in the small area, and then divided through by the probability that people in the local population are financially eligible. For example, if 100 people in a small area are in LA-funded care homes and on average half of the people with care needs are financially eligible, then the total number of people with care needs in the small area is 100/0.5=200. We actually used data on new admissions in the analysis, so that recent need factors could be applied to the pre-care address and, therefore, avoid problems of out-of-area placements.

Finally, the calculations from steps 3 and 4 were combined to calculate the expected total additional expenditure requirement that would arise from the extended means test for the people in each LSOA that would pass both a needs and the (new) extended means test.

A regression model at LSOA level was used to estimate an equation for this additional expenditure requirement in terms of need, wealth, supply and (population) scaling variables (see Table 13, p. 41). The results were then used to determine the allocation formula for the extension to the means test, which is:

Attendance Allowance claimants 65+ per capita 65+	x	0.4678	+
Limiting (significantly) condition 85+ per capita 65+	x	0.3238	+
Living arrangements: couple households per household 65+	x	-0.2169	+
Pension Credit Claimants 80+ per capita 65+	x	0.2863	+
Home-owner households 65+ per households 65+ × properties in council tax band ABCDE per all properties	x	0.0769	+
Home-owner households 65+ per households 65+ × properties in council tax band FGH per all properties	x	-0.0472	+
(Constant)		0.1844	

The per capita allocations are robust to using alternative unit costs for the simulation of financial eligibility and expenditure requirements, as well as alternative wealth indicators.

Discussion

Estimation of allocation formulae relies on access to good-quality data. It also requires that we make certain assumptions during the analysis in order to produce results, some of which only approximate (and simplify) reality. Nonetheless, the results of this study clearly support the principles of need adjustment (however that is made). Need levels differ between areas and do impact on the amount each local authority will need to provide for care support to meet its obligations. Without allowance for these differences, local authorities would have differing financial capacity to meet their care responsibilities as a result of different levels of need for care in their population.

1 Introduction

1.1 Allocating funding

Local authorities in England have responsibility for securing adult social care for their local populations. Historically, social care support has included services such as home care and residential care, personal budgets and direct payments, equipment, as well as some professional support such as social work.

Following the Layfield enquiry in 1976 (Cmnd 6453 1976), social care funding has been allocated to local authorities using a formula to help account for differences in local funding requirements (Bebbington, Davies 1980a, Bebbington, Davies 1980b). The latest incarnation – in operation since 2006/7 – is the Relative Needs Formulae (Darton, Forder et al. 2010).

The fundamental principle underpinning the use of allocation formulae is to ensure equal opportunity of access to 'support' for equal need. The conventional way to interpret this principle is that each council should have, after their allocation, sufficient net funding so that they can provide an equivalent level of support (services or otherwise) to all people in their local population who would satisfy national standard eligibility conditions (Gravelle, Sutton et al. 2003). For a detailed literature review on resource allocation formulae see (Smith 2007).

Recent (planned) reforms of Government policy (as laid out in the Care Act 2014) mean that local authorities will take on two new responsibilities regarding social care. These reforms are to the financial eligibility rules that govern who is entitled to publicly-funded social care. They are the ***cap on lifetime care costs*** and the new ***extended financial means*** test. Because they are new responsibilities, they each need additional allocation formulae.

The aim of this work is to develop needs-based formulae that will determine funding allocations to local authorities to cover:

(a) the funding of existing responsibilities of local authorities for adult social care;
(b) the additional expenditure requirements as a result of the cap on lifetime care costs; and
(c) the additional expenditure requirements as a result of the extension of the means test.

Ethical approval for this study was gained from the National Institute of Social Care and Health Research Ethics Committee on 29 April 2013.

1.1.1 Principles

The objective of the system of Relative Needs Formulae (RNF) is to provide a way of assessing the relative need for a particular set of services or support by different local authorities. The formulae have to be based on factors that are measured and updated routinely, which have a demonstrable and quantifiable link with needs and costs, and are outside the influence of local authorities (particularly through past decisions about services). Furthermore, the formulae have to be designed to measure variations in needs between local authorities and costs, other than area costs. They are not concerned with the absolute level of expenditure needed, or with the short-run implications of actual funding arrangements. The current formula contains four components: a need component, a low-income adjustment, a sparsity adjustment, and an area cost adjustment.

Two sets of eligibility conditions/tests are relevant for public social care support in general (Wanless, Forder et al. 2006, Forder, Fernandez 2009, Fernandez, Forder 2010, Fernandez, Forder et al. 2011). First, the *needs test* determines whether a person should receive support, and if so how much, given their condition (e.g. the level of impairment) and circumstances (e.g. the availability of informal

care). Second, the *financial means test* determines whether a person is eligible for any public support on the basis of relevant non-need criteria, particularly the person's financial circumstances.

Together these tests determine how much funding is required to meet the national standard. The number of people satisfying these tests and the public cost of their support as dictated by the tests will vary between local authorities according to the size and nature of both 'need' and wealth within the local population. These factors can largely be regarded as being 'exogenous' beyond the (reasonable) control of the local council, and therefore the funding allocations going to local authorities should be adjusted to reflect differences in these exogenous factors. Relevant factors will include indicators of need such as rates of disability in the local population. These will largely affect expenditure requirements through the first test. Furthermore, factors will include markers of asset-holding and income, which mainly work through the second test. Conventionally, a formula is deployed to account for these exogenous factors and adjust each local authority's funding allocation accordingly.

1.1.2 RNF for adult social care

The formula for allocating funding to local authorities so that they can meet their (existing) responsibilities for adult social care, given differences in the needs of their local populations, is (currently) called the Adult Social Care Relative Needs Formulae (ASC RNF).

Since their introduction, these formulae for adult social care have been revised several times, in order to incorporate new and better data and up-to-date methods. This revision aims to improve the modelling of the social care needs distribution between local authorities by:

- using data at much smaller area level, i.e. Lower Layer Super Output Area (LSOA), compared to ward level in the 2005/06 analysis;
- using a much higher number of observations, i.e. more than 13,000 compared to 775 in 2005/06;
- using newer data, e.g. Census 2011 and DWP 2013 compared to the Census 2001 data used for developing of the current (2005/06) ASC RNF;
- using additional variables to capture need by taking advantage of the Census 2011, i.e. the share of people with limiting (significant) conditions;
- using additional variables to capture the distribution of wealth, i.e. interaction terms between the share of home ownership and the share of properties in various council tax bands.

1.1.3 Care Act reforms

Under the current (pre-reform) rules, people with savings and assets worth more than £23,250 (an amount called the *upper capital limit*) generally do not qualify for means-tested financial support for their care. Where a person is living alone, the definition of assets for this rule also includes the property, if owned, in which they live. People who do not qualify – called *self-funders* – must pay for care themselves (although there are some benefits that they can claim to help) and these costs can be significant, e.g. more than £36,000 per year in a care home.

Where people qualify for some publicly-funded support under the current financial means test by virtue of having assets of less than the upper capital limit (i.e. £23,250), they may still have to cover part of the costs themselves with the local authority meeting the difference. These charging rules are complex, with the amount people have to pay dependent on their income and the amount of their assets above £14,250 (i.e. the *lower capital limit*). Assets under £14,250 are not considered for charging purposes.

Self-funders can potentially face large costs for care over their lifetime. One in ten people are estimated to face paying more than £100,000 over their lifetime, and sometimes people have to sell their home to meet these costs (Department of Health 2015). In order to help self-funders, a key reform was for them to receive a publicly-funded contribution from their local authority to cover their eligible care costs once these exceed a running total of £72,000.

The cost figure used to calculate the running total towards the cap is the amount that it would cost the person's local authority to meet their needs, if they were eligible for local authority support. It is intended to cover only the cost for eligible care services and not the costs of daily living (e.g. accommodation and food) or any additional costs (e.g. a bigger room).

When a person reaches the cap, the local authority will pay a contribution towards their care fees to cover the cost of care to meet their needs. This means that a person receiving care in a care home will have to pay only a set amount for their daily living costs (i.e. £230 per week) plus any cost for upgraded accommodation or extra services (Department of Health 2015).

Department of Health estimations on the impact of the policy change reveal that after about ten years from implementation about 80,000 self-funders will financially benefit from the cap.

A further reform announced by the Care Act 2014 is a new ***extended financial means test***. Under the current rules, only people with assets below £23,250 qualify for means-tested financial support for their care. Given the significant increase in property values over recent decades, this means that most home owners have to pay the full social care cost themselves. In order to adapt the public funded social care system to these new realities, the level at which someone qualifies for means-tested support was recommended to be raised (Department of Health 2015).

The upper capital limit of the means test was proposed to increase to £118,000 if a person receives care in a care home and all their assets are taken into account in their financial assessment. However, if a person is receiving care in any other setting (e.g. home care in their own home) or if a person is receiving care in a care home but their home is disregarded in the financial assessment (e.g. because their spouse continues to live in the home) then the upper capital limit should be £27,000 (see Figure 1 below). The lower capital limit of the means test was also recommended to increase from £14,250 to £17,000.

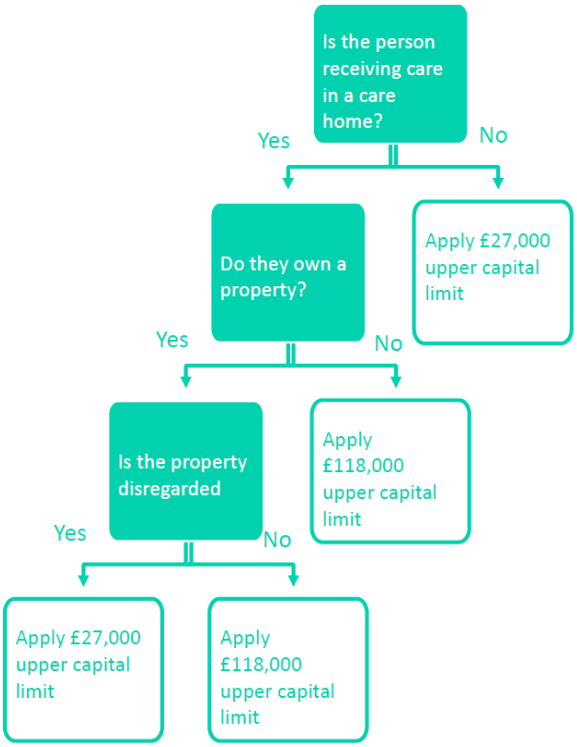
This reform would mean that wealth of £17,000 or less is fully disregarded for charging purposes; wealth between £17,000 and the relevant upper capital limit is considered for charging purposes on a sliding scale;[2] and people with total wealth above the relevant upper capital limit are expected to fully cover their social care cost, until they meet the cap.

As a result of these reforms, local authorities will need to provide both higher levels of support to currently eligible people (i.e. due to the increase of the lower capital limit) and support to newly eligible people (i.e. both due to the cap on lifetime care costs and the increase of the upper capital limit). The allocation of the new funds to support LAs in meeting these new responsibilities will need to fairly reflect the new burden on the LA budgets. Some local authorities (such as those with more self-funders in residential care and those with more people of low to middling wealth) will be affected more than others by the new policies.

[2] 'Tariff income' is used to determine what contribution a person is asked to make towards their care costs from their capital in addition to a contribution from their income. People who receive local authority support are asked to make a contribution of £1 per week for every £250 in assets which fall between the lower limit and relevant upper capital limit.

Besides the revision of the current relative needs formulae for the allocation of adult social care funding, the aim of this work is therefore to develop needs-based formulae that will determine funding allocations to local authorities for the additional expenditure requirements as a result of the cap on lifetime care costs and the extension of the means test respectively.

Figure 1. Application of upper capital limits according to the (new) extended means test



Source: Social Care Local Government and Care Partnerships Directorate Analytical Unit, Department of Health.

1.2 Methodological approaches

There are broadly two alternative approaches to determining resource allocation formulae as debated in the literature (although almost exclusively referring to the distribution of healthcare funding). An essential difference in the approaches concerns how the concept of 'need' is defined and determined.

The first is the *utilisation-based* approach (Gravelle, Sutton et al. 2003, Smith 2007, Darton, Forder et al. 2010). The central premise is that the effect of need – and differences in patterns of need between individuals – is reflected in observed patterns of utilisation. Put simply, people with high levels of need will use more services/support than people with low levels of need. Importantly, this approach does not require a definition of some absolute level of need but rather the *relative* patterns between individuals. Statistical techniques (generally regression analysis) can then be used to estimate the causal effects of need and other factors on utilisation. After deciding which of the factors in the estimation are legitimately beyond the control of the public care system, the size of the effect of these factors is used as the basis for a relative needs formula.

There are three key concepts/assumptions involved with this approach. First, when we think about 'need' – with respect to the underlying principle of resource allocation (equal access for equal need) – we are assuming that the needs-related criteria used by care commissioners in their decisions about how much care to provide to people (of given assessed need) are in some sense 'appropriate'. In other words, the criteria and professional judgements that commissioners employ must be

accepted as defining the concept of need. This assumption might be challenged if some externally-determined normative standard was available and if current practice was found not to conform to this standard. In that case, the utilisation approach would be perpetuating existing practice, i.e. not the 'best' practice.

The second assumption is that the other (non-need) influences on final patterns of utilisation can be sufficiently accounted for in the analysis. The other main influence is the supply of care services. In particular, if current supply has been affected by factors other than need, then observed patterns of utilisation will also embody these non-need influences. We would want to identify these non-need influences in the analysis and be content that the methods employed for this purpose are robust. To complicate that issue with regard to supply, there is an important question – especially regarding social care – about whether supply should be 'removed', especially if supply factors are beyond the control of the public care system. In any case, if supply effects can be separately identified in the analysis, then any allocation formula can either incorporate these effects or not, depending on whether supply is considered to be externally determined or influenced by the care system. We revisit this issue below.

The third assumption is that we can find appropriate empirical measures of need in practice that are good indicators or proxies for the theoretical concepts of need. For example, in making decisions about meeting people's need, care staff will assess the person's level of functional impairment. We would therefore need datasets that contain variables that are good indicators of functional impairment. In practice, we can never capture *every* aspect of need. Rather, the assumption of the utilisation approach is that *unbiased* estimates of need effects can be obtained.

The second method might be called the *epidemiological* or *normative* approach. In this case, need is determined on the basis of specific normative criteria and the measures of need populating these criteria are used directly to allocate resources (Asthana, Gibson 2011, Asthana, Gibson et al. 2004, Galbraith, Stone 2011, Vallejo-Torres, Morris et al. 2009). This approach has been described in health care and would involve using morbidity data to allocate health care resources. In particular, within disease groups, resources would be allocated geographically on the basis of the relative prevalence of the disease.

There are three key assumptions in this case. The first is that a normative definition of need exists and is agreed nationally. In particular, this standard must be specified in a way so that it can be implemented in an allocation formula, including the determination of the relative weight given to key elements.

The second assumption is that the need factors used in the normative criteria are measurable and are free from non-need influences. For example, if we use prevalence data, we have to be sure that diagnosis thresholds are not influenced by non-need factors, such as supply.

Third, as with the utilisation approach, we need good-quality empirical datasets with the required need indicators. This can often be a particular challenge for the normative approach since it requires specific indicators and these are not normally part of routine, administrative datasets, e.g. information on disability rates.

As regards the healthcare case, the vast majority of allocation formulae have used the utilisation approach. Social care formulae have also largely been determined on this basis. In theory, if each of the assumptions outlined above was upheld, then the two approaches would produce the same allocation. In practice, the assumptions are not all likely to hold, and therefore the preferred approach becomes a second-best choice. The main judgement is whether the needs criteria that can

be inferred from a utilisation analysis are more or less robust than a practical interpretation of need and support criteria from the normative principles underpinning social care.

In the social care case, we argue that sufficiently specific normative principles are not available – there are no agreed national definitions. There is a needs-based eligibility framework that is used by local authorities, although this does allow significant room for interpretation by care managers and social workers on the ground, and for each local authority (Department of Health 2010, Department of Health 2014). This framework encompasses multiple aspects of 'need', including not only personal impairment but also concepts such as risks to safety (which include environmental factors) and, importantly, the availability of informal care. There are also financial-means-testing rules (which are highly specific for residential care) which apply to determine access to the publicly-funded care system (Department of Health 2010, Department of Health 2014).

However, these criteria are not in a form that allows a direct synthesis of a normative allocation rule for the purposes of developing a resource allocation formula. A normative approach would need to determine weights for each of the main elements – personal impairment, safety, informal care and financial situation – to reflect their significance in the local population when assessing 'overall need' for an allocation formula. Particular challenges in this regard for social care are as follows. First, as social care is a *local* system, with 152 local authorities able to interpret needs-based eligibility criteria to some extent, any normative approach would need to synthesise and average-out a national set of criteria. Second, setting out specific rules for how much need can be met by informal care has proved to be extremely difficult and controversial in other countries. Those countries that have adopted an entitlement-based care system – usually a long-term care (social) insurance system which requires explicit criteria – have had to make the system 'carer-blind' to avoid this problem (Fernandez, Forder 2012).

The practical limitations of the (full) normative approach are therefore significant in social care, and this approach was not used in this study. However, we could use the pure *utilisation-based* approach only for the revision of the Relative Needs Formulae. Regarding the Care Act reforms, the aim was to estimate formulae for the newly eligible people. As there are not specific utilisation data for people not yet receiving LA support, a pure utilisation approach was not applicable for this part of the analysis.

Instead, the analysis on the cap on lifetime care costs is based on a *mixed-utilisation-based* approach. We used data on care home service utilisation by self-funders and assumed that self-funders in care homes would pass a needs test if LA assessment criteria were applied. Given the high level of care need of care home residents (including self-funders), this seemed to be a reasonable assumption.

For the extension to the means test we adopted a *hybrid* analysis that employed utilisation data and methods, but used (normative) prevalence-based simulation for predicting the additional expenditure requirement for new eligible people.

The methods used in this study and the related assumptions are summarised in Box 1.

1.3 Methods for existing and new local authority responsibilities

1.3.1 Existing adult social care responsibilities

Relative needs formulae in social care are generally determined by using data on the support that local authorities currently provide, and establishing (using statistical models) the relationship between exogenous need variables and the amount of that support. In particular, this has involved

using data on the current level of publicly-funded social care service utilisation by local populations (Darton, Forder et al. 2010).

Individual person data including both their service use and needs-related characteristics are generally not available. Rather, in this analysis we used a small area approach whereby the relationship between per capita expenditure (or the count of service users) and per capita need is estimated across small areas of our sample LAs. In particular, we use the ONS standard geographical unit of the Lower Layer Super Output Area (LSOA), of which there are 32,844 in England. LSOAs are relatively homogenous and allowed us to link in a wide range of potentially relevant need, wealth and supply data.

