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The real value of house prices: What the cost of accommodation can tell policymakers

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***Abstract*:** This paper explores the potential for the housing market to inform public policy in Ireland by developing a model of the determinants of the cost of accommodation. It does this by using a rich dataset of sales and lettings accommodation costs in Ireland over the period 2006-2010. A large empirical literature has grown up around a core concept that households pay to enjoy particular amenities. Five categories of amenity are included in the analysis: market depth, transport, human capital, social capital and environmental amenities. The typical amenity included is found to have a significant effect on accommodation costs, one that is larger in the sales segment than in the rental segment. Differences by amenity type highlight the importance of using "supply-side variation" to ensure the robustness of estimates of private benefit from public goods.

Keywords: housing markets; housing prices; hedonic regression
JEL Classifications: R31, G12, H4, L92.

1. INTRODUCTION

Choice of residence is one of the most important economic decisions a household makes. The very unequal spread of populations and economic activity within countries and around the world suggests that there are both centripetal forces that bring economic agents closer together and centrifugal forces pushing them apart. To understand why households live where they do, it is necessary to understand the consumption and investment aspects of choosing somewhere to live.

This paper examines the choice of accommodation as a consumption decision. This choice by a household is one of a bundle of services, from the amount of shelter per person to a range of amenities specific to the location or the population that lives there – some clear, such as access to transport services, others nebulous such as heritage or social capital. The key hypothesis investigated in this paper is that prices in both sales and lettings segments reflect a willingness to pay for amenities not directly in the marketplace, such as proximity to transport facilities, the labour market, or environmental amenities.

The research combines a rich and heretofore unused dataset of advertised prices in the sales and lettings segments with data on amenities and, from the Census, on population characteristics, to shed light on the reasons why people live where they do. The dataset includes over 1.4 million observations from Ireland's property market, over the period 20062010, almost half a million of which are mapped to the exact building. This cross-sectional and intertemporal depth allows a degree of analysis uncommon in the literature.

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The paper is structured as follows. The next section reviews the economic theory and some relevant papers on accommodation as a composite good, while Section 3 outlines the data used in this study. Section 4 presents results of the analysis of the determinants of accommodation costs, while the final section concludes and outlines strands for future research.

2. THEORY AND LITERATURE

2.1 Economic Theory

The housing market is one of the most important markets in an economy both from a household perspective, as the cost of accommodation is typically by far the largest expense in a household's budget, and from a policymaker's perspective, with the bulk of a developed country's wealth in real estate. Unsurprisingly for such an important market, it is intertwined with other key aspects of an economy, including financial stability, labour market conditions, building regulations and public service provision. Perhaps surprisingly, however, price signals from the residential property market have remained a largely under-utilised tool for policy analysis in Ireland. The principal use of such prices by Irish policymakers at the moment is, quite simply, to track the movement of the cost of accommodation (rents) and the value of real estate (house prices). Particularly since the work of Rosen (1974), though, economists and other researchers have known that, when dealing with a good such as housing, a composite good with many attributes, there is a rich vein of information lying under the surface.

The theory has distinguished roots, with the earliest formal model of accommodation costs dating back to Von Thunen (1863). His theory was that farmers would locate by opportunity cost of distance to a market: the rent a farmer was willing to pay for a plot would, in a competitive market, equal the value of the marginal product of the land to him, after deducting costs of production and transport to the market. Thus, closest to the centre would be farmers with perishable goods such as vegetables and dairy products, i.e. with a high opportunity cost of not being close to the market. Of non-perishable goods, those with the greater transport costs, e.g. bulky timber, would be next closest, and so on until those farmers with the smallest opportunity cost of distance from the centre would produce furthest from the market.

This was translated a century later into by urban theorists into a model of how rents in cities vary with distance from the centre, with households ordering themselves by willingness to pay to live close to the centre (Alonso 1964). This was typically told as reflecting households' different willingness to pay to be close to a central business district where they worked, i.e. access to employment was the amenity on which the cost of accommodation depended (Straszheim 1987). The limitation with these kinds of models is that they assume only one amenity (the market place in von Thunen's model and in Alonso's model somewhere to work) and that its location is exogenous and central.

In practice, however, employment may certainly be a key factor, but it is far from clear that in modern cities the central business district is even the main employment centre, let alone the only one. In addition, there are a large number of considerations beyond employment that enter a household's "decision function" when choosing somewhere to live. For the purposes of this paper, one can think of five main categories of amenity: market depth, transport, human capital, natural capital and social capital.

Amenities relating to market depth are those of von Thunen and Alonso recast: people need to be near centres of economic activity both as suppliers (of factor services) and as consumers (of market goods and services). So in addition to proximity to jobs, another market depth amenity of value might be the variety of consumer services in an area, from clothes and food retail to arts and culture services. Transport amenities, such as motorways, train stations or light rail services, often feature prominently in for example property advertisements and quality of life rankings, as do human capital amenities, such as schools, universities and hospitals nearby. Geography also suggests that landscape and natural capital may matter, such as proximity to coastline or green space, or distance from "disamenities" such as waste facilities, mobile phone masts or power stations. Lastly, households may value population-specific (rather than location-specific) amenities, what one may term social capital amenities. This is necessarily less easy to measure, but may reflect the professional composition of a neighbourhood, its ethnic homogeneity or diversity, or perceptions of safety and crime.

Viewed this way, a house is a bundle of services, including shelter but also a varied stream of other amenities. Theoretical work by Rosen (1974) developed a model suitable or such composite goods, highlighting that a buyer of a composite good such as housing ultimately has a value function for that good which includes some measure of the value of each constituent attribute or amenity. This value function is the multidimensional

counterpart to Alonso's "bid rent gradient". This theoretical foundation identifies two stages of research on the demand for particular amenities: identifying the implicit price (where the demand and supply schedules intersect) and identifying the nature of demand (the location of the demand curve).

