Revision of the Relative Need Formulae for Adult Social Care

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Acknowledgements

We regret to report that Professor Julien Forder, co-author of this report, passed away following its completion.

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Executive Summary

Background

Local authorities (LAs) in England are responsible for providing Adult Social Care (ASC) services for their local populations. ASC includes support provided in the community, such as home care services and direct payments, as well as nursing and residential care.

As defined by the Care Act 2014, eligibility for LA funded ASC depends on: i) meeting nationally defined criteria for having a sufficient degree of impairment, and ii) wealth levels that meet the financial means test. Subject to meeting these eligibility criteria, the level of support provided is determined through individual LAs' care and support planning, after taking into consideration access to unpaid care.

Funding for ASC is allocated to LAs using formulae which account for differences in local funding needs. These allocation formulae have been periodically updated to take into consideration changes in the mix of available services and support, and to reflect latest developments in data collection and statistical methods. The formulae currently in use, called the Adult Social Care Relative Needs Formulae (ASC RNF), have been in operation since 2006/07. A study published in 2018 proposed a revision of the ASC RNF, using more granular and updated data and introducing new indicators to better capture care needs and wealth distribution (Vadean and Forder 2018).

Aims

The aim of this study is to update the 2018 version of the ASC RNF (hereafter, 2018 ASC RNF) by:

- using the latest available data capturing the distribution of care needs as well as income/wealth in the population;
- using new benefit claims indicators of care need which account for changes in benefits since 2018 (e.g., the introduction of Universal Credit) and availability of new data; and
- accounting for the role of ASC supply through newly developed indicators.

The study further provides an overview of potential avenues for using recently established national routine data collections and alternative methodologies in future iterations of the ASC RNF.

Methodology

The present analysis applies the *utilisation-based* approach, which has been used to derive the ASC RNF currently in use (Darton et al, 2010) and the 2018 ASC RNF (Vadean and Forder, 2018). The central premise of this approach is that differences in eligible care need across individuals and localities are reflected in observed patterns of LA funded support. Based on this premise, the objective of the utilisation-based approach is to derive a formula that can express variation in observed levels of services and support in terms of available indicators of need.

Three assumptions underpin this approach. First, that ASC commissioning choices accurately reflect and implicitly define the concept of need. Second, non-need factors influencing

observed ASC services and support, such as supply factors, can be accounted for. Third, empirical indicators of need are good proxies (i.e., accurately capture) underlying theoretical concepts of need.

The assumption that observed ASC service levels (and the care planning and commissioning choices from which they stem) reflect underlying levels of need is fundamental. In England, people receive LA funded ASC support because they have an eligible level of physical and/or cognitive impairment and suffer safety risks that affect their wellbeing, lack the financial means to buy social care services themselves (i.e., have financial means below a certain threshold), and have no or insufficient unpaid care. Although LAs may interpret national eligibility guidelines differently or prioritise different forms of support, the assumption behind this analysis is that observed levels of LA funded ASC support reflect the geographic distribution of care needs in the population.

Empirical analysis

Analysis was performed at the small area level, whereby the relationship between LA funded ASC support and care need is estimated across Lower Layer Super Output Areas (LSOAs) within each sampled Local Authority (LA). This allowed us to link in a wide range of potentially relevant need, wealth and supply data.

As routine collection on the number of people accessing LA supported ASC was not available at LSOA level and a primary data collection was not feasible under the timeline of this report, the analysis is based on data for the period 1 April 2012 to 31 March 2013, collected for the 2018 ASC RNF revision. This data covered a representative sample of 60 LAs.

Four econometric models were estimated: 1) community-based services for people aged 18 to 64; 2) care home services for people aged 18 to 64; 3) community-based services for people aged 65 and over; and 4) care home services for people aged 65 and over.

To account for unobserved systematic geographical differences in LA funded ASC support (e.g., differences in care planning and commissioning practices, local area characteristics, differences in data reporting) the estimations included controls for LA fixed effects.

Building on advancements made in the 2018 study, the present analysis accounts for the influence of the supply of care home beds and social care workforce on local ASC support levels. An instrumental variables (IV) approach is applied to avoid bias from the likely interdependence between levels of LA funded ASC support and supply factors.

Results

The estimates from the empirical analysis were rescaled and supply, ethnicity and population scaling effects were sterilised to produce the RNF coefficients for each care setting and age group. 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.

	(1) Community-based care	(2) Residential and nursing care	Combined (1) + (2)
UC-NWR or ESA or PIP/DLA/AA claimants aged 18 to 64 per capita aged 18 to 64	15.97	3.09	19.06
Share of household reference persons aged 16 to 64 living in one-family households	-1.79	-1.27	-3.06
Share of people aged 16 to 24 in population aged 16 to 64	-2.61	-3.53	-6.15
Constant	3.30	2.85	6.15

	(1) Community-based care	(2) Residential and nursing care	Combined (1) + (2)
PIP/DLA/AA claimants aged 65 and over per capita 65 plus	9.25	5.63	14.88
Share of household reference persons aged 65 and over living as a couple	-5.72	-7.01	-12.73
Share of people aged 80 and over in population aged 65 plus	7.21	5.78	12.99
PC claimants aged 80 and over per capita 65 plus	4.84	21.11	25.95
Share of household reference persons aged 65 and over who own home outright × Share of all dwellings in Council tax bands A-E	-3.45	-5.67	-9.12
Share of household reference persons aged 65 and over who own home outright × Share of all dwellings in Council tax bands F-H	-6.20	-12.12	-18.32
Constant	7.37	15.05	22.42

Sensitivity analysis

Robustness of the estimates was explored by using Census-based indicators of care needs in place of the benefits-based indicators in the main analysis and by using (mean) prices paid in housing transactions instead of housing stock by Council Tax Band as wealth indicators.

Overall, there was no difference in sign and little difference in magnitudes of coefficient estimates when benefits-based indicators were replaced with Census-based needs indicators. To facilitate routine updating of the RNF, the more routinely collected and published DWP benefit claimants-based needs indicators were therefore preferred for the RNF specification.

There was similarly no difference in sign and little difference in coefficient sizes when wealth indicators based on Council Tax Bands were replaced by indicators based on mean house (transaction) prices. As Council Tax band data covers all residential housing stock, while Land Registry Price Paid Data is available only for the subset of the dwelling stock that had a market transaction (about 3% per year), wealth indicators based on Council Tax bands were preferred for the RNF specification.

Discussion

The formulae coefficients show good face validity, consistent with theoretical expectations about the impact of need, income/wealth, and ASC supply on LA funded ASC support. Nonetheless, the analysis has limitations that would need to be addressed in future revisions of the allocation formulae.

Access to good quality data is crucial for robust estimations of allocation formulae. A comprehensive update of ASC RNF based on the utilisation-based approach requires up-to-date data on LA funded ASC support to accurately reflect the differences in current levels of support across and within LAs. The Adult Social Care Client Level Data (ASC CLD) has the potential to substantially improve the quality of available individual (and small area) data on LA funded ASC support. The ASC CLD contains individual-level information on clients' personal characteristics, and documents each stage of their care pathway, including requests for support, needs assessments, care packages (and costs) received, as well as planned and unplanned reviews. The first year of data collected (i.e., 2023/24) has started to be made available in summer 2024.

In addition to data quality, the *utilisation-based* approach used in this study depends on the assumption that observed levels of LA funded ASC support reflect the geographic distribution of underlying care needs in the population. As LAs may interpret national eligibility and care and support planning guidelines differently or prioritise different forms of support, it is difficult to assess how far observed levels of support deviate from levels of underlying need.

An alternative approach to determining resource allocation formulae is the *normative* approach, in which care need is instead inferred directly from indicators for needs and financial eligibility together with measures of the availability of unpaid care. However, due to the lack of routinely collected individual or small-area level data on care needs and unpaid care, a *normative* approach requires more complex modelling based on a combination of both survey data and routinely collected administrative datasets. Moreover, additional assumptions need to be made regarding the level and forms of (eligible) needs that unpaid carers are willing and able to meet.

In theory, if all assumptions for each approach were upheld, then they would produce the same allocation. In practice, not all assumptions will hold, and the main judgement is whether needs, as inferred from the analysis of (past) LA funded ASC support, are more (or less) robust than a practical interpretation of need and support criteria from the normative principles underpinning ASC.

List of abbreviations

ASC	Adult Social Care
AA	Attendance Allowance
CQC	Care Quality Commission
DHSC	Department for Health and Social Care
DLA	Disability Living Allowance
DWP	Department for Work and Pensions
ESA	Employment and Support Allowance
IV	Instrumental Variable
LA	Local Authority
LSOA	Lower Layer Super Output Area
MSOA	Middle Layer Super Output Area
OLS	Ordinary Least Squares
PC	Pension Credit
PIP	Personal Independence Payment
RNF	Relative Needs Formulae
SIC	Standard Industrial Classification
SOC	Standard Occupational Classification
UC	Universal Credit
UTLA	Upper-tier local authority
VOA	Valuation Office Agency

1   Introduction

Local authorities (LAs) in England are responsible for providing social care for their local populations. Adult social care (ASC) includes community-based care and support, like domiciliary care, day care, direct payments, equipment and adaptations, professional support (i.e., social work), and nursing and residential care. Eligibility for LA funded ASC depends on passing a needs assessment and a financial means test. Following the implementation of the *Care Act 2014*, the physical or cognitive impairment eligibility levels are defined in the *Care and Support (Eligibility Criteria) Regulations 2015*, while capital thresholds for the financial means test are set by the *Care and Support (Charging and Assessment of Resources) Regulations 2014*. Moreover, the level of support received by eligible people further depends on their access to informal care, as set in the *Care and Support Statutory Guidance*, with LAs responsible to meet only the needs that are not covered by an 'able and willing' unpaid carer.

Since the 1970s, funding for ASC has been allocated to LAs using formulae accounting for differences in local funding needs. The fundamental principle behind the use of allocation formulae is to ensure equal opportunity of access to social care support for equal need. This means that after budget allocation, each local authority should have sufficient net funding to provide an equivalent level of support to all people in their local population who are eligible for LA funded ASC (Gravelle et al. 2003). A detailed literature review on resource allocation formulae is provided by Smith (2007).

These allocation formulae have been periodically updated to account for changes in the mix of available services and support, and to reflect latest developments in data collection and statistical methods. The version of the formulae currently in use, called the **Adult Social Care Relative Needs Formulae (ASC RNF)**, have been in operation since 2006/07 (Darton et al., 2010). A revision of the ASC RNF was carried out in 2018 but has not been implemented (Vadean and Forder, 2018). Advancements in the 2018 revision included:

- using more granular data (i.e., lower layer supper output area [LSOA], compared to previously ward level) and a much higher number of observations (i.e., c.13,000, compared to previously 775);
- using updated data (e.g., Census 2011 combined with 2013 data from various national returns, compared to previously Census 2001);
- introducing new variables to capture care need (i.e., the share of people with limiting [significant] conditions from Census 2011) and 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   Aims

The aim of this study is to update the 2018 version of the ASC RNF (hereafter, 2018 ASC RNF) by:

- using the latest available data capturing the distribution of care needs as well as income/wealth in the population (e.g., Census 2021 as well as 2023 data on benefit claims [Department of Work and Pensions] and properties in various council tax bands [Valuation Office Agency]);

- using new benefit claims indicators of care need which account for changes in benefits since 2018 (e.g., the rollout of Universal Credit) and availability of new data (e.g., information on the number of people receiving combinations of various benefits); and
- accounting for the role of care home bed supply and social care labour supply through new data (e.g., Census 2021 employment information) and newly developed indicators.

1.2 Methodological approach

The present analysis follows the 2018 ASC RNF in using a *utilisation-based* approach (Vadean and Forder, 2018). The approach does not require a definition of an absolute level of need. Rather, the central premise of this approach is that differences in eligible care need across individuals and localities are reflected in observed patterns of LA funded support. That is, higher/lower relative eligible care need is inferred from higher/lower levels of LA funded ASC support. Based on this premise, the objective of the utilisation-based approach is to derive a formula that can express variation in observed levels of services and support in terms of available indicators of need.

Three assumptions underpin this approach. First, that ASC commissioning choices accurately reflect and implicitly define the concept of need. Second, non-need factors influencing observed ASC services and support, such as supply factors, can be accounted for. Third, empirical indicators of need are good proxies (i.e., accurately capture) underlying theoretical concepts of need.

The assumption that observed ASC service levels and the commissioning choices from which they stem reflect underlying levels of need is fundamental. In England, people receive LA funded ASC support because they have an eligible level of physical and/or cognitive impairment and suffer safety risks that affect their wellbeing, have insufficient informal care support as well as lack the financial means to buy social care services themselves (i.e., have financial means below a certain threshold). However, as LAs may interpret national eligibility and care and support planning guidelines differently or prioritise different forms of support, one cannot assess how far (if at all) observed levels of support deviate from 'true' levels of need. In light of this, Section 6.2 discusses alternative methodological approaches and outlines the requirements for their implementation.

Successive revisions and updates to the ASC RNF, including the present analysis, have sought to address the issue of using good proxies of need, by using newer and more granular data (Darton et al., 2010, Vadean and Forder, 2018). The current analysis continues this line of work by considering recently available data on disability (e.g., Personal Independence Payments, Disability Living Allowance, Attendance Allowance) and income-related (e.g., Universal Credit, Pension Credit) benefits. The 2018 ASC RNF also sought to account for the possible confounding effect of supply factors by controlling for local area care home bed supply (Vadean and Forder, 2018). The current analysis builds on this work by considering an additional measure of supply: the size of the local ASC workforce.

2   Analytical framework

All people receiving LA funded ASC support in England must satisfy both a need (denoted by) and a financial eligibility test (denoted by). The expenditure requirement for ASC ( ) for each individual can be expressed as:

$$ \tag{1} $$

where is the joint probability that a person satisfies both tests and is the net cost of care incurred by the LA, conditional on providing support to that person. The net cost equals to the total cost of providing the required care less the person's own contribution (i.e., charge), which is determined by charging regulations and depends on the individual's assets, income and housing situation.

If we assume that individual-level probabilities in a given small area are about the same (i.e., the need and financial characteristics of people in a small area are similar), we can express expenditure requirements at small area level. We use the smallest geography level as possible in the analysis, which is the Lower Layer Supper Output Area (LSOA), comprising a resident population of between 1,000 and 3,000 persons. In this case the expenditure requirement for ASC ( ) in LSOA   is given by:

$$ \tag{2} $$

where is the population of LSOA , and the count of people in LSOA   eligible and receiving LA-supported services.

The net cost of care to LAs varies by the level of need of the individual, their financial situation (i.e., because individuals might pay charges to the LA for their care) and price/cost differences between local markets.

Regarding the differences in financial situation, the conventional approach to ASC 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. Pragmatically, charges to supported people are relatively small compared to the total cost of care and differences between LAs in charges to individuals due to differences in income and wealth are also small, in particular relative to differences in eligibility. Therefore, the variation in net unit costs should be rather similar to that of gross unit costs. Moreover, the rationale for using constant (i.e., national) unit costs is that: (a) it avoids incorporating cost efficiency differences between LAs into the needs formulae and (b) it reduces the problem of accounting for factors that can be (at least partially) influenced by LAs (e.g., relating to care and support planning and charges). In this analysis, therefore   is treated as a constant and is normalised to equal 1.