Box 1. Methods and key assumptions by allocation formula

Methods:

- Relative Needs Formulae revision – ***pure utilisation-based*** approach using data on LA assessed service use;
- Allocation formula for the cap on lifetime care cost – ***mixed-utilisation-based*** approach, using data on self-assessed needs through self-funders;
- Allocation formula for the extension to the financial means test – ***hybrid*** approach using a combination of *utilisation* data and methods, but (normative) *prevalence-based* simulation for predicting the additional expenditure requirement for new eligible people.

Key assumptions:

- The assessment criteria used by care commissioners are appropriate for determining social care needs.
- Other (non-need) influences on final patterns of utilisation (e.g. supply of social care services) can be sufficiently accounted for in the analysis.
- Available data include appropriate measures of need (e.g. rates of Attendance Allowance uptake, rates of limiting long-standing illness in population, etc.) that are good indicators for the theoretical concepts of need and allow the estimation of *unbiased* need effects.
- Individual level characteristics of people in each small-area population (i.e. LSOA/MSOA) are similar.

Additional assumptions:

- Self-funders in residential and nursing care have eligible needs according to LA assessment criteria – *Allocation formula for the cap on lifetime care cost*
- Self-funders' average level of need at LA level is similar between all LAs, i.e. self-funders with a relatively higher level of need are not clustered in particular LAs – *Allocation formula for the cap on lifetime care cost*
- Older people aged 75 and over and needing help with at least one activity of daily living (ADL) have eligible needs according to LA assessment criteria – *Allocation formula for the extension to the financial means test*
- Regional average unit cost for residential and nursing care capture regional differences in economic activity and prices of services, but are not under the control of a particular local authority (i.e. are exogenous) – *Allocation formula for the extension to the financial means test*
- Individuals with assets just above the a capital limit have the same behaviour and are assessed consistently across all LAs – A*llocation formula for the extension to the financial means test*

Current datasets provide a range of indicators of need and different aspects of need (i.e. rates of Attendance Allowance uptake, rates of limiting long-standing illness in population, age, sex, living arrangements, etc.) as well as financial indicators (i.e. rates of Income Support or Pension Credit uptake, rates of home ownership, average property prices, etc.). These need and wealth factors will

determine whether a person is eligible for LA-funded social care support. The problem is that both tests embody a combination of needs and income/wealth-related conditions. What we require is a way of combining these indicators into a single *index of need and wealth* for each LA. One way of doing this is to see how far these factors explain social care utilisation (service user numbers) by LAs, using regression analysis. A formula for a relative needs index can be estimated on this basis.

1.3.1.1 Supply factors

One limitation with using social care provision is that utilisation of support reflects not only current need and wealth levels in the population, but also current supply patterns. These effects need to be 'cleaned' from the social care utilisation data because leaving them in such a formula will bias the results.

In theory, supply factors can be 'cleaned' by including a supply variable in the analysis. With regard to the care homes sector, a potentially suitable indicator is the number of available beds in each area. The difficulty is that supply itself is likely to be affected by demand/need. For example, we might expect to see higher supply in areas that have high need and vice versa. As a result, the direct use of a supply factor such as care home beds could bias our estimates of need effects.

We used a two-fold strategy to tackle this potential issue. First, rather than include beds for the small area (the LSOA), we used the larger middle-layer super output area (MSOA) which nests LSOAs. This aggregated supply variable should better reflect actual effects of supply, as potential providers look to the availability of competitors and capacity in the local market. Moreover, supply at this level should be less directly affected by the need level in a given LSOA.

Second, we used an instrumental variable (IV) approach to test for this potentially interdependent effect (or 'endogeneity') between our supply variable and need. We tested both LSOA-level and MSOA-level supply in this way as a validity test for our assumptions about supply.

Once supply effects are isolated, they can be removed by setting this variable to a constant for all LAs.

1.3.1.2 Differences in LA social care policy

LA fixed effects were modelled to control for any non-need effects at LA level (e.g. differences in commissioning practices, local area characteristics, data collection methods and quality, etc.). Once isolated, they were removed by using their national average values and included in the constant term.

1.3.1.3 Out-of-area placements

One of the important benefits of using existing local authority-funded service use for estimating relative needs is that this avoids problems of out-of-area placement. Many LAs, but particularly those in London, have some residents placed in care homes outside the LA boundaries. The public costs of care for these people generally remains the responsibility of the referring LA. We used data on LA-supported provision, not on what services are used within the local authorities, so precluding this issue.

1.3.2 New responsibilities

The methodological issues discussed above apply to the analysis of all allocation formulae. However, due to the fact that utilisation of LA support is observed only for current eligible people, for the analysis on the cap on lifetime care cost we had to use data on non-LA-supported people (i.e. self-funders), while for the analysis on the extension to the means test we had to simulate a predicted additional expenditure requirement for newly eligible people.

By using data on self-funders' care home service utilisation, we have assumed that all self-funders residing in care homes have eligible needs according to an LA needs-test and that the self-funders' average level of need at LA level is similar between all LAs. In other words, we assume that self-funders with a high level of need are not clustered in particular LAs. This may be plausible if we bear in mind that all care home residents (including self-funders) have relatively high care needs.

In order to obtain an estimate of the amount of service utilisation by new eligible people in each small area due to the (new) extended means test, we first *simulated* both the expenditure requirement according to the current financial means test and the expenditure requirement according to the (new) extended financial means test using individual data available from the English Longitudinal Study of Ageing. Then, we estimated the effect of relevant need and financial indicators on each *simulated* expenditure requirement for all people with care needs. Using need and financial indicators at small-area level and the coefficients from the first step, we obtained in a next step for each small area (i.e. LSOA) a predicted expenditure requirement according to either the current or the new capital limits conditional on being financially eligible. Finally, by subtracting from the LSOA-level expenditure requirement according to the (new) extended means test the LSOA-level expenditure requirement according to the current means test, we obtained for each small area the expected additional expenditure requirement for all people that would pass both a needs and the (new) extended means test.

1.4 The allocation formulae

1.4.1 The Relative Needs Formulae

Four distinctive Relative Needs Formulae are estimated for adult social care, by two age groups (i.e. young adults aged 18 to 64 and older people aged 65 and over) and two types of services (i.e. residential/nursing care and community-based care). This allows, on the one side, a better specification of the relationship between utilisation patterns and need and wealth factors. On the other side, the distinction between care homes and community-based services had become more and more blurred, and the government policies gave increasing importance to helping people meet their care needs in their own homes for as long as possible (Bebbington 2002, Darton, Forder et al. 2010, Department of Health 2014). For each age group, the two service type formulae are ultimately combined in one single formula.

1.4.2 The allocation formulae for the Care Act reforms

The biggest share of the new financial support to be provided due to the Care Act reforms is likely to be for self-funders aged 65 and over with residential care needs: the upper capital limit for people in residential care will greatly increase from £23,250 to £118,000, and older people who pay for their own social care account for about 45 to 47 per cent of residential and nursing home places (Institute of Public Care 2011).

The policy change is likely to have only a marginal effect for older people receiving community-based care: according to existing estimates only about 20 per cent of them are self-funders; the increase of the upper capital limit from £23,250 to £27,000 is rather small; and the majority of older people in community-based care receive fewer than four hours of care per week and would most likely never reach the cap (Forder 2007, Institute of Public Care 2011). Furthermore, the vast majority of young adults with care needs are already publicly funded.

The gain from modelling new eligible young adults and older community-based clients would be rather low, but would increase the risk of introducing bias in the allocation formulae. The formulae for the Care Act reforms are, therefore, estimated only for older people with residential care needs.

2 Analytical framework

2.1.1 RNF for adult social care

Any person who actually receives LA-funded support will have satisfied both a needs test (R) and a financial eligibility test (E). To estimate a relative needs formula, we need to use need factors to predict the local authority's expenditure requirement for adult social care. For any individual in the local population this expenditure requirement is:

$$ER^{asc} = p(R+E) \times u(R+E) \quad (1)$$

that is, the probability of being eligible for LA-supported care (p) times the unit cost of care to the LA (u). The probability that a person in the population satisfies the needs and financial eligibility tests can be expressed as a function of need, wealth and supply indicators:

$$p(R+E) = f^{R+E}(x, y, s) \quad (2)$$

where x denotes needs factors, y wealth indicators, and s supply. The analysis readily generalises to small-area level, if we assume that individual-level probabilities in a given small-area population are about the same. This assumption seems reasonable if the relevant characteristics of people in that population are similar. For this reason, we use as small a population level as possible for the analysis, namely the Lower Layer Super Output Area (LSOA) populations. In this case the number or count of people who are eligible and using LA-supported services is: $c_i^{R+E} = p(R+E) \times m_i$, where i denotes the LSOA and m_i is the population of the LSOA.

In theory, the unit cost of care to the LA will also vary by the level of need of the individual and their financial situation, because individuals might pay charges to the LA for their care. As regards the former, in this analysis we estimate separate formulae for care homes and community-based care and then weight the results together to reflect differences in the unit costs of different service types. As regards the latter, the conventional approach to social care allocation formulae is not to directly include any differences between LAs in net unit costs, but rather to assume that this is a constant factor between areas. The rationale is that (a) using local unit cost data will also mean incorporating cost efficiency differences between LAs into the needs formulae and (b) this reduces the problem of controlling for factors (in this case relating to charging policy) that are at least partially in the control of LAs. More pragmatically, for the eligible people, charges are relatively small and differences between LAs in charges to individuals as a result of differences in income and wealth are also small (in particular relative to differences in eligibility). In this analysis, therefore $u(R+E)$ is treated as a constant, and is normalised to equal 1. Any further differences between LAs in terms of eligible clients' income and wealth as well as cost of services are addressed by using an Area Cost Adjustment and a Low Income Adjustment in the calculation of the final allocations.

Data on c_i^{R+E} were available from local authorities participating in the study – see section 3.1.1 below. The general method involves using regression analysis to estimate a formula predicting either the count of LA-supported people in each LSOA receiving care home services, or the cost-weighted gross weekly LA-utilisation of community-based care, based on LSOA population rates of relevant need, wealth and supply factors.

We fit count models to the LSOA level:

$$ER_i^{asc} = c_i^{R+E} = \exp\left(\beta_0^{asc} + \sum_k \beta_k^{asc} \frac{z_i^k}{m_i} + \beta_m^{asc} \ln(m_i)\right) \quad (3)$$

where c_i^{R+E} is stands for either the count of LA-supported people in care homes or the cost-weighted utilisation of community-based care in the LSOA i; z_i are the need, wealth and supply variables; and m_i is the population of the LSOA. The inclusion of a population size variable in an LSOA-level analysis is mainly to account for scale effects. Other things being equal, the numbers of clients in any area should be proportional to the population in that area.

We could estimate a model in rates of service use per capita, but count models should be better able to deal with integer effects in small areas by having population on the right-hand side. We observe only integer counts of service use by LSOA in the data, rather than the underlying (continuous) probabilities. Consequently, in small LSOAs we might observe zero service use even if the underlying probability is greater than zero. Similarly, in larger LSOAs we are more likely to see positive integer numbers of clients. Consequently, the size of the LSOA can artificially affect the actual observed service use (i.e. number of clients or cost-weighted utilisation), and we need to control for this artefact in the analysis.

2.1.2 Cap on lifetime care costs

The additional expenditure requirement (AER) will arise from LAs having to make contributions to the care costs of people that have cumulative assessed care costs that exceed the cap. For any individual in the local population this is:

$$AER^{cap} = p(R + C) \times u(R + C) \tag{4}$$

i.e. the probability of being eligible (p) times the unit costs of care (u) where R is the needs test and C is the condition of having total costs that exceed the £72,000 cap.

We do not have a direct measure of this probability but we can make inferences based on the design of the cap policy. First, although both LA-supported people and self-funders might pass the cap, for the former group LAs will already be paying for most of the care costs. In other words, we can assume that $u(R + C|E = 1) = 0$, where E is the means test for LA-supported care. As a consequence, we need only consider self-funders, $p(R + C|E = 0)$. Second, given the cap is set at £72,000, the vast majority of people hitting the cap will be in care homes. For tractability, we can assume that the numbers of people with community-based services reaching the cap-limit is zero. Consequently, we need to assess the probability: $p(R^{CH} + C^{CH}|E = 0)$, where the superscript CH means care home. As with the other allocation formulae, we used standard unit costs (to avoid incorporating cost-efficiency differences between LAs in needs formulae) and therefore $u(R^{CH} + C^{CH})$ is a constant, which can be normalised to equal 1. For the purposes of estimating *relative* needs formulae, the main indicator of the share of the total additional expenditure between local authorities is proportional to, on average, $AER^{cap} = p(R^{CH} + C^{CH}|E = 0)$. At a small-area level, this is equivalent to a count of the number of self-funders in care homes:

$$AER_i^{cap} = p(R^{CH} + C^{CH}|E = 0) \times m_i = c_i^{SF} \tag{5}$$

We can proceed by using a regression model to estimate a formula predicting the count of self-funders in each small area based on population rates of relevant need, wealth and supply factors:

$$c_i^{SF} = \beta_0 + \sum_k \beta^k \frac{z_i^k}{m_i} + \beta^m \ln(m_i) \tag{6}$$

where c_i^{SF} is the count of self-funders in the small area i; z_i are the need, wealth and supply variables; and m_i is the small-area population. The inclusion of a population size variable is mainly to account for scale effects.

The count of self-funders in a small area is not directly known, however. Instead we conducted a survey of care homes – see section 3.1.2 – which provided information on the numbers of self-funders per registered care home bed for a random sample of care homes.

Using regression analysis at the care home level (for care homes j), we modelled the relationship between the share of self-funders per registered bed (sf_j) and various care home characteristic (x_j), socio-economic characteristics of the population in the small area in which the care home was located (y_i), and supply factors (s_i). The estimated coefficients (α) could then be used compute a predicted share of self-funders in each CQC-registered care home in England ($\widehat{sf_j}$):

$$\widehat{sf_j} \cong \alpha_0 + \alpha_1 x_j + \alpha_2 y_{j\in i} + \alpha_3 s_{j\in i} \tag{7}$$

The predicted count of self-funders in each small area (the predicted c_i^{SF} value for Eq. (6)) was calculated by multiplying the predicted share of self-funders in each care home ($\widehat{sf_{j\in i}}$) by the number of registered beds (b_i) and then aggregating at small-area level:

$$\hat{c}_i^{SF} = \sum_i \left(\widehat{sf_{j\in i}} b_i\right) \tag{8}$$

It remained to run a regression model at the LSOA level to estimate coefficients for an allocation formula:

$$AER_i^{cap} \cong \hat{c}_i^{SF} = \beta_0^{cap} + \beta_1^{cap} x_i + \beta_2^{cap} y_i + \beta_3^{cap} s_i \tag{9}$$

2.1.3 Extended financial means test

As mentioned above, any person who actually receives LA-funded support will have satisfied both a needs and a financial eligibility test; the individual's joint probability for satisfying both tests is $p(R+E)$. The financial support received by an individual is given by the probability of satisfying both the needs and financial eligibility test, $p(R+E)$, multiplied by the net unit cost of care to the LA, $u(R+E)$ (determined in Eqs. 16 to 18 below).

As a results of the extension of the means test, the additional expenditure requirement for an individual is the difference between the expenditure requirement to the LA under the (new) extended means test with that under the old means test:

$$AER^{ext} = ER^{NEW} - ER^{OLD} = p(R+E^{NEW}) \times u(R+E^{NEW}) - p(R+E^{OLD}) \times u(R+E^{OLD}) \tag{10}$$

The extension of the means test will result in an increased probability of an individual being financially eligible. Also, because the tariff income becomes a more significant part of the charged amount – the difference between the upper and lower capital limits is greater than £100,000 under the new means test rather than less than £10,000 under the old means test – the net cost to the LA of an eligible person can be quite different between old and new means tests. Because of its significance, we do not treat in this case net unit costs (u) as a constant. However, by simulating the joint impact of net unit costs and charges for the mean local authority, we avoid the problem of controlling for differences in the LA's capacity to raise income from charges, where that is a policy over which LAs have some control. Moreover, we use in the analysis regional (rather than) local average unit costs. As the regions are much broader areas than local authorities, it is reasonable to assume that a particular local authority has no control over prices in a whole region. The differences in unit cost between regions would, therefore, rather reflect differences in economic activity and can be regarded as exogenous.

With data on the share of people at small-area level that are LA-supported, we have an estimate of the joint probability of being eligible under both the needs and the current means test: $p(R + E^{OLD})$. This can be decomposed in the probability of being in need, $p(R)$, multiplied by the conditional probability of satisfying the financial means test *given eligible needs*, $p(E^{OLD}|R)$:

$$p(R + E^{OLD}) = p(R) \times p(E^{OLD}|R) \tag{11}$$

The probability of a person satisfying both a needs test and the (new) extended means test, $p(R + E^{NEW})$, cannot be estimated from available data. We can, however, compute it by using the probability of being in need ($p(R)$) obtained in Eq. (11):

$$p(R + E^{NEW}) = p(R) \times p(E^{NEW}|R) = \frac{p(R + E^{OLD})}{p(E^{OLD}|R)} \times p(E^{NEW}|R) \tag{12}$$

Eq. (10) can, therefore, be re-written as:

$$AER^{ext} = \frac{p(R + E^{OLD})}{p(E^{OLD}|R)} [p(E^{NEW}|R) \times u(R + E^{NEW}) - p(E^{OLD}|R) \times u(R + E^{NEW})] \tag{13}$$

The share of LA-supported people at small-area level is a suitable measure of the joint probability to satisfy both a needs test and the current means test: $p(R + E^{OLD})$.[3]

While we cannot directly observe from utilisation data the number of people that satisfy the financial means tests only, or the individual expenditure requirement given needs – because the information in utilisation data is the result of both a needs and a means tests – the financial eligibility tests (E) and the expenditure requirement (u) can be simulated by approximating the rules for assessment and charging using individual-level survey data. As the assessment and charging rules are formulaic and explicit (especially for residential care), the eligibility and LA financial support of a person with given characteristics can be calculated, at least to a reasonable degree of approximation. The calculations can be done according to either the current or the new capital limits.

The financial eligibility according to current upper capital limit is:

$$\begin{cases} E^{OLD} = 1 \; if \; NHW + 0.9 \times HW \times alone < £23{,}250 \\ E^{OLD} = 0 \; if \; NHW + 0.9 \times HW \times alone \geq £23{,}250 \end{cases} \tag{14}$$

while the financial eligibility according to new upper capital limits is:

$$\begin{cases} E^{NEW} = 1 \; if \; \begin{cases} HW \times (1 - alone) > 0 \; and \; NHW < £27{,}000 \\ HW \times (1 - alone) = 0 \; and \; NHW + 0.9 \times HW < £118{,}000 \end{cases} \\ E^{NEW} = 0 \; if \; \begin{cases} HW \times (1 - alone) > 0 \; and \; NHW \geq £27{,}000 \\ HW \times (1 - alone) = 0 \; and \; NHW + 0.9 \times HW \geq £118{,}000 \end{cases} \end{cases} \tag{15}$$

where NHW denotes non-housing wealth, HW denotes housing wealth and $alone$ equals to 1 if the person lives alone and 0 if the person lives with a spouse, partner or a relative (i.e. son, daughter, etc.). Only a 0.9 share of housing wealth (HW) is considered, as the financial assessment allows a 10 per cent deduction for selling expenses.