The Rosen (1974) framework allows estimation of the incremental change in spending on a good such as housing in response to a marginal increase in one attribute, holding all other attributes constant. This increase in expenditure represents the marginal willingness to pay for the attribute in question, or its "implicit price". In this first stage, implicit prices are calculated, using standard regression techniques and data on the attributes of the composite good. In the case of housing, the standard model explains the individual house price or rent as a function of the attributes of the house, the location and the neighbourhood/population.[1] This is usually done in a log-linear form (the log of the house price is used), so that regression coefficients can – to a first approximation – be taken as the percentage impact on house prices.

The word marginal is key: cost-benefit analysis for a project involving non-marginal changes to an amenity requires some knowledge or assumptions about the underlying nature of demand for that amenity. For example, where there are buyers who are heterogeneous in their preferences, how price and distance interact may be highly non-linear. While it may seem intuitive – thinking in terms of diminishing marginal utility – that the marginal willingness to pay would be constant or even decline with the level of the attribute, the opposite may be the case. Gibbons & Machin (2008) give the example of willingness to pay for improved school quality, but the same holds for any amenity, such as public transport access to a particular employment centre (e.g. business park). Suppose one area has poor access to the business park, while another has significantly better access. Those living or looking to live in the area with poor access to the business park may be less likely to commute there in the first place and thus be less prepared to pay for an improvement in public transportation to the business park than those living in the area that already has better access. The relationship between price and distance need not be straightforward.

Thus, the second step after identifying the implicit price is to understand the nature of the underlying demand for the amenity. The second stage involves a demand equation, where estimated prices are regressed on attributes of both the good and the buyers. To do this, a researcher can assume some functional form for demand or – as is becoming more common – exploit variations in the supply of the amenity. For example, to estimate the value to residents of a new train station, a study may examine house prices beside a train station (1) before it is announced, (2) after it is announced but before it is built, and (3) after it is built, all relative to house prices elsewhere. Differences in the coefficient on the variable of interest are interpreted as the change in implicit price, or value of the train station to residents, with allowance made for announcement effects.

2.2 Empirical Literature

Since Rosen's (1974) seminal paper, a large empirical literature has developed, estimating the implicit price of a wide range of amenities. It is beyond the scope of this paper to review the literature in detail, so I will mostly restrict this section to the mention of useful overviews of papers and findings on the valuation of amenities using property market information. Much of the early literature was focused on environmental public goods, such as air and water quality; the interested reader is referred to reviews by Smith & Huang (1995) on air quality and Boyle & Kiel (2001) on water quality, and a more recent overview paper by Kuminoff et al. (2010). There is also a large literature on the effect of transport facilities on property values (Debrezion et al. 2007, RICS Policy Unit October 2002, Wrigley et al. 2001). A good overview of the method in general, and of the findings from recent research on the value of education, transport and safety amenities, is given by Gibbons & Machin (2008). Literature on other amenities – in particular social capital – is much less developed at this stage, most likely as the bulk of empirical work is at city-or county-level and thus there is significantly less variation in population-specific characteristics than at country-level.

Aside from these pointers to the literature, two comments are worthwhile. The first is that, by and large, well-specified studies – especially those that both control for omitted variables and exploit supply-side variation – do find that a wide range of amenities is factored into the cost of accommodation with the expected sign, although there is often little agreement across researchers on the magnitude. This may be understandable given that the studies vary hugely in terms of regions (and time periods) analysed, as well as sample sizes and methods.

Secondly, it is worth specifically mentioning two existing hedonic price studies using data on Irish house prices by Mayor et al. (2009) and Mayor et al. (2008). Their research on Dublin between 2001 and 2006 finds evidence

[1] Kuminoff et al. (2010) find evidence that fixed effects for location and time are important to prevent omitted variable bias.

that both urban green space and transport access are valued in house prices: increasing urban green space by 10% was associated with an increase of at least 7% in the house price, similar to the effect of being less than 2km from a stop on the Green Luas line. Another amenity they report is proximity to the coast, associated with a premium of 12%-22% premium for being within a kilometre of the coast (the closer to the coast, the larger the premium).

In summary, economic theory that attempts to explain differences in accommodation costs ultimately appeals to differential willingness to pay for particular attributes of accommodation as a composite good. Early theoretical contributions centred on access to a single centre of employment. These single-amenity models have since been generalised to allow for many amenities of unknown location. The underlying concept is that different prices for identical houses in similar neighbourhoods reveal a willingness to pay for some amenity present in one neighbourhood but not in the other. The underlying microeconomic theory also suggests a straightforward econometric process for estimation of the implicit prices of amenities and, with a suitable identification strategy, of underlying demand.

3. DATA

The dataset collated for this research is a combination of four types of information, each of which is explained in more detail below: price information, property-specific characteristics, location-specific characteristics, and population-specific characteristics.

3.1 Price information

There are two datasets spanning the period January 1 2006 to December 31 2010: one for properties for sale, the other for properties for rent. The price metric being measured in each case is advertised asking price (including rent). This means that, for example, measuring the trend in prices over time captures changes in the expectations on the part of sellers (including landlords), in the case of the sales segment typically based on the advice of the estate agent selling the property on their behalf.[2]

Sample sizes

The residential sales dataset of properties of between one and five bedrooms listed for sale in the Republic of Ireland between January 1 2006 and December 31 2010 comprises just under 540,000 property listings. About 190,000 of these are sellers who revised their asking price – these are included, as systematic relative price gaps should still be informative. This is a very significant sample size in a country that had 1.46 million permanent private households in the 2006 Census. The lettings market database is of a similar scale. For the period 2006-2010, there is a total valid sample of almost 815,000 properties. For reference, in 2006, there were 145,317 privately rented households in Ireland (CSO 2007).

There are three distinguishing features about this dataset. The first is its size, not only relative to the size of Ireland's housing market but also in absolute terms, compared to studies from other countries. In their review of 69 hedonic studies of willingness to pay for environmental amenities in the two decades to 2006, Kuminoff et al. (2010) find that only about one in five (22%) contains more than 10,000 observations. The second is the fact that the two datasets cover an entire country. Only about one in ten hedonic studies (9%) has been at the national level (Kuminoff et al. 2010). The third distinguishing feature is the fact that both sales and lettings markets are included.