With respect to differences in care needs, one would ideally estimate separate versions of Equation (2) for each level of care need. However, as small-area level data on the level/intensity of care needs (e.g., the proportions of people with various ADL difficulties in each LSOA) is not available, such an approach is infeasible. Instead, to account for differences in care need levels and unit costs between support settings, we estimate separate formulae for care home services and community-based services. To obtain an RNF for all ASC services, we then weight the (normalised) estimates from each care setting by their respective England-average unit costs before combining them.

Data on _____ were collected from LAs participating in the study. 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 gross cost-weighted measure of community-based care, based on LSOA population ( ) and relevant need ( ), income ( ), wealth ( ) and supply ( ) proxies, expressed in per capita terms:

$$ \tag{3} $$

Accounting for supply effects is important since their omission would lead them to be incorrectly attributed to other factors included in the model (i.e., need, income, wealth). For example, the number of care home beds in an LSOA is positively correlated with the number of people aged 65 and supported in residential or nursing care (correlation coefficient of 0.278). At the same time, the number of care home beds is also positively correlated with the proportion of people aged 80 and over in the population aged 65 and over (correlation coefficient of 0.430). Given these relationships, omitting a measure of care home bed supply in the model would lead to the coefficient on the proportion of people aged 80 and over being biased upwards. Intuitively, this is due to (part of) the impact of care home bed supply being misattributed to the age demographics factor.

RNFs are traditionally provided in linear form and are applied at the LA level as rates per capita. For the LA ____, the Relative Need can be expressed as:

$$ \tag{4} $$

where _____ is the count of LA-supported people for each LSOA. The proxy variables are expressed in rates per capita at the LA level. The ___s are the coefficients of the relative need formula and are derived, and rescaled, from the ___s in Equation (3).

Supply effects 'sterilised' by computing the term, _____, at the sample mean value of _____ and including the resulting value in the constant term _____ This approach allows us to account for care supply effects when modelling LAs' expenditure requirements while omitting supply factors in the final RNF. Supply factors are themselves not included in the final allocation formula (i.e., Equation 4) since the principle of relative needs allocation is to allocate resources based on differences in drivers of spending need, while avoiding factors that can be influenced by LAs' policies. Population effects are processed similarly to supply effects, so that population scale effects on spending are accounted for in the modelling but per capita allocations to LAs are independent of their population size. For a more detailed discussion of these principles see Forder and Vadean (2018).

The relative need adjustment, _____, gives the relative amount per capita that should go to each LA to adjust for differences in need. For example, this would mean that the ratio of resources per capita going to local authority ____ compared to local authority ____ would be _____ to account for differences in relative need.

3   Data

3.1   Small-area data on LA funded ASC support

Until 2023-24, routine data on the number of people receiving LA funded ASC support was only collected at the LA-level. While routine collection of client-level data has been implemented since 2023-24, this data was not available for the present analysis. As a

separate primary data collection of current numbers of people receiving services and support was not feasible under the timeline for this report, our analysis is based on data for the period 1 April 2012 to 31 March 2013, collected by LG Futures for an earlier revision of the ASC RNF (Ranasinghe and Tideswell, 2014; Forder and Vadean, 2018).

The 2012/13 LG Futures data collection covered 60 LAs and obtained counts of LA-supported permanent admissions to residential and nursing care and people receiving LA-supported community-based services (i.e., home care, day care, direct payments, professional support, and equipment and adaptations) at the Lower layer Super Output Area (LSOA) level. Data were collected separately for the 18 to 64 and 65 and over age groups.

3.1.1   Operational definition of residential and nursing care support

For each age group, we measure LA funded residential and nursing care support as the number of *new* permanent admissions into a residential or nursing home (i.e., admission during the year of the data collection: between 1 April 2012 and 31 March 2013). The 2012-13 small area data collection focussed on new permanent admissions as it was identified that pre-care address data would be more likely to be available for new admissions (see Section 3 of Ranasinghe and Tideswell, 2014).

The objective of the RNF is to relate each LA's ASC spending to the needs and financial characteristics of people who the LA has ASC responsibility for. Because people can move into care homes outside of their LA of residence (i.e., out-of-area placements), LAs can be responsible for supporting people in care homes located outside their geographical boundaries. Pre-care addresses (i.e., a person's address before moving in a care home) are therefore required for the present analysis in order to assign care home residents to the LAs with responsibility for their care.

The raw data was cleaned to exclude incomplete data (LAs with problems in identifying pre-care addresses were excluded). Suppressed values, where LSOAs have positive but fewer than 5 admissions, were imputed. LA-level totals from the data collection were compared with corresponding figures from RAP/ASC-CAR returns and LAs with inconsistencies were excluded. The resulting analysis samples consist of 12,205 LSOAs in 48 LAs for the 18 to 64 age group and 13,238 LSOAs in 48 LAs for the 65 and over age group (see Annex A.1 for details).

3.1.2   Operational definition of community-based care support

For each age group, we measure community-based care LA-support as the cost-weighted sum of people receiving home care, day care, direct payments, professional support and equipment and adaptations in an LSOA on 31 March 2013. Specifically, the number of people receiving each type of community-based service is weighted by the corresponding 2013-14 England-average unit cost of that service. This resulting measure reflects the gross weekly expenditure on community-based care services in each LSOA. To minimise the influence of outliers, observations with values above the 99th percentile are set to the 99th percentile value.

Like the care home admissions data, the raw data was cleaned to exclude incomplete data and suppressed values, where LSOAs have positive but fewer than 5 admissions, were

imputed. The resulting analysis samples consist of 12,245 LSOAs in 47 LAs for the 18 to 64 age group and 12,715 LSOAs in 46 LAs for the 65 and over age group (see Annex A.1.2 for details).

3.1.3 Adjustments to 2012-13 data for current analysis

To adjust for changes in ASC service use over time, we scaled 2012-13 LSOA-level data by the corresponding change in LA-level public ASC support between 2012-13 and 2022-23. This procedure is outlined in more detail in Annex A.1.3. Broadly, the adjustment shifts care home admissions and cost-weighted community care expenditures of LSOAs within the same LA by the same amount. This preserves the relative differences between LSOAs within each LA, while shifting the average differences between LAs so that they reflect those in the 2022-23 data. The implicit assumption underlying this adjustment procedure is that changes in LA funded ASC support across time is similar within LAs.

3.2 Need and financial eligibility indicators

We use separate sets of need and financial eligibility indicators for the 18 to 64 and 65 and over age groups. The variables were required to meet the following 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 LAs. Different combinations and variants of an initial set of indicators were trialled and the final set of indicators was chosen after discussion and input from DHSC and DWP.

To model ASC support for people aged 18 to 64, we used Census 2021 data on population age structure, ethnicity and living arrangements and DWP data on numbers of claimants of Personal Independence Payments (PIP) or Disability Living Allowance (DLA) or Attendance Allowance (AA) or Employment Support Allowance (ESA) or Universal Credit with no work requirement (UC-NWR).

For the models of ASC service utilisation by people aged 65 and over, we used Census 2021 data on population age structure, ethnicity, living arrangements and home ownership, DWP data on numbers of claimants of Attendance Allowance (AA) or PIP or DLA and numbers of Pension Credit claimants, Valuation Office Agency (VOA) housing stock by council tax band data and house prices data from HM Land Registry.

3.3 Social care supply proxies

For each of the 18-64 and 65 and over age groups, we constructed a measure of residential and nursing care home beds supply to each LSOA using information on number of beds from the September 2023 extract of the CQC care directory. This measure accounts simultaneously for the number of beds in each care home, the distance between each care home and each LSOA and the number of people in the relevant age group in each LSOA (details in Annex A.1.5).

As an indicator of ASC labour supply, we use the number of residents employed in caring and personal service occupations (SOC2020-61) in human health and social work (SIC2007-Q) per-capita (18 to 64 or 65 and over, respectively) at the Middle Layer Super Output Area (MSOA), published in Census 2021 (details in Annex A.1.6).

4   Empirical analysis

Four models were estimated: 1) community-based services for people aged 18 to 64; 2) care home services for people aged 18 to 64; 3) community-based services for people aged 65 and over; and 4) care home services for people aged 65 and over.

Community-based care support models for both age groups were estimated by OLS. The linear OLS estimator was preferred (over Poisson regressions) as the cost-weighted utilisation measures showed relatively little clustering at zero and took non-integer values for most of the sample (see Figure A4).

Due to the small number of residential and nursing care placements amongst people aged 18 to 64, 99 percent of LSOAs in the sample had either zero or one care home admission (see Table A1), we defined the dummy indicator variable which equals one if there are any care home admissions from an LSOA and zero otherwise. This dummy dependent variable model was then estimated by logistic regression.

For people aged 65 and over, about a third of LSOAs had zero permanent admissions to care homes (see Table A1). This is likely to be due to the combination of the relatively low overall prevalence of care home admissions and the small size of some LSOAs, rather than separate processes determining whether an LSOA had any permanent admissions to care homes and the subsequent number of these admissions in that LSOA. As such, a count model (as opposed to a two-part model) is likely to be most appropriate. A Negative Binomial regression model was chosen over Poisson after checking for overdispersion.

To account for unobserved systematic geographical differences in LA funded ASC support (e.g., differences in commissioning practices, local area characteristics, differences in data reporting) the models controlled for LA fixed effects. The use of LA fixed effects has two key implications. Conceptually, it means any factors that differ across LAs but affect small areas within LAs equally (i.e., constant within each LA) are 'absorbed' into the constant and cannot be treated as a separate factor in the RNF. Relatedly, it also means coefficient estimates are inferred from variation in LA funded ASC support, needs, wealth, and supply measures across small areas (i.e., LSOAs) within each LA.

This approach makes the following implicit trade-off. On one hand, a model without LA fixed-effects leaves estimates vulnerable to omitted variable bias. Specifically, the unobserved systematic differences in ASC support planning and commissioning practices mentioned above could potentially bias coefficient estimates of the local area needs indicators included in the model. On the other hand, a model with LA fixed-effects means the resulting RNF allocations cannot depend on factors that differ across but not within LAs.

Table 1 and Table 2 report the descriptive statistics of the needs, financial status, and social care supply indicators for each of the four (two age groups by two care settings) estimation samples. Within each table (i.e., age group) descriptive statistics are highly similar across care settings. This suggests there is no reporting bias across care settings and that our treatment of missingness did not affect care settings differentially.

Within each age group and care setting sample, there is noticeable variation in needs and care supply factors across LSOAs. For example, within the Age 18 to 64 Residential and Nursing care sample, the 25th percentile share of benefit claimants in the 18 to 64 population (0.054) is less than half of the 75th percentile share (0.133). Supply of care home beds in the 75th percentile of LSOAs is slightly over two and a half times that of the 25th

percentile. Similarly, social care labour supply in the 75th percentile is around 1.7 times that of the 25th percentile. For the age 65 and over samples, the statistics also indicate considerable variation in local area housing wealth. For example, within the age 65 and over Residential and Nursing care sample, the bottom 25th percentile of LSOAs have no properties in Council Tax bands F to H, while the 75th percentile of LSOAs have around 11.5 percent of properties in the three highest Council Tax bands.

Table 1 Descriptive statistics - Age 18 to 64 analysis samples

	Community-based care				Residential and Nursing care			
	mean	s.d.	p25	p75	mean	s.d.	p25	p75
Log of population aged 18 to 64	6.874	0.238	6.714	7.013	6.873	0.24	6.711	7.014
Share of people aged 16 to 64 of White ethnicity	0.836	0.191	0.784	0.96	0.85	0.173	0.804	0.962
Share of household reference persons aged 16 to 64 living in one-family households	0.691	0.106	0.639	0.766	0.693	0.104	0.641	0.766
Share of people aged 16 to 24 in population aged 16 to 64	0.157	0.061	0.131	0.165	0.155	0.060	0.130	0.162
UC-NWR or ESA or PIP/DLA/AA claimants aged 18 to 64 per capita aged 18 to 64	0.100	0.062	0.054	0.133	0.098	0.061	0.054	0.133
Supply of care home beds for younger adults per capita 18 to 64	0.008	0.011	0.003	0.008	0.008	0.011	0.003	0.008
MSOA-level ASC employment per capita aged 18 to 64[1]	0.036	0.013	0.026	0.045	0.036	0.013	0.026	0.045
Number of LAs	47				48			
Observations	12,245				12,205			

Notes: ASC employment defined as employment in SOC2020-61 occupations in SIC2007-Q industries.

Annex Table A8and Table A9 reproduce the means and standard deviations in Table 1 and Table 2 for their respective samples alongside the corresponding statistics for all LSOAs in England. Overall, the analysis sample means and standard deviations are highly similar to their England counterparts. Annex Table A10 reports comparisons of the per capita number of people receiving LA-supported ASC on 31 March 2023 in the analysis sample compared to numbers for England on the same date. These figures are also rather similar, confirming the representativeness of the analysed sample.

Table 2 Descriptive statistics - Age 65 and over analysis samples

	Community-based care				Residential and Nursing care			
	mean	s.d.	p25	p75	mean	s.d.	p25	p75
Log of population aged 65 and over	5.649	0.516	5.375	5.986	5.666	0.505	5.398	5.999
Share of people aged 65 and over of White ethnicity	0.907	0.163	0.909	0.990	0.92	0.145	0.928	0.990
Share of household reference persons aged 65 and over living as a couple	0.452	0.118	0.368	0.542	0.458	0.116	0.377	0.546
Share of people aged 80 and over in population aged 65 plus	0.262	0.066	0.218	0.301	0.260	0.065	0.217	0.299
PC claimants aged 80 and over per capita 65 plus	0.053	0.039	0.026	0.070	0.050	0.035	0.025	0.066
PIP/DLA/AA claimants aged 65 and over per capita 65 plus	0.217	0.095	0.145	0.272	0.211	0.092	0.142	0.262
Share of household reference persons aged 65 and over who own home outright × Share of all dwellings in Council tax bands A-E	0.604	0.186	0.485	0.749	0.612	0.184	0.496	0.754
Share of household reference persons aged 65 and over who own home outright × Share of all dwellings in Council tax bands F-H	0.087	0.139	0.000	0.115	0.087	0.136	0.000	0.117
Supply of care home beds for older people per capita 65 plus	0.042	0.043	0.019	0.047	0.041	0.042	0.018	0.046
MSOA-level ASC employment per capita aged 65 plus	0.133	0.087	0.07	0.173	0.129	0.084	0.069	0.164
Number of LAs	46				48			
Observations	12,715				13,238			

Notes: ASC employment defined as employment in SOC2020-61 occupations in SIC2007-Q industries.

4.1 Addressing endogeneity in care supply

The level of LA funded ASC support and the supply of these services are likely to be interdependent. All else equal, admission into a care home can be expected to depend on the availability of care home beds in a locality while, simultaneously, care providers may increase the number of beds or choose to locate themselves in areas with higher expected demand for residential and nursing care. Similarly, because the provision of both residential and community-based care services depends heavily on care workers, all else equal, the availability of ASC services and hence observed levels of support are likely to depend on the size of the local care workforce. Conversely, we can also expect the size of the local care workforce to depend on factors driving local area demand.

These examples suggest that direct estimation of the relationships between our two care supply variables and LA funded ASC support is likely to suffer from simultaneity bias. That is, the estimates would not account for the fact that care supply depends on demand for care and vice versa. Importantly, this also means that the estimates of the coefficients of the other needs indicators may also be biased.