The weekly LA net expenditure requirement for an individual (u) is approximated by the gross unit cost for residential care (UC^{RC})[4] from which we subtract the individual's weekly income (I), the

[3] Annex 1 in (Forder, Vadean 2017) provides further details.

[4] The 'usual cost' (or 'standard rate') is the maximum amount the local authority is usually prepared to pay to for care services to meet a certain level of eligible needs. This maximum amount varies from authority to authority, and for different levels and types of care.

tariff income (TI) and add the personal expenses allowance (PA). According to the tariff income rules, supported people are expected to contribute towards their care costs from their assets above the lower capital limit (LCL). Housing wealth (HW) is considered only if there is no (eligible) dependent living in the property ($alone = 1$) and with a 10 per cent discount from its market value for selling expenses, while non-housing wealth (NHW) is considered at market value.

$$\begin{aligned} u(R+E) &= UC^{RC} - (I + TI - PA) \\ &= UC^{RC} - \left(I + \frac{0.9 \times HW \times alone + NHW - LCL}{250} - PA\right) \geq 0 \end{aligned} \quad (16)$$

The amount is constrained to be greater than or equal to zero, as supported persons are not expected to contribute from their income and savings in addition to the cost of their care package.

Therefore, the expenditure requirement according to the current capital limits is approximated by:

$$\begin{aligned} u(R+E^{OLD}) &= UC^{RC} \\ &- \left(I + \frac{0.9 \times HW(E^{OLD}) \times alone + NHW(E^{OLD}) - £14{,}250}{250} - £24.90\right) \geq 0 \end{aligned} \quad (17)$$

while the expenditure requirement according to the new capital limits is:

$$\begin{aligned} u(R+E^{NEW}) &= UC^{RC} \\ &- \left(I + \frac{0.9 \times HW(E^{NEW}) \times alone + NHW(E^{NEW}) - £17{,}000}{250} - £24.90\right) \geq 0 \end{aligned} \quad (18)$$

noting that maximum wealth for eligible people under the old rules is £23,250, but under the new rules is £118,000.

A dataset with relevant variables (i.e. level of disability, living arrangements, income, housing and non-housing wealth) that enabled us to most closely simulate the eligibility tests and expenditure requirements is the English Longitudinal Study of Ageing (ELSA). Relevant information was not available in routine datasets at the local authority level and, therefore, financial eligibility and expenditure requirements could not be calculated directly.

Eligibility conditions and expenditure requirements are approximated by applying the above criteria (i.e. Eqs 14, 15, 17 and 18) according to the characteristics of people in the ELSA dataset. The conditional probabilities of satisfying the financial eligibility criteria as well as the expenditure requirements are estimated by using a linear probability model (OLS) over a sub-sample of people with eligible needs (i.e. at least one ADL and aged 75 and over; chosen pragmatically after experimentation to include a sufficiently large sample size). We selected explanatory variables, including need, wealth and supply proxies, that were available in both ELSA and routine datasets so that the results of the estimations using the ELSA data could be approximated at small-area level using routine dataset variables. In particular, we used the coefficients from the ELSA estimates to predict the share of people in each small area (i) that are financially eligible given eligible need according to either the current ($\hat{p}_i(E^{OLD}|R)$) or the extended means test ($\hat{p}_i(E^{NEW}|R)$),[5] as well as the net individual expenditure requirement for each small area according to either the current ($\hat{u}_i^{OLD}$) or the new capital limits ($\hat{u}_i^{NEW}$).

These estimated values could be substituted into Eq. (13) and multiplied by LSOA population to get the total AER for the small area:

[5] For more details on the prediction of financial eligibility, see (Forder, Vadean 2017), Annex 1.

$$AER_i^{ext} = \frac{p_i(R + E^{OLD}) \times m_i}{\hat{p}_i(E^{OLD}|R)} \times [\hat{p}_i(E^{NEW}|R) \times \hat{u}_i^{NEW} - \hat{p}_i(E^{OLD}|R) \times \hat{u}_i^{OLD}] \quad (19)$$

With this measure, we can use a statistical model to determine how it is affected by relevant exogenous factors that are available in routine data sets, as we require. The result of this estimation is a (linear) equation predicting the additional expenditure requirement:

$$AER_i^{ext} \cong \beta_0^{ext} + \beta_1^{ext} x + \beta_2^{ext} y + \beta_3^{ext} s \quad (20)$$

where the terms in the equation are: need proxies (x), wealth proxies (y) and supply (s), and the coefficients are the βs.

3 Data

Three datasets were used for the analysis.

3.1.1 LA-funded social care service users survey

The first dataset is on social care service use at Lower Layer Super Output Area (LSOA) level for the period 1 April 2012 to 31 March 2013, which has been collected by LG Futures from 60 local authorities that agreed to participate in the study (Ranasinghe, Tideswell 2014). Specifically, anonymous, aggregated data were collected on the number of:

- LA-supported permanent admissions to residential and nursing care of young adults aged 18 to 64;
- LA-supported permanent admissions to residential and nursing care of older people aged 65 and over;
- LA-supported community-based service users aged 18 to 64; and
- LA-supported community-based service users aged 65 and over.

The data on LA-supported care home clients were based on new admissions, so that needs factors could be applied to the pre-care address and, therefore, avoid problems of out-of-area placements. A number of LAs reported some problems in identifying pre-care addresses (LSOAs) and so were not included in the final sample. Another issue was that some LAs appeared to select clients for the downloaded data in a way that was inconsistent with their RAP/ASC-CAR returns. In other words, the LA-level total clients differed from the number reported in RAP/ASC-CAR. The inclusion of LA-level effects helped to deal with this latter problem, although we also ran models with some excluded LAs where differences were substantial. In the main, this made relatively little difference to the results.

To explore different specifications, we estimated models with total numbers of service users. We also estimated models where we added the (cost-weighted) numbers of only home care and direct payment service users together, and disregarded other community-based service users. This made relatively little difference to the results of the analysis.

After excluding LAs with incomplete and/or inconsistent data, the final sample of permanent admissions to residential and nursing care for both age groups included 14,003 LSOAs in 53 LAs; the sample of community-based service users aged 18 to 64 included 13,430 LSOAs in 50 LAs; while the sample of community-based service users aged 65 and over included 13,116 LSOAs in 49 LAs.

Regarding needs, wealth and supply control variables, we put together LSOA-level data on: benefits uptake (e.g. Attendance Allowance, Income Support, Employment and Support Allowance, Jobseeker Allowance, and Pension Credit) downloaded from the Department for Work and Pensions website; various Census 2011 variables capturing information on people's activities of daily life limitations,

home ownership, living arrangements and ethnicity; Office of National Statistics population estimates; Valuation Office Agency (VOA) council tax data; house prices data from the Land Registry; and the number of care home beds from the Care Directory statistics provided by the Care Quality Commission (CQC).

3.1.2 Care home survey

The second dataset is about care homes, and specifically: the number of self-funders, the number of beds and occupancy rates from care homes for older people. The data were collected in December 2013 and January 2014 by LG Futures through an online survey. Around 1,200 care homes responded (Ranasinghe, Tideswell 2014). The data were matched with CQC data on the number of registered care home beds and Laing & Buisson data on care home type, sector, care home group, and date of first registration. After excluding observations with missing values for the variables of interest, our matched dataset includes 11,372 observations (i.e. care homes), from which we had information on the number of permanent residents who pay for their own care from 918 care homes from the survey (in 140 LAs).

3.1.3 English Longitudinal Study of Ageing (ELSA)

The third dataset used was the English Longitudinal Study of Ageing (ELSA). This dataset has a wide range of data about the individuals in the survey, including information about their needs-related characteristics and their wealth and income, including benefit uptake. Five waves of ELSA were combined (with financial variables inflated to be in line with the last wave). The data were reweighted so that the characteristics of the individuals in ELSA were in line with rates in the LSOA data.

The data sources and manipulations are described in more detail in Annex A1.

4 Empirical analysis and results

4.1 Adult social care

In this section we report the estimations of Eq. (3). Four distinct service utilisation models were estimated, by two population groups and two service types: 1) care home services for young adults aged 18 to 64; 2) community-based services for young adults aged 18 to 64; 3) care home services for older people aged 65 and over; and 4) community-based services for older people aged 65 and over.

The particular set of dependent and independent variables used in the models and descriptive statistics is presented in Table 1.

Due to the small number of residential and nursing care placements for young adults, we specified the models with a dummy dependent variable rather than a count (any admissions versus no admissions in the LSOA). The model was estimated by logistic regression.

Although a third of LSOAs had zero permanent admissions to care home services for older people, this is likely to be a characteristic of the small size of some LSOAs (with service user counts censored to zero) rather than there being a different underlying process for whether an LSOA has any service users and the subsequent number of service users in that LSOA. As such, a count model (as opposed to a two-part model) is likely to be most appropriate. After experimenting, we used a negative binomial model.

For community-based care – both age groups – the dependent variable was the cost-weighted gross weekly community-based care utilisation by LSOA. The services included were home care, day care, direct payments, professional support and equipment, while national average unit costs were

Table 1. Descriptive statistics by population group – LSOA level

	Obs	Mean	Std Dev	Min	Max
Young Adults (aged 18 to 64)					
Dependent variables:					
Any permanent admissions to residential and nursing care for young adults in the LSOA (dummy variable)	13,074	0.11	0.31	0.00	1.00
Cost-weighted weekly community-based care utilisation for young adults (£/wk per LSOA)	13,430	2,005.55	1,710.69	0.00	30,301.00
Need x:					
Limiting (significantly) condition 16-64 per capita 16-64	13,430	0.05	0.03	0.00	0.25
Population 16-24 per capita 16-64	13,430	0.17	0.07	0.06	0.91
Ethnic White 16-64 per capita 16-64	13,430	0.87	0.18	0.01	1.00
Wealth/income y:					
Income Benefits Claimants 16+[a] per capita 16-59	13,430	0.10	0.08	0.00	0.57
Living arrangements: share of people in one-family households	13,430	0.76	0.10	0.09	0.97
Supply, s:					
Total MSOA care home beds for young adults (18-64) per MSOA population 18-64	13,430	0.002	0.003	0.00	0.05
Sparsity:					
Population (all) density	13,430	40.04	43.55	0.00	684.70
Population/scale:					
Population aged 18 to 64	13,430	998.30	276.24	398.00	7,694.00
Older People (aged 65 and over)					
Dependent variable:					
Permanent admissions to residential and nursing care for older people aged 65+ (count per LSOA)	13,415	1.36	1.48	0.00	8.00
Cost-weighted weekly community-based care utilisation for older people aged 65+ (£/wk per LSOA)	13,071	1,892.03	1,442.96	0.00	27,001.00
Need x:					
Attendance Allowance claimants 65+ per capita 65+	13,415	0.15	0.06	0.00	0.65
Limiting (significantly) condition 85+ per capita 65+	13,415	0.06	0.03	0.00	0.40
Living arrangements: couples per households 65+	13,415	0.45	0.12	0.00	0.86
Ethnic White population 65+ per capita 65+	13,415	0.94	0.13	0.00	1.00
Wealth/income y:					
Pension Credit Claimants 80+ per capita 65+	13,415	0.08	0.05	0.00	0.50
Home-owner households 65+ per households 65+ × properties in council tax band ABCDE	13,415	0.58	0.20	0.00	1.00
Home-owner households 65+ per households 65+ × properties in council tax band FGH	13,415	0.08	0.13	0.00	0.91
Supply, s:					
Total MSOA care home beds for old age/dementia per MSOA population 65+	13,415	0.04	0.05	0.00	0.31
Population/scale:					
Population aged 65 and over	13,415	284.50	123.43	1.00	1,109.00

Note: [a] Income Support (IS) 16-59, Employment and Support Allowance (ESA) 16-59, and Jobseekers Allowance (JSA) 16+ claimants.

applied for weighting, as local unit cost can be influenced by differences in the commissioning practices of local authorities (for details see Annex A1). Less than 5 per cent of the sample LSOAs had zero community-based care service users for either the young adults or the older people group. After experimenting, a GLM model for count data (i.e. Poisson) was used in the analysis.

Although the relationship between utilisation of social care services and need factors proved to be non-linear, and non-linear models more appropriate for estimating service use, formulae are required to be easy to interpret and apply. We, therefore, used the marginal effects (i.e. the linear

Table 2. Models for young adults (18-64) predicting: permanent admissions to residential and nursing care (Res & Nur Care) and the costs of community-based services (Comm Care) at LSOA level – marginal effects

	Res & Nur Care	Comm Care
	IV logit (ME)	GLM (ME)
Limiting (significantly) condition 16-64 per capita 16-64	0.596***	14,861***
	(0.158)	(1,842)
Living arrangements: share of people in one-family households	-0.142***	-1,789***
	(0.0392)	(243.1)
Population 16-24 per capita 16-64	-0.161***	-2,109***
	(0.0516)	(264.6)
Ethnic White 16-64 per capita 16-64	-0.00913	-286.1**
	(0.0250)	(111.2)
Income Benefits Claimants 16+ (i.e. IS, ESA, and JSA) per capita 16-59	0.148**	1,629***
	(0.0617)	(482.9)
Supply: MSOA care home beds for young adults per MSOA pop 18-64	8.596***	
	(1.594)	
Sparsity: Population (all) density	-0.0002**	0.545
	(0.0001)	(0.417)
Population 18-64 (log)	0.0744***	1,135***
	(0.0123)	(96.22)
LA fixed effects	Yes	Yes
Observations (LSOAs)	13,074	13,430
Clusters (Local Authorities)	49	50
Weak instruments – F-test (p-value)	110.42 (0.000)	
Over-identification – F-test (p-value)	0.02 (0.997)	

IV logit: bootstrapped (500 replications) standard errors in parentheses
GLM: robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

approximation of the predicted effects of the need and wealth factors on social care utilisation) to compute the formulae coefficients.

The variables included in the analysis passed several rather restrictive inclusion criteria: they are measured and updated routinely at small area level, have a demonstrable link with social care needs, and are outside the influence of local authorities. A range of explanatory variables, such as age groups and gender, were tested but did not prove to be statistically significant in any specification and so were not used. We included, however, local authority fixed effects in the estimations in order to control for any non-need effects at local authority level (e.g. differences in commissioning practices, local area characteristics, etc.).

The estimation results, under the form of marginal effects, are given in Table 2 (for young adults) and Table 3 (for older people). The estimator used in each case was chosen to reflect the distribution of the dependent variable and whether supply indicators appeared to be endogenous, as we discuss below. Table 2 shows the effects of small changes in LSOA characteristics (i.e. needs, wealth, and supply) on a) the LSOAs probability to have new LA supported residential care service users aged 18 to 64, and b) the weekly cost on LA supported community care for young adults aged 18 to 64 in the LSOA. Table 3 shows the effects of small changes in LSOA characteristics (i.e. needs, wealth, and supply) on a) the count of new LA supported residential care service users aged 65 and over in the LSOA, and b) the weekly cost on LA supported community care service users aged 65 and over in the LSOA.

Table 3. Models for older people (65+) predicting: permanent admissions to residential and nursing care (Res & Nur Care) and the costs of community-based services (Comm Care) at LSOA level – marginal effects

	Res & Nur Care	Comm Care
	nbreg (ME)	IV GLM (ME)
Attendance Allowance claimants 65+ per capita 65+	2.452***	3,716***
	(0.441)	(309.6)
Limiting (significantly) condition 85+ per capita 65+	1.446***	5,458***
	(0.502)	(534.1)
Living arrangements: couple households per households 65+	-0.406**	-759.2***
	(0.182)	(125.7)
Ethnic White population 65+ per capita 65+	0.815***	-365.9***
	(0.167)	(79.86)
Pension Credit Claimants 80+ per capita 65+	1.923***	2,281***
	(0.512)	(306.4)
Home-owner households 65+ per households 65+ × properties in council tax band ABCDE per all properties	-0.510***	-712.8***
	(0.176)	(71.30)
Home-owner households 65+ per households 65+ × properties in council tax band FGH per all properties	-1.340***	-1,598***
	(0.189)	(120.0)
Supply: Total MSOA care home beds for old age/dementia per MSOA pop 65+	1.026***	-4,726***
	(0.257)	(599.4)
Population 65+ (log)	0.924***	1,386***
	(0.0293)	(24.68)
LA fixed effects	Yes	Yes
Observations (LSOAs)	13,415	13,071
Clusters (Local Authorities)	50	49
Weak instruments – F-test (p-value)		211.75 (0.000)
Over-identification – F-test (p-value)		1.37 (0.251)

nbreg: robust standard errors in parentheses
IV GLM: bootstrapped (500 replications) standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4.1.1 Endogeneity of supply

Total care home beds per capita was the variable used as a supply measure in both care home and community-based care estimations, where we expect a positive effect on the former and a negative effect on the latter. However, the utilisation of care home services and the level of supply are likely to be interdependent, as at the same time the supply of care home beds can be a result of local demand for care and the presence of care homes in an area might support the decisions of care commissioners to make care home placements. For this reason, rather than use number of beds at the LSOA level, we used for each LSOA observation the total number of beds in the corresponding middle-layer super-output area (MSOA).[6] Moreover, we undertook some sensitivity analysis using instrumental variable (IV) models. The instruments used were MSOA-level need indicators (i.e. the MSOA population 65+ and the proportion of MSOA population that was of working age), the MSOA unemployment level, and a 'spatial lag' variable capturing the share of LA-level care home bed supply in the relevant population net of the LSOA's supply level.

Instrumental variables are used to correct for the bias that may result from the potential relationship between need factors and supply. They have to satisfy two important conditions: a) to

[6] MSOAs and LSOAs are coterminous.

be highly correlated with supply, and b) not be directly related to the utilisation of care services in the LSOA.

Supply of care services to a given LSOA population is likely to be affected by the population size of the (wider) area (i.e. the MSOA), because a large MSOA population will attract more providers. Service utilisation levels in the LSOA however, will be directly affected by LSOA population, and not the population of the MSOA. Need in the LSOA depends on the number of people that live in the LSOA, not on the number of people living in the whole area. Supply, by contrast, is not localised.

The 'MSOA population that was of working age' and 'MSOA unemployment level' are likely to capture labour supply effects on services in a local area, including for the social care sector. The size of the local labour force should, however, have no direct effect on utilisation of care, but only through supply of care services. Moreover, demand in only one sector (i.e. social care) and in a small area (i.e. the LSOA) would be not strong enough to affect the size of the labour force in a much larger area (i.e. the MSOA).