Source

The source of the data is property website Daft.ie. Daft.ie is the largest property website in Ireland, across a range of metrics including number of properties, number of estate agents, number of page impressions per month and number of unique IP addresses per month.[3] For example, in late 2010, there were almost 73,000 properties for sale in the Republic of Ireland on daft.ie and over 17,500 for rent.[4] Each of the 26 counties within the Republic of Ireland contains significant listings, with all counties having more than 1,000 properties for sale on that date. This enables a modelling of regional property markets in Ireland heretofore impossible without great expense.

[2] Less than 10% of properties in the sales sample had no entry for estate agent, i.e. were more than likely listed for sale by the owner.

[3] See, for example, http://www.abceireland.ie/Data/ProductPage.aspx?tid=20638
or http://www. daft.ie/news/2009/daft_audit_july_2009.daft. Daft.ie is run by Distilled Media.

[4] The next largest websites in each market segment listed just over 41,000 properties (sales) and 5,800 properties (rental) on the same date.

3.2 Property-specific attributes

About a dozen explanatory variables of interest are collected for each property listed for sale or rent, in relation to date, size, type and location, with rental properties also having information on a further ten facilities. On date, the date each property is listed for sale or rent is known, as is whether this is a property being relisted. The models use quarterly dummy variables interacted with regional markets (see below), to capture the change in price levels by region over time. A similar strategy is adopted for size, using two main sets of variables, number of bedrooms and number of bathrooms (relative to number of bedrooms). In the lettings market, a third piece of information is also available, namely the number of single and/or double bedrooms.[5]

On a property's type, there are five main categories for properties for sale (detached house, semi-detached/end-terrace house, terraced/townhouse, apartment/duplex, bungalow) and three for rental properties (house, apartment and flat).[6] [6] Particularly for properties listed for rent, there are also a number of variables that capture property-specific amenities, not only largely unalterable features such as garden, parking space and wheelchair accessibility, but also a number of utilities and white goods (cable television, house alarm, Internet access, central heating, washing machine, dryer, dishwasher, and microwave).

Regional and micro-markets

To capture location, each property is placed by the advertiser on the website in one of around 4,000 areas in the country. For this research, these areas are grouped into sixteen regional markets, six markets in Dublin, one each for the other four cities (Cork, Galway, Limerick, Waterford), and six regional markets for non-city areas.[7] At a more granular level, areas are grouped into one of about 400 "micro-markets", which capture effects that are not measured in a given specification, including location-specific, population-specific and any pure label effect. These have been manually configured for each part of the country, according to a combination of the volume of listings (without which it would not be possible to consistently estimate an effect), geographic coherence and market logic.

Table 1: Accuracy of Geographical location: Sales and Rental Datasets

Accuracy Level	Sales	Rental
Building Level	38.8%	22.5%
Street Level	13.4%	40.2%
General Estate	16.7%	13.1%
Village Level	6.2%	9.0%
Area Level	20.3%	14.7%

Exact building location

The address of each property is also known and is used to generate a level of accuracy for the exact geographic location of each property. There are five levels of accuracy, ranging from Area Level (i.e. nothing more specific is known about the location of the property other than its area on the system) up to Building Level (i.e. the location of the exact building is known). The Building Level coordinates come from the GeoDirectory database, run by An Post and the Ordinance Survey of Ireland.[8] [8] As the level of accuracy will affect the robustness of measuring the valuation of exogenous amenities in particular, Table 1 outlines what percentage of properties is at each level of accuracy in both the sales and lettings datasets. Between 50% and 60% of both datasets are at street level or building level.

[5] Ideally, one would include square meterage of a property. There is traditionally a general lack of interest in the exact size in square metres of a property. This information is available for some properties but not all. Analysis of this subsample is suggested for future research.

[6] Other information on a property's quality that may be included in future research is a property's energy efficiency, which is measured in a subsample of properties through its Building Efficiency Rating (BER), and a property's age.

[7] The six markets in Dublin are: Dublin city centre (postcodes 1, 2, 7, 8), north and south city (the other odd and even postcodes respectively), and north, south and west county Dublin (the N81 road and the N3 road being used for boundaries between west Dublin and north/south county Dublin). The six markets outside the cities are: Dublin's commuter counties (Meath, Kildare, Wicklow, Louth), west Leinster (Laois, Longford, Offaly, Westmeath), south-east Leinster (Carlow, Kilkenny, Wexford), Munster (excluding the three cities), Connacht (excluding Galway city), and Ulster (the three counties in the Republic).

[8] For more, see http://www.geodirectory.ie/About-GeoDirectory.aspx.

3.3 Environmental amenities

Three natural endowments are included in the research: coastline, lakes, and rivers.[9] Ireland has extensive coastline, 1,448km in total, which has been geocoded and provided by Ireland's Environmental Protection Agency (EPA). For each property, a distance is calculated to the coastline, from which buffer variables are calculated: "on the coast" (less than 250 metres), "near the coast" (between 250 metres and 1.6km), properties 1.6-5km from the coast and all other properties.[10] Ireland is also home to numerous lakes, rivers and streams. Geographic Information Systems (GIS) data on these are contained in the Water Framework Directive (Ireland) database. Property-specific variables for lakes and rivers are as per coastline variables.

3.4 Transport amenities

Four location-specific transport amenities are included: train stations, rail track, and the two Luas light rail systems in Dublin.[11] The location of all passenger and light rail stations is known, as is the location of rail track, through Ireland's Railway Procurement Agency (RPA). Using GIS information, the distance of each property from the nearest railway station and track was calculated and buffer variables generated, as with environmental amenities. In addition, for Dublin properties, distance from the stations of the two Luas light rail lines was also included.