To address this issue, we applied an instrumental variables (IV) approach when estimating models which control for care supply. For an instrumental variable to be valid, it should be: 1) correlated with the supply indicator that is being "instrumented" (i.e., instrument relevance), and 2) uncorrelated with LA funded ASC support in the LSOA (i.e., instrument exogeneity).

For residential and nursing care bed supply, we use the MSOA leave-one-out average number of care homes with beds for clients aged 18 to 64 as an IV in the 18 to 64 models. Abstracting from age groups, for LSOA   in an MSOA containing   LSOAs, the IV is defined as: , where   denotes the number of care homes in LSOA   and   denotes the number of care homes in the MSOA. Similarly, we use the MSOA leave-one-out average number of care homes with beds for clients aged 65 and over as IV for the 65 and over age group models.

We use the number of care homes in the IV for care home bed supply because the number of care homes is less likely to be affected by shifts in demand for ASC compared to the number of beds. Intuitively, correlation between unobserved demand shifts and the IV threaten the IV's validity due to the relationship between demand for and provision of LA supported ASC. However, to the extent that residential care supply responds to demand changes, it is more likely that this adjustment occurs through changes in capacity in existing care homes rather than the starting up or closure of care homes. The number of care homes, used in our IV, is more plausibly to be uncorrelated to LA supported ASC.

There is also the potential issue of people with higher expected demand for residential care likely choosing to reside in areas with a higher number of care homes, in anticipation of their future need. Such sorting would result in a selection bias, since part of the observed relationship between local area residential care utilisation and supply could be driven by people 'selecting' into different localities. The leave-one-out average addresses such selection effects by disregarding information on the number of care homes in the LSOA of interest.

For social care labour supply, we use the Upper Tier Local Authority (UTLA) leave-one-out average employment in SIC-Q industries per MSOA for both the 18 to 64 and 65 and over age group models. Specifically, while local area demand for social care services may affect

local area employment in direct care job roles (for example through wages), employment in the human health and social work sector, which includes the NHS, is more likely to be driven by broader labour market conditions.

Annex Table A11 and Table A12 report the estimates from IV 'first-stage' regressions of the care home beds supply and ASC labour supply measures on the proposed IVs and remaining regressors from the 18-64 and 65 and over models, respectively. The statistically significant coefficients on the IVs, after conditioning on all other model variables, suggest that the proposed IVs satisfy the instrument relevance condition. The IV relevance condition is further assessed in our main analysis by reporting first-stage F-statistics in our analysis results.

In contrast, the exogeneity condition cannot be verified directly. However, following best practice, we assess if the condition is violated by estimating 'balance regressions' of the relationship between the proposed IVs and proxies for local area need. Intuitively, since the motivation for the use of IVs in the present analysis is to account for the influence of demand factors on care supply, a statistically significant relationship between the IV and proxies for local area need, after controlling for local area characteristics, casts doubt on IV exogeneity.

Annex Table A13 and Table A14 report estimates from regressions of the share of PIP/DLA/AA claimants[1] and the share of people reporting daily activity-limiting disability[2] against the proposed the IVs, for the age 18 to 64 and 65 and over age groups, respectively. They show that after controlling for a minimal set of local area demographic characteristics (age structure, ethnicity, living arrangements, LA fixed effects), the IVs have no statistically significant relationship with the two proxies of local area needs. This provides reassurance that the IV exogeneity assumption is not violated.

5   Results

5.1   LA funded ASC support for people aged 18 to 64

Table 3 reports the estimates for the models of ASC support for people aged 18 to 64 in the community (Columns 1 and 2) and residential and nursing care settings (Columns 3 and 4). Columns 1 and 3 contain models which do not account for the impact of care home bed supply and social care labour supply on LA funded ASC support, while Columns 2 and 4 model the influence of supply factors via instrumental variable (IV) estimation. To allow assessment of the impact of IV versus direct estimation, Annex Table A15 and Table A16 report estimates from models accounting for supply factors directly without using IVs.

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[1] PIP/DLA/AA claimants aged 18 to 64 and over per capita 18 to 64 (18-64 models) and PIP/DLA/AA claimants aged 65 and over per capita 65 plus (65 plus models).
[2] Share of people aged 16 to 64 disabled under the Equality Act: day-to-day activities limited a lot (18-64 models) and share of people aged 65 and over disabled under the Equality Act: day-to-day activities limited a lot (65 plus models).

Table 3 Models for LA funded ASC support for people aged 18 to 64

	Community-based care		Residential and Nursing care	
	No supply controls	Supply controls with IV	No supply controls	Supply controls with IV
Log of population aged 18 to 64	1,064.812*** (146.418)	1,183.701*** (153.759)	0.053*** (0.013)	0.067*** (0.014)
Share of people aged 16 to 64 of White ethnicity	-594.302** (248.404)	-678.377*** (216.904)	-0.020 (0.022)	-0.033 (0.025)
Share of household reference persons aged 16 to 64 living in one-family households	-1,874.817*** (273.417)	-1,198.432*** (356.486)	-0.166*** (0.027)	-0.074* (0.041)
Share of people aged 16 to 24 in population aged 16 to 64	-2,107.197*** (353.826)	-1,747.538*** (366.893)	-0.274*** (0.059)	-0.206*** (0.069)
UC-NWR or ESA or PIP/DLA/AA claimants aged 18 to 64 per capita aged 18 to 64	11,023.756*** (874.575)	10,673.887*** (1,346.337)	0.371*** (0.046)	0.180 (0.127)
Supply of care home beds for younger adults per capita 18 to 64		35,528.916*** (13,106.265)		4.272*** (1.340)
MSOA-level ASC employment per capita aged 18 to 64		444.344 (8,999.151)		1.314 (1.002)
LA FE	Y	Y	Y	Y
R-squared	0.342	0.158	-	-
Adj R-squared	0.340	0.157	-	-
AIC	-	-	8006.7212	8078.8704
BIC	-	-	8043.7692	8501.2177
Number of LAs	47	47	48	48
Observations	12,245	12,245	12,205	12,205
First-stage F-stat	-	38.82	-	35.94

Notes: Robust standard errors clustered at UTLA-level in parentheses *** p<0.01, ** p<0.05, * p<0.1. MSOA-level ASC employment defined as MSOA total employment in SOC2020-61 occupations in SIC2007-Q industries. Community-based care models are estimated by OLS regression. Residential and Nursing care are estimated by Logit regression and estimates are marginal effects evaluated at sample mean values of regressors. First-stage F-stats reported are heteroskedasticity-robust KP Wald statistics.

To enable interpretation and comparison across models, the residential and nursing care setting estimates are reported as marginal effects evaluated at the sample mean value of covariates. This means all the estimates in Table 3 can be interpreted as the change in LA funded ASC support associated with a unit change in the needs or supply indicator. For example, the estimates imply that, accounting for supply factors, a 10 percentage point increase in the share of people aged 16 to 24 in population aged 16 to 64 in a local area is associated with a £174.7 decrease in weekly cost-weighted community-based care utilisation. For residential and nursing care use, the estimates imply that, accounting for

supply factors, a 10-percentage point increase in the share of 16 to 24s is associated with a 2.1 percentage point decrease in probability of any care home admissions from residents in the area.

The estimates are broadly in line with theory. For example, the share of people aged 18 to 64 claiming either UC (with no work requirement), ESA, PIP or DLA is a benefits-based indicator of local area care needs. The positive and statistically significant relationship between this indicator and ASC service use in both care settings is thus as expected. Similarly, the share of people aged 16 to 24 in the population aged 16 to 64 reflects the share of the local population who we expect to have less need for care. The negative and statistically significant coefficients in both care settings are thus as expected.

5.2   LA funded ASC support for people aged 65 and over

Table 4 reports the estimates for the models of LA funded ASC support for people aged 65 and over in the community-based (Columns 1 and 2) and residential and nursing (Columns 3 and 4) care settings. Annex Table A17 and Table A18 report estimates from models accounting for supply factors directly, without the use IVs.

As with the 18 to 64 models, the residential and nursing care setting estimates are reported as marginal effects evaluated at the sample mean value of covariates. However, because the measure of residential and nursing care support for people aged 65 and over is the count of care home admissions, the estimates in Columns 3 and 4 are now interpreted as the change in number of local-area care home admissions associated with a unit change in the needs or supply indicator. For example, accounting for supply factors, the estimates in Column 4 imply that a 10 percentage point increase in the share of people aged 80 and over in population aged 65 and over is associated with a 0.080 increase in the number of care home admissions from the area.

The share of people aged 65 and over claiming PIP/DLA/AA is an indicator of local area care needs and has the expected positive relationship with LA funded ASC support. The share of pension credit claimants in the 65 and over population is an indicator of (low) income and hence is expected to be positively related to need and eligibility for LA-supported ASC services. Indicators of local area (housing) wealth are more direct indicators for financial eligibility as they enter the ASC means test criteria directly. The coefficients have the expected negative sign and are of larger magnitude for the indicators for Council Tax bands F to H (i.e., higher value dwellings). Finally, the share of people aged 80 and over in the population aged 65 and over reflects the share of the local population who we expect to have greater need for care. The coefficients for this indicator have the expected positive sign and are statistically significant in both care settings.

Table 4 Models for LA funded ASC support care for people aged 65 and over

	Community-based care		Residential and Nursing care	
	No supply controls	Supply controls with IV	No supply controls	Supply controls with IV
Log of population aged 65 and over	861.594*** (60.674)	880.139*** (77.962)	1.023*** (0.048)	1.036*** (0.045)
Share of people aged 65 and over of White ethnicity	116.338 (92.944)	168.594 (108.606)	1.081*** (0.164)	1.050*** (0.145)
Share of household reference persons aged 65 and over living as a couple	-1,196.745*** (140.232)	-1,149.293*** (149.299)	-0.971*** (0.241)	-0.967*** (0.173)
Share of people aged 80 and over in population aged 65 plus	1,013.337*** (253.096)	1,447.764*** (381.678)	1.564*** (0.373)	0.798** (0.347)
PC claimants aged 80 and over per capita 65 plus	1,133.873** (505.786)	972.691* (537.748)	2.646*** (0.572)	2.913*** (0.594)
PIP/DLA/AA claimants aged 65 and over per capita 65 plus	1,725.045*** (231.418)	1,857.570*** (285.041)	1.131*** (0.331)	0.777*** (0.278)
Share of household reference persons aged 65 and over who own home outright × Share of all dwellings in Council tax bands A-E	-708.908*** (94.259)	-692.238*** (91.168)	-0.750*** (0.184)	-0.783*** (0.113)
Share of household reference persons aged 65 and over who own home outright × Share of all dwellings in Council tax bands F-H	-1,283.962*** (149.222)	-1,243.961*** (149.467)	-1.619*** (0.216)	-1.673*** (0.191)
Supply of care home beds for older people per capita 65 plus		-1,746.298 (1,076.289)		3.046** (1.300)
MSOA-level ASC employment per capita aged 65 plus		466.879 (562.012)		-0.200 (0.611)
LA FE	Y	Y	Y	Y
R-squared	0.464	0.339	-	-
Adj R-squared	0.462	0.339	-	-
AIC	-	-	39343.407	39411.813
BIC	-	-	39410.824	39868.755
Number of LAs	46	46	48	48
Observations	12,715	12,715	13,238	13,238
First-stage F-stat	-	65.28	-	65.192605

Notes: Robust standard errors clustered at UTLA-level in parentheses *** p<0.01, ** p<0.05, * p<0.1. MSOA-level ASC employment defined as MSOA total employment in SOC2020-61 occupations in SIC2007-Q

industries. Community-based care models are estimated by OLS regression. Residential and Nursing care are estimated by Negative Binomial regression and estimates are marginal effects evaluated at sample mean values of regressors. First-stage F-stats reported are heteroskedasticity-robust KP Wald statistics.

5.3 Relative Needs Formulae for Adult Social Care

The coefficients of the Relative Needs Formulae in Table 5 and Table 6 are derived by rescaling the marginal effects from the above models (Table 3 and Table 4) so that the formula predicts the average weekly per capita costs of residential and nursing or community-based care in the LSOA (with sample average need factors). Supply, ethnicity and population scaling effects are removed by setting them at sample 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.

As discussed in Section 2, care supply factors are likely to influence observed levels of LA-supported ASC and, at the same time, be correlated with local needs indicators. The preferred formulae are therefore based on estimations which account for the supply of care home beds and social care workforce. Formulae without controls for supply are presented for comparison.

Table 5 Relative Needs Formulae for 18 to 64 age group

	(1) Community-based care	(2) Residential and nursing care	Combined (1) + (2)
Without controls for supply			
UC-NWR or ESA or PIP/DLA/AA claimants aged 18 to 64 per capita aged 18 to 64	16.49	6.35	22.84
Share of household reference persons aged 16 to 64 living in one-family households	-2.80	-2.84	-5.64
Share of people aged 16 to 24 in population aged 16 to 64	-3.15	-4.69	-7.84
Constant	4.02	3.79	7.81
With controls for supply			
UC-NWR or ESA or PIP/DLA/AA claimants aged 18 to 64 per capita aged 18 to 64	15.97	3.09	19.06
Share of household reference persons aged 16 to 64 living in one-family households	-1.79	-1.27	-3.06
Share of people aged 16 to 24 in population aged 16 to 64	-2.61	-3.53	-6.15
Constant	3.30	2.85	6.15

Table 6 Relative Needs Formulae for 65 and over age group

	(1) Community-based care	(2) Residential and nursing care	Combined (1) + (2)
Without controls for supply			
PIP/DLA/AA claimants aged 65 and over per capita 65 plus	8.59	8.20	16.79
Share of household reference persons aged 65 and over living as a couple	-5.96	-7.04	-13.00
Share of people aged 80 and over in population aged 65 plus	5.05	11.34	16.38
PC claimants aged 80 and over per capita 65 plus	5.65	19.17	24.82
Share of household reference persons aged 65 and over who own home outright × Share of all dwellings in Council tax bands A-E	-3.53	-5.44	-8.97
Share of household reference persons aged 65 and over who own home outright × Share of all dwellings in Council tax bands F-H	-6.39	-11.73	-18.13
Constant	8.24	12.95	21.19
With controls for supply			
PIP/DLA/AA claimants aged 65 and over per capita 65 plus	9.25	5.63	14.88
Share of household reference persons aged 65 and over living as a couple	-5.72	-7.01	-12.73
Share of people aged 80 and over in population aged 65 plus	7.21	5.78	12.99
PC claimants aged 80 and over per capita 65 plus	4.84	21.11	25.95
Share of household reference persons aged 65 and over who own home outright × Share of all dwellings in Council tax bands A-E	-3.45	-5.67	-9.12
Share of household reference persons aged 65 and over who own home outright × Share of all dwellings in Council tax bands F-H	-6.20	-12.12	-18.32
Constant	7.37	15.05	22.42

5.4   Robustness

A concern with using housing stock by Council Tax bands as a wealth indicator is that Council Tax bands could be outdated. We therefore estimated alternative specifications of the age 65 and over models with mean house prices instead (see Annex Table A19 and Table A20). Across all models, estimates are of identical sign and very similar magnitude. Specifications

with the Council Tax band indicators show slightly better goodness-of-fit statistics. Our preferred specification uses Council Tax band data as it is comprehensive (i.e., it covers all residential dwellings). A drawback of using house prices from Land Registry Price Paid Data is that these are only available for the subset of residential housing stock (about 3% per year) that had a market transaction during the observed period.