The 'spatial lag' instrument captures the mean level of LA-level care home bed supply in the relevant surrounding area net of the LSOA's supply level. As with the MSOA population variable, the rationale behind this instrument is that the supply of care in the local area (i.e. the MSOA) is likely to affect the supply in an LSOA through, for example, competition effects, but should have no direct bearing on LSOA-level utilisation. In particular, LSOA level utilisation is directly affected by supply in the LSOA, but not directly affected by the supply in neighbouring areas. If care home places were available in a given LSOA, it would not matter to the individual's choice in that LSOA that supply was, for sake of argument, zero elsewhere since they can use services in their own LSOA. However, clearly the availability of places in that LSOA is affected by supply elsewhere because people in other LSOAs would want to use that supply.

In Annex A2, Table 18 and Table 19, we report the estimation results for IV models compared to the non-IV counterparts. This analysis indicates how much difference arises by instrumenting, i.e. whether supply is endogenous or not.

As theoretically expected, supply is endogenous in the estimations for community care service use (for both age groups), as supply of community care services can be adapted more flexibly to changes in demand. However, the coefficient for supply in the model for community care services for young adults had the wrong sign, leading to the decision to exclude supply from this model.

Care home supply is not as easily adaptable to use/demand levels, due to the fixed cost involved. However, the finding that supply is endogenous in the care home model for younger adults could be due to the fact that care home demand for younger adults is mostly through LA commissioning. Therefore, both service use and supply of care home services for young adults are rather determined by LA social care policy and commissioning.

We need to note, however, that controlling for endogeneity of supply had no significant effect on the coefficients of the other covariates included in the analysis and, therefore, no substantive effect on the final per capita allocations.

4.1.2 The Relative Needs Formulae for adult social care

The coefficients of the Relative Needs Formulae in Table **4** are derived by rescaling the marginal effects from the above models (Table 2 and Table 3) so that the formula predicts on average the weekly per capita costs for either residential of community-based care in the LSOA (with sample average need factors). Supply, ethnicity and population scaling effects are removed by setting them

at national average values and adding them to the constant term. The combined formula for each age group (i.e. the last column) is obtained by the summation of the respective coefficients for each service type. By convention the RNF are linearized, i.e. the effect is assumed to be the same at any value of a variable.

Table 4. Relative Needs Formulae for adult social care

	(1) Res & Nur Care	(2) Comm Care	(1)+(2) Combined
Young adults aged 18 to 64			
Limiting (significantly) condition 16-64 per capita 16-64	9.20	13.51	22.71
Living arrangements: share of people in one-family households	-2.19	-1.63	-3.82
Population 16-24 per capita 16-64	-2.49	-1.92	-4.40
Income Benefits Claimants 16+ (i.e. IS, ESA, and JSA) per capita 16-59	2.29	1.48	3.77
Constant	3.04	2.55	5.58
Older people aged 65 and over			
Attendance Allowance claimants 65+ per capita 65+	17.61	11.92	29.53
Limiting (significantly) condition 85+ per capita 65+	10.39	17.50	27.89
Living arrangements: couple households per households 65+	-2.92	-2.43	-5.35
Pension Credit Claimants 80+ per capita 65+	13.81	7.32	21.13
Home-owner households 65+ per households 65+ × properties in council tax band ABCDE per all properties	-3.66	-2.29	-5.95
Home-owner households 65+ per households 65+ × properties in council tax band FGH per all properties	-9.62	-5.13	-14.75
Constant	9.50	5.39	14.89

4.1.2.1 Sensitivity analysis

In order to check the robustness of the formulae, we estimated alternative models from which we excluded one or more covariates not included in the 2005/2006 version of the RNF; a further model was estimated by jointly modelling care home and community-based services (as for the current RNF version). Annex A3 gives details. In the main, there was a high correlation between versions in terms of the per capita allocations to local authorities, with all coefficients above 0.92 (see Figure 2).[7]

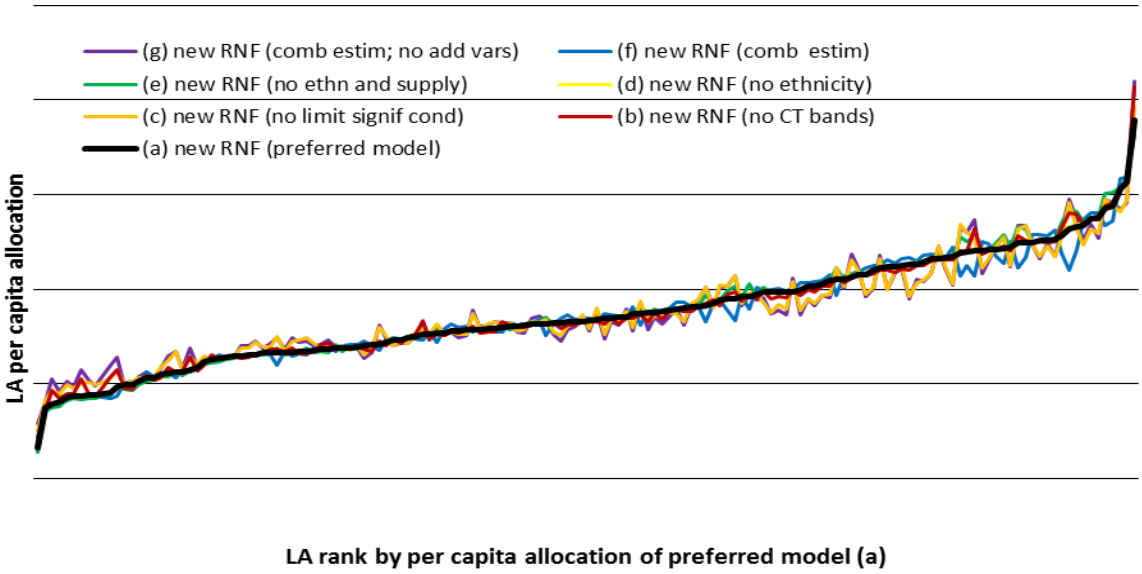
4.1.2.2 Comparison to 2005/06 RNF

With a correlation coefficient of 0.91, the per capita allocations according to the new and the 2005/06 RNF for adult social care are relatively high as well. The new RNF should, however, better approximate the distribution of care needs between local authorities due to a number of improvements to the empirical analysis:

- using data at much smaller area level, i.e. LSOA compared to ward level in 2005/06;
- using a higher number of observations, i.e. more than 13,000 compared to 775 in 2005/06;
- using newer data, e.g. Census 2011 and DWP 2013 compared to the Census 2001 data used for developing of the current (2005/06) ASC RNF;
- using additional covariates to capture need by taking advantage of the 2011 Census, i.e. the share of people with limiting (significant) conditions;
- using additional covariates to capture the distribution of wealth, i.e. interaction terms between the share of home ownership and the share of properties in various council tax bands.

[7] A correlation coefficient of 1.00 would indicate identical allocations between models.

Figure 2. Per capita allocations by local authority – sensitivity to model specification



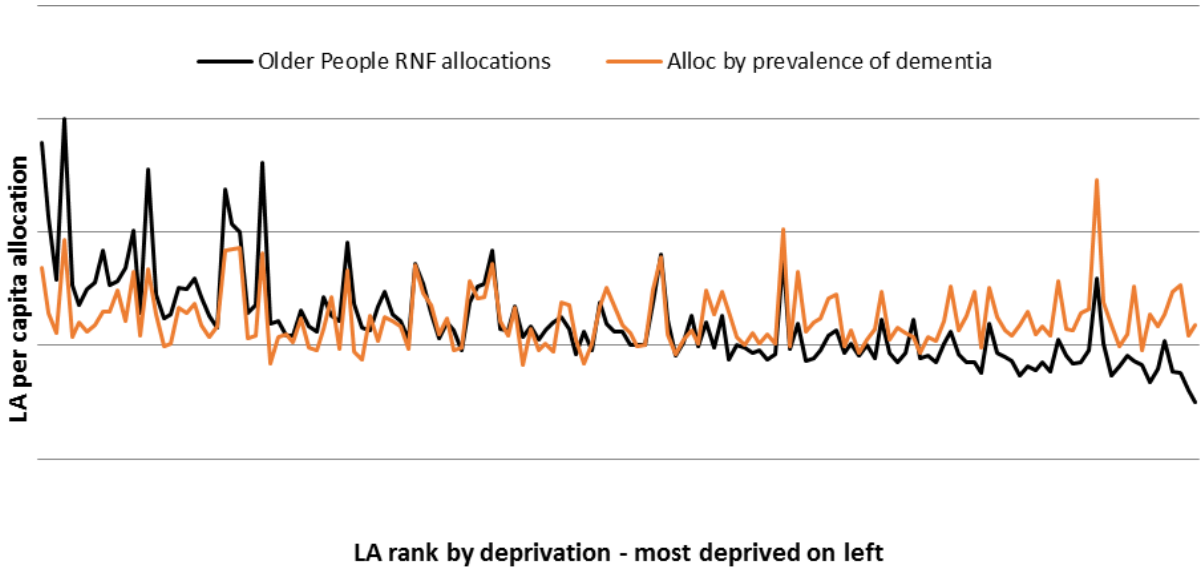
Note: Per capita allocations are based on a hypothetical budget.

4.1.2.3 Comparison with allocations based on alternative measure of care needs

In order to test the redistributional performance of the RNF formula, we compared the allocations based on the new RNF with allocations based on alternative indicators of underlying need. Figure 3 plots allocations based on the new RNF for older people along with allocations based on prevalence of dementia. Due to the fact that the RNF formula does take into account also geographic variation in wealth/income in the local population, while prevalence of dementia does not, we should be able to identify a relation with deprivation rank only in the case of RNF allocations.

Figure 3 illustrates that RNF allocations for older people are quite well related to underlying need as captured by prevalence of dementia (i.e. correlation coefficient of 0.60). Furthermore, and as expected, the RNF is allocating relatively more resources to more deprived LAs (i.e. decreasing trend with respect to decrease in deprivation), while allocations by prevalence of dementia seem less related to deprivation.

Figure 3. Per capita allocations by local authority - new RNF for older people vs. dementia prevalence



Note: Per capita allocations are based on a hypothetical budget. LA level dementia prevalence data are from Alzheimer's Society (2014), Dementia UK Update: Appendix A.

4.2 Cap on lifetime care costs

4.2.1 Care-home level analysis

The analysis for the estimation of the cap on lifetime care cost formula is performed in two stages. The first stage of the analysis is at care home level and has the aim of predicting the share of self-funders per number of registered beds for each CQC registered care home for older people.

Descriptive statistics for our sample of 919 care homes are presented in Table 5. The average share of self-funders in the total number of permanent care home residents for our analysed sample is 45.4 per cent, and therefore very similar to the self-funder share estimated by previous studies. The Institute for Public Care (2011) estimated the proportion of people who pay for their care home place using CQC data on the number of registered beds, Laing & Buisson data on occupancy, CRILL data on publicly-funded care home placements, and PSSX1 data on NHS-supported placements and obtained a figure of 44.9 per cent.

Table 5. Descriptive statistics – care home level

	Obs	Mean	Std. Dev.	Min	Max
Share of self-funders (per registered beds)	919	0.391	0.248	0.000	1.000
Share of self-funders (per occupancy)	919	0.454	0.270	0.000	1.000
Sector: voluntary	11,372	0.148	0.355	0.000	1.000
Sector: nursing	11,372	0.370	0.483	0.000	1.000
Group size: three or more	11,372	0.535	0.499	0.000	1.000
No. of MSOA care home beds for old age/dementia net of LSOA care home beds per capita 65+	11,372	0.077	0.076	0.000	0.509
Share of properties in council tax band FGH per all properties (LSOA)	11,372	0.115	0.165	0.000	1.000
Attendance Allowance claimants 65+ per capita 65+ (LSOA)	11,372	0.202	0.067	0.036	0.816
Pension Credit Claimants 80+ per capita 65+ (LSOA)	11,372	0.104	0.053	0.000	0.500
Living arrangements: couple households per households 65+ (LSOA)	11,372	0.438	0.117	0.087	0.800
Population 65+ (LSOA)	11,372	350.628	135.037	24.000	1049.000
Share of ethnic White people aged 65+ per capita 65+ (LSOA)	11,372	0.958	0.097	0.067	1.000
MSOA unemployment rate	11,372	0.036	0.026	0.003	0.182

We used regression analysis to establish the relationship between the share of self-funders in the sampled care homes and various care home characteristics as well as socio-economic factors at LSOA/MSOA level – see Table 6. The predicted value for each CQC-registered care home was then obtained by extrapolation. The preferred model was Tobit because it restricts the predicted share in the (0,1) range; the OLS estimation results were, however, very similar.

The coefficients of the estimated model had the expected signs, with care needs (i.e. rates of Attendance Allowance uptake) and wealth (i.e. the share of properties in council lax bands FGH) in the local population positively affecting the share of self-funders in residential care. On the other hand, measures of low income (e.g. rates of Pension Credit uptake and MSOA unemployment levels) and the presence of a potential informal carer in the household (i.e. the share of couple households in all households aged 65+) had a negative effect on the share of people self-funding their care home placement. In terms of care home characteristics, care homes in the voluntary sector were catering for a larger share of self-funders, while nursing homes and providers owning three or more care homes had a relatively lower share of self-funder among their residents.

Table 6. Self-funder rate estimation at care home level

	OLS	Tobit
Sector: voluntary	0.0726***	0.0703***
	(0.0234)	(0.0219)
Sector: nursing	-0.118***	-0.119***
	(0.0208)	(0.0197)
Group size: 2 or more	-0.0613***	-0.0623***
	(0.0204)	(0.0189)
No. of MSOA care home beds for old age/dementia net of LSOA care home beds for old age/dementia per capita 65+	-0.198	-0.209
	(0.133)	(0.127)
Share of properties in council tax band FGH per all properties (LSOA)	0.141*	0.144**
	(0.0740)	(0.0695)
Attendance Allowance claimants 65+ per capita 65+ (LSOA)	1.024***	1.040***
	(0.228)	(0.215)
Pension Credit Claimants 80+ per capita 65+ (LSOA)	-2.220***	-2.247***
	(0.291)	(0.272)
Living arrangements: couple households per households 65+ (LSOA)	-0.288***	-0.292***
	(0.0832)	(0.0801)
Population 65+ (log) (LSOA)	0.0432	0.0446
	(0.0323)	(0.0302)
Share of ethnic White people aged 65+ per capita 65+ (LSOA)	0.125	0.137
	(0.142)	(0.132)
MSOA unemployment rate	-1.369***	-1.367***
	(0.389)	(0.372)
LA fixed effects	Yes	Yes
Constant	0.280	0.266
	(0.203)	(0.194)
Sigma		0.190***
		(0.00670)
Observations	919	919
Left censored observations (=0)		17
Uncensored observations		895
Right censored observations (=1)		7
R-squared	0.437	
Log likelihood		188.4

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The predicted self-funders' shares per care home were then used to compute an estimated number of self-funders at small-area level. This has been obtained by multiplying the share of self-funders in each care home with the registered number of care home beds and then aggregating the results at small-area level. We obtained in this way a valid estimated number of self-funders for 8,217 LSOAs; the rest (or about 24,600 LSOAs) do not have care homes located in them and, therefore no self-funders in residential care.

4.2.2 Small area analysis

4.2.2.1 Accounting for excess zeros

A challenge for modelling the count of self-funders at small-area level is that care addresses of residential care self-funders are clustered in areas where care homes are located (i.e. in about 25 per cent of LSOAs). One solution is to perform the analysis at a larger area level; for example, about 4,800 out of 6,791 MSOAs (or about 70 per cent) have care homes located in them. One argument in

Table 7. Descriptive statistics – MSOA level

	Obs	Mean	Std. Dev.	Min	Max
Count of self-funders aged 65+	6,787	21.022	27.199	0.000	360.000
Attendance Allowance claimants 65+ per capita 65+	6,787	0.158	0.042	0.000	0.353
Pension Credit Claimants 80+ per capita 65+	6,787	0.088	0.038	0.000	0.246
Limiting (significantly) condition 85+ per capita 65+	6,787	0.063	0.015	0.011	0.167
Living arrangements: couple households per households 65+	6,787	0.435	0.096	0.048	0.721
Home-owner households 65+ per households 65+ × properties in council tax band ABCDE per all properties	6,787	0.578	0.154	0.027	0.908
Home-owner households 65+ per households 65 over × properties in council tax band FGH per all properties	6,787	0.065	0.098	0.000	0.710
Population 65+	6,787	1333.882	494.404	48.000	4484.000
Number of registered beds for old age/dementia per capita 65+	6,787	0.044	0.049	0.000	0.361
No. of LAD care home beds for old age/dem. net of MSOA care home beds for old age/dem. per capita 65+	6,787	0.042	0.010	0.008	0.081
LAD unemployment rate	6,787	0.037	0.016	0.011	0.087
LAD share of rural area	6,787	0.401	0.386	0.000	0.989

favour of this approach would be that the market of a care home is larger than the LSOA. On the other hand, a problem with conducting the analysis at a larger area level is that larger areas are less homogenous in terms of residents' socio-economic characteristics, which is a main assumption of small-area analysis.

To balance these two concerns, we opted for an analysis at the MSOA level. The small-area dataset includes a total of 6,787 MSOAs in 150 LAs (i.e. without City of London and the Isles of Scilly), out of which 1,993 have zero self-funders. Descriptive statistics are reported in Table 7.

In order to account for the zero values areas that remained, we experimented with a number of models: Zero Inflated Negative Binomial (i.e. a count model that models separately excessive zeros), and three models for censored data (i.e. Tobit, Censored Regression model, and Heckman). The Tobit and Heckman models assume left censoring at '0', while the censored regression model assumes right censoring at full capacity – this is implicitly '0' in MSOAs with no care home bed vacancies.

We selected between these estimation options by considering their results in terms of the aggregated predicted values of self-funders they produced, and also by looking that their respective goodness-of-fit measures. Details of this analysis can be found in Table 22 of Annex A4. In summary, the predicted aggregated number of self-funders resulting from the Censored Regression model greatly underestimated the number of self-funders, while the predicted aggregated number of self-funders according to the Heckman model greatly overestimated the number of self-funders. The Tobit model appeared to perform the best in this respect. It also showed good results in terms of residual sum squared (RSS), and the Akaike Information Criterion (AIC).

The results of the Tobit model are presented in Table 8. The marginal effects are based on the expected value of the dependent variable being zero for MSOAs with no self-funders (Y*), as we know there are no self-funders in MSOAs with no care homes. As expected, the needs factors (i.e. the Attendance Allowance uptake and the share of people with significant limiting conditions) have a positive effect on the count of self-funders.