3.5 Human capital amenities

Proximity to primary schools is also included in this research. The Department of Education and Skills publishes an annual list of all primary schools in Ireland. Most of these contain imprecise addresses. With the assistance of Neil Cremins and Paul Conroy at Distilled Media, each primary school was mapped using GeoDirectory and contains an accuracy similar to the accuracy with which individual properties are known. About half of primary schools were mapped to estate level or better. Buffer variables were created for a property's distance to the nearest school, by level of accuracy with which the school's location is known.

3.6 Social capital amenities

Social capital factors, such as class, educational attainment, diversity or sense of community in an area, may have an impact on property prices. However, without a more rigorous treatment, many of these factors belong in a second-stage analysis that attempts to describe the underlying demand curve. It should be noted, however, that it is standard in much of the literature to include local unemployment rates, to capture some index of neighbourhood quality, which is a hugely important determinant of house prices. Here, the focus is on neighbourhood attributes related to social capital that are, in a relative sense, more exogenous or difficult to change.

Four are included in this analysis. Two factors are effectively exogenous, at least in the short run: the average building size (in rooms) and the average age of properties (in years) in a neighbourhood, as measures related an area's spaciousness and maturity. Two other variables are included as measures of community that market participants may take as relatively exogenous, firstly the percentage of the population that speaks Irish regularly (i.e. Gaeltacht areas), and secondly the proportion of an area that is local authority or State-provided accommodation. Irish-speaking areas, controlling for employment opportunities (see below), may exhibit community cohesion effects. Regular use of Irish outside the education system is measured in the 2006 Census and available at Census district level. Each of these four variables is a (continuous) "score" variable, rather than a categorical variable. The use of "Small Area Population Statistics" involved mapping each property into one of 3,400 Census areas, which was done using the official Census boundaries.

3.7 Market depth amenities

Three labour market variables are included. Census information is available on the neighbourhood unemployment rate (for Q2 2006), and on the average commute in kilometres, as well as for the contemporaneous sectoral allocation of the labour force. The proportion of people employed in agriculture is used as a simple reduced form index of employment opportunity for an area, giving three measures of the local labour market amenity: unemployment, commuting, and opportunity. These can be best thought of as an area-level fixed effect, as they are not time-varying and labour market conditions changed substantially over the period under consideration.

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[9] Future research can be extended to include many more, including beaches, cliffs, sunshine, urban and rural green space, cultural and built heritage, flood risk and potential disamenities relating to waste, energy and heavy industry facilities.

[10] The calculation of buffer variables for individual properties in relation to specific environmental, transport, education and retail facilities was done with the generous assistance of Sean Lyons in the Economic & Social Research Institute.

[11] Again, there is rich potential to add to this in future work, including bus services, the road network from motorways to local roads, sea-and airports, the effect of transport noise, the proposed Dublin Metro North, and the public bicycle rental scheme in Dublin.

Two final variables are included. The first is the percentage of single people in an area. A "marriage market premium" might exist in the rental market, i.e. those who have not yet formed households might be prepared to pay more than those who have, to live in an area with more potential marriage partners. The second is the (log of) population density, which should capture any premium for being close to or far from population centres/agglomeration. Both of these are also from Census 2006 information.[12]

4. DETERMINANTS OF THE COST OF ACCOMMODATION

This section presents a model of the cost of accommodation, reflecting location-specific and population-specific factors that may impact on the cost of accommodation, as well as controlling for property-specific characteristics. The model is not supposed to be a comprehensive list of amenities that may impact on the cost of accommodation. Rather, it is an exploration of the issues that arise when valuing amenities with time and location fixed effects as controls, intended to show the strengths and limitations of the method. The model is applied to both sales and lettings segments, and – as explained below – to two different levels of accuracy in relation to location: those mapped at street level or better; and those mapped only at building level. First though a baseline model is presented.

4.1 A Baseline Model

The most parsimonious model of accommodation costs is one that attempts to put a value on observable housing characteristics only, and uses location-based fixed effects for all other factors, relating to location-and population-specific attributes. This is the type of model used in hedonic house prices indices that are concerned with trends over time, but not the determinants of regional differences in price, such as the Halifax House Price index in the UK or, in Ireland (until 2011), the permanent-tsb ESRI house price index (Duffy 2004).

The price of each house in the database can be represented as the sum of the estimated value of its constituent components (i.e. fixed effects for location and time, and variables reflecting house size, type, and facilities), as well as an error term, ε, reflecting the gap between the predicted value and the actual value; in matrix algebra:

$$log(price_i) = X'_{1i}\beta_1 + X'_{2i}\beta_2 + X'_{3i}\beta_3 + \varepsilon_i \qquad (1)$$

where: X'_{1i} refers to house-specific characteristics, including size and type, X'_{2i} refers to the time period; and X'_{3i} refers to the refers to the location, the micro-market described in Section 3.2. X'_{1i} and X'_{2i} are measured at the level of the regional market, not nationally, to allow variation in the valuation of particular characteristics, a level of granularity suggested by Allen et al. (1995) in their study of the South Carolina rental market.