A potential concern with using DWP benefits claims data as indicators of local area care need is that claimant numbers depend on benefits uptake. This may not correspond perfectly with actual care needs or may differ across local areas with the same level of care needs. To explore the robustness of our estimates with respect to the use of benefits data, we estimated alternative specifications which replace the benefits-based indicators (i.e., UC-NWR or ESA or PIP/DLA/AA claimants aged 18 to 64 per capita aged 18 to 64 and PIP/DLA/AA claimants aged 65 and over per capita 65 plus) with a Census 2021-based indicator of disability (see Annex Table A21, Table A22 for Age 18 to 64 models and Table A23, Table A24 for Age 65 and over models). Overall, estimates are of identical sign and very similar magnitude. Goodness-of-fit statistics are also very close between the two alternative measures. Therefore, as census-based indicators can only be updated once a decade, we preferred the more routinely updated DWP benefit claimants-based needs indicators for our main specification.

6   Discussion

We used in this study a *utilisation-based* approach to update the 2018 version of the ASC RNF. Like the 2018 ASC RNF, the results showed good face validity, consistent with theoretical expectations about the impact of need, income/wealth, and ASC supply on LA funded ASC support. Moreover, statistical models performed well in terms of statistical diagnostic testing. Nonetheless, the analysis has limitations that would need to be addressed in future revisions of the allocation formulae.

6.1   Limitations and scope for comprehensive revision of the ASC RNF

Access to good quality data is crucial for robust estimations of allocation formulae. The update of the ASC RNF reported in this study is based on LA social care support data for 2012/13. While this data has been rescaled to reflect differences between LAs in 2022/23 (see Annex 2.1, 2.2 and 2.3), the distribution of social care support *within* LAs may have changed during the 10-year period. For example, the Covid-19 pandemic could have had differential effects on levels of need within LAs. Because our estimates are based on variation between small areas, such distributional changes may mean that the resulting RNFs do not accurately reflect current relative needs. However, without up-to-date and granular data on the patterns of social care support, we are limited in the kind of adjustments we can make to existing data.

A recent development with potential to substantially improve access to individual or small area data on LA funded ASC support is the Adult Social Care Client Level Data (ASC CLD). ASC CLD is designed as a development of the LA-level Short and Long Term (SALT) data on public ASC, containing individual level data on a quarterly basis, for a broader analytical use. Data for the first year (i.e., 2023/24) has started be made available in summer 2024, with

information on LA social care clients' personal characteristics, their requests, assessments, and reviews for LA funded ASC support, as well as care packages (and costs) received.

A key aspect for the ASC CLD to be a feasible source of data for a more comprehensive revision of the ASC RNF is to include for each person information on the type of services received (e.g., residential care, nursing care, home care, Direct Payment, equipment, etc.) and the postcode (or LSOA) of residence. For clients supported in residential/nursing care, this would need to be the postcode/LSOA of their last residence before moving into the care home, as the analysis links support incidence to care need and wealth characteristics of the usual place of residence. The care home address could be, on the other hand, in an area with different population characteristics (i.e., care need and wealth) or even in a different LA (i.e., out-of-area placement).

In the long-term, the ambition is for ASC CLD to capture individuals' full history of interactions with the LA funded ASC support system, from the initial contact for assessment to their last observed support status. This should allow mapping all social care support to pre-care addresses. During the first year(s) of the ASC CLD collection, though, we expect only the care homes' address to be available for (most) care home residents. Therefore, as with the 2012/13 LA social care support data collection, for the residential/nursing care analysis, we will have to restrict the analysis to the subset of permanent admissions to residential/nursing care during the reference year, which should be recorded with their pre-care address.

Another limitation of the 2012/13 data on LA social care support (as well as current Short and Long Term (SALT) data collection), is that it only includes information on the count of people supported in different settings, but not their level of disability and care needs. As care home residents have on average higher care needs than people supported in the community, we estimated separate formulae for residential/nursing care and community-based care and weighted the results together in a final allocation formula.

6.2   Alternative approach

An alternative approach to determining resource allocation formulae is the *normative* (or *epidemiological*) approach (Asthana et al., 2004, Vallejo-Torres et al., 2009). The main difference to the *utilisation-based* approach is that care need is not determined using observed patterns of LA funded ASC support in local populations, but instead inferred directly from criteria that LAs use to define care eligibility and national thresholds for financial eligibility. Resources would, therefore, be allocated geographically based on the relative prevalence of the *normatively defined* care need levels and financial eligibility.

This approach relies on three key assumptions:

- The existence of a normative definition of care need agreed nationally, specified in a way that can be implemented in an allocation formula.
- Need factors used in the normative criteria are measurable and not influenced by external (non-need) factors (e.g., local care supply).
- Good-quality datasets including the required care need and household finance indicators.

With respect to the first assumption, while financial eligibility criteria for social care support are defined nationally, the adult care needs eligibility criteria set in the *Care Act 2014* (and

the related regulations) allows room for interpretation by LA care managers and social workers. According to *The Care and Support (Eligibility Criteria) Regulations 2015*, eligible care needs are defined as the physical or cognitive impairment resulting in a person being unable to achieve two or more Activities of Daily Living (ADLs) without assistance and/or significant pain/distress and/or safely and/or in a reasonable amount of time. Moreover, after eligibility has been determined, the LA is not obliged to meet any needs that are covered by an unpaid carer and can take that unpaid care into account when planning the amount of support to be provided (see *Care and Support Statutory Guidance,* 28 March 2024, Sections 6.15 and 10.26). In this regard, LAs should assess the capacity and willingness of the carer to continue providing unpaid care.

Regarding the second assumption, both the ability to perform ADLs without assistance and amount of wealth held by a person are measurable and not under the influence of external factors. Moreover, financial eligibility assessments are formulaic and explicit and can, therefore, be calculated with a reasonable degree of approximation. The likelihood of an eligible need to be met by unpaid care is often not directly measured, but could be approximated, for example, by the presence of a presence in the household of a healthy and able adult (i.e., can perform all ADLs without assistance), that is not in full-time employment or education. Nonetheless, this will have its limitations, as the willingness and capacity of a person to provide care is more difficult to capture. Moreover, observed participation in education and/or employment of working age adults can be affected by availability of LA ASC funding and associated unmet need.

Considering the third assumption, a particular challenge for the *normative* approach is that indicators of care need (e.g., difficulty with ADLs and access to unpaid care) are not part of routine administrative datasets. This information is, however, available in survey data of national representative population samples, like the English Longitudinal Study of Ageing (ELSA). Following, methodology developed in previous studies (see Fernandez and Snell, 2018; Forder, Vadean and Teo, 2022), one could identify in these survey samples people with a defined number of ADLs not able to achieve independently and having assets below financial eligibility thresholds as well as no access to unpaid care. The likelihood of having *normatively* defined eligible needs, being financially eligible for social care support, and unable to access unpaid care can be then statistically modelled as a function of predictors available at small area level in national routine data collections (e.g., age group, self-reported general health, living alone, and claiming benefits [e.g., Personal Independence Payment, Attendance Allowance, Pension Credit, etc.]). The coefficients obtained from predicting the likelihood of this *normatively* defined eligibility for LA social care support in the survey sample, can be then used to predict the number of *normatively* defined eligible people in each LSOA in England as function of the same predictors.

A limitation for using survey data for identifying a *normatively* defined eligibility for LA social care support, is that these datasets do not cover people living in an institutional setting (e.g., care home with or without nursing). For people in care homes, one would need to assume that care needs (and financial eligibility) can be approximated by the characteristics of people in the community at risk of admission into care homes. These would be people with higher level of disability (e.g., inability to achieve four and more ADLs) as compared to people that are usually eligible for a community care support (e.g., inability to achieve two and more ADLs) (see Fernandez and Snell, 2018). For practical reasons, we could also

assume that the needs of people at risk of admission into care homes are higher than could be met by unpaid carers in the community.

Figure 1 Flow chart of normative approach methodology
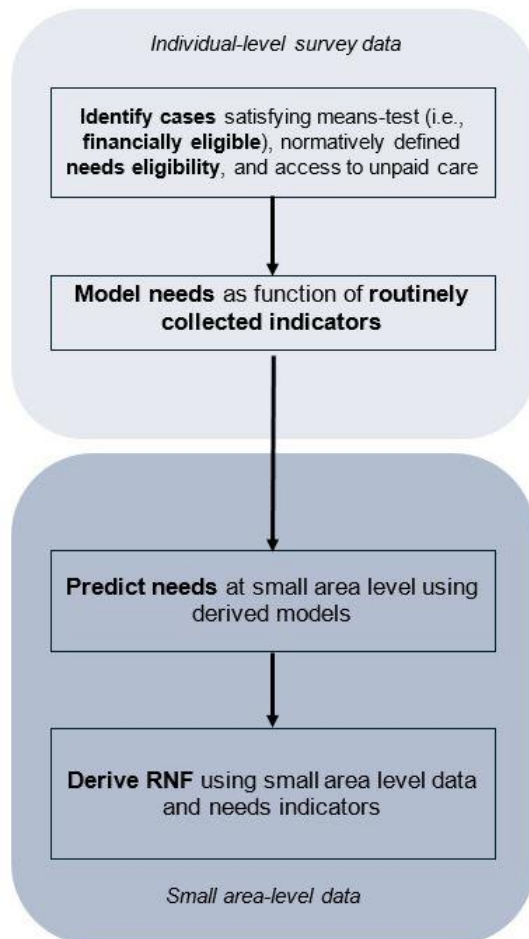
Both the *utilisation-based* and the *normative* approach have specific strengths and limitations. There are arguments that LA funded ASC support is distorted relative to underlying care need (i.e., that people with similar level of care need would get LA support in some areas, while in others not) and that allocation formulae based on the distribution of current (or historic) LA support levels would maintain current inequity with respect to access to social care and support. Nonetheless, the statistical models predicting LA funded ASC support include LA-level effects to account for differences in policy (and generosity) between LAs. Moreover, equations are estimated over a large sample of LAs. Therefore, final formulae predict average support levels for similar levels of need in the population (i.e., LAs with similar level of disability and financial eligibility in their population would be allocated [per capita] the same level of resources, even if their current social care support levels differ). Despite this, the contribution of different need and wealth factors in the formula could be slightly different if based on utilisation data reflecting a different eligibility policy.

On the other hand, as described above, due to the lack of routinely collected national data on indicators of care need, a *normative* approach requires more complex modelling based

on a combination of both survey data and routinely collected administrative datasets. Moreover, additional assumptions would have to be made for the care needs of the population in care home settings, for which survey data on (pre)care needs and financial eligibility are not available.

In theory, if all assumptions for each approach were upheld, then they would produce the same allocation. In practice, not all assumptions will hold, and the preferred approach is rather a second-best choice. The main judgement is whether the needs criteria that can be inferred from the analysis of (past) LA funded ASC support are more (or less) robust than a practical interpretation of need and support criteria from the normative principles underpinning ASC.

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Annexes

A.1. Data sources and manipulation

A.1.1. 2012-13 data on LA-funded residential and nursing care support

LSOA-level data 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). The data were collected for two age groups: a) 18 to 64 and b) 65 and over. Data were supplied on the number of supported people living in each LSOA before admission to the care home. For details on the data collection and manipulation see (Vadean and Forder, 2018).

A.1.2. 2012-13 data on LA-funded community-based service use

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). The data were collected for two population groups: a) 18 to 64, and b) 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. Details on the data collection and manipulation are presented in Vadean and Forder (2018).

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.[3]

The cost-weighted utilisation for younger adults for each LSOA j, was calculated as: $GWCommCareExp1864_j = 300 \times HomeCare_j + 288 \times DayCare_j + 250 \times DirPay_j + 117 \times ProfSupport_j + 22 \times Equipment_j$.

The cost-weighted utilisation for older people for each LSOA j, was calculated as: $GWCommCareExp65plus_j = 193 \times HomeCare_j + 138 \times DayCare_j + 188 \times DirPay_j + 117 \times ProfSupport_j + 22 \times Equipment_j$.

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[3] http://www.hscic.gov.uk/catalogue/PUB16111

A.1.3. Adjustments for changes between 2012-13 and 2022-23

To account for changes in LA funded ASC support over time, we scaled the 2012-13 LSOA-level data, described in Sections A.1 and A.1.2, by changes in corresponding LA-level utilisation between 2012-13 and 2022-23.

A.1.3.1. Residential and nursing care

For each of two age groups, a measure of LSOA-level residential and nursing care support in 2022-23 ($R_{res,j}^{2023}$) was obtained by multiplying an LSOA's 2012-13 total number of residential and nursing care admissions ($R_{res,j}^{2012}$) by the ratio of the corresponding LA's 2022-23 over 2012-13 residential and nursing care support:

$$R_{res,j}^{2023} = R_{res,j}^{2012} \cdot \frac{C_{res}^{2023}(LA)}{C_{res}^{2013}(LA)}$$

Where:

- $R_{res,j}^{2012}$ is the LSOA-level number of LA-supported permanent admissions to residential and nursing care in LSOA j of local authority between 1 April 2012 to 31 March 2013;

- $C_{res}^{2013}(LA)$ is the number of LA-supported residents in Permanent residential and nursing placements on 31 March 2013 in local authority ;[4]

- $C_{res}^{2023}(LA)$ is the number of clients accessing long term support for Nursing and Residential care on 31 March 2023 in local authority .[5]

Figure A2 plots the number of people accessing residential and nursing care on 31 March 2023 in each LA reported in ASC-FR 2022-23 against the LA total number of residential and nursing care admissions obtained from the rescaled LSOA-level data for the 18 to 64 (left panel) and 65 and over (right panel) age groups. The dashed grey line represents the case where both measures coincide. The fact that values in both figures are everywhere above the reference line implies that the rescaled data understates the *level* of utilisation in 2022-23. Nonetheless, and crucially for a relative needs analysis, there is a strong positive and nearly linear relationship between the rescaled utilisation measure and actual utilisation. This implies that the rescaled utilisation measure is able to capture differences in *relative* utilisation in 2022-23, at least across LAs.

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[4] Source: Adult Social Care Combined Activity Return (ASC-CAR) 1 April 2013 to 31 March 2014. For each age group, this is the sum over primary client types (i.e., physical disability, mental health, learning disability, substance misuse and other vulnerable people for age 18 to 64, and all the above plus non allocated by client group for age 65 and over).