Table 8. Count of self-funders estimation at MSOA level

	Tobit	ME (Y*)
No. of registered care home beds for old age/dementia per capita 65+	434.3***	361.2***
	(11.57)	(9.233)
Attendance Allowance claimants 65+ per capita 65+	243.2***	202.3***
	(17.21)	(13.96)
Pension Credit Claimants 80+ per capita 65+	-298.6***	-248.3***
	(22.54)	(18.26)
Limiting (significantly) condition 85+ per capita 65+	47.84*	39.79*
	(24.51)	(20.31)
Living arrangements: couple households per households 65+	-36.72***	-30.54***
	(7.004)	(5.825)
Home-owner households 65+ per households 65+ × properties in council tax band ABCDE per all properties	7.987**	6.643**
	(3.764)	(3.130)
Home-owner households 65+ per households 65+ × properties in council tax band FGH per all properties	40.63***	33.80***
	(5.672)	(4.716)
Population 65+	0.0251***	0.0209***
	(0.0008)	(0.0006)
Population density	-0.0278*	-0.0231*
	(0.0155)	(0.0129)
LA fixed effects	Yes	
Constant	-44.10***	
	(5.470)	
sigma	15.47***	
	(0.393)	
Observations	6,787	
Left censored observations (=0)	1,993	
Uncensored observations	4,794	
Log likelihood	-20,774	

Bootstrapped standard errors in parentheses (500 replications)
*** p<0.01, ** p<0.05, * p<0.1

The share of people aged 65+ owning a home in a higher council tax band (i.e. FGH) had a strong positive effect on the count of self-funders in the MSOA, as wealthier people are more likely to be able to afford to fund their own care. On the other hand, the share of people with low income (i.e. the share of Pension Credit uptake) and the availability of potential informal carers (i.e. the share of households living as a couple) had a negative effect on the count of people self-funding their residential care. Finally, as expected, the number of beds at MSOA level has a positive effect on care home utilisation.

4.2.2.2 Endogeneity of supply

The supply of care home beds is likely to be an important determinant of the utilisation of care home services. However, as mentioned in the section on the empirical analysis on the RNF for adult social care, the utilisation of residential care services and the level of supply are likely to be interdependent. Moreover, unobserved needs and/or local area characteristics may affect both the demand for care home beds and care home location.

To address the potential endogeneity, we undertook some sensitivity analysis using instrumental variable (IV) models. The instruments used were a 'spatial lag' variable, which captures the share of

Table 9. Allocation formula for the cap on lifetime care costs

	(1) With supply	(2) With supply sterilised
No. of registered care home beds for old age/dementia per capita 65+	0.2655	
Attendance Allowance claimants 65+ per capita 65+	0.1487	0.1487
Limiting (significantly) condition 85+ per capita 65+	0.0292	0.0292
Home-owner households 65+ per households 65+ × properties in council tax band ABCDE per all properties	0.0049	0.0049
Home-owner households 65+ per households 65+ × properties in council tax band FGH per all properties	0.0248	0.0248
Pension Credit Claimants 80+ per capita 65+	-0.1825	-0.1825
Living arrangements: couple households per households 65+	-0.0224	-0.0224
Constant	-0.0005	0.0113

a local authority district's (LAD) care home bed supply in the population aged 65+ corresponding to the MSOA in question, net of the MSOA's supply level and the unemployment rate at LAD level.[8] The instrument used to identify the modelling of the excess zeros in the Zero Inflated Negative Binomial model as well as the selection process in the Heckman model was the 'share of rural area at LAD level'. The rationale behind this instrument is that care providers are less likely to set up care homes in less populated areas due to lower demand and limited access to services.

Estimation results are presented in Annex A4, Table 21. The test statistics of the Zero Inflated Negative Binomial model showed that the dependent variable was over-dispersed (i.e. alpha is significantly different from zero). Therefore, the Negative Binomial model is to be preferred over the Poisson regression model. Moreover, the Vuong test suggested that the additional modelling of the excess zero values was an improvement over the standard Negative Binomial model.

With respect to endogeneity of supply, although the chosen instruments performed well (i.e. they are strong and relevant, as suggested by the weak identification and over-identification tests), the Wald endogeneity test revealed that care home supply was not endogenous either in the Zero Inflated Negative Binomial or the Tobit or the Censored Regression IV model.

4.2.3 The allocation formula for the cap on lifetime care costs

Table 9 gives the allocation formula for the cap on lifetime care costs. The coefficients are based on the marginal effects in Table 8, rescaled to per capita values. The coefficients are expressed in £s per week per person 65 and over.

As it is not clear whether the supply of care home places (to self-funders) is under the control of local authorities, we derived two alternative formulae: (1) with a coefficient for supply; and (2) with the effect of supply set at the national average and included in the constant term.

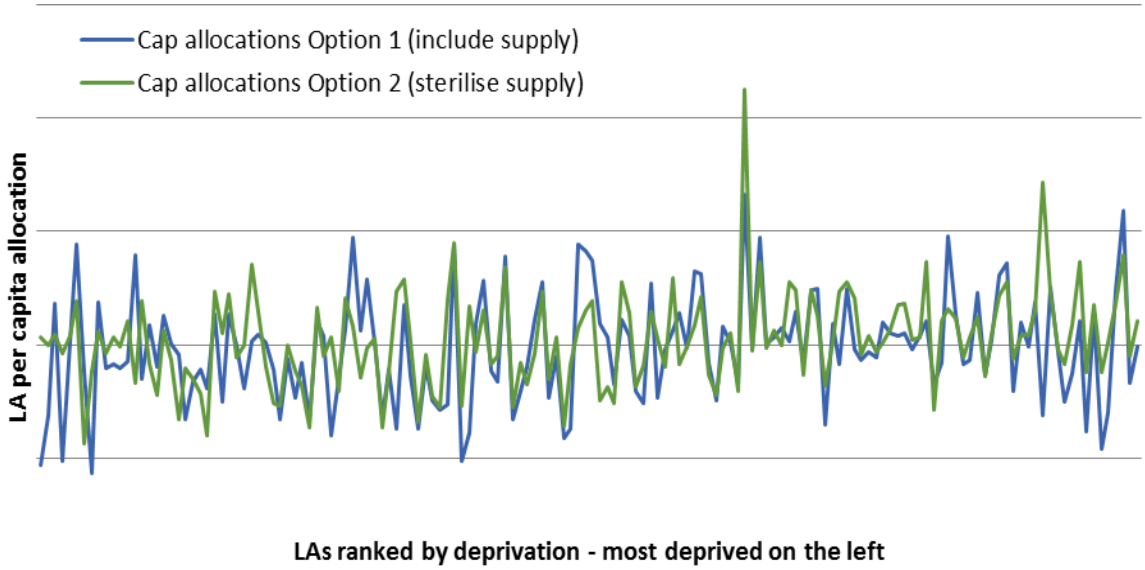
The correlation coefficient between LA per capita allocations according to the two formulae is 0.563 and between LA total allocations 0.991. Figure 4 shows the correlation graphically. Accounting for supply does make some difference in allocations.

The decision regarding which formula to apply should ideally be based on the timing of the LA assessment application. If self-funders apply for assessment after moving into a care home – and this will be the case for the majority of self-funders applying for assessment during the first year after implementation, and potentially even in subsequent years – the LA of their care home residence will become responsible for them, even if they have moved there from another LA. This decision by the

[8] For a discussion on the instruments see section 4.1.1, pp. 29-30.

self-funder will be affected by supply, and that supply is beyond the individual's control. Since this supply effect would have already applied by the time of assessment, it is effectively outside the local authority's control as well. The allocation formula ought to provide sufficient funding to LAs to support the eligible people with care need in their locality. This argument, therefore, suggests that supply indicators should be used in the cap formula.

Figure 4. Per capita allocations for the cap formula by local authority



Note: Per capita allocations are based on a hypothetical budget.

4.3 Extension to the financial means test

An allocation formula for the extended means test was estimated for people aged 65 and over with residential care needs. As there were no utilisation data for newly eligible people under the extended means test, their expenditure requirement (i.e. the LA contribution to their care costs) was estimated following the steps outlined in section 2.1.3, that is: first using simulation with ELSA data; second, applying these results at LSOA level; and third, doing an LSOA-level analysis to derive an allocation formula.

4.3.1 ELSA analysis

Using data from the English Longitudinal Study of Ageing (ELSA), we estimated the following:

- the probability of the person being selected under the current (old) means test (Eq. (14)),
- the probability of being selected under the (new) extended means test (Eq. (15)),
- the net individual expenditure requirement applying the old capital limits (Eq. (17)), and
- the net individual expenditure requirement applying the new capital limits (Eq. (18)).

We used the regional average unit cost for residential and nursing care in Eqs (17) and (18). Using regional unit costs (rather than the national average) allows us to capture regional differences in the prices of services. As the regions are much broader areas than local authorities, it is reasonable to assume that a particular local authority has no control over prices in a whole region. The differences in unit cost between regions would rather reflect differences in economic activity and can be regarded as exogenous.[9]

[9] We tried also alternative models in which we used national unit cost for the simulation of the individual expenditure requirements. The results, however, were not significantly different.

Table 10. Descriptive statistics ELSA sample (age >= 75, ADL >= 1)

	Obs	Mean	Std. Dev.	Min	Max
Financial eligibility: new means test	3,741	0.696	0.460	0	1
Financial eligibility: old means test	3,741	0.527	0.499	0	1
Exp. requirement: new means test	3,737	216.751	190.466	0	649
Exp. requirement: old means test	3,737	192.060	199.429	0	649
Gender: female	3,741	0.685	0.464	0	1
Aged 85+	3,741	0.327	0.469	0	1
Home owner	3,741	0.567	0.496	0	1
Home value	3,741	117,942	150,322	0	2,540,070
Log of home value	3,741	6.680	6.035	0	14.748
In receipt of pension credit	3,741	0.313	0.464	0	1
Lives alone	3,741	0.679	0.467	0	1
Wave 2	3,741	0.195	0.397	0	1
Wave 3	3,741	0.192	0.394	0	1
Wave 4	3,741	0.180	0.384	0	1
Wave 5	3,741	0.190	0.393	0	1

Descriptive statistics of the analysed ELSA sample are shown in Table 10. The analysed sample contains pooled observations from the ELSA waves 1 to 5. After restricting the analysis to persons with at least one ADL and aged 75 and over, the sample has 3,741 observations. For the analysed sample, the extended means test increases average financial eligibility from about 53 per cent to almost 70 per cent in the population and the average expenditure requirement from about £192 to £217 per person per week.

Table 11 presents OLS estimation results for the net expenditure requirements and needs test. As expected, given the nature of the means test and charging rules, home values were negatively related to both the likelihood to satisfy the financial eligibility test and the net expenditure requirement. Having a low income (i.e. in receipt of Pension Credit) is associated with a significantly

Table 11. OLS estimation results ELSA sample (age >= 75, ADL >= 1)

	(1) Net expd requirement: New means test	(2) Net expd requirement: Old means test	(3) Probability of being needs eligible
Gender: female	22.75***	19.83***	-0.0131
	(6.458)	(6.861)	(0.0155)
Aged 85 and over	-12.07**	-15.28**	-0.0375***
	(5.612)	(6.042)	(0.0134)
Log home value	-19.37***	-20.13***	-0.0567***
	(0.505)	(0.547)	(0.00125)
In receipt of pension credit	53.26***	56.25***	0.128***
	(6.184)	(6.441)	(0.0142)
Lives alone	-136.6***	-146.7***	-0.356***
	(6.770)	(7.071)	(0.0162)
Wave dummies	Yes	Yes	Yes
Constant	440.2***	420.2***	1.142***
	(7.846)	(8.560)	(0.0198)
Observations	3,737	3,737	3,741
R-squared	0.486	0.477	0.554

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

increased chance of being financially eligible and a greater expenditure requirement. Moreover, living alone reduced the probability of being financially eligible for care home services and the expenditure requirement, because in that case the home can normally be counted as an assessable asset.

4.3.2 LSOA level analysis

The coefficients from the three regression models above were applied at small-area level to predict their counterpart value at the LSOA level, i.e. to give predicted values for $\hat{p}_i(E^{NEW}|R) \times \hat{u}_i^{NEW}$, $\hat{p}_i(E^{OLD}|R) \times \hat{u}_i^{OLD}$, and $\hat{p}_i(E^{OLD}|R)$. These values would be used in Eq. (19).

We calibrated between the ELSA and LSOA datasets by scaling the expected share of people in each LSOA who satisfy the old means test given eligible needs ($\hat{p}(E^{OLD}|R)$) so that the net effect of home ownership on the predicted probability of satisfying a need-only test ($\hat{p}(R)$) is zero. The predicted expenditure requirement values were also rescaled so that their mean values equal the respective mean values in the ELSA sample.

A further regression model was estimated at LSOA level to provide a value for $p_i(R + E^{OLD})$ in Eq. (19). We estimated the determinants of the count of LA-supported permanent admissions by older people to residential and nursing care in each LSOA (i.e. people that satisfy both a needs and the old financial means test) in terms of need, wealth and supply. The distribution of supported people in LSOAs was based on new admissions, so that recent needs data could be applied to the pre-care address and, therefore, avoid problems of out-of-area placements.

Together these results were fed into Eq. (19) to calculate the additional expenditure requirement at LSOA level from the extension of the means test: AER_i^{ext}. This value is used as a dependent variable in a linear regression that is suitable for calculating an allocation formula – i.e. the regression of Eq. (20) using need, wealth, supply and (population) scaling variables. As the dependent variable is stochastic, the statistical error for the whole LSOA level process (the LSOA regressions) was estimated using bootstrapping.

Descriptive statistics of the LSOA sample are presented in Table 12. After excluding observations with missing data for the variables included in the analysis, the final sample covered 13,798 LSOAs in 53 local authorities. The figures confirm the quite substantial geographic variation in need and wealth. For example, the predicted additional expenditure requirement per LSOA varies between nil and £262, with an average of just over £47. The share of Attendance Allowance claimants varies from 0 to 65 per cent with an average of 15.2 per cent, while the share of households owning their home in the population aged 65 and over varies from 0 to 100 per cent, with an average of 65.7 per cent. Supply of residential care is also far from evenly distributed. At MSOA level, the number of care home beds varies from 0 to 309 per 1,000 people aged 65 and over, with an average of 44 beds per 1,000 people aged 65 and over.

Table 13 shows the results of the GLM small-area estimation of the additional expenditure requirement (Eq. (20)) and corresponding marginal effects (i.e. the linear approximation). As intended by the policy change, people with lower and middling levels of wealth would benefit from the policy change: ownership of homes in the lower and middle council tax bands has a positive effect on the additional expenditure requirement. Ownership of homes in the upper council tax bands had a statistically insignificant effect (although the coefficient was negative) on the additional expenditure requirement: as people with higher levels of wealth will still not qualify for LA-funded social care support under the new policy.

Table 12. Descriptive statistics LSOA sample

	Obs	Mean	Std. Dev.	Min	Max
Predicted value of additional LA expend. requirement per LSOA (£)	13,798	48.688	22.779	0	273.611
Attendance Allowance claimants 65+ per capita 65+	13,798	0.152	0.059	0	0.650
Limiting (significantly) condition 85+ per capita 65+	13,798	0.060	0.026	0	0.400
Home-owner households 65+ per households 65+ × properties in council tax band ABCDE per all properties	13,789	0.575	0.200	0	0.980
Home-owner households 65+ per households 65+ × properties in council tax band FGH per all properties	13,789	0.082	0.133	0	0.907
Pension Credit Claimants 80+ per capita 65+	13,798	0.082	0.049	0	0.500
Living arrangements: couple households per households 65+	13,798	0.447	0.121	0	0.865
Ethnic White population 65+ per capita 65+	13,798	0.936	0.130	0.011	1
Population 65+ (log)	13,798	5.540	0.495	0.693	7.011
Total MSOA care home beds for old age/dementia per MSOA pop 65+	13,798	0.044	0.047	0	0.309

Living as a couple had a negative effect on the additional expenditure requirements, as in this case the owned home is likely to be disregarded from assessed wealth. Moreover, the presence of a partner who can provide informal care significantly decreases the likelihood of moving into a care home.

As expected, higher levels of need (i.e. the share of Attendance Allowance claimants and the share of people with significant limiting conditions) and low income (i.e. the share of Pension Credit claimants) significantly increased the additional expenditure requirement.

Table 13. Estimation results of the additional expenditure requirement at LSOA level

	GLM	Marg Eff
Attendance Allowance claimants 65+ per capita 65+	2.186***	90.75***
	(0.360)	(14.91)
Limiting (significantly) condition 85+ per capita 65+	1.513***	62.81***
	(0.418)	(17.66)
Home-owner households 65+ per households 65+ × properties in council tax band ABCDE per all properties	0.359**	14.92**
	(0.140)	(5.943)
Home-owner households 65+ per households 65+ × properties in council tax band FGH per all properties	-0.220	-9.152
	(0.148)	(6.053)
Pension Credit Claimants 80+ per capita 65+	1.338***	55.54***
	(0.446)	(18.89)
Living arrangements: couple households per households 65+	-1.013***	-42.08***
	(0.145)	(6.654)
Ethnic White population 65+ per capita 65+	0.749***	31.08***
	(0.135)	(5.906)
Population 65+ (log)	0.845***	35.10***
	(0.0263)	(1.342)
Total MSOA care home beds for old age/dementia per MSOA pop 65+	0.415***	17.23***
	(0.103)	(4.097)
Constant	-1.944***	
	(0.270)	
Observations	13,798	
Log Likelihood	-30,055	

Bootstrapped (100 replications) standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4.3.3 Sensitivity analysis and robustness checks

4.3.3.1 Endogeneity of supply

Supply is a significant factor in the modelling which supports our expectation that using utilisation levels alone as predictors of need will be biased. However, as supply might be endogenous, we undertook sensitivity analysis using instrumental variable (IV) models. The instruments used were MSOA-level need indicators (i.e. the MSOA population 65+ and the proportion of MSOA population that was of working age) and a 'spatial lag' variable which captures the share at LA-level of care home bed supply in the population 65+ corresponding to the LSOA in question net of the LSOA's supply level.[10]

These results are given in Annex A5, Table 23. The results of an endogeneity test suggested that the number of beds at MSOA level is not endogenous. The endogeneity of the supply variable at LSOA level, however, could not be rejected with sufficient confidence.

4.3.3.2 Robustness checks

Due to concerns that home ownership alone does not adequately capture the distribution of wealth in the ELSA-level analysis, we also ran estimations with a home value variable. The effect (i.e. coefficient) of this covariate was then used at LSOA level to predict the financial eligibility and the expenditure requirements in combination with a LSOA variable on the share of home-owner households aged 65 and over multiplied by the average LSOA house price. This further allowed the estimation of three different formulae: 1) with a coefficient for home ownership; 2) with coefficients for interactions between home ownership and council tax bands; and 3) with coefficients for interactions between home ownership and the average house price.

Table 24 to Table 27 (Annex A6) present the ELSA-level and LSOA-level estimation results based on models resulting from a combination of the alternatives outlined above; the derived allocation formulae are shown in Table 28. Per capita allocations based on the different models are all rather similar, with correlations of 0.922 to 0.999.

4.3.4 The allocation formula for the extension to the financial means test

Table 14 gives the allocation formula for the extension to the means test. The coefficients are based on the marginal effects in Table 13, rescaled to per capita values. The coefficients are in £s per week per capita aged 65 and over. Supply effects were removed by using their national average values and adjusting the constant term.