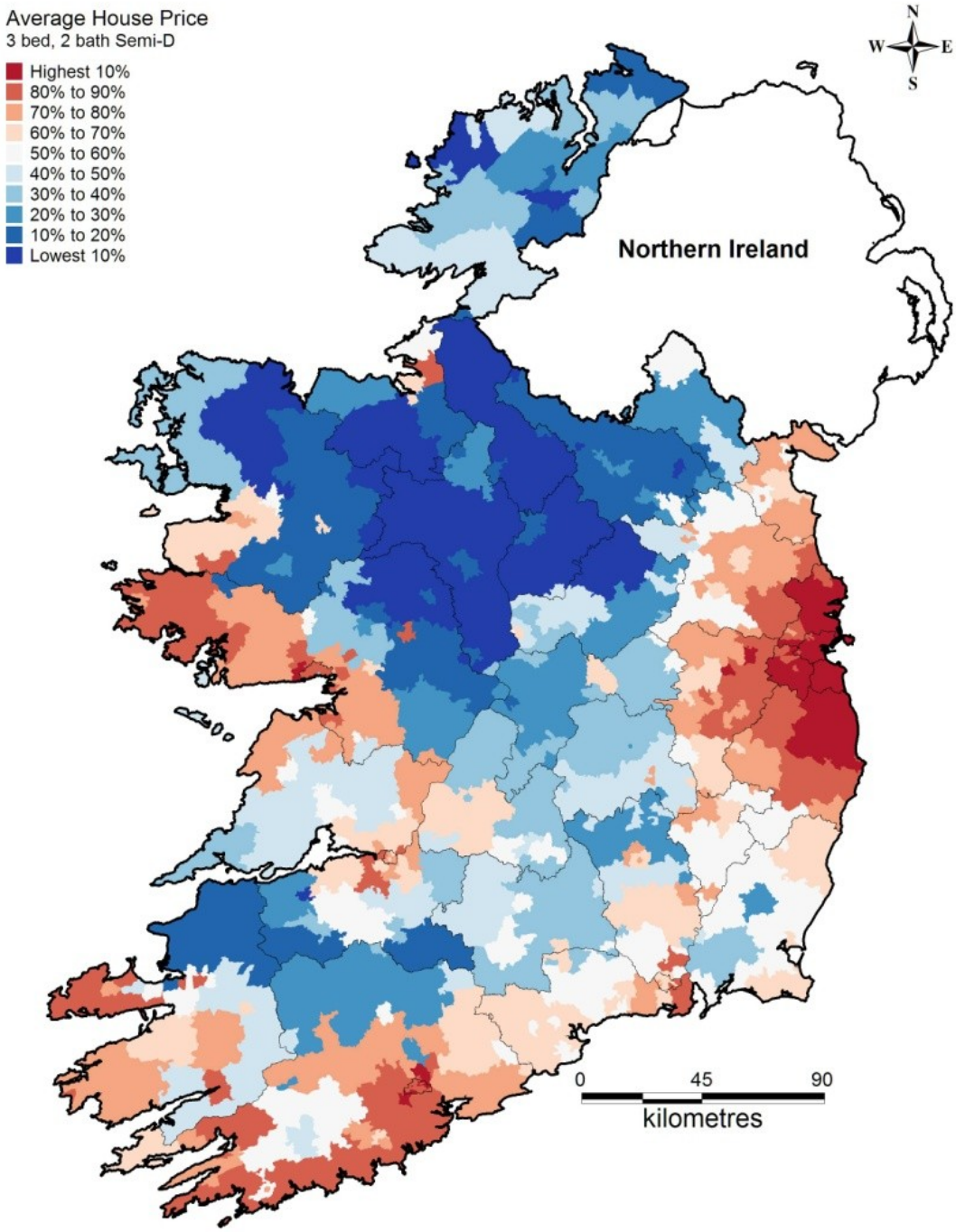
The β-coefficient are the estimates of the effect on the price of each of the measured attributes. In this model, β_3 captures all location-specific attributes, both exogenous and endogenous, in a single micro-market fixed effect. The model presented later will attempt to "explain away" some of this fixed effect as possible, i.e. the reason why some areas are more expensive than others, by accounting for the various types of amenity described in Section 3.

The ε_i term, the gap between the predicted price and the observed price, can be used to help improve the accuracy of the model. Specifically, the model is estimated in two stages, to filter out atypical properties whose actual prices are either at least twice or less than half their estimated price. This is done by excluding, after the first-stage regression, properties with significantly large gaps between predicted and actual asking prices, specifically where the absolute value of the residual is greater than 0.75. To give an indication of the impact of this, it involves the exclusion of about 2% of sales properties and 1% of lettings properties.

[12] Reference is made in the results to the effect of proximity to supermarkets and convenience stores, as a measure of the retail market amenity. Data on the location of supermarkets and convenience stores come from the Irish Competition Authority, via the cooperation of the authors of Layte et al. (2011).

The overall fit of this baseline model is good, with about 80% of the variation in house prices, and about 85% of the variation in rental prices, explained by the factors included. Regression output for this model is not shown for reasons of space but a more compact presentation of results across one key dimension, location, is presented below.[13] The micro-markets developed with this research do not correspond to a pre-existing geographical division of the Republic of Ireland, but a matching function was developed by associating each Census district with a particular micro-market.[14]

Figure 1: Decile heatmap of accommodation costs by location: sales



[13] Other dimensions of the baseline model whose analysis is omitted due to space constraints include time, property type and size.

[14] This matching function, and the resulting "heat-maps", were developed with assistance from the National Institute of Regional & Spatial Analysis (NIRSA), at the National University of Ireland, Maynooth.

Figure 1 shows the variation in the price of a standardised property (a three-bedroom, one bathroom, semi-detached property), across Ireland's 3,400 Census districts. The figure is a decile distribution, using the average asking price over 2009-2010. It shows that the most expensive properties in the Republic of Ireland, on a like-for-like basis, were in Dublin and Wicklow. Other relatively expensive locations are in Galway and Cork, not just in the cities but also on the coast, followed by Limerick and Waterford cities (and Sligo and Kilkenny towns).