[5] Source: Adult Social Care Activity and Finance: England 2022-23, Table 38

Figure A2 LA-level concordance between rescaled 2012-13 residential and nursing care utilisation and actual 2022-23 residential and nursing care utilisation
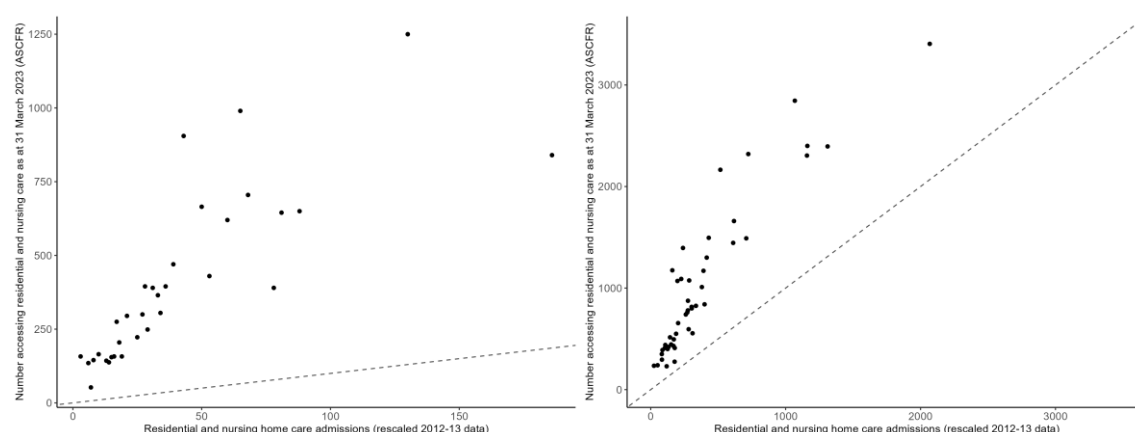
A.1.3.2. Community-based support

As the Adult Social Care Activity and Finance: England 2022-23 does not include information on Gross Current Expenditures by the client types reported in PSS-EX1 2013-14 (i.e., the denominator in the calculation below), we use as numerator the Gross Current Expenditure on long-term care by support setting (i.e., the sum of 'Community: Direct Payments', 'Community: Home Care', 'Community: Supported Living', 'Community: Other Long Term Care' [from ASC-FR 2022-23, Table 43 for age group 18-64 and Table 44 for age group 65 and over]). Despite the differences, the two measures of Gross Current Expenditures on long-term community care are highly correlated (0.884 for the 18 to 64 age group, 0.904 for the 65 and over age group).

For each of 18 to 64 and 65 and over age groups, the LSOA-level cost-weighted community-based care utilisation in 2022-23 (｡ « © ©   is obtained by obtained by scaling the 2012-13 LSOA-level data, described in Section A.1.2, as follows:

$$ _｡ « © © \qquad fi ® « ^{- -}_ ｡ | « ´©–© \qquad \frac{fi _｡ |_｡ « © ©' _｡ / \&}{fi _｡ |_｡ « © \$ ' ' | _,} $$

where:

- $fi ® « ^{- -}_ ｡ | « ´©–©$ is the gross weekly expenditure on community-based care in LSOA of local authority , defined as the number of supported people on 31 March 2013 multiplied by the national average unit cost of care from PSS-EX1 2013-14;

- $fi _｡ |_｡ « © \$ ' ' | _,$ is the Gross Current Expenditure on Home care, Day care, Direct Payments, Equipment and adaptations, Assessment and care management between in 2013-14 in local authority ;[6]

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[6] Source: Personal Social Services: Expenditure and Unit Costs, England, 2013-14, Final release

- $fi_{¸l_{¸}}«©©'_{¸}/&$ is the Gross Current Expenditure on Community: Direct Payments, Community: Home Care, Community: Supported Living, Community: Other Long Term Care between 1 April 2022 and 31 March 2023 in local authority .[7]

Figure A3 plots the total gross current expenditure on community-based services for 2022-23 in each LA reported in ASC-FR 2022-23 (i.e., $fi_{¸l_{¸}}«©©'_{¸}/&$ against the LA-total cost-weighted community care utilisation obtained from our rescaled LSOA-level data (i.e., $_{¸}«©©$ for the 18 to 64 (left panel) and 65 and over (right panel) age groups. The figures suggest that the rescaled data overstates the *level* of utilisation in 2022-23. However, as for the residential and nursing care support data, there is a strong positive and nearly linear relationship between the rescaled measure and actual support.

Figure A3 LA-level concordance between rescaled 2012-13 community-based care utilisation and actual 2022-23 community-based care utilisation
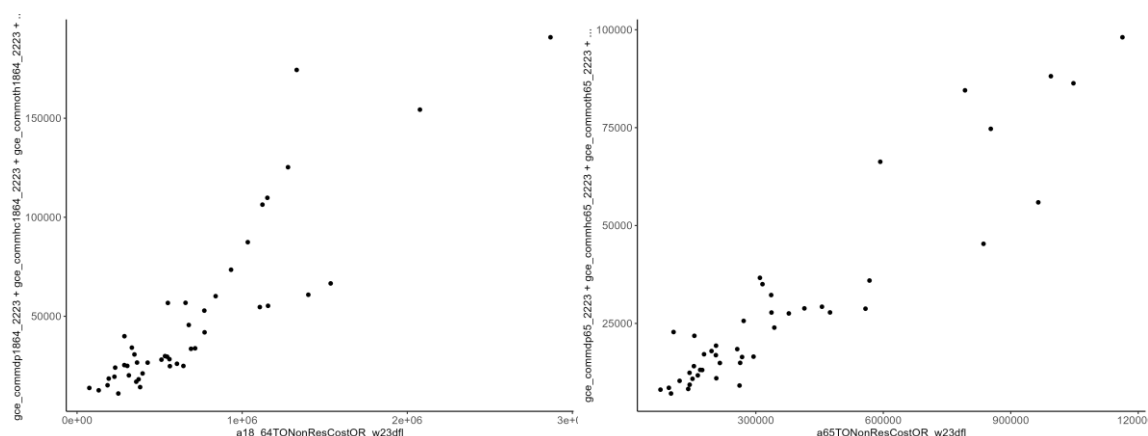
Table A1 presents the distribution of LA supported admissions to residential and nursing care, while Figure A3 the distribution of the cost-weighted community-based LA support in the analysed sample by age group.

Table A1 Distribution of LA supported admission to residential and nursing care by age group in the analysis sample

	Proportion of zeroes	mean	s.d.	p50	p75	p90	p99
LA-supported age 18 to 64 admissions to residential and nursing care	0.897	0.115	0.366	0	0	1	1
LA-supported age 65 and over admissions to residential and nursing care	0.337	1.541	1.517	1	2	3	7

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[7] Source: Adult Social Care Activity and Finance: England 2022-23, Table 43 and Table 44 for 18 to 64 and 65 and over age groups, respectively.

Figure A4 Density plots of cost-weighted community-based support for peopled aged 18 to 64 and 65 and over

kernel = epanechnikov, bandwidth = 181.2305

kernel = epanechnikov, bandwidth = 105.8780
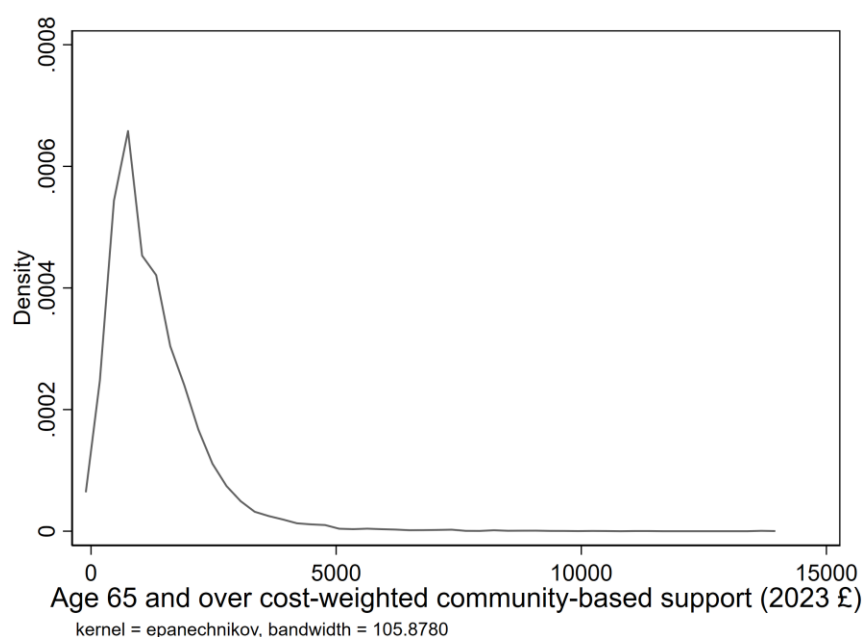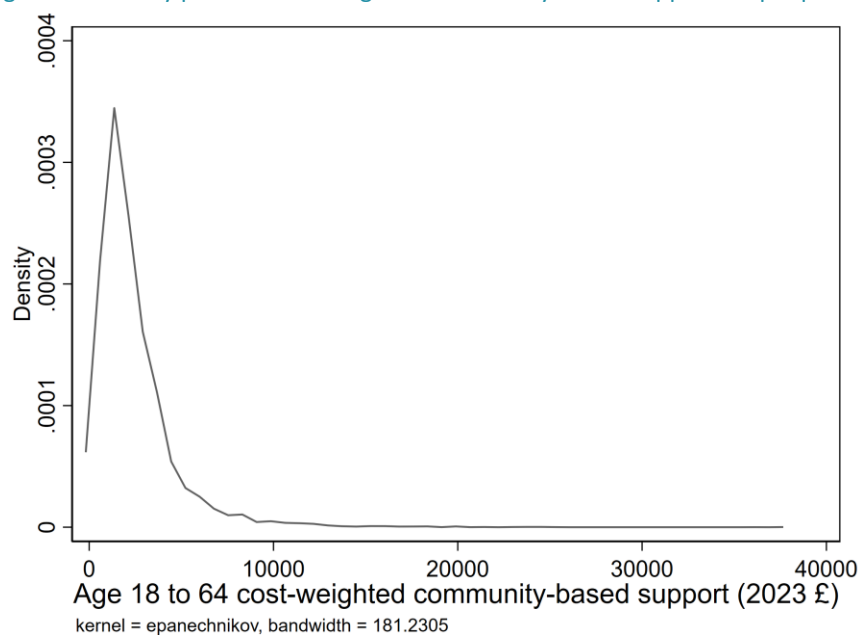
A.1.4. Need and financial status indicators

A.1.4.1. Census 2021 data on population characteristics

Census 2021 LSOA-level numbers of usual residents by age[8] were used as independent variables in regression models and as denominators for DWP benefit claimant indicators. Additionally, data on LSOA-level population characteristics was used to derive the following needs and financial status indicators.

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[8] RM121 – Sex by age https://www.nomisweb.co.uk/datasets/c2021rm121

Table A2 Census 2021 variables and derivations - Age 18 to 64 model

Independent variable	Numerator	Denominator
Share of people aged 16 to 24 in population aged 16 to 64	Number of usual residents aged 16 to 24[9]	Number of usual residents aged 16 to 64
Share of people aged 16 to 64 of White ethnicity	Number of usual residents aged 16 to 64 of white ethnicity[10]	Number of usual residents aged 16 to 64
Share of household reference persons aged 16 to 64 living in one-family households	Number of household reference persons aged 16 to 64 living in one-family households[11]	Number of household reference persons aged 16 to 64

Table A3 Census 2021 variables and derivations - Age 65 and over model

Independent variable	Numerator	Denominator
Share of people aged 80 and over in population aged 65 plus	Number of usual residents aged 80 and over [12]	Number of usual residents aged 65 and over
Share of people aged 65 and over of White ethnicity	Number of usual residents aged 65 and over of white ethnicity[13]	Number of usual residents aged 65 and over
Share of household reference persons aged 65 and over living as a couple	Number of household reference persons who are either married, cohabiting, in a civil partnership or separated but still married or in a civil partnership[14]	Number of household reference persons aged 65 and over
Share of household reference persons aged 65 and over who owned own home outright	Number of household reference persons aged 65 and over who owned own home outright[15]	Number of household reference persons aged 65 and over

A.1.4.2.   Department for Work and Pensions (DWP) benefit claimant data

Data on counts of benefit claimants were obtained from the "Benefit Combinations for England and Wales - Data from August 2021" dataset available on DWP Stat-Xplore[16].

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[9] RM121 – Sex by age https://www.nomisweb.co.uk/datasets/c2021rm121
[10] Lower layer Super Output Areas, Ethnic group (6 categories) and Age (3 categories) https://download.ons.gov.uk/downloads/filter-outputs/3287a8c2-fe93-4ef0-ac90-c98ceb74dd0f.csv
[11] Household composition (6 categories), Lower layer Super Output Areas and Age (3 categories) https://download.ons.gov.uk/downloads/filter-outputs/03391617-55e4-48d2-8069-04b7240143f0.csv
[12] RM121 – Sex by age https://www.nomisweb.co.uk/datasets/c2021rm121
[13] Lower layer Super Output Areas, Ethnic group (6 categories) and Age (3 categories) https://download.ons.gov.uk/downloads/filter-outputs/3287a8c2-fe93-4ef0-ac90-c98ceb74dd0f.csv
[14] RM066 – Living arrangements by age – Household Reference Person https://www.nomisweb.co.uk/datasets/c2021rm066
[15] Lower layer Super Output Areas, Tenure of household (5 categories) and Age (3 categories) https://download.ons.gov.uk/downloads/filter-outputs/0732b9cf-1560-4ed0-9e97-4d54a4936726.csv
[16] https://stat-xplore.dwp.gov.uk/

Benefit claims data at LSOA-level from Aug 2022, Nov 2022, Feb 2023 and May 2023 were used construct the benefit claims indicators used in the analysis.

Table A4 DWP benefit claimants variables and derivations - Age 18 to 64 and over model

Independent variable	Numerator	Denominator
UC-NWR or ESA or PIP/DLA/AA claimants aged 18 to 64 per capita aged 18 to 64	Mean over the four quarters to May 2023 of number of claimants aged 18 to 64 claiming either of Universal Credit with No Work Requirements, Employment Support Allowance, Personal Independence Payments, Disability Living Allowance or Attendance Allowance[17]	Number of usual residents aged 18 to 64

Table A5 DWP benefit claimants variables and derivations - Age 65 and over model

Independent variable	Numerator	Denominator
PIP/DLA/AA claimants aged 65 and over per capita 65 and over	Mean over the four quarters to May 2023 of number of PIP/DLA/AA claimants aged 65 and over (i.e., people claiming either Personal Independence Payments, Disability Living Allowance or Attendance Allowance)	Number of usual residents aged 65 and over
PC claimants aged 80 and over per capita 65 and over	Mean over the four quarters to May 2023 of number of Pension Credit claimants aged 80 and over	Number of usual residents aged 65 and over

A.1.4.3. Valuation Office Agency (VOA) dwelling stock by council tax band data

LSOA-level data on the stock of domestic properties by Council Tax bands on 31 March 2023 were obtained from the VOA[18]. These counts of properties in each Council Tax band in each LSOA were used in interaction with the share of household reference persons aged 65 and over who own home outright (from Census 2021) to define the following housing wealth indicators.

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[17] This is constructed by taking the sum of all ESA, all UC and all PIP/DLA/AA claimants and subtracting: 1) the number of UC-Out-of-Work claimants not on ESA and not on PIP/DLA/AA; 2) the number of UC with Work Requirements claimants not on ESA and not on PIP/DLA/AA; 3) the number of UC-Unknown requirements claimants not on ESA and not on PIP/DLA/AA; and 4) the number of people not on UC and not on ESA and not on PIP/DLA/AA

[18] Table CTSOP 1.1: number of properties by Council Tax band and region, county, local authority district, and lower and middle layer super output area, 1993 to 2023 https://www.gov.uk/government/statistics/council-tax-stock-of-properties-2023

Independent variable	Numerator	Denominator
Share of household reference persons aged 65 and over who own home outright × Share of all dwellings in Council tax bands A-E	Number of properties in Council Tax bands A, B, C, D, E *multiplied by* Share of household reference persons aged 65 and over who own home outright	Number properties in Council Tax bands A to H
Share of household reference persons aged 65 and over who own home outright × Share of all dwellings in Council tax bands F-H	Number of properties in Council Tax bands F, G, H *multiplied by* Share of household reference persons aged 65 and over who own home outright	Number properties in Council Tax bands A to H

A.1.4.4. Land Registry Price Paid Data

Data on house prices was obtained from the Land Registry Price Paid data for 2021, 2022 and 2023[19]. The Price Paid Data contains information on all property sales in England and Wales that are sold for value and registered with HM Land Registry. Data on Category A (Standard Price Paid entry, single residential property sold for full market value) transactions in England was used.