Table 14. Allocation formula for the extension to the financial means test

Attendance Allowance claimants 65+ per capita 65+	0.4678
Limiting (significantly) condition 85+ per capita 65+	0.3238
Home-owner households 65+ per households 65+ × properties in council tax band ABCDE per all properties	0.0769
Home-owner households 65+ per households 65+ × properties in council tax band FGH per all properties	-0.0472
Pension Credit Claimants 80+ per capita 65+	0.2863
Living arrangements: couple households per households 65+	-0.2169
Constant	0.1844

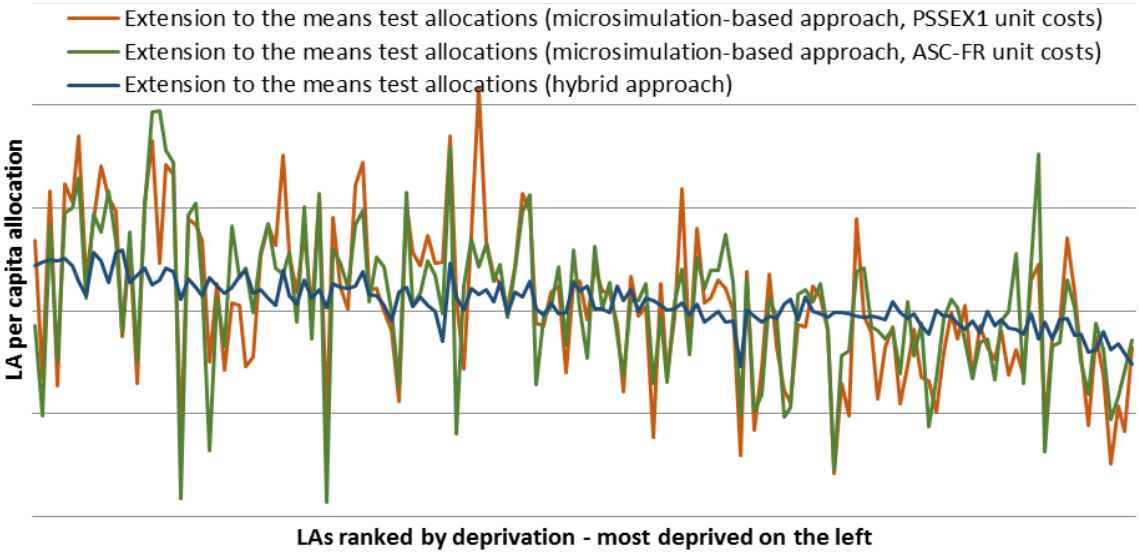
4.3.4.1 Comparison of allocations between the hybrid and a microsimulation-based approach

A further robustness check involved comparing the allocations for the extension to the means test as derived using the methods in this paper (i.e. the hybrid approach) with those using an entirely

[10] For a discussion on the instruments see section 4.1.1, pp. 29-30.

different method based on estimating average relationships between needs and utilisation across local authorities (i.e. the microsimulation-based approach). Full details of the latter method are outlined in (Fernandez, Snell 2018).

Figure 5. Per capita allocations for the extension to the means test by local authority



Note: Per capita allocations are based on a hypothetical budget.

Figure 5 gives a comparison of the relative need shares per capita 65+ for each LA as derived using two variants of the microsimulation-based approach (i.e. one using ASC-FR unit cost, the second using PSSEX1 unit costs) and the hybrid method used in this study. Overall, dependent on whether ASC-FR or PSSEX1 unit costs where used in the microsimulation-based approach, we found a correlation of 0.45 to 0.54 between per capita allocations according to the microsimulation-based and the hybrid approach. The correlation between total allocations is 0.92 to 0.93,[11] which gives us confidence that each method is properly reflecting differences in need, even though the methods differ in their assumptions. The allocations according to the microsimulation-based approach display significantly higher variation, this being (partly) due to the inclusion of LA unit costs in the modelling.

5 Concluding points

There are a number of alternative methodologies for estimating relative needs formulae, each with strengths and weaknesses. Their suitability often depends on the assumptions and principles which are chosen to be embodied in relative needs formulae. The utilisation-based method produces a relative needs formula where need is principally defined by local authority eligibility policy. This concept of 'need' differs from the actual utilisation of services, where the latter is also determined by demand and supply factors. The choice as to whether demand and supply factors should be in the final needs formula depends on assumptions as to whether or not they are within the control of local authorities.

We argue, principally, that in the absence of explicit, workable criteria – that account for the multiple dimensions of need and financial eligibility – a more 'normative' approach using epidemiological data with such best practice criteria is not currently viable for generating allocation formulae in social care. The utilisation approach indicates that need dimensions include: levels of

[11] See footnote 7.

people's impairment, issues of environment and safety, the availability of informal care, as well as the effects of the financial means test.

The utilisation-based approach determines need by analysing the numbers of people that meet local authority eligibility criteria. There are, however, arguments that the provision of social care is distorted relative to underling need, i.e. that people with a certain level of social care needs would get support in some areas, while in other areas not. We include in the analysis local authority-level effects to account for differences in policy between LAs. Moreover, as the equations are estimated over a range of (sampled) local authorities, the final formulae represent the average practice of local authorities with regard to meeting need. In other words, LAs with populations having on average the same level of observed need (i.e. functional impairment, availability of informal care support, and income/wealth) are allocated (per capita) the same level of resources, even if their current practice (and utilisation levels) differ. There may be a second order effect, whereby the contribution of different need factors in the formula might be slightly different if based on utilisation data reflecting a different eligibility policy. But, again, specifying normative policy in this area is not possible with sufficient precision.

A utilisation-based approach also has to rely on certain assumptions, including statistical modelling assumptions, when used to generate allocation formulae. In the study, we conducted a range of sensitivity analyses to help understand the significance of these assumptions. In the main we found that the results – and the formulae that were produced – were robust to different specifications and assumptions.

Overall, the statistical models performed well, in terms of statistical diagnostic testing, and also in producing results that were consistent with our expectations about the impact of need, supply, and the various means tests; in other words, the results showed good face validity.

We used a standard utilisation approach to produce the RNF for existing adult social care responsibilities. For the new responsibilities – the cap on care costs and the extension of the means test – we used a hybrid approach that combines a utilisation approach with simulation modelling of relevant aspects of the criteria for the new responsibilities that LAs will take on following the Care Act.

The treatment of supply is an important element of any approach to generating allocation formulae. For mainstream responsibilities, we argue that LAs can make choices about how best to meet need locally and have the power to provide services directly if independent sector supply is insufficient. This argument suggests that current supply indicators should not be used in the formula. The main approach – used in the case of the RNF for adult social care and the analysis on the extension to the financial means test – uses data on supply to remove short-term supply effects from the formula. We, however, found supply to have no substantive effect on the final per capita allocations.

In the analysis on the cap on lifetime care cost we were, however, confronted with an alternative scenario. If self-funders apply for assessment only after moving into a care home, a LA with a high supply level of care home services (either directly or through independent providers) is likely to attract self-funders from other LAs and ultimately will become responsible for them when they apply for assessment. In this case the supply effect occurs before assessment which means it is largely outside the LA's control. As the formula ought to provide sufficient funding to LAs to support the eligible people with care needs in their locality, this second argument suggests that supply indicators should be used in the cap allocation formula. We provided two alternative formulae for the cap on

lifetime care cost: one with a supply indicator included and one in which supply effects are removed. Accounting for supply did affect the allocations in this case to some extent.

With regards to the analysis on the allocation formula for the cap on lifetime care costs, the weakness in determining need through the extrapolation of the count of self-funders is that we essentially assume that all self-funders have eligible needs, and the (unknown) average individual need levels are similar between LAs. An alternative approach would be one in which – after the implementation of the cap – LAs collect data on self-funders properly assessed as having eligible needs. This may not only allow a more accurate assessment of the count of self-funders, but also of their level of need. The approach would also be feasible in terms of timing, as LAs will face additional costs with newly eligible people only a couple of years after the implementation of the reform, once the accumulated care costs of the first assessed self-funders reach the cap.

Estimation of allocation formulae relies on access to good quality data. As noted, it also requires that we make certain assumptions during the analysis. Some assumptions might be over-simplifications and so some error and bias is therefore possible. Nonetheless, the results of this study clearly support the principles of need adjustment (however that is made). Need levels (i.e. functional impairment, availability of informal care support, and income/wealth) differ between areas and do impact on the amount for care support each local authority will need to provide to meet its obligations. Without allowance for these differences, local authorities would have differing financial capacity to meet their care responsibilities as a result of different levels of need for care in their population.

Annexes

A1 Data sources and manipulation

A1.1 LA-funded social care service user data

A1.1.1 Care home service users

Source: Aggregated data at LSOA level on the Number of Local Authority (LA) Supported Permanent Admissions to Residential and Nursing Care during 1 April 2012 and 31 March 2013 were collected by LG Futures from 60 local authorities that agreed to participate in the study (for more details see (Ranasinghe, Tideswell 2014) and Table 15). The data were collected for two population groups: a) young adults aged 18 to 64 and b) older people aged 65 and over. Data were supplied on the number of service users living in each LSOA before admission to the care home.

This collection was of anonymous data. Only data on numbers of service users per LSOA were collected. Where there were any services users in an LSOA, numbers below 5 were masked, i.e. data were supplied with an '*' for values between 1 and 4.

From the 60 sampled LAs, three submitted incomplete data, while four were excluded as aggregated totals could not be validated when compared to national returns from the Community Care Statistics, Social Services Activity, England - 2012-13, Final release [NS], reported by the Health and Social Care Information Centre.[12] The final sample included 53 Local Authorities, covering 14,003 LSOAs. The sample characteristics were representative of all England's LSOAs; see (Forder, Vadean 2017), Table 6 and 7, p. 24.

Missing values: For each type of residence, we replaced missing values for Total Primary Clients with the sum of values for the respective primary client types and zero values of Total Primary Clients with the sum of values for the respective primary client types if at least one of the latter values was different from zero.

A synthetic value for the number of service users was used for LSOAs with masked values. Those "*" LSOAs were attached values based on the average number of service users across all the LSOAs in the local authority that had five service users or more. For Total Primary Clients in Residential Care (i.e. LA Staffed Residential Care + Independent Residential Care) and Total Primary Clients in Nursing Care, we replaced masked values with '*' LA-level mean values, computed as:

$$\bar{*}_{RCi} = \frac{NRResCare_i - \sum_j ResCare_{ij}}{N^*_{RCi}}, \forall\, ResCare_{ij} \geq 5$$

where $NRResCare_i$ stands for National Return of Total Primary Client Types in Residential Care in the LA *i*, $ResCare_{ij}$ stands for Total Primary Client Types in Residential Care in LA *i* and LSOA *j*, and N^*_{RCi} represents the total number of '*' values for residential care clients in the LA *i*.

The '*' mean value for nursing care for LA *i* ($\bar{*}_{NCi}$) is computed as:

$$\bar{*}_{NCi} = \frac{NRNurCare_i - \sum_j NurCare_{ij}}{N^*_{NCi}}, \forall\, NurCare_{ij} \geq 5$$

[12] http://www.hscic.gov.uk/catalogue/PUB13148/comm-care-stat-act-eng-2012-13-fin-data.zip

where $NRNurCare_i$ stands for National Return of Total Primary Client Types in Nursing Care in the LA *i*, $NurCare_{ij}$ stands for Total Primary Client Types in Nursing Care in LA *i* and LSOA *j*, and N^*_{NCi} represents the total number of '*' values for nursing care clients in the LA *i*.

In order to remove outliers from both $\bar{*}_{RCi}$ and $\bar{*}_{NCi}$, values smaller than the 5th percentile weighted by the number of stars at LA level (i.e. N^*_{RCi} and N^*_{NCi} respectively) were replaced with the 5th weighted percentile value. Similarly, values higher than the 95th weighted percentile were replaced with the 95th weighted percentile value.

A1.1.2 Community-based service users

Source: Data on the on the Number of Clients Registered to Receive Community Based Services Provided or Commissioned by the CASSR on 31 March 2013 by primary client type and components of service were provided at LSOA level by local authorities that agreed to participate in the study. The data were collected by LG Futures from 60 local authorities that agreed to participate in the study (for more details see (Ranasinghe, Tideswell 2014) and Table 16). The data were collected for two population groups: a) young adults aged 18 to 64, and b) older people aged 65 and over. One LA could not submit all the data required and was not used in the analysis, while data from nine further LAs were excluded from the analysis of the 18 to 64 group and ten from the analysis of the 65+ group due to apparent inconsistencies between counts of clients at LA level and RAP returns.

As above, LAs provided masked data to the project with a "*" in place of actual count for LSOAs that had counts between 1 and 4.

Missing data: Five components of service were used for the estimation of the Relative Needs Formulae: Home Care, Day Care, Direct Payments, Professional Support, Equipment and Adaptations. For each of these components, we first replaced missing values of total primary client types with the sum of values for the respective primary client types and zero values of total primary client types were replaced with the sum of values for the respective primary client types if at least one of the latter values was different from zero.

LSOAs with a masked value were given a synthetic count value based on the average number of service users across all the LSOAs in the local authority that had five service users or more, computed by component as:

$$\bar{*}_{Ki} = \frac{RAPK_i - \sum_j K_{ij}}{N^*_{Ki}} \text{ , } \forall\, K_{ij} \geq 5$$

where $RAPK_i$ stands for RAP Return for service component K in the LA *i*, K_{ij} stands for count of clients for service component K in LA *i* and LSOA *j*, and N^*_{Ki} represents the total number of '*' values for the service component K in the LA *i*.

For each service component, star mean values ($\bar{*}_{Ki}$) that were out of the (0,5) range were replaced with the average value of the in-range values. In order to remove outliers, values smaller than the 5th percentile weighted by the number of stars at LA level (N^*_{Ki}) were replaced with the 5th weighted percentile value. Similarly, values higher than the 95th weighted percentile were replaced with the 95th weighted percentile value.

After replacing the masked values, the counts of community-based care service users were used to estimate gross weekly cost-weighted community-based care utilisation at LSOA level. As local unit cost can be influenced by differences in the commissioning practices of councils, national average unit costs were applied. The unit cost figures were taken from the Personal Social Services

Expenditure and Unit Costs - England, 2013-14, Final release [NS] reported by the Health and Social Care Information Centre.[13] The cost-weighted utilisation for younger adults for each LSOA *j* ($GWCommCareExp1864_j$) was calculated as:

$$GWCommCareExp1864_j = 300 \times HomeCare_j + 288 \times DayCare_j + 250 \times DirPay_j$$

$$+117 \times ProfSupport_j + 30 \times Equipment_j$$

The cost-weighted utilisation for older people for each LSOA *j* ($GWCommCareExp65plus_j$) was:

$$GWCommCareExp65plus_j = 193 \times HomeCare_j + 138 \times DayCare_j + 188 \times DirPay_j$$

$$+117 \times ProfSupport_j + 22 \times Equipment_j$$

A1.2 Care Home Survey data

Source: A care home survey was conducted by LG Futures in December 2013 and January 2014 collecting data on the number of self-funders, the number of registered beds and occupancy. Non-local authority residential care providers in England were contacted by email on our behalf, working with CQC and DH. They were invited to participate in a short online survey (Ranasinghe, Tideswell 2014).

Very small homes (less than 5 beds) were screened out. The dataset included a range homes for younger adults, older people and both groups.

Following further theoretical analysis and consideration of the policy, we subsequently decided that the empirical analysis should just use data on homes for older people (younger adults are much less likely to be affected by the cap in theory). Due to this focus, observations for homes for younger adults and homes with missing values for the number of self-funders were excluded. The final sample for the analysis of includes about 1,200 care homes offering services to older people.

A1.3 Population Estimates at July 2012

Source: We used mid-2012 population estimates for Lower Layer Super Output Areas 2011 by single year of age and sex, as they are the closest population estimates available to the data collection on care home and community-based service users. The statistics are provided by the Office of National Statistics, Population Statistics Division.[14]

Using these statistics, we computed through aggregation of single years of age and/or gender various population groups at LSOA 2011 level: e.g. total population, population aged 18 to 64, population aged 60 and over, population aged 65 and over, female population aged 65 and over, population aged 70 and over, and working age population (i.e. aged 16 to 64).

A1.4 Benefits Claimants Data

Source: We used data on counts of benefits claimants at February 2013 (i.e. Attendance Allowance, Employment and Support Allowance, Income Support, Jobseekers Allowance and Pension Credit claimants) provided by the Department for Work and Pensions.[15] The statistics are at 2001 Lower Layer Super Output Area (LSOA).

Calculation: As the analysis is performed at 2011 LSOA level, we matched 2001 to 2011 LSOAs by using the 'Lower Layer Super Output Area 2001 to Lower Layer Super Output Area 2011 E+W

[13] http://www.hscic.gov.uk/catalogue/PUB16111
[14] http://www.ons.gov.uk/ons/publications/re-reference-tables.html?edition=tcm%3A77-320861
[15] http://tabulation-tool.dwp.gov.uk/NESS/BEN/iben.htm

Lookup' provided by the UK Data Service Census Support.[16] For LSOAs 2011 that resulted from a merge of two or more LSOAs 2001 (i.e. 145 LSOAs 2011), the count of benefits claimants was computed as the sum of benefits claimants from the respective LSOAs 2001. For LSOAs 2011 that resulted from a split of a LSOA 2001 (i.e. 881 LSOAs 2011), the count of benefits claimants was estimated as a share of benefits claimants from the respective LSOA 2001. The shares are based on the population living in a LSOA 2011 that resulted from a split divided by the sum of populations living in all LSOAs 2011 that resulted from that particular split. We used different population groups to compute the population shares for the various types of benefit claimants:

- for Attendance Allowance claimants we used the population aged 65 and over;
- for Employment and Support Allowance, Income Support, Jobseekers Allowance claimants - the working age population (i.e. aged 16 to 64);
- for Pension Credit claimants - the population 60 and over.

We could not estimate the count of benefit claimants for 146 LSOAs 2011 that resulted from a mix of merges and splits of LSOAs 2001. For these LSOAs, the values for the count of benefit claimants are set as missing.

A1.5 Number of Care Home Beds

Source: Data on the number of care home beds at February 2013 were extracted from the Care Directory statistics provided by the Care Quality Commission.[17] The statistics are at care home level.

Calculation: Before estimating the number of care home beds at LSOA 2011 level, we cleaned the data by dropping duplicated care homes (24 care homes),[18] corrected typos in the care home postal codes (1 care home), corrected the entry for Local Authority Area (10 care homes) and replaced missing values for Service User Band (i.e. type of client) using information from carehome.co.uk (7 care homes).

The number of care home beds for both 'Young Adults' and 'Old Age/Dementia' clients at LSOA 2011 level was estimated in two steps. In the first step, the number of care home beds of the care homes registered to serve either 'Young Adults' or 'Old Age/Dementia' clients was aggregated at postal code level. Then, using the November 2013 Office for National Statistics Postcode Directory Open Edition,[19] postcodes were matched to LSOAs 2011. In the second step, the care home bed numbers for each age group were aggregated at LSOA 2011 level.