Figure 2: Decile heat-map of accommodation costs by location: rents

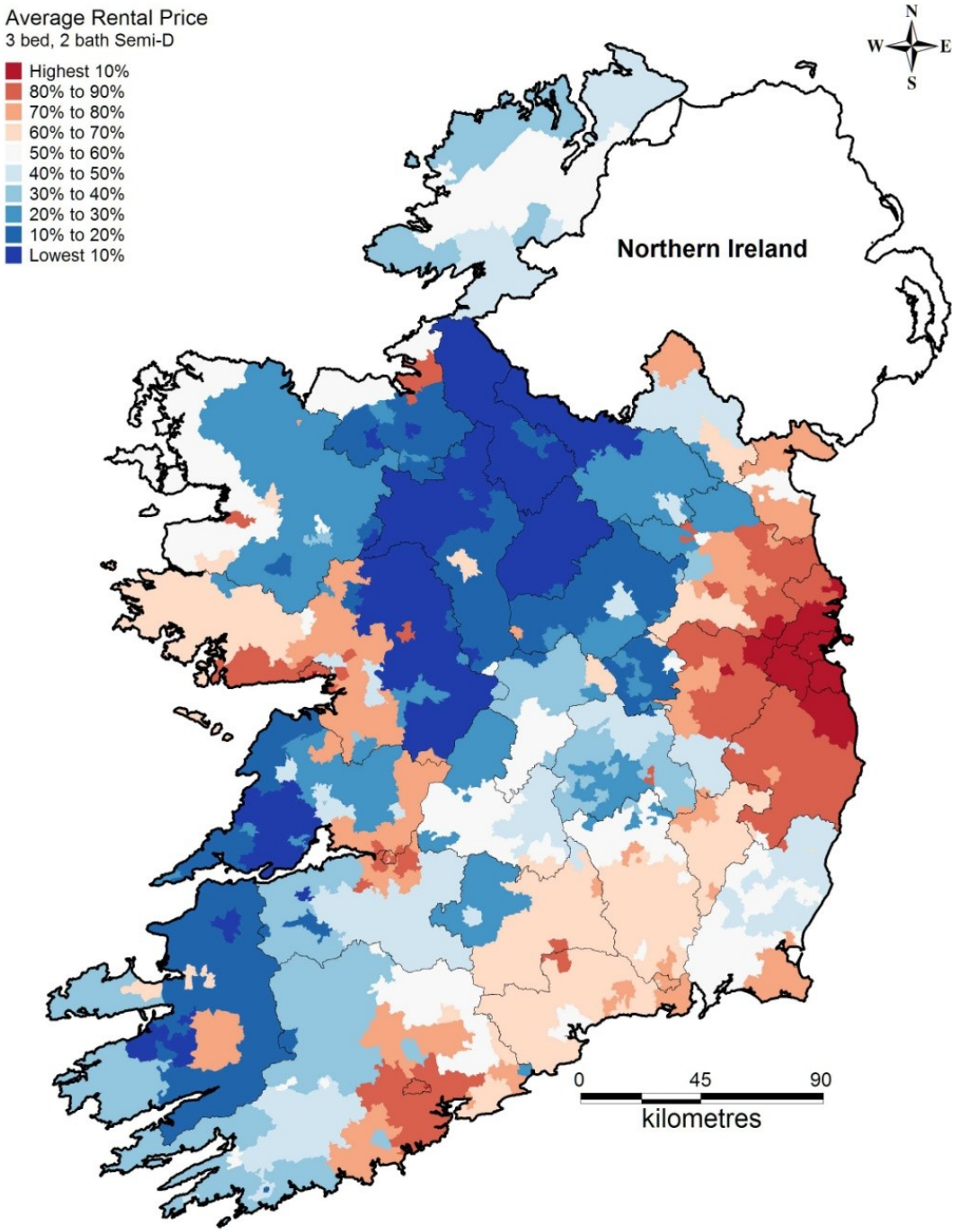


Figure 2 is the lettings counterpart to the sales decile map. As with sales, the lowest costs of accommodation are in the Midwest region, while the most expensive accommodation is in Dublin and Wicklow. Similarly, the other major cities can be easily spotted on the map. However, what is noticeably different about the lettings map is the much lower ordering of areas along the South-West coastline and conversely the higher ordering of areas in the central part of the south of the country.

4.2 Valuation of Amenities

The heat-maps clearly reveal that location matters. As discussed above, a range of factors beyond the attributes of the property itself influence the cost of accommodation. By including location-and population-specific amenities, it may be possible to disentangle at least some of an area's "fixed effect" into the contributions of the different amenities. The inclusion of these amenities is captured by $X_{4i}^{'}$ (location-specific factors) and $X_{5i}^{'}$ (population-specific factors) in the extended equation below:

$$log(price_i) = X_{1i}^{'}\beta_1 + X_{2i}^{'}\beta_2 + X_{3i}^{'}\beta_3 + X_{4i}^{'}\beta_4 + X_{5i}^{'}\beta_5 + \varepsilon_i \qquad (2)$$

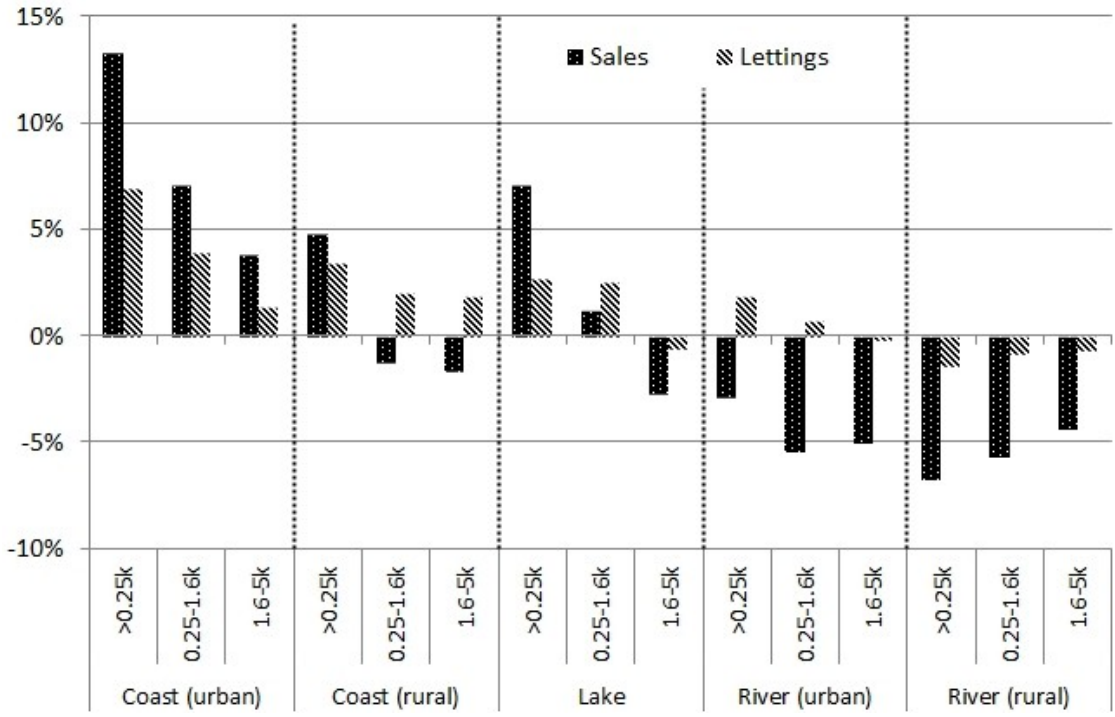
Across both sales and lettings segments, seven location-specific amenities are included, reflecting environmental, transport and human capital amenities. All of these are included by binary categorical variables in this research. Table 2 in the Appendix outlines the sample sizes for the various amenities when included in the model through categorical buffer variables (e.g. 0-250m, 250m-1000m, etc). For categorical buffer variables relating to amenities, there are typically 10,000 to 15,000 observations in the buffer. Regressions results from the extended model are presented in the Appendix.[15]

