**Empirical strategy**

The purpose of our analysis is to study empirically the effects of the house prices on the proportion of care homes in local long term care markets. The regression is based on the following specification

Where Eq. (1) indicates the relationship between the proportion of care homes per 1000 population over 65, , in a local authority in a time period and the average of the house prices, . represents an error term that is identically and independently distributed. Equation (1) can be estimated by OLS and the parameter of interest,, may be interpreted as a causal effect of the house prices, only if is exogenous so that ,. Nonetheless, as we have outlined in the introduction, house prices may be endogeneous to unobservable factors which may also determine the proportion of care homes in an area. If the influence of these potential unobservable variables is not appropriately undertaken, the OLS estimations of may be inconsistent.

An example that may illustrate the latter could be an unobserved shock that affects positively the values of the properties and also incentivise the entries in the market given likely wealth effects. Hence, higher level of housing prices may result in wealth effects that lead to greater levels of consumption and then attract businesses. This implies that the selection of an area by a care home provider is likely to be *known* and then non-random. In this case the effect of may be associated partially with . Likewise another potential problem can be associated with the reverse causality between the number of care homes and the level of house prices. Care homes may be considered an amenity that increases the quality of the neighbourhood and potentially the values of the properties in an area.

In order to tackle with these problems associated with , we may use an instrumental variable that is uncorrelated with but is correlated with . Our identification strategy is based on Hilber and Vermeulen (2016). These authors take advantage of the variability in restrictiveness of local planning regulations for analysing the effects of supply constraints on house prices. Their findings confirm the vision that tight supply regimes – e.g. with more regulatory constraints in the planning regulations, lead to increases in the prices. In our case, however, we apply the planning regulation variables as direct instruments to the house prices. For our identification we assume that this instrument, in addition to being correlated with the local earnings, is also correlated with the house prices (see Figure 1).

A variable used by Hilber and Vermeulen to indicate the planning restrictiveness is the rate of refusal of major projects. Despite being a well-established variable in the literature (refs) they highlight at least to potential problems that may result in bias. A first source for bias is referred to the procyclical nature of the rate of refusal. Also, it may be problematic that developers do not apply for project in certain local authorities if they know in advance that they are restrictive. For these cases the observed refusal rates may not reflect realistically the level of restrictiveness. In order to address this limitation it is possible to employ two identification strategies.

The first involves a planning reform aimed at speeding up the planning processes and the second links the planning regulations and the variation in the share of local political power. The main idea of the first identification strategy consists of using the variation in the change in the delay rates before and after the reform. Set in 2002, this reform included the establishment of an explicit goal for concluding major development projects. The rationale was to avoid the delays of major projects. Local authorities were not formally penalised for not meeting the target but they had good incentives to reach it. Funds from the central government could be retained otherwise. Local authorities could still meet the target by approving smaller projects and refusing greater projects that were more difficult to be finished on time.

The former suggests that local planning authorities could have a different behaviour before and after the reform. Before the reform, more restrictive local authorities would have more delays and the least likely to meet the target. After the reform, these local authorities would more likely to refuse more projects and therefore suffer less delays. Meanwhile, less restrictive local authorities would not have to alter their behaviour substantially after the reform. On the basis of the former, we allow for a 10-year period to represent the average delay rates pre and post reform. Hence we use the delay rates 1994 and 1996 and the delay rates between 2004-2006.

The second strategy consists of exploiting the relationship between the political composition of local councils and the application of local planning regulations. In addition to Hilber and Veemeulen (2016), similar strategies have been used by other authors such Bertrand and Karmaz (2002) or Sadun (2008) for addressing the endogeneity associated with planning decisions. As introduced before, we use the historical share of Labour party since the General Election of 1983. We choose the share of Labour voters since the attitudes of these voters regarding construction will be more on the basis of the job implications and inclined to grant house access rather than to preserve the value of the properties. We could have used the results derived from local elections. However, given the local nature of planning decisions, these have the risk of being correlated with the development of local housing market. The time frame of 1983 provides the earliest date where election results can be linked to data corresponding to local authorities.

Physical constraints may also restrict the supply of houses. In addition to the topography, the share of developed land can be thought as an example of those. A potential limitation referred the share of developed land is that the availability (or scarcity) of this type of land implies opportunity costs that can transmitted to the house prices. These can be a source of bias. For addressing this problem, the historic density of the population density can reflect earlier forms of agglomeration and used for identifying the share of developable land since. Hence, we use the density of population in 1991 as an instrument for the share of developable land.

Considering these caveats, we specify Eq. (2) in order to estimate the first-stage fitted values of the house prices. The predicted values derived from this equation are used then in Eq. (2) for getting a consistent estimate of

where refers to the variable associated with the planning regulation (e.g. the rate of refusal of major projects) and to the variable referred to the physical constraint (e.g. share of developed land). An In addition to the specification developed by Hilber and Vermeulen (2016), we include as a control for the contemporaneous share of Labour voters for each local authority. We introduce this variable in order to control for unobserved trends that may affect the historical share of labour voters. For example, some areas may have received the inflow of certain residents that have changed the demographic composition and the voting behaviour.

The main difference of our approach in comparison to the strategy developed by Hilber and Vermeulen (2016), is that use two instruments for identifying the house prices rather than a single instrument for identifying variables that determine them such as the planning regulations and the share of developed land.

Table (2) shows evidence on the validity of the instruments. Considering the regression specified in Eq. (2), columns (1) and (2) present the estimates corresponding to the change in the rate of delay and the local share of Labour voters respectively. The results associated with these estimations point at the direction that we would expect. Greater changes between the delay rates pre and post reform, influence negatively the house prices. Bigger differences indicate greater reductions in the rates of delay. As we explained before, less delay rates would be substituted with more rejections of the major projects in the case of more restrictive local authorities. Likewise, the share of Labour voters is also associated with lower levels in the house prices. Column (3) includes the estimation results considering only the density in the population in 1911 as the single instrument and column (4) includes all the instruments.

The bottom of Table (2) shows various tests that assess validity of the instruments. First, we evaluate the strength of the correlation between the instruments and . The join test of excluded instruments is highly significant at at a lower level than 0.01 in all the cases. On the same basis, we also present the results of weak instruments test using a Cragg Donald Wald statistic and a Kleibergen-Paap Wald rk statistic. The results yielded by these tests suggest that weak instruments do not seem to be a problemd in our regressions.

Second, since our estimations use in some cases various instrumental variables for identifying a single endogenous variable, we present the results of over-identification tests based on Sargan (1958)[[1]](#footnote-1). The referred to the statistic considering the rate of refusal and the share of Labour voters (columns (2), and (4) respectively) are lower than 0.01. This suggests the rejection of the null hypothesis of valid over identification restrictions and raises a caveat when interpreting the results derived from these specifications since not all the instruments may be identifying the the same vector of parameters .

1. The statistic resulting from this test is distributed as a distribution under the joint null hypothesis that the instruments are valid instruments. [↑](#footnote-ref-1)