The raw data was cleaned by: i) removing observations with no postcode data; ii) removing observations that could not be matched with a Census 2021 using the ONS postcode to LSOA lookup (PCD to LSOA); and iii) removing duplicate entries with identical date, postcode, price, house name or unit number, and street.

To define LSOA (geometric) mean house price in 2021-2023, prices from each year were inflated to 2023 values using the December 2023 England House Price Index[20]. The geometric mean of house prices in each LSOA over the three years was then computed.

A.1.5. Residential and nursing care home bed supply

Data on non-dormant CQC-registered care homes' number of beds and location (in terms of postcode) were obtained from the September 2023 extract of the CQC care directory. The raw data was cleaned by: i) removing dormant care home entries and ii) removing duplicate entries with identical street address, postal code and number of beds. Each care home is then categorised into one of three mutually exclusive categories based on their reported "Service user band":

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[19] http://prod.publicdata.landregistry.gov.uk.s3-website-eu-west-1.amazonaws.com/pp-2023.csv

http://prod.publicdata.landregistry.gov.uk.s3-website-eu-west-1.amazonaws.com/pp-2022.csv

http://prod.publicdata.landregistry.gov.uk.s3-website-eu-west-1.amazonaws.com/pp-2021.csv

[20] https://publicdata.landregistry.gov.uk/market-trend-data/house-price-index-data/Indices-2023-12.csv?utm_medium=GOV.UK&utm_source=datadownload&utm_campaign=index&utm_term=9.30_14_02_24

- Care homes with services for "Older people" or "Dementia" but no services for "younger adults" or "whole population" are classified as care homes with services for people aged 65 and over;
- Care homes with services for "Younger adults" but no services for "Older people" or "Dementia" or "whole population" are classified as care homes with services for people aged 18 to 64;
- Care homes with services for "Older people" or "Dementia" *and for* "Younger adults", or care homes with services for "whole population" are classified as Mixed care homes.

Based on the above categories, a "care home bed for people aged 18 to 64" is defined as a bed in either a care home with services for people aged 18 to 64 or a mixed care home. A "care home bed for people aged 65 and over" is defined as a bed in either a care home for people aged 65 and over or a mixed care home.

For each of the 18 to 64 and 65 and over age groups, we constructed a measure of residential care beds supply using information on each care home's location, its number of beds for the age group, Census 2021 population-weighted LSOA centroids, and LSOA-level resident population.

To construct this measure, we first computed the straight-line distance from each LSOA centroid to each care home. Next, for each LSOA-care home pair, we defined the term, , where is the relevant population (i.e., aged 18 to 64 or 65 and over) in LSOA , and is the squared-distance between LSOA and Care home . For a given care home, , with number of beds, we then apportion the share equal to of their beds to LSOA . Finally, we define the residential care beds supply to each LSOA to be the sum of beds assigned from each care home .[21]

The proposed care home beds supply measure has two useful properties. First, because the shares, , sum to one for each care home, the measure apportions out exactly the number of beds in each care home. Put differently, the measure avoids double-counting of beds. Second, because the supply to each LSOA is the sum over all care homes, the measure accounts for all registered care homes.

Intuitively, all else equal, 'assigns' a larger share of Care home 's beds to LSOAs which are closer and have a larger relevant population. As the measure of supply from Care home to LSOA , , is increasing in the LSOA population and number of beds and decreasing in the distance between the LSOA and care home, we refer to our supply measure as a gravity-based measure of residential care supply.

The gravity-based measure of residential care supply was chosen as the preferred proxy after consideration of a range of alternatives including: the total number of care home beds in the local area (e.g., LSOA, MSOA), the number of beds within a 10km (or other distance cut-off) radius of the LSOA centroid, and the number of beds in the closest care home. Table A7 reports England-level descriptive statistics of the gravity-based measure along with corresponding statistics from alternative measure. Comparing the total value of the gravity-

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[21] Alternative variants, with squared, square-root and natural-log of population and distance values were trialled. Differences in descriptive statistics of the raw measures and differences across model estimates using these variants were minor.

based measure against total value of the 10km cutoff-based measure shows that the latter significantly overstates total beds supply. This arises because in areas with high population density, each care home is likely to fall within the 10km catchment of multiple LSOAs. In such cases, a single care home bed is treated as 'supply' to multiple LSOAs by the distance cutoff-based measure. Comparing the gravity-based measure against measure based on the number of beds in closest care home shows that the latter omits beds in care homes that are not the closest to any LSOA. On the other hand, as care homes usually offer services to areas larger than an LSOA, the measure of number of beds in a LSOA includes a large share (over 50 per cent) of LSOAs without care homes located in them, displaying a rather skewed distribution of supply due entirely to geographic location.

Table A7 Descriptive statistics of alternative measures of residential and nursing care home bed supply

Supply proxy	England total	Mean	p10	p50	p90
Age 18 to 64					
Beds in LSOA	263,712.00	7.81	0.00	0.00	30.00
Gravity-based measure	263,712.00	7.81	1.92	4.58	16.53
Beds in closest care home	243,172.00	7.20	0.57	3.74	17.25
Beds within 10km radius	64,321,022.00	1,905.53	316.00	1,512.00	4,155.00
Age 65 and over					
Beds in LSOA	430,640.00	12.76	0.00	0.00	52.00
Gravity-based measure	430,640.00	12.76	2.98	7.52	28.97
Beds in closest care home	378,645.00	11.22	1.07	7.00	25.93
Beds within 10km radius	104,255,908.00	3,088.61	545.00	2,484.00	6,765.60

Figure A5 and A6 plot the geographical distribution of the gravity-based measure of residential care supply for people aged 18 to 64 and 65 and over, respectively. Broadly, they show higher levels of supply in (or around) areas with higher population density, such as London and the metropolitan centres in the West Midlands and North West.

Figure A5 Residential and nursing home bed supply for people aged 18 to 64

■	16.53 - 199.34
■	9.67 - 16.53
■	7.05 - 9.67
■	5.55 - 7.05
■	4.58 - 5.55
■	3.83 - 4.58
■	3.22 - 3.83
■	2.62 - 3.22
■	1.92 - 2.62
■	0.10 - 1.92
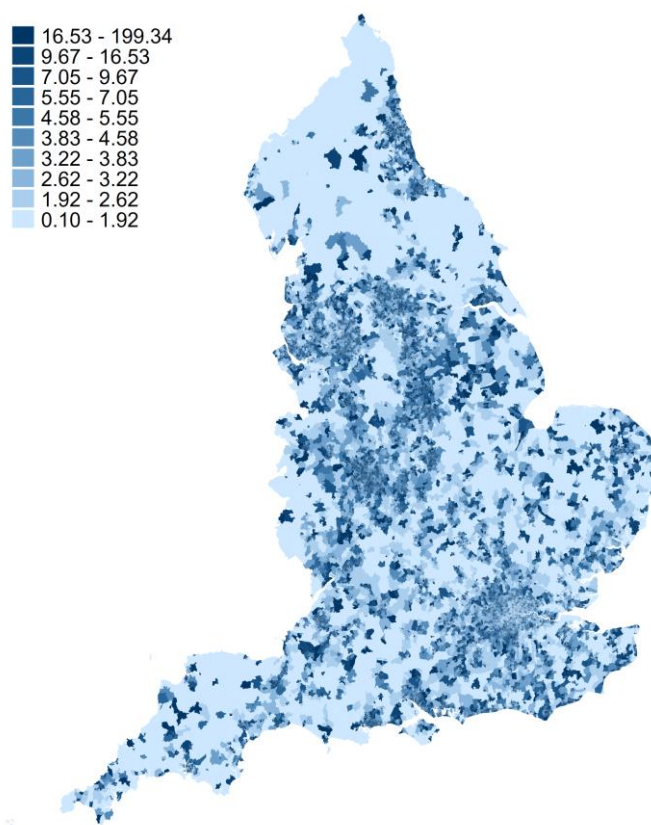
Figure A6 Residential and nursing home bed supply for people aged 65 and over

■	28.97 - 220.29
■	17.08 - 28.97
■	12.03 - 17.08
■	9.29 - 12.03
■	7.52 - 9.29
■	6.22 - 7.52
■	5.11 - 6.22
■	4.07 - 5.11
■	2.98 - 4.07
■	0.02 - 2.98
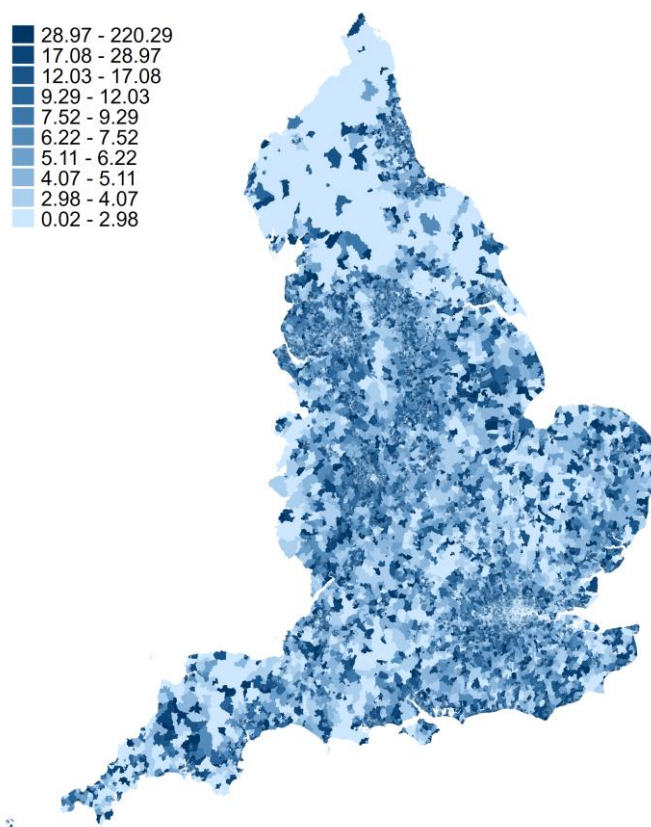
A.1.6. Social care labour supply

We use the MSOA-level number of people employed in Caring personal service occupations (SOC2020-61) in the Human health and social work activities (SIC2007-Q) industry, from Census 2021[22], as our measure of social care labour supply.

While this indicator is a broad measure of labour supply to the health and social care sector, it is highly correlated to narrower measures of direct care employment in ASC. This is illustrated in Figure A7 which plots, for each LA, its total SIC-Q-SOC-61 employment against its total domiciliary care direct care FTE as published by Skills for Care.

Figure A7 Concordance between Census 2021-based social care labour supply measure and Skills for Care domiciliary direct care worker FTE at LA level

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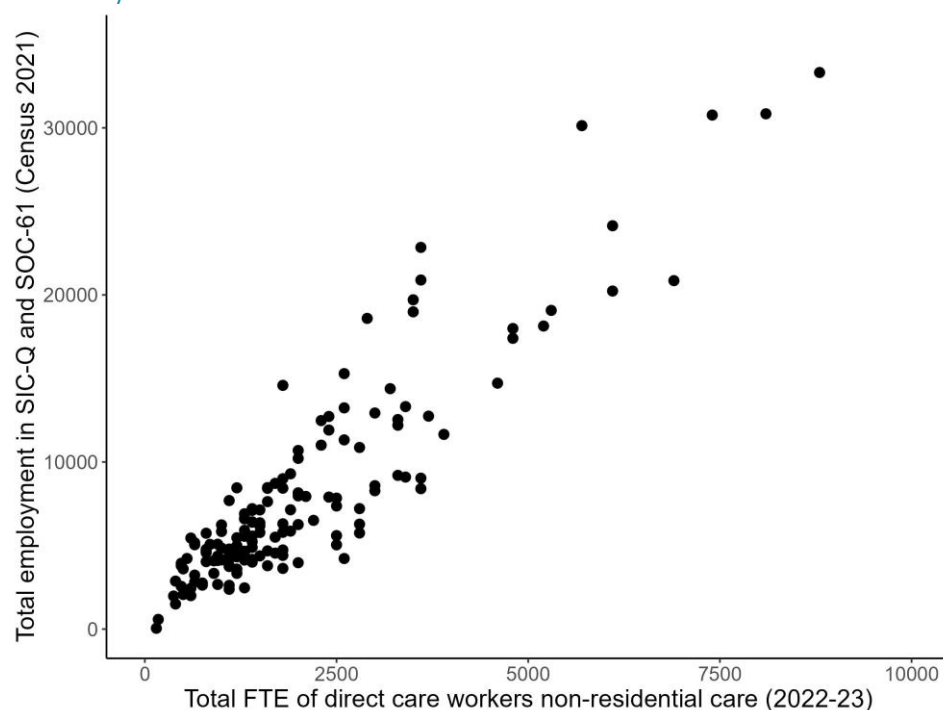
[22] Middle layer Super Output Areas, Industry (current) (16 categories) and Occupation (current) (27 categories) https://download.ons.gov.uk/downloads/filter-outputs/a5f9d844-f890-438a-bd6f-1986e4b85618.csv

A.1.7. Sample selection and representativeness

Table A8 Descriptive statistics of model indicators of analysis sample compared to England overall – age group 18 to 64

	Community-based care sample		Residential and Nursing care sample		England	
	mean	s.d.	mean	s.d.	mean	s.d.
Log of population aged 18 to 64	6.874	0.238	6.873	0.24	6.892	0.246
Share of people aged 16 to 64 of White ethnicity	0.836	0.191	0.85	0.173	0.817	0.203
Share of household reference persons aged 16 to 64 living in one-family households	0.691	0.106	0.693	0.104	0.683	0.109
Share of people aged 16 to 24 in population aged 16 to 64	0.157	0.061	0.155	0.060	0.158	0.067
UC-NWR or ESA or PIP/DLA/AA claimants aged 18 to 64 per capita aged 18 to 64	0.100	0.062	0.098	0.061	0.103	0.063
Supply of care home beds for younger adults per capita 18 to 64	0.008	0.011	0.008	0.011	0.008	0.011
MSOA-level ASC employment per capita aged 18 to 64[1]	0.036	0.013	0.036	0.013	0.036	0.013
Number of LAs	47		48		152	
Observations	12,245		12,205		33,755	

	Community-based care sample		Residential and Nursing care sample		England	
	mean	s.d.	mean	s.d.	mean	s.d.
Log of population aged 65 and over	5.649	0.516	5.666	0.505	5.613	0.531
Share of people aged 65 and over of White ethnicity	0.907	0.163	0.92	0.145	0.897	0.172
Share of household reference persons aged 65 and over living as a couple	0.452	0.118	0.458	0.116	0.444	0.120
Share of people aged 80 and over in population aged 65 plus	0.262	0.066	0.260	0.065	0.259	0.065
PC claimants aged 80 and over per capita 65 plus	0.053	0.039	0.050	0.035	0.056	0.040
PIP/DLA/AA claimants aged 65 and over per capita 65 plus	0.217	0.095	0.211	0.092	0.228	0.099
Share of household reference persons aged 65 and over who own home outright × Share of all dwellings in Council tax bands A-E	0.604	0.186	0.612	0.184	0.606	0.193
Share of household reference persons aged 65 and over who own home outright × Share of all dwellings in Council tax bands F-H	0.087	0.139	0.087	0.136	0.071	0.124
Supply of care home beds for older people per capita 65 plus	0.042	0.043	0.041	0.042	0.041	0.042
MSOA-level ASC employment per capita aged 65 plus	0.133	0.087	0.129	0.084	0.139	0.090
Number of LAs	46		48		152	
Observations	12,715		13,238		33,755	