4.2.1 Location-Specific Amenities

Environmental

Features such as coastline, rivers and lakes are the most exogenous of the amenities included. An overview of the estimated amenity value on a property's sale or lettings cost is shown in Figure 3, where the model used contains properties mapped to building level only.

Figure 3: Premium associated with environmental amenities: overview



[15] Categorical buffer variables should be interpreted as follows: *vn_lake* takes a value of 1 where a property is less than 250 metres from a lake, 0 otherwise. The coefficient on a categorical buffer variable represents the effect on the log of the price (or rent), which – to a first approximation – can be interpreted as the percentage change in price.

There are four striking results:

- Firstly, properties for sale close to coastline and lakes enjoy a premium over other properties, whereas those close to rivers in general are subject to a penalty. This suggests the risk of flooding is priced in and for rivers more than outweighs any aesthetic and recreational value of the river.

- Secondly, the buffer effects typically work the expected way: the effect is largest in absolute size when the property is "very near" (less than 250 metres) from the amenity in question. (One exception to this is the effect of rivers on house prices in urban centres.)

- Thirdly, there is a noticeable difference between the sales and lettings segments. The premium associated with urban coastline is twice as large for properties for sale as it is for properties for rent. This may represent the impact of search costs, i.e. "secondary" amenities are not valued by renters the same way they are as buyers. Alternatively, it may capture cohort-specific amenities: (working) renters may not value leisure amenities such as coastline as much as (partly retired) homeowners.

- Finally, while there is a significant penalty in the sales segment for proximity to rivers, there is by and large no similar penalty in the rental market. Indeed, urban properties close to the river enjoy a small but statistically significant premium (2.0%). Compared to properties not near a river, landlords can buy at a discount and rent at a premium: this is consistent with Henderson & Ioannides's (1983) model, which predicts that landlords will overcharge tenants for costs of maintenance and damage.

Transport

Rail infrastructure is a policy decision, not an exogenous condition, but due to its durability and immobility will often be taken as exogenous by property market agents at any given moment in time. An overview of the estimated amenity value of rail on a property's sale or lettings cost is shown in Figure 4.

Figure 4: Premium associated with transport amenities: overview

There are three key findings.

Firstly, both the signs of the effect and the buffer gradient are as expected. Train stations are a clear amenity, even at close distances where congestion may occur. Railway track, particularly in the cities, has a negative effect on accommodation costs. Secondly, for train stations and rail, track the (dis)amenity value does not vary significantly across sales and lettings segments. The average ratio of the sales to lettings premiums for transport amenities is 1.0, compared to 2.7 for environmental amenities.

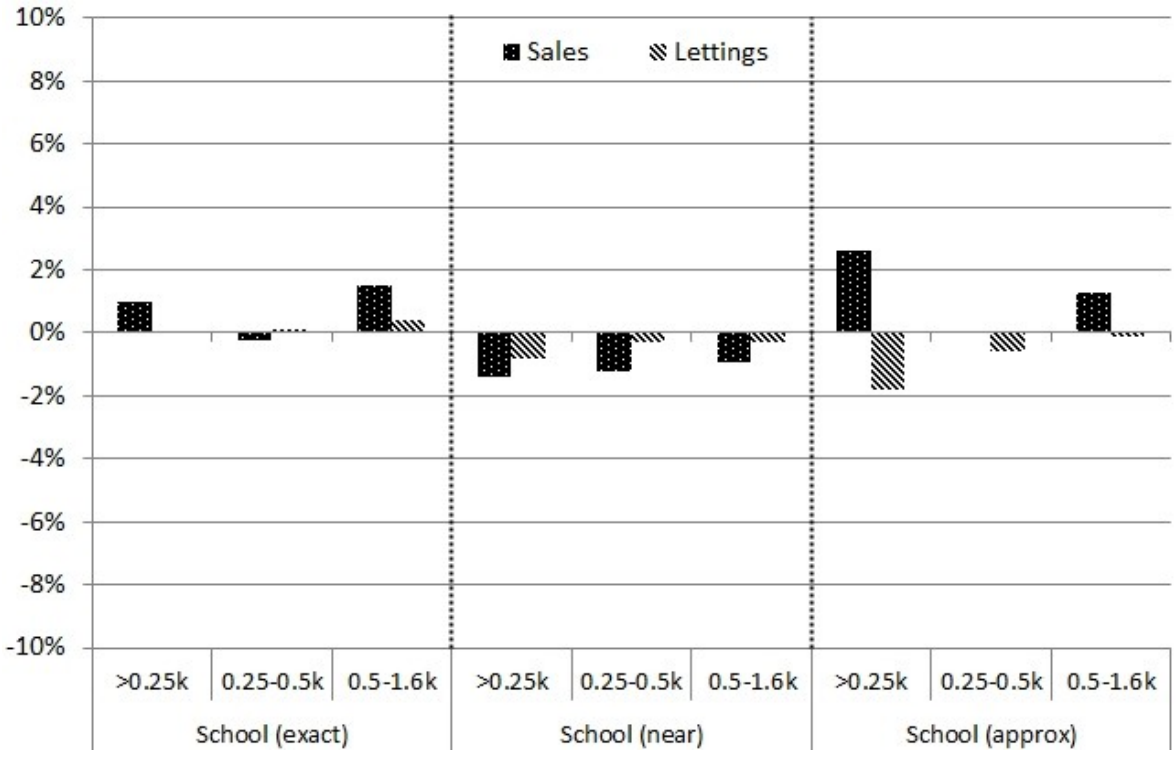
Thirdly, however, the results for the Luas light rail system show that there are limitations to the analysis. Certainly, it is to be expected that proximity of less than five kilometres might boost house prices and rents. For comparison, Mayor et al. (2008) find a premium of 10-15% for the Luas B line using 2001-2006 data. However, the very large amenity value associated with properties less than one kilometre from the Luas B line (over 15%) suggests that a closer examination of the exact relationship between Luas stations and other amenities is required to ensure that this is robust to other amenities that may be collinear.[16]