The number of care home beds was used in the analysis as a measure of supply of care services.

A1.6 Census 2011 data

We used Census 2011 data at LSOA level for specific indicators of needs and wealth:

- The share of people aged 16 to 64 with substantial activities of daily life limitations (i.e. day-to-day activities limited a lot) in the Census 2011 population aged 16 to 64 – Table ID LC3302EW;[20]

[16] http://ukbsrv-at.edina.ac.uk/html/lut_download/lut_download.html?data=lsoa01_lsoa11_ew_lu
[17] http://www.cqc.org.uk/cqcdata
[18] Double entries in the Care Home register are sometimes due to a change in management.
[19] http://ukbsrv-at.edina.ac.uk/html/pcluts_download/pcluts_download.html?data=pcluts_2013nov
[20] https://www.nomisweb.co.uk/census/2011/lc3302ew

- The share of people aged 85 and over with substantial activities of daily life limitations (i.e. day-to-day activities limited a lot) in the Census 2011 population aged 65 and over – Table ID LC3302EW;
- The share of households with members living as a couple (i.e. married or cohabiting) aged 65 and over in the Census 2011 households 65 and over – Table ID LC1102EW; [21]
- The share of people living in one-family households – Table ID QS112EW; [22]
- The share of homeowner households (i.e. home owned outright) aged 65 and over in the Census 2011 households 65 and over – Table ID LC4201EW.[23]

The share of people with substantial activities of daily life limitations were used as an indicator of social care needs. For older people, we used the share of couples aged 65 and over in the total number of households 65 and over as an additional need indicator, as people living as a couple may help each other in times of need and access less LA care support.

The share of people living in one-family households is used as a wealth proxy in the young adults' models, while the share of homeowner households aged 65 and over in the total number households 65 and over is used as a measure of housing wealth in the models for older people.

A1.7 VOA Council Tax data

Source: Data on the dwelling stock by council tax bands were extracted from the Valuation Office Agency (VOA). The data give the overall number of domestic properties allocated to each of the eight standard Council Tax bands at Lower Layer Super Output Area (LSOA).

Calculation: The dwelling stock by council tax bands for 2013 are used to calculate the share of dwellings in each council tax band in the total number of dwellings in a LSOA.

A1.8 Land Registry Price Paid data

Source: Data on the house prices were extracted from the Land Registry Price Paid Data provided by data.gov.uk.[24] The data track the residential property sales in England and Wales that are lodged with the Land Registry for registration.

Calculation: Land Registry Price Paid data for 2013 are used to calculate mean values at LSOA level. In order to reduce the influence of extremes, we compute a geometric mean instead of an arithmetic mean. As in log form the low and high values are not as extreme relative to the rest of the data, the data are first transformed into log values, then averaged at LSOA level and, finally, converted back to a linear value.

A1.9 English Longitudinal Study of Ageing (ELSA)

The English Longitudinal Study of Ageing (ELSA) began in 2002, drawing on the sample of individuals aged 50 and over from the Health Survey of England (1998, 1999, 2001). ELSA collects a large amount of data on the individual and family circumstances and quality of life among older people. It explores the dynamic relationships between health and functioning, social networks and participation, and economic position of people during the pre-retirement period and after retirement.

This dataset provides a range of sound financial variables which are not routinely available at the regional level, but which determine eligibility. Data from waves 1 to 5 were used to model financial

[21] https://www.nomisweb.co.uk/census/2011/lc1102ew
[22] https://www.nomisweb.co.uk/census/2011/qs112ew
[23] https://www.nomisweb.co.uk/census/2011/lc4201ew
[24] http://data.gov.uk/dataset/land-registry-monthly-price-paid-data

eligibility and expenditure requirements, as outlined in the main text. Summary statistics of the variables used in the analysis are presented in Table 17.

Data from the English Longitudinal Study of Ageing (ELSA) were made available through the UK Data Archive (UKDA). ELSA was developed by a team of researchers based at the National Centre for Social Research, University College London and the Institute for Fiscal Studies. The data were collected by the National Centre for Social Research. The funding is provided by the National Institute of Aging in the United States, and a consortium of UK government departments co-ordinated by the Office for National Statistics. The developers and funders of ELSA and the Archive do not bear any responsibility for the analyses or interpretations presented in this report.

Table 15. Sampled local authorities – residential and nursing care

LA code	LA name	LA code	LA name
E06000055	Bedford	E08000034	Kirklees
E09000004	Bexley[b]	E10000017	Lancashire
E08000025	Birmingham[a]	E06000016	Leicester
E06000009	Blackpool	E10000019	Lincolnshire
E06000036	Bracknell Forest	E08000003	Manchester
E09000006	Bromley	E09000024	Merton
E10000002	Buckinghamshire	E06000042	Milton Keynes
E10000003	Cambridgeshire	E06000024	North Somerset
E09000007	Camden	E06000048	Northumberland
E06000049	Cheshire East	E10000024	Nottinghamshire
E06000052	Cornwall	E10000025	Oxfordshire
E06000047	County Durham	E06000031	Peterborough[a]
E08000026	Coventry	E06000038	Reading
E09000008	Croydon[b]	E08000005	Rochdale
E10000007	Derbyshire	E08000028	Sandwell
E09000009	Ealing	E08000014	Sefton
E10000011	East Sussex	E08000029	Solihull
E09000010	Enfield[b]	E08000013	St Helens
E10000012	Essex	E08000007	Stockport
E10000013	Gloucestershire	E10000029	Suffolk
E09000012	Hackney	E10000030	Surrey
E09000013	Hammersmith and Fulham	E09000029	Sutton[a]
E10000014	Hampshire	E06000030	Swindon
E09000014	Haringey	E06000027	Torbay
E06000001	Hartlepool	E09000030	Tower Hamlets
E09000017	Hillingdon	E09000031	Waltham Forest
E09000018	Hounslow[b]	E09000033	Westminster
E06000046	Isle of Wight	E06000054	Wiltshire
E09000020	Kensington and Chelsea	E08000031	Wolverhampton
E10000016	Kent	E06000014	York

Notes: [a] Excluded due to incomplete data submitted. [b] Excluded due to inconsistencies between aggregated totals and national returns.

Table 16. Sampled local authorities – community-based care

LA code	LA name	LA code	LA name
E06000055	Bedford	E08000034	Kirklees
E09000004	Bexley[b,c]	E10000017	Lancashire
E08000025	Birmingham	E06000016	Leicester
E06000009	Blackpool	E10000019	Lincolnshire
E06000036	Bracknell Forest	E08000003	Manchester
E09000006	Bromley	E09000024	Merton[b,c]
E10000002	Buckinghamshire	E06000042	Milton Keynes
E10000003	Cambridgeshire[c]	E06000024	North Somerset
E09000007	Camden	E06000048	Northumberland
E06000049	Cheshire East	E10000024	Nottinghamshire[b,c]
E06000052	Cornwall[b]	E10000025	Oxfordshire
E06000047	County Durham	E06000031	Peterborough
E08000026	Coventry[b,c]	E06000038	Reading
E09000008	Croydon[b,c]	E08000005	Rochdale
E10000007	Derbyshire	E08000028	Sandwell
E09000009	Ealing	E08000014	Sefton
E10000011	East Sussex	E08000029	Solihull
E09000010	Enfield[b]	E08000013	St Helens[c]
E10000012	Essex	E08000007	Stockport
E10000013	Gloucestershire[c]	E10000029	Suffolk
E09000012	Hackney	E10000030	Surrey
E09000013	Hammersmith and Fulham[a]	E09000029	Sutton
E10000014	Hampshire	E06000030	Swindon
E09000014	Haringey	E06000027	Torbay
E06000001	Hartlepool	E09000030	Tower Hamlets
E09000017	Hillingdon	E09000031	Waltham Forest[b,c]
E09000018	Hounslow[b,c]	E09000033	Westminster
E06000046	Isle of Wight	E06000054	Wiltshire
E09000020	Kensington and Chelsea	E08000031	Wolverhampton
E10000016	Kent	E06000014	York

Notes: [a] Excluded due to incomplete data submitted. [b] Excluded form analysis of community-based care for young adults due to inconsistencies between aggregated totals and national returns for clients aged 18 to 64. [c] Excluded form analysis of community-based care for older people due to inconsistencies between aggregated totals and national returns for clients aged 65 and over.

Table 17. Summary statistics (mean values) ELSA data

	Wave 1	Wave 2	Wave 3	Wave 4	Wave 5
Female	0.555	0.556	0.560	0.545	0.545
Age group: 65 to 74	0.575	0.557	0.527	0.589	0.570
Age group: 75 to 84	0.343	0.354	0.349	0.311	0.327
Age group: 85 and over	0.082	0.089	0.124	0.100	0.104
Owns home (outright)	0.680	0.718	0.710	0.738	0.751
Home value (£; 2011 prices)	144,290	195,745	214,328	212,146	221,912
Attendance Allowance claimant	0.084	0.088	0.089	0.084	0.081
Pension Credit claimant	0.140	0.147	0.130	0.118	0.110
Lives alone	0.359	0.360	0.360	0.335	0.324
No. of activities of daily life limited (==0)	0.730	0.725	0.731	0.738	0.751
No. of activities of daily life limited (==1)	0.136	0.146	0.136	0.134	0.123
No. of activities of daily life limited (==2)	0.064	0.062	0.057	0.061	0.059
No. of activities of daily life limited (==3)	0.033	0.030	0.036	0.030	0.028
No. of activities of daily life limited (>=4)	0.036	0.036	0.040	0.037	0.039
Region: North East	0.068	0.066	0.068	0.066	0.066
Region: North West	0.131	0.131	0.119	0.121	0.114
Region: Yorkshire and the Humber	0.107	0.108	0.113	0.107	0.104
Region: East Midlands	0.091	0.096	0.095	0.099	0.101
Region: West Midlands	0.112	0.109	0.109	0.112	0.114
Region: East of England	0.115	0.118	0.124	0.123	0.128
Region: London	0.093	0.088	0.089	0.084	0.084
Region: South East	0.159	0.161	0.162	0.168	0.165
Region: South West	0.123	0.123	0.122	0.121	0.123
Observations	5,541	4,741	4,562	5,167	5,350

A2 Supply effects – adult social care

Table 18. Care home and community-based services models for young adults aged 18 to 64 – non-endogenous and endogenous estimations

	LA supported permanent admissions to residential and nursing care per LSOA (binary)		Cost-weighted weekly community-based care expenditures per LSOA	
	logit	IV logit	GLM	IV GLM
Limiting (significantly) condition 16-64 per capita 16-64	7.066***	7.041***	8.168***	8.155***
	(1.723)	(1.857)	(1.044)	(0.476)
Living arrangements: share of people in one-family households	-1.928***	-1.679***	-0.894***	-0.813***
	(0.458)	(0.465)	(0.133)	(0.0977)
Population 16-24 per capita 16-64	-2.118***	-1.902***	-1.078***	-1.005***
	(0.576)	(0.612)	(0.144)	(0.125)
Ethnic White 16-64 per capita 16-64	-0.0962	-0.108	-0.164***	-0.168***
	(0.236)	(0.296)	(0.0598)	(0.0458)
Income Benefits Claimants 16+ (i.e. IS, ESA, and JSA) per capita 16-59	1.964**	1.751**	0.798***	0.746***
	(0.802)	(0.730)	(0.259)	(0.169)
Supply: Total MSOA care home beds for young adults (18-64) per MSOA pop 18-64	44.63***	101.6***	13.94***	30.13***
	(9.260)	(18.69)	(2.391)	(4.681)
Sparsity: Population (all) density	-0.0030***	-0.0027**	0.0004	0.0005**
	(0.0010)	(0.0012)	(0.0002)	(0.0002)
Population 18-64 (log)	0.887***	0.879***	0.619***	0.621***
	(0.142)	(0.149)	(0.0528)	(0.0375)
LA fixed effects	Yes	Yes	Yes	Yes
Constant	-6.691***	-7.028***	3.859***	3.728***
	(1.140)	(1.169)	(0.375)	(0.296)
Observations	13,074	13,074	13,430	13,430
Weak instruments – F-test (p-value)		110.42 (0.000)		160.38 (0.000)
Over-identification – F-test (p-value)		0.02 (0.997)		1.28 (0.277)
Endogeneity test: equal supply coefficients between non-IV and IV – Chi-squared (p-value)		10.21 (0.001)		12.06 (0.001)

logit: robust standard errors in parentheses; IV: bootstrapped (500 replications) standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 19. Care home and community-based services models for older people aged 65 and over – non- endogenous and endogenous estimations

	LA supported permanent admissions to residential and nursing care per LSOA (count)		Cost-weighted weekly community-based care expenditures per LSOA	
	nbreg	IV nbreg	GLM	IV GLM
Attendance Allowance claimants 65+ per capita 65+	2.213***	2.162***	1.673***	2.271***
	(0.404)	(0.284)	(0.175)	(0.188)
Limiting (significantly) condition 85+ per capita 65+	1.305***	1.305***	3.628***	3.334***
	(0.453)	(0.407)	(0.430)	(0.325)
Living arrangements: couple households per households 65+	-0.367**	-0.390***	-0.400***	-0.464***
	(0.163)	(0.136)	(0.0991)	(0.0771)
Ethnic White population 65+ per capita 65+	0.736***	0.730***	-0.272***	-0.224***
	(0.151)	(0.125)	(0.0564)	(0.0488)
Pension Credit Claimants 80+ per capita 65+	1.736***	1.728***	1.436***	1.394***
	(0.465)	(0.331)	(0.251)	(0.188)
Home-owner households 65+ per households 65+ × properties in council tax band ABCDE per all properties	-0.460***	-0.458***	-0.481***	-0.436***
	(0.159)	(0.0723)	(0.0485)	(0.0433)
Home-owner households 65+ per households 65+ × properties in council tax band FGH per all properties	-1.209***	-1.210***	-1.124***	-0.977***
	(0.171)	(0.130)	(0.120)	(0.0732)
Supply: Total MSOA care home beds for old age/dementia per MSOA pop 65+	0.926***	1.136**	-1.004***	-2.888***
	(0.234)	(0.513)	(0.124)	(0.367)
Population 65+ (log)	0.834***	0.836***	0.851***	0.847***
	(0.0297)	(0.0239)	(0.0355)	(0.0159)
LA fixed effects	Yes	Yes	Yes	Yes
Constant	-5.297***	-5.297***	2.938***	2.945***
	(0.316)	(0.177)	(0.176)	(0.109)
Observations	13,415	13,415	13,071	13,071
Weak instruments – F-test (p-value)		203.33 (0.000)		211.75 (0.000)
Over-identification – F-test (p-value)		1.01 (0.386)		1.37 (0.251)
Endogeneity test: equal supply coefficients between non-IV and IV – Chi-squared (p-value)		0.17 (0.681)		36.32 (0.000)

nbreg: robust standard errors in parentheses; IV: bootstrapped (500 replications) standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

A3 Sensitivity analysis – adult social care

The specifications tested were:

(a) the preferred model (above);
(b) a model with a covariate for the share of homeowner households in the estimations for services for older people, but no interactions with council tax bands (i.e. 'properties in council tax band ABCDE per all properties' and 'properties in council tax band FGH per all properties');
(c) a model without controlling for the share of people with limiting (significant) conditions;
(d) a model without the covariate for the share of ethnic White population;
(e) a model without covariates for both the share of ethnic White population and supply;
(f) a joint model for care home and community-based services;
(g) a joint model for care home and community-based services, but without covariates for the share of people with limiting (significant) conditions, the share of ethnic White population and supply.

Table 20 gives the correlation coefficients between simulated per capita allocations. The correlation coefficients show that the per capita allocations are rather similar, with most coefficients above 0.97 and all above 0.92.[25] The fact that per capita allocations according to the models above are fairly similar is also illustrated in Figure 2, with variations from the preferred model being relatively small.

Table 20. Correlation coefficients between per capita allocations of various model specifications

	(a)	(b)	(c)	(d)	(e)	(f)	(g)
(a) preferred model	1.0000						
(b) no council tax interactions	0.9942	1.0000					
(c) no limiting (significantly) condition	0.9765	0.9833	1.0000				
(d) no ethnicity	0.9999	0.9945	0.9776	1.0000			
(e) no ethnicity and supply	0.9973	0.9944	0.9845	0.9980	1.0000		
(f) combined residential and community-based care estimation	0.9889	0.9736	0.9416	0.9876	0.9764	1.0000	
(g) combined estimation; no limiting condition, ethnicity and supply	0.9652	0.9804	0.9960	0.9666	0.9744	0.9262	1.0000

[25] A correlation coefficient of 1.00 would indicate identical allocations between models.