Table A10 Number of people supported at year end per 1000 residents, by age group

	Community-based care		Residential and nursing care	
	Analysed sample	England	Analysed sample	England
Age group 18 to 64				
Mean	6.466	6.533	1.201	1.102
s.d.	1.790	1.692	0.388	0.387
Number of LAs	47	152	48	152
Age group 65 and over				
Mean	23.736	26.340	14.161	14.497
s.d.	9.039	12.182	4.025	3.733
Number of LAs	46	152	48	152

A.2. Instrumental variables estimation

A.2.1. IV first-stage regressions

Table A11 First-stage regressions – Age 18 to 64 models

	(1) Care home beds supply	(2) ASC labour supply	(3) Care home beds supply	(4) ASC labour supply
MSOA leave-one-out average number of care homes with beds for younger adults per LSOA	0.004*** (0.000)		0.004*** (0.000)	
MSOA-level ASC employment per capita aged 18 to 64	0.074*** (0.013)		0.072*** (0.013)	
Supply of care home beds in care homes for younger adults per capita 18 to 64		-0.003*** (0.001)		-0.004*** (0.001)
UTLA leave-one-out average employment in SIC-Q occupations per MSOA		0.056*** (0.011)		0.057*** (0.011)
Log of population aged 18 to 64	-0.003*** (0.001)	-0.000 (0.001)	-0.003*** (0.001)	0.000 (0.001)
Share of people aged 16 to 64 of White ethnicity	0.001 (0.001)	0.006*** (0.002)	0.000 (0.001)	0.005* (0.003)
Share of household reference persons aged 16 to 64 living in one-family households	-0.017*** (0.002)	0.002 (0.003)	-0.017*** (0.002)	0.003 (0.003)
Share of people aged 16 to 24 in population aged 16 to 64	-0.007*** (0.002)	-0.009*** (0.003)	-0.007*** (0.002)	-0.010*** (0.003)
UC-NWR or ESA or PIP/DLA/AA claimants aged 18 to 64 per capita aged 18 to 64	-0.000 (0.003)	0.114*** (0.006)	0.001 (0.003)	0.115*** (0.006)
LA FE	Y	Y	Y	Y
R-squared	0.089	0.570	0.093	0.573
Adj R-squared	0.0852	0.568	0.0889	0.571
LAs	47	47	48	48
Observations	12,245	12,245	12,205	12,205

Notes: Robust standard errors clustered at UTLA-level in parentheses *** p<0.01, ** p<0.05, * p<0.1. The dependent variable for Columns 1 and 3 is Supply of care home beds in care homes for younger people per capita 18 to 64. The dependent variable for Columns 2 and 4 is MSOA total employment in SOC2020-61 occupations in SIC2007-Q industries per capita aged 18 to 64. Columns 1 and 2 are based on the estimation

sample for Community-based care and Columns 3 and 4 the estimation sample for Residential and Nursing care.

	(1) Care home beds supply	(2) ASC labour supply	(3) Care home beds supply	(4) ASC labour supply
MSOA leave-one-out average number of care homes with beds for older people per LSOA	0.015*** (0.001)		0.014*** (0.001)	
MSOA-level ASC employment per capita aged 18 to 64	0.039*** (0.013)		0.035*** (0.012)	
Supply of care home beds in care homes for older people per capita 65 plus		0.044* (0.024)		0.042* (0.023)
UTLA leave-one-out average employment in SIC-Q industries per MSOA		-0.021*** (0.003)		-0.022*** (0.003)
Log of population aged 65 and over	-0.006*** (0.002)	-0.062*** (0.008)	-0.008*** (0.002)	-0.057*** (0.007)
Share of people aged 65 and over of White ethnicity	0.017** (0.007)	-0.056* (0.033)	0.009 (0.006)	-0.065 (0.043)
Share of household reference persons aged 65 and over living as a couple	0.012 (0.011)	-0.100*** (0.021)	0.005 (0.010)	-0.102*** (0.022)
Share of people aged 80 and over in population aged 65 plus	0.235*** (0.012)	-0.077** (0.029)	0.225*** (0.012)	-0.097*** (0.025)
PC claimants aged 80 and over per capita 65 plus	-0.102*** (0.023)	-0.067 (0.044)	-0.076*** (0.024)	-0.048 (0.064)
PIP/DLA/AA claimants aged 65 and over per capita 65 plus	0.114*** (0.013)	0.171*** (0.030)	0.109*** (0.011)	0.198*** (0.025)
Share of household reference persons aged 65 and over who own home outright × Share of all dwellings in Council tax bands A-E	0.002 (0.006)	-0.023 (0.016)	0.008 (0.005)	-0.006 (0.017)
Share of household reference persons aged 65 and over who own home outright × Share of all dwellings in Council tax bands F-H	-0.001 (0.010)	-0.069*** (0.022)	0.008 (0.009)	-0.051** (0.023)

LA FE	Y	Y	Y	Y
R-squared	0.200	0.561	0.191	0.548
Adj R-squared	0.196	0.559	0.187	0.546
LAs	46	46	48	48
Observations	12,715	12,715	13,238	13,238

Notes: Robust standard errors clustered at UTLA-level in parentheses *** p<0.01, ** p<0.05, * p<0.1. The dependent variable for Columns 1 and 3 is Supply of care home beds in care homes for older people per capita 65 plus. The dependent variable for Columns 2 and 4 is MSOA total employment in SOC2020-61 occupations in SIC2007-Q industries per capita aged 65 plus. Columns 1 and 2 are based on the estimation sample for Community-based care and Columns 3 and 4 the estimation sample for Residential and Nursing care.

A.2.2. IV balance regressions

Table A13 Regressions of correlates of local area ASC demand on instrumental variables for care home beds and ASC labour supply – Age 18 to 64 model

	(1) PIP/DLA/AA	(2) PIP/DLA/AA	(3) PIP/DLA/AA	(4) PIP/DLA/AA	(5) Disabled: limited a lot	(6) Disabled: limited a lot	(7) Disabled: limited a lot	(8) Disabled: limited a lot
MSOA leave-one-out average number of care homes with beds for younger adults per LSOA	0.004*** (0.001)	0.002 (0.001)			0.004*** (0.001)	0.002 (0.001)		
UTLA leave-one-out average employment in SIC-Q occupations per MSOA			-0.001 (0.001)	0.000 (0.001)			-0.001 (0.001)	0.001 (0.001)
Share of people aged 16 to 24 in population aged 16 to 64		-0.059*** (0.020)		-0.060*** (0.020)		-0.044*** (0.016)		-0.045*** (0.016)
Share of people aged 16 to 64 of White ethnicity		0.007 (0.010)		0.007 (0.010)		0.010 (0.008)		0.010 (0.008)
Share of household reference persons aged 16 to 64 living in one-family households		-0.137*** (0.017)		-0.138*** (0.018)		-0.116*** (0.014)		-0.117*** (0.014)
LA FE	Y	Y	Y	Y	Y	Y	Y	Y
R-squared	0.219	0.310	0.217	0.310	0.240	0.341	0.236	0.340
Adj R-squared	0.216	0.308	0.214	0.307	0.237	0.338	0.234	0.338
LAs	47	47	47	47	47	47	47	47
Observations	12,245	12,245	12,245	12,245	12,245	12,245	12,245	12,245

Notes: Robust standard errors clustered at UTLA-level in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$. The dependent variable for Columns 1 to 4 is PIP/DLA/AA claimants aged 18 to 64 per capita 18 to 64 from DWP Stat-Xplore. The dependent variable for Columns 5 to 8 is Share of people aged 16 to 64 disabled under the Equality Act: day-to-day activities limited a lot from Census 2021.

Table A14 Regressions of correlates of local area ASC demand on instrumental variables for care home beds and ASC labour supply – Age 65 and over model

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
					Disabled:	Disabled:	Disabled:	Disabled:
	PIP/DLA/AA	PIP/DLA/AA	PIP/DLA/AA	PIP/DLA/AA	limited a lot	limited a lot	limited a lot	limited a lot
MSOA leave-one-out average number of care homes with beds for older people per LSOA	-0.001 (0.003)	-0.002 (0.002)			0.002 (0.002)	0.000 (0.001)		
UTLA leave-one-out average employment in SIC-Q industries per MSOA			-0.010*** (0.004)	-0.002 (0.002)			-0.006** (0.002)	-0.002 (0.001)
Share of people aged 80 and over in population aged 65 plus		0.063*** (0.015)		0.064*** (0.015)		0.243*** (0.012)		0.245*** (0.012)
Share of people aged 65 and over of White ethnicity		-0.154*** (0.017)		-0.154*** (0.017)		-0.078*** (0.011)		-0.077*** (0.011)
Share of household reference persons aged 65 and over living as a couple		-0.430*** (0.019)		-0.429*** (0.019)		-0.245*** (0.014)		-0.243*** (0.014)
LA FE	Y	Y	Y	Y	Y	Y	Y	Y
R-squared	0.304	0.596	0.310	0.596	0.227	0.487	0.231	0.488
Adj R-squared	0.302	0.594	0.308	0.594	0.225	0.485	0.228	0.486
LAs	46	46	46	46	46	46	46	46
Observations	12,715	12,715	12,715	12,715	12,715	12,715	12,715	12,715

Notes: Robust standard errors clustered at UTLA-level in parentheses *** p<0.01, ** p<0.05, * p<0.1. The dependent variable for Columns 1 to 4 is PIP/DLA/AA claimants aged 65 and over per capita 65 plus from DWP Stat-Xplore. The dependent variable for Columns 5 to 8 is Share of people aged 65 and over disabled under the Equality Act: day-to-day activities limited a lot from Census 2021.

A.3. Supplemental estimation output

A.3.1. Main specification with non-IV estimates

Table A15 Community-based care for people aged 18 to 64

	(1) No supply controls OLS	(2) Supply controls without IV OLS	(3) Supply controls with IV TSLS
Log of population aged 18 to 64	1,064.812***	1,090.875***	1,183.701***
	(146.418)	(144.337)	(153.759)
Share of people aged 16 to 64 of White ethnicity	-594.302**	-630.475**	-678.377***
	(248.404)	(242.212)	(216.904)
Share of household reference persons aged 16 to 64 living in one-family households	-1,874.817***	-1,702.379***	-1,198.432***
	(273.417)	(275.836)	(356.486)
Share of people aged 16 to 24 in population aged 16 to 64	-2,107.197***	-1,982.490***	-1,747.538***
	(353.826)	(354.585)	(366.893)
UC-NWR or ESA or PIP/DLA/AA claimants aged 18 to 64 per capita aged 18 to 64	11,023.756***	10,636.072***	10,673.887***
	(874.575)	(902.861)	(1,346.337)
Supply of care home beds in care homes for younger adults per capita 18 to 64		8,968.574***	35,528.916***
		(1,741.520)	(13,106.265)
MSOA total employment in SOC2020-61 occupations in SIC2007-Q industries per capita aged 18 to 64		2,713.418	444.344
		(2,608.064)	(8,999.151)
Observations	12,245	12,245	12,245
R-squared	0.342	0.345	0.158
LA FE	Y	Y	Y
IV Res	N	N	Y
IV Com	N	N	Y
LAs	47	47	47
Adj R-squared	0.340	0.342	0.157
First-stage (KP Wald)			38.82
Hausman stat			4.264
Hausman p-val			0.119

Notes: Robust standard errors clustered at UTLA-level in parentheses *** p<0.01, ** p<0.05, * p<0.1.

	(1)		(2)		(3)	
	No supply controls		Supply controls without IV		Supply controls with IV	
	Logit (coef)	Logit (marg)	Logit (coef)	Logit (marg)	Logit-IV (coef)	Logit-IV (marg)
Log of population aged 18 to 64	0.615***	0.053***	0.662***	0.057***	0.772***	0.067***
	(0.150)	(0.013)	(0.149)	(0.013)	(0.160)	(0.014)
Share of people aged 16 to 64 of White ethnicity	-0.236	-0.020	-0.268	-0.023	-0.386	-0.033
	(0.250)	(0.022)	(0.249)	(0.022)	(0.285)	(0.025)
Share of household reference persons aged 16 to 64 living in one-family households	-1.907***	-0.166***	-1.644***	-0.142***	-0.860*	-0.074*
	(0.311)	(0.027)	(0.310)	(0.027)	(0.478)	(0.041)
Share of people aged 16 to 24 in population aged 16 to 64	-3.153***	-0.274***	-2.960***	-0.256***	-2.391***	-0.206***
	(0.692)	(0.059)	(0.675)	(0.058)	(0.807)	(0.069)
UC-NWR or ESA or PIP/DLA/AA claimants aged 18 to 64 per capita aged 18 to 64	4.270***	0.371***	3.974***	0.343***	2.091	0.180
	(0.545)	(0.046)	(0.651)	(0.056)	(1.467)	(0.127)
Supply of care home beds in care homes for younger adults per capita 18 to 64			10.680***	0.923***	49.537***	4.272***
			(2.288)	(0.197)	(15.501)	(1.340)
MSOA total employment in SOC2020-61 occupations in SIC2007-Q industries per capita aged 18 to 64			2.111	0.182	15.237	1.314
			(3.367)	(0.291)	(11.640)	(1.002)
1st-stage resid.: Beds IV					-40.866***	
					(15.632)	
1st-stage resid.: Dom. care FTE IV					-18.105	
					(11.702)	
Observations	12,205	12,205	12,205	12,205	12,205	12,205
AIC	8006.7212	8006.7212	7987.8689	7987.8689	8078.8704	8078.8704
BIC	8043.7692	8043.7692	8039.7361	8039.7361	8501.2177	8501.2177
LA FE	Y	Y	Y	Y	Y	Y
IV Res	N	N	N	N	Y	Y

IV Com	N	N	N	N	Y	Y
First-stage (KP Wald)					35.940346	35.940346

Notes: Robust standard errors clustered at UTLA-level in parentheses *** p<0.01, ** p<0.05, * p<0.1. Marginal effects evaluated at sample mean values of regressors.

Table A17 Community-based care for people aged 65 and over

	(1) No supply controls OLS	(2) Supply controls without IV OLS	(3) Supply controls with IV TSLS
Log of population aged 65 and over	861.594*** (60.674)	821.898*** (57.700)	880.139*** (77.962)
Share of people aged 65 and over of White ethnicity	116.338 (92.944)	102.075 (91.095)	168.594 (108.606)
Share of household reference persons aged 65 and over living as a couple	-1,196.745*** (140.232)	-1,246.487*** (138.941)	-1,149.293*** (149.299)
Share of people aged 80 and over in population aged 65 plus	1,013.337*** (253.096)	1,188.797*** (261.583)	1,447.764*** (381.678)
PC claimants aged 80 and over per capita 65 plus	1,133.873** (505.786)	984.490* (499.416)	972.691* (537.748)
PIP/DLA/AA claimants aged 65 and over per capita 65 plus	1,725.045*** (231.418)	1,923.824*** (248.353)	1,857.570*** (285.041)
Share of household reference persons aged 65 and over who own home outright × Share of all dwellings in Council tax bands A-E	-708.908*** (94.259)	-719.483*** (90.390)	-692.238*** (91.168)
Share of household reference persons aged 65 and over who own home outright × Share of all dwellings in Council tax bands F-H	-1,283.962*** (149.222)	-1,327.470*** (151.513)	-1,243.961*** (149.467)
Supply of care home care home beds in care homes for older people per capita 65 plus		-889.531*** (219.467)	-1,746.298 (1,076.289)
MSOA total employment in SOC2020-61 occupations in SIC2007-Q industries per capita aged 65 plus		-500.499*** (179.740)	466.879 (562.012)
Observations	12,715	12,715	12,715
R-squared	0.464	0.467	0.339
LA FE	Y	Y	Y
IV Res	N	N	Y
IV Com	N	N	Y
LAs	46	46	46
Adj R-squared	0.462	0.464	0.339
First-stage F-stat			65.28
Hausman stat			4.260

Hausman p-val	0.119

Table A18 Residential and nursing care for people aged 65 and over

	(1) No supply controls		(2) Supply controls without IV		(3) Supply controls with IV	
	NB (coef)	NB (marg)	NB (coef)	NB (marg)	NB-IV (coef)	NB-IV (marg)
Log of population aged 65 and over	0.787***	1.023***	0.792***	1.029***	0.797***	1.036***
	(0.039)	(0.048)	(0.036)	(0.044)	(0.035)	(0.045)
Share of people aged 65 and over of White ethnicity	0.832***	1.081***	0.824***	1.070***	0.808***	1.050***
	(0.127)	(0.164)	(0.124)	(0.159)	(0.112)	(0.145)
Share of household reference persons aged 65 and over living as a couple	-0.747***	-0.971***	-0.750***	-0.974***	-0.744***	-0.967***
	(0.185)	(0.241)	(0.184)	(0.239)	(0.133)	(0.173)
Share of people aged 80 and over in population aged 65 plus	1.204***	1.564***	0.913***	1.186***	0.614**	0.798**
	(0.286)	(0.373)	(0.233)	(0.302)	(0.267)	(0.347)
PC claimants aged 80 and over per capita 65 plus	2.036***	2.646***	2.123***	2.759***	2.242***	2.913***
	(0.443)	(0.572)	(0.435)	(0.562)	(0.458)	(0.594)
PIP/DLA/AA claimants aged 65 and over per capita 65 plus	0.870***	1.131***	0.746***	0.969***	0.598***	0.777***
	(0.256)	(0.331)	(0.239)	(0.309)	(0.214)	(0.278)
Share of household reference persons aged 65 and over who own home outright × Share of all dwellings in Council tax bands A-E	-0.577***	-0.750***	-0.589***	-0.765***	-0.603***	-0.783***
	(0.141)	(0.184)	(0.140)	(0.183)	(0.087)	(0.113)
Share of household reference persons aged 65 and over who own home outright × Share of all dwellings in Council tax bands F-H	-1.246***	-1.619***	-1.270***	-1.650***	-1.288***	-1.673***
	(0.166)	(0.216)	(0.165)	(0.214)	(0.147)	(0.191)
Supply of care home beds in care homes for older people per capita 65 plus			0.988***	1.284***	2.344**	3.046**
			(0.314)	(0.408)	(0.999)	(1.300)

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	(1)	(2)	(3)	(4)	(5)	(6)
MSOA total employment in SOC2020-61 occupations in SIC2007-Q industries per capita aged 65 plus			-0.079	-0.103	-0.154	-0.200
			(0.123)	(0.160)	(0.470)	(0.611)
1st-stage resid.: Beds IV					-1.399	
					(0.993)	
1st-stage resid.: Dom. care FTE IV					0.044	
					(0.494)	
Observations	13,238	13,238	13,238	13,238	13,238	13,238
AIC	39343.407	39343.407	39313.791	39313.791	39411.813	39411.813
BIC	39410.824	39410.824	39396.19	39396.19	39868.755	39868.755
LA FE	Y	Y	Y	Y	Y	Y
IV Res	N	N	N	N	Y	Y
IV Com	N	N	N	N	Y	Y
First-stage F-stat					65.192605	65.192605

Notes: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Marginal effects evaluated at sample mean values of regressors.

A.3.2. Alternative specifications

Table A19 Community-based care for people aged 65 and over – Alternative specification with house prices

	(1) No supply controls OLS	(2) Supply controls without IV OLS	(3) Supply controls with IV TSLS
Log of population aged 65 and over	836.999*** (60.652)	800.491*** (58.363)	860.948*** (78.669)
Share of people aged 65 and over of White ethnicity	189.434* (97.212)	180.821* (96.321)	251.007** (118.744)
Share of household reference persons aged 65 and over living as a couple	-1,743.375*** (157.772)	-1,783.852*** (152.899)	-1,656.768*** (162.519)
Share of people aged 80 and over in population aged 65 plus	633.571*** (232.301)	828.325*** (241.402)	1,170.331*** (367.405)
PC claimants aged 80 and over per capita 65 plus	1,820.584*** (571.412)	1,669.337*** (564.037)	1,606.314*** (596.659)
PIP/DLA/AA claimants aged 65 and over per capita 65 plus	2,133.582*** (253.557)	2,321.457*** (268.022)	2,266.496*** (295.619)
Share of household reference persons aged 65 and over who own home outright × LSOA (geometric) mean house price in 2021-2023 (thousands £)	-0.328*** (0.094)	-0.367*** (0.092)	-0.331*** (0.099)
Gravity-based measure of care home beds in care homes for older people per capita 65 plus		-938.489*** (219.041)	-2,074.182* (1,074.824)
MSOA total employment in SOC2020-61 occupations in SIC2007-Q industries per capita aged 65 and over		-443.885** (177.714)	567.828 (549.932)
Observations	12,715	12,715	12,715
R-squared	0.464	0.467	0.339
LA FE	Y	Y	Y
IV Res	N	N	Y
IV Com	N	N	Y
LAs	46	46	46
Adj R-squared	0.462	0.464	0.339
First-stage F-stat			65.28
Hausman stat			4.260
Hausman p-val			0.119

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

	(1) No supply controls NB (marg)	(2) Supply controls without IV NB (marg)	(3) Supply controls with IV NB-IV (marg)
Log of population aged 65 and over	1.009*** (0.049)	1.010*** (0.043)	1.006*** (0.045)
Share of people aged 65 and over of White ethnicity	1.177*** (0.156)	1.163*** (0.151)	1.140*** (0.144)
Share of household reference persons aged 65 and over living as a couple	-1.362*** (0.280)	-1.393*** (0.274)	-1.418*** (0.162)
Share of people aged 80 and over in population aged 65 plus	1.266*** (0.399)	0.898*** (0.315)	0.609* (0.356)
PC claimants aged 80 and over per capita 65 plus	3.482*** (0.670)	3.603*** (0.647)	3.722*** (0.578)
PIP/DLA/AA claimants aged 65 and over per capita 65 plus	1.359*** (0.281)	1.243*** (0.263)	1.151*** (0.264)
Share of household reference persons aged 65 and over who own home outright × LSOA (geometric) mean house price in 2021-2023	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)
Gravity-based measure of care home beds in care homes for older people per capita 65 plus		1.176*** (0.406)	2.389* (1.303)
MSOA total employment in SOC2020-61 occupations in SIC2007-Q industries per capita aged 65 and over		-0.177 (0.163)	-0.372 (0.610)
Observations	13,238	13,238	13,238
AIC	39372.877	39348.471	39447.482
BIC	39432.804	39423.38	39896.933
LA FE	Y	Y	Y
IV Res	N	N	Y
IV Com	N	N	Y
First-stage F-stat			67.4251

Notes: Robust standard errors clustered at UTLA-level in parentheses *** p<0.01, ** p<0.05, * p<0.1. Marginal effects evaluated at sample mean values of regressors.

Table A21 Community-based care for people aged 18 to 64 – Alternative specification with Census 2021 disability

	(1) No supply controls	(2) Supply controls without IV	(3) Supply controls with IV
	OLS	OLS	TSLS
Log of population aged 18 to 64	1,151.552***	1,163.887***	1,237.325***
	(144.389)	(142.505)	(153.690)
Share of people aged 16 to 64 of White ethnicity	-896.415***	-925.976***	-960.789***
	(219.119)	(216.168)	(194.069)
Share of household reference persons aged 16 to 64 living in one-family households	-1,689.057***	-1,548.641***	-1,178.108***
	(268.171)	(269.158)	(329.819)
Share of people aged 16 to 24 in population aged 16 to 64	-2,183.048***	-2,033.030***	-1,867.059***
	(339.308)	(335.634)	(353.471)
Share of people aged 16 to 64 disabled under the Equality Act: day-to-day activities limited a lot	22,856.352***	21,512.046***	21,491.663***
	(1,818.954)	(1,820.919)	(2,432.283)
Supply of care home beds in care homes for younger adults per capita 18 to 64		7,424.909***	28,891.531**
		(1,872.370)	(12,611.830)
MSOA total employment in SOC2020-61 occupations in SIC2007-Q industries per capita aged 18 to 64		5,333.327**	2,525.636
		(2,416.891)	(8,313.410)
Observations	12,245	12,245	12,245
R-squared	0.346	0.349	0.172
LA FE	Y	Y	Y
IV Res	N	N	Y
IV Com	N	N	Y
LAs	47	47	47
Adj R-squared	0.344	0.346	0.171
First-stage F-stat			36.44
Hausman stat			3.020
Hausman p-val			0.221

Notes: Robust standard errors clustered at UTLA-level in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table A22 Residential and nursing care for people aged 18 to 64 – Alternative specification with Census 2021 disability

	(1) No supply controls Logit (marg)	(2) Supply controls without IV Logit (marg)	(3) Supply controls with IV Logit-IV (marg)
Log of population aged 18 to 64	0.057***	0.060***	0.067***
	(0.013)	(0.012)	(0.014)
Share of people aged 16 to 64 of White ethnicity	-0.029	-0.031	-0.037
	(0.020)	(0.021)	(0.024)
Share of household reference persons aged 16 to 64 living in one-family households	-0.161***	-0.140***	-0.079**
	(0.028)	(0.029)	(0.040)
Share of people aged 16 to 24 in population aged 16 to 64	-0.268***	-0.250***	-0.201***
	(0.058)	(0.056)	(0.067)
Share of people aged 16 to 64 disabled under the Equality Act: day-to-day activities limited a lot	0.758***	0.670***	0.339
	(0.087)	(0.099)	(0.238)
Supply of care home beds in care homes for younger adults per capita 18 to 64		0.870***	4.030***
		(0.200)	(1.337)
MSOA total employment in SOC2020-61 occupations in SIC2007-Q industries per capita aged 18 to 64		0.292	1.388
		(0.271)	(0.982)
Observations	12,205	12,205	12,205
AIC	8005.5161	7988.3473	8080.3651
BIC	8042.5641	8040.2145	8502.7124
LA FE	Y	Y	Y
IV Res	N	N	Y
IV Com	N	N	Y
First-stage F-stat			33.540236

Notes: Robust standard errors clustered at UTLA-level in parentheses *** p<0.01, ** p<0.05, * p<0.1. Marginal effects evaluated at sample mean values of regressors.

Table A23 Community-based care for people aged 65 and over – Alternative specification with Census 2021 disability

	(1) No supply controls	(2) Supply controls without IV	(3) Supply controls with IV
	OLS	OLS	TSLS
Log of population aged 65 and over	863.606***	833.406***	881.767***
	(59.079)	(56.305)	(76.777)
Share of people aged 65 and over of White ethnicity	137.242	130.002	187.163*
	(94.526)	(94.131)	(110.265)
Share of household reference persons aged 65 and over living as a couple	-1,229.667***	-1,275.976***	-1,195.138***
	(151.089)	(150.694)	(165.085)
Share of people aged 80 and over in population aged 65 plus	1,078.371***	1,163.690***	1,379.300***
	(278.289)	(284.706)	(349.313)
PC claimants aged 80 and over per capita 65 plus	2,873.774***	2,783.670***	2,674.666***
	(648.374)	(648.657)	(669.322)
Share of people aged 65 and over disabled under the Equality Act: day-to-day activities limited a lot	368.055*	686.536***	772.986**
	(215.074)	(205.801)	(380.524)
Share of household reference persons aged 65 and over who own home outright × Share of all dwellings in Council tax bands A-E	-935.313***	-927.452***	-886.192***
	(106.475)	(102.344)	(102.984)
Share of household reference persons aged 65 and over who own home outright × Share of all dwellings in Council tax bands F-H	-1,651.567***	-1,659.631***	-1,560.193***
	(173.487)	(173.769)	(172.086)
Supply of care home care home beds in care homes for older people per capita 65 plus		-809.063***	-1,650.248
		(195.664)	(1,087.397)
MSOA total employment in SOC2020-61 occupations in SIC2007-Q industries per capita aged 65 plus		-367.457**	451.186
		(181.835)	(577.587)
Observations	12,715	12,715	12,715
R-squared	0.456	0.458	0.330
LA FE	Y	Y	Y
IV Res	N	N	Y
IV Com	N	N	Y
LAs	46	46	46
Adj R-squared	0.454	0.456	0.330
First-stage F-stat			74.95
Hausman stat			3.467
Hausman p-val			0.177

Notes: Robust standard errors clustered at UTLA-level in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table A24 Residential and nursing care for people aged 65 and over – Alternative specification with Census 2021 disability

	(1) No supply controls	(2) Supply controls without IV	(3) Supply controls with IV
	NB (marg)	NB (marg)	NB-IV (marg)
Log of population aged 65 and over	1.030***	1.034***	1.045***
	(0.047)	(0.044)	(0.045)
Share of people aged 65 and over of White ethnicity	1.104***	1.096***	1.074***
	(0.165)	(0.162)	(0.145)
Share of household reference persons aged 65 and over living as a couple	-1.055***	-1.035***	-1.006***
	(0.230)	(0.233)	(0.178)
Share of people aged 80 and over in population aged 65 plus	1.233***	1.026***	0.733**
	(0.336)	(0.303)	(0.285)
PC claimants aged 80 and over per capita 65 plus	3.361***	3.483***	3.669***
	(0.641)	(0.632)	(0.550)
Share of people aged 65 and over disabled under the Equality Act: day-to-day activities limited a lot	1.337***	0.950***	0.370
	(0.349)	(0.301)	(0.476)
Share of household reference persons aged 65 and over who own home outright × Share of all dwellings in Council tax bands A-E	-0.736***	-0.781***	-0.840***
	(0.173)	(0.167)	(0.120)
Share of household reference persons aged 65 and over who own home outright × Share of all dwellings in Council tax bands F-H	-1.611***	-1.687***	-1.771***
	(0.209)	(0.203)	(0.201)
Supply of care home care home beds in care homes for older people per capita 65 plus		1.087***	3.118**
		(0.395)	(1.355)
MSOA total employment in SOC2020-61 occupations in SIC2007-Q industries per capita aged 65 plus		-0.076	-0.134
		(0.168)	(0.604)
Observations	13,238	13,238	13,238
AIC	39335.726	39318.148	39415.756
BIC	39403.143	39400.547	39872.698
LA FE	Y	Y	Y
IV Res	N	N	Y
IV Com	N	N	Y
First-stage F-stat			66.676583

Notes: Robust standard errors clustered at UTLA-level in parentheses *** p<0.01, ** p<0.05, * p<0.1. Marginal effects evaluated at sample mean values of regressors.