A4 Sensitivity analysis – cap on lifetime care costs

Table 21. Models for the count of self-funder at MSOA level with and without endogeneity correction for supply

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	2SLS	**IV zinb**	**zinb**	**IV Tobit**	**Tobit**	**IV cnreg**	**cnreg**	**IV Heckman**
No. of registered care home beds for old age/dementia per capita 65+	391.1***	11.25***	11.50***	463.20***	434.3***	279.6***	226.3***	502.7***
	(24.79)	(0.726)	(0.294)	(27.48)	(11.57)	(34.74)	(20.63)	(25.16)
Attendance Allowance claimants 65+ per capita 65+	133.9***	6.757***	5.871***	209.70***	243.2***	151.3***	221.7***	224.1***
	(30.28)	(0.980)	(0.418)	(34.04)	(17.21)	(43.60)	(17.48)	(41.56)
Pension Credit Claimants 80+ per capita 65+	-260.4***	-11.17***	-10.97***	-294.2***	-298.6***	-328.5***	-318.3***	-325.8***
	(18.37)	(0.697)	(0.633)	(16.97)	(22.54)	(23.02)	(24.32)	(17.75)
Limiting (significantly) condition 85+ per capita 65+	45.13*	1.367	3.626***	68.99**	47.84*	36.93	-0.826	108.8***
	(25.61)	(0.902)	(0.696)	(28.13)	(24.51)	(37.81)	(19.88)	(33.78)
Living arrangements: couple households per households 65+	-36.13***	-0.851***	-0.868***	-34.84***	-36.72***	-44.37***	-47.57***	-39.66***
	(5.820)	(0.194)	(0.194)	(6.134)	(7.004)	(7.448)	(8.193)	(6.446)
Home-owner households 65+ per households 65+ × properties in council tax band ABCDE per all properties	-2.489	0.213*	0.340***	6.063*	7.987**	-4.576	1.952	11.64***
	(3.224)	(0.129)	(0.105)	(3.598)	(3.764)	(4.493)	(3.201)	(3.996)
Home-owner households 65+ per households 65+ × properties in council tax band FGH per all properties	20.17***	0.620***	0.783***	34.96***	40.63***	14.74*	32.58***	45.82***
	(6.321)	(0.212)	(0.179)	(7.078)	(5.672)	(8.907)	(5.360)	(8.223)
Population 65+	0.0198***	0.0005***	0.0006***	0.0251***	0.0251***	0.0162***	0.0178***	0.0296***
	(0.0007)	(0.0001)	(0.0002)	(0.0005)	(0.0008)	(0.0009)	(0.0011)	(0.0008)
Population density	0.0175	-0.0022***	-0.0029***	-0.0235*	-0.0278*	0.0419**	0.0259*	-0.0430***
	(0.0117)	(0.0005)	(0.0004)	(0.0135)	(0.0155)	(0.0168)	(0.0142)	(0.0155)
IMR (from probit selection eq)								17.79***
								(1.973)
LA fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-9.485**	2.033***	1.659***	-41.76***	-44.10***	18.19***	3.157	-57.24***
	(4.543)	(0.246)	(0.137)	(6.538)	(5.470)	(6.678)	(4.511)	(8.475)

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	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	
	1st Stage Reg	**Inflate**	**Inflate**	**1st Stage Reg**		**1st Stage Reg**		**1st Stage Reg**	**Selection Eq**
Attendance Allowance claimants 65+ per capita 65+	1.130***	-44.57***	-46.77***	1.130***		1.130***		1.638***	25.79***
	(0.0352)	(2.088)	(2.639)	(0.0261)		(0.0352)		(0.0532)	(1.142)
Pension Credit Claimants 80+ per capita 65+	-0.169***	2.056	-1.380	-0.169***		-0.169***		-0.149***	-1.719
	(0.0450)	(2.969)	(3.423)	(0.0360)		(0.0450)		(0.0430)	(1.409)
Limiting (significantly) condition 85+ per capita 65+	-0.721***	24.74***	28.81***	-0.722***		-0.721***		-1.119***	-13.62***
	(0.0531)	(3.131)	(3.501)	(0.0426)		(0.0531)		(0.0560)	(1.640)
Living arrangements: couple households per households 65+	-0.0785***	2.664***	2.282**	-0.0785***		-0.0785***		-0.0802***	-1.526***
	(0.0154)	(0.864)	(0.948)	(0.0128)		(0.0154)		(0.0155)	(0.497)
Home-owner households 65+ per households 65+ × properties in council tax band ABCDE per all properties	0.0683***	-3.446***	-3.654***	0.0684***		0.0683***		0.0931***	1.997***
	(0.0081)	(0.505)	(0.521)	(0.0067)		(0.0081)		(0.0089)	(0.256)
Home-owner households 65+ per households 65+ × properties in council tax band FGH per all properties	0.195***	-9.111***	-9.865***	0.195***		0.195***		0.273***	5.256***
	(0.0118)	(0.769)	(0.977)	(0.0101)		(0.0118)		(0.0151)	(0.407)
Population 65+	-2.03e-06	-0.00138***	-0.00134***	-2.03e-06		-2.03e-06		1.86e-06	0.0008***
	(1.34e-06)	(0.0001)	(0.0001)	(1.35e-06)		(1.34e-06)		(1.92e-06)	(6.01e-05)
Population density	-0.0001***	0.0067***	0.0060***	-0.0001***		-0.0001***		-0.0002***	-0.0040***
	(3.20e-05)	(0.0020)	(0.0022)	(2.65e-05)		(3.20e-05)		(3.65e-05)	(0.0010)
Number of registered beds for old age/dementia in the LAD net of registered beds in the MSOA per capita 65+	-1.214***	37.27***	35.85***	-1.213***		-1.214***		-1.498***	-22.29***
	(0.0824)	(6.042)	(10.80)	(0.0792)		(0.0824)		(0.0935)	(3.189)
LAD unemployment rate	-0.0366	-3.578	-1.990	-0.0449		-0.0366		-0.0608	2.607
	(0.0829)	(7.382)	(9.859)	(0.0902)		(0.0829)		(0.0969)	(4.313)
LAD share of rural area		-0.519**	-0.529**						0.329***
		(0.208)	(0.244)						(0.111)
IMR (from probit selection eq)								0.0557***	
								(0.0049)	
LA fixed effects	Yes	Yes		Yes		Yes		Yes	Yes
Constant	-0.0015	6.013	6.763***	-0.0009		-0.0015		-0.0837***	-3.464***
	(0.0190)	(4.293)	(1.132)	(0.0153)		(0.0190)		(0.0203)	(0.650)

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	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	
(ln)alpha		-1.382***	-2.419***	-29.93					
		(0.0277)	(0.0542)	(27.95)					
lns				2.739***					
				(0.0102)					
lnv				-3.245***					
				(0.00858)					
sigma					15.47***	19.05***	15.78***		
					(0.393)	(0.529)	(0.739)		
Observations	6,787	6,787	6,787	6,787	6,787	6,787	6,787	4,789	6,782
R-squared	0.723							0.710	
R-squared 1st stage equation	0.376	0.376		0.376		0.376		0.420	
Log-Likelihood		-21,654	-19,746	-8,382	-20,774	-20,799	-20,178		
Pseudo R-squared						0.0657	0.0936		0.252
Anderson canon. corr. LM stat (underid)	262.6	262.6		262.6		231262.6.5		255.6	
p-value	0	0		0		0		0	
Cragg-Donald Wald F stat (weakiv)	115.9	115.9		115.9		115.9		130.5	
Stock-Yogo weak ID test 10% critical values	19.93	19.93		19.93		19.93		19.93	
Sagran test (overid)	1.729	1.729		1.729		1.729		2.599	
p-value	0.189	0.189		0.189		0.189		0.107	
Uncensored obs./Non-zero obs.		4,794		4,794	4,794	4,612	4,612		
Left censored obs. (=0)/ Zero obs.		1,993	1,993	1,993	1,993				
Right censored obs (=SF+(RegBeds-Occup))						2,175	2,175		
Vuong test		49.05							
p-value		0.0000							
Endogeneity test (chi-squared)	5.71	0.05		1.65		1.79		52.99	
p-value	0.017	0.818		0.199		0.181		0.000	

Robust/bootsraped standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 22. Predicted number of self-funders and goodness-of-fit statistics for various models with and without endogeneity correction for supply

	2SLS	IV zinb	zinb	IV Tobit	Tobit	IV cnreg	cnreg	IV heckman
Predicted number of self-funders	142,676	141,108	141,108	148,342	148,341	114,620	134,752	165,805
Correlation between dep variable and predicted values	0.8517	0.7972	0.7972	0.8965	**0.8965**	0.9045	0.9199	0.8895
Residual Sum Squared (RSS)	1,391,681	3,597,673	3,597,673	997,804	**998,486**	1,178,869	774,482	1,129,985
Akaike Information Criterion (AIC)	16,339	19,138	19,138	15,358	**15,360**	15,849	14,611	15,725

A5 Supply effects – extension to the financial means test

Table 23. Negative binomial count models for care home residents per LSOA – non-endogenous and endogenous estimations

	(1)	(2)	(3)	(4)
	nbreg	IV nbreg	nbreg	IV nbreg
Attendance Allowance claimants 65+ per capita 65+	2.214***	2.143***	1.283***	2.097***
	(0.398)	(0.279)	(0.233)	(0.275)
Limiting (significantly) condition 85+ per capita 65+	1.269***	1.280***	1.871***	1.346***
	(0.438)	(0.389)	(0.348)	(0.389)
Home-owner HHs 65+ per HHs 65+ × properties in council tax band ABCDE per all properties	-0.457***	-0.455***	-0.517***	-0.458***
	(0.155)	(0.0745)	(0.137)	(0.0743)
Home-owner HHs 65+ per HHs 65+ × properties in council tax band FGH per all properties	-1.212***	-1.215***	-1.349***	-1.199***
	(0.165)	(0.133)	(0.128)	(0.129)
Pension Credit Claimants 80+ per capita 65+	1.781***	1.776***	1.633***	1.701***
	(0.454)	(0.344)	(0.419)	(0.344)
Living arrangements: couple households per households 65+	-0.349**	-0.370**	-0.471***	-0.429***
	(0.163)	(0.144)	(0.148)	(0.140)
Ethnic White population 65+ per capita 65+	0.748***	0.740***	0.671***	0.741***
	(0.146)	(0.124)	(0.130)	(0.123)
Population 65+ (log)	0.838***	0.839***	0.840***	0.834***
	(0.0298)	(0.0222)	(0.0297)	(0.0223)
Total MSOA care home beds for old age/dementia per MSOA pop 65+	0.938***	1.218**		
	(0.234)	(0.549)		
Total LSOA care home beds for old age/dementia per LSOA pop 65+			0.886***	0.343**
			(0.268)	(0.137)
LA fixed effects	Yes	Yes	Yes	Yes
Constant	-5.343***	-5.338***	-5.066***	-5.232***
	(0.311)	(0.190)	(0.263)	(0.195)
Observations	13,807	13,807	13,807	13,807
Weak instruments – F-test (p-value)		221.16 (0.000)		198.64 (0.000)
Over-identification – F-test (p-value)		0.89 (0.445)		0.66 (0.574)
Endogeneity test: equal supply coefficients between non-IV and IV – Chi-squared (p-value)		18.73 (1.000)		77.81 (0.072)

nbreg: robust standard errors in parentheses; IV: bootstrapped (500 replications) standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

A6 Empirical analysis and robustness – extension to the financial means test

Table 24. Estimation results ELSA sample (**national** unit cost; age >= 75, ADLcount >= 1)

	(1)	(2)	(3)	(4)	(5)	(6)
	Exp Req new	Exp Req old	FinElig old	Exp Req new	Exp Req old	FinElig old
Gender: female	28.26***	25.09***	0.00202	23.23***	19.84***	-0.0131
	(6.093)	(6.578)	(0.0160)	(5.924)	(6.424)	(0.0155)
Aged 85 and over	-12.23**	-13.76**	-0.0305**	-14.45***	-16.17***	-0.0375***
	(5.430)	(5.810)	(0.0138)	(5.187)	(5.641)	(0.0134)
Home owner	-219.8***	-233.9***	-0.675***			
	(5.836)	(6.377)	(0.0157)			
Log house value				-18.75***	-19.68***	-0.0567***
				(0.461)	(0.508)	(0.00125)
In receipt of pension credit	63.41***	65.30***	0.142***	57.96***	60.27***	0.128***
	(6.102)	(6.492)	(0.0148)	(5.867)	(6.254)	(0.0142)
Lives alone	-139.5***	-152.9***	-0.371***	-135.1***	-147.7***	-0.356***
	(6.531)	(6.888)	(0.0169)	(6.279)	(6.664)	(0.0162)
Wave dummies	Yes	Yes	Yes	Yes	Yes	Yes
Constant	429.1***	413.7***	1.147***	429.8***	412.2***	1.142***
	(7.568)	(8.326)	(0.0206)	(7.286)	(8.074)	(0.0198)
Observations	3,741	3,741	3,741	3,741	3,741	3,741
R-squared	0.478	0.481	0.537	0.502	0.496	0.554

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 25. Estimation results ELSA sample (**regional** unit cost; age >= 75, ADLcount >= 1)

	(1)	(2)	(3)	(4)	(5)	(6)
	Exp Req new	Exp Req old	FinElig old	Exp Req new	Exp Req old	FinElig old
Gender: female	27.93***	25.19***	0.00202	22.75***	19.83***	-0.0131
	(6.573)	(6.996)	(0.0160)	(6.458)	(6.861)	(0.0155)
Aged 85 and over	-9.751*	-12.82**	-0.0305**	-12.07**	-15.28**	-0.0375***
	(5.821)	(6.194)	(0.0138)	(5.612)	(6.042)	(0.0134)
Home owner	-228.3***	-239.5***	-0.675***			
	(6.362)	(6.866)	(0.0157)			
Log house value				-19.37***	-20.13***	-0.0567***
				(0.505)	(0.547)	(0.00125)
In receipt of pension credit	58.62***	61.33***	0.142***	53.26***	56.25***	0.128***
	(6.391)	(6.690)	(0.0148)	(6.184)	(6.441)	(0.0142)
Lives alone	-141.4***	-152.1***	-0.371***	-136.6***	-146.7***	-0.356***
	(7.001)	(7.297)	(0.0169)	(6.770)	(7.071)	(0.0162)
Wave dummies	Yes	Yes	Yes	Yes	Yes	Yes
Constant	440.4***	422.0***	1.147***	440.2***	420.2***	1.142***
	(8.106)	(8.806)	(0.0206)	(7.846)	(8.560)	(0.0198)
Observations	3,737	3,737	3,741	3,737	3,737	3,741
R-squared	0.466	0.463	0.537	0.486	0.477	0.554

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 26. Estimation results of the additional expenditure requirement at LSOA level (**national** unit cost)

	(1) ELSA home ownership		(2) ELSA house value		(3) ELSA house value	
	GLM	Marg Eff	GLM	Marg Eff	GLM	Marg Eff
Attendance Allowance claimants 65+ per capita 65+	2.205***	94.99***	2.163***	93.68***	2.181***	94.38***
	(0.360)	(15.51)	(0.371)	(16.07)	(0.368)	(16.00)
Limiting (significantly) condition 85+ per capita 65+	1.322***	56.98***	1.449***	62.74***	1.434***	62.06***
	(0.419)	(18.31)	(0.428)	(18.76)	(0.433)	(18.96)
Home-owner households 65+ per households 65+ × properties in council tax band ABCDE per all properties	0.535***	23.05***	0.414***	17.93***		
	(0.141)	(6.283)	(0.140)	(6.227)		
Home-owner households 65+ per households 65+ × properties in council tax band FGH per all properties	-0.213	-9.199	-0.161	-6.965		
	(0.148)	(6.279)	(0.150)	(6.428)		
Home-owner households 65+ per households 65+					2.969***	128.5***
					(0.534)	(22.64)
Home-owner households 65+ per households 65+ × log of average LSOA house price in 2013					-0.215***	-9.311***
					(0.0449)	(1.884)
Pension Credit Claimants 80+ per capita 65+	1.473***	63.48***	1.360***	58.89***	1.394***	60.30***
	(0.443)	(19.48)	(0.443)	(19.58)	(0.439)	(19.42)
Living arrangements: couple households per households 65+	-1.121***	-48.28***	-1.095***	-47.44***	-1.081***	-46.77***
	(0.146)	(7.046)	(0.145)	(7.001)	(0.135)	(6.580)
Ethnic White population 65+ per capita 65+	0.773***	33.30***	0.730***	31.60***	0.782***	33.82***
	(0.136)	(6.189)	(0.133)	(6.093)	(0.146)	(6.662)
Population 65+ (log)	0.836***	36.00***	0.842***	36.48***	0.848***	36.68***
	(0.0268)	(1.382)	(0.0262)	(1.404)	(0.0267)	(1.387)
Total MSOA care home beds for old age/dem per MSOA pop 65+	0.424***	18.27***	0.403***	17.44***	0.397***	17.16***
	(0.102)	(4.195)	(0.106)	(4.420)	(0.0984)	(4.063)
Constant	-1.933***		-1.861***		-1.952***	
	(0.269)		(0.274)		(0.276)	
Observations	13,805	13,805	13,798	13,798	13,798	13,798
Log Likelihood	-30,581		-31,194		-29,095	

Bootstrapped (100 replications) standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 27. Estimation results of the additional expenditure requirement at LSOA level (**regional** unit cost)

	(4) ELSA home ownership		(5) ELSA house value		(6) ELSA house value	
	GLM	Marg Eff	GLM	Marg Eff	GLM	Marg Eff
Attendance Allowance claimants 65+ per capita 65+	2.223***	91.86***	2.186***	90.75***	2.202***	91.35***
	(0.360)	(14.88)	(0.360)	(14.91)	(0.380)	(15.85)
Limiting (significantly) condition 85+ per capita 65+	1.401***	57.90***	1.513***	62.81***	1.501***	62.28***
	(0.419)	(17.59)	(0.418)	(17.66)	(0.445)	(18.62)
Home-owner households 65+ per households 65+ × properties in council tax band ABCDE per all properties	0.450***	18.58***	0.359**	14.92**		
	(0.141)	(6.010)	(0.140)	(5.943)		
Home-owner households 65+ per households 65+ × properties in council tax band FGH per all properties	-0.291*	-12.01**	-0.220	-9.152		
	(0.148)	(6.027)	(0.148)	(6.053)		
Home-owner households 65+ per households 65+					2.940***	121.9***
					(0.531)	(21.62)
Home-owner households 65+ per households 65+ × log of average LSOA house price in 2013					-0.217***	-9.016***
					(0.0447)	(1.800)
Pension Credit Claimants 80+ per capita 65+	1.439***	59.47***	1.338***	55.54***	1.368***	56.76***
	(0.443)	(18.68)	(0.446)	(18.89)	(0.434)	(18.44)
Living arrangements: couple households per households 65+	-1.034***	-42.73***	-1.013***	-42.08***	-0.999***	-41.45***
	(0.146)	(6.653)	(0.145)	(6.654)	(0.134)	(6.169)
Ethnic White population 65+ per capita 65+	0.789***	32.61***	0.749***	31.08***	0.799***	33.14***
	(0.136)	(5.956)	(0.135)	(5.906)	(0.146)	(6.381)
Population 65+ (log)	0.840***	34.70***	0.845***	35.10***	0.851***	35.30***
	(0.0268)	(1.327)	(0.0263)	(1.342)	(0.0266)	(1.339)
Total MSOA care home beds for old age/dem per MSOA pop 65+	0.434***	17.94***	0.415***	17.23***	0.408***	16.94***
	(0.102)	(4.044)	(0.103)	(4.097)	(0.102)	(4.052)
Constant	-1.999***		-1.944***		-2.033***	
	(0.268)		(0.270)		(0.277)	
Observations	13,805		13,798		13,798	
Log Likelihood	-29,138		-30,055		-27,837	

Bootstrapped (100 replications) standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 28. Allocation formulae for the extension to the financial means test

	national unit cost			regional unit cost		
	(1) ELSA home ownership	(2) ELSA house value	(3) ELSA house value	(4) ELSA home ownership	(5) ELSA house value	(6) ELSA house value
Attendance Allowance claimants 65+ per capita 65+	0.4898	0.4829	0.4865	0.4736	0.4678	0.4709
Limiting (significantly) condition 85+ per capita 65+	0.2938	0.3234	0.3199	0.2985	0.3238	0.3210
Home-owner households 65+ per households 65+ × properties in council tax band ABCDE per all properties	0.1189	0.0924		0.0958	0.0769	
Home-owner households 65+ per households 65+ × properties in council tax band FGH per all properties	-0.0474	-0.0359		-0.0619	-0.0472	
Home-owner households 65+ per households 65+			0.6622			0.6286
Home-owner households 65+ per households 65+ × log of average LSOA house price in 2013			-0.0480			-0.0465
Pension Credit Claimants 80+ per capita 65+	0.3273	0.3036	0.3108	0.3067	0.2863	0.2926
Living arrangements: couple households per households 65+	-0.2489	-0.2445	-0.2411	-0.2203	-0.2169	-0.2137
Constant	0.1581	0.1934	0.1925	0.1745	0.1844	0.1837

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