As highlighted by Mayor et al. (2008), given the neighbourhoods it passes through, the Luas A line is less likely to be subject to such effects. Regression results suggest a premium for proximity to A line stops of up to 5% for sale properties, and 2% for rental properties, although again the 3-5km buffer results suggests further analysis will be necessary.[17]

Human Capital

As described earlier, there were problems with the quality of addresses for primary schools, hampering their geolocation. Results for the various levels of accuracy of school matching are shown in Figure 5.[18] The scale of the graph is set so as to be comparable to the other graphs in this section. The most striking result is that, regardless of the level of accuracy with which the school's location is known, there does not appear to be a large premium for being within walking distance: the largest premium is of the order of 2%.

Figure 5: Premium associated with primary school amenities: overview



[16] It is interesting to note, for example, that the Luas B line effect is significantly smaller here than an a specification without area maturity and spaciousness (20-25%), suggesting that some of the premium is indeed related to other characteristics not included in the model.

[17] Mayor et al. (2008) were unable to draw any definitive conclusions about the Luas A line, due the small number of corresponding observations in their sample.

[18] Only properties mapped to building were analysed, so "School (exact)" refers to where the school's location is known exactly, and the property's location is known to the building level.

The apparent reversal of the premium for schools whose location is known "near" (to the street or housing estate) rather than "exact" highlights the need for a more systematic treatment of the relationship between schools and the cost of accommodation. In addition, proximity is only one aspect of the potential amenity value of primary schools to households: a fuller treatment of the effect of schools, including a metric of school quality, might be able to disentangle congestion effects, such as noise and competition for parking, from the value of access to human capital amenities.

This need for a full treatment of a particular amenity is also apparent from results in relation to supermarkets and convenience stores (not shown). The presence of convenience stores is actually inversely related to accommodation costs, while variation of the supermarket effect by chain reflects a combination of endogenous location decisions by supermarket chains and underlying neighbourhood characteristics.[19]

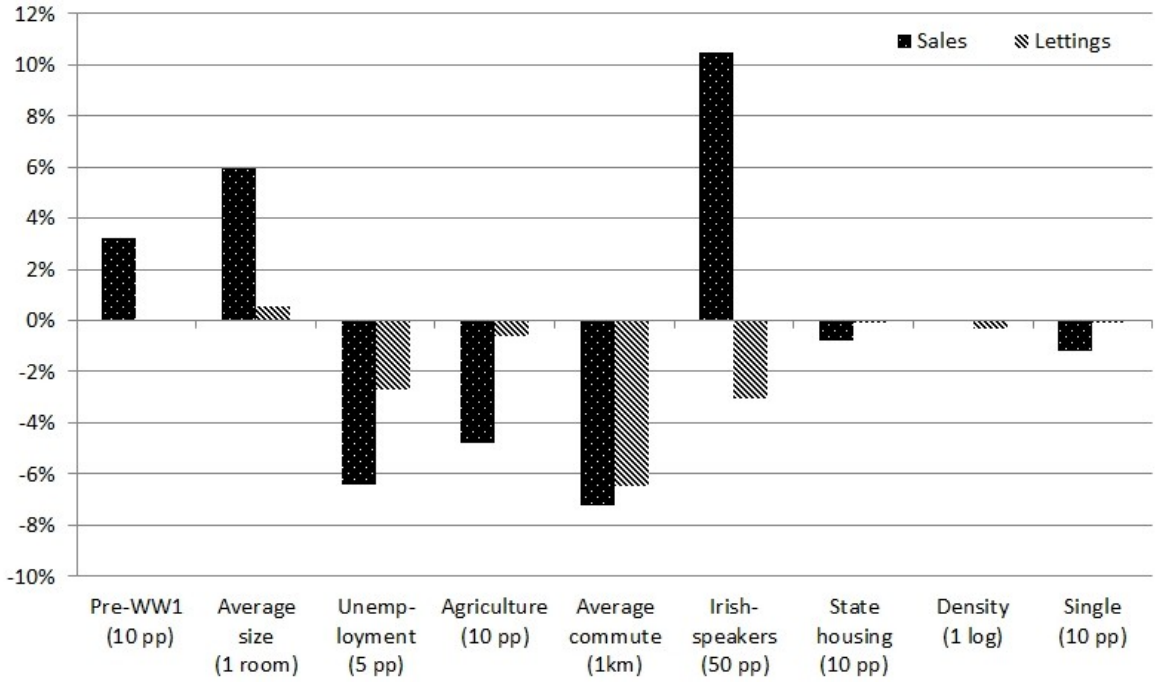
4.2.2 Population characteristics

Nine population-specific variables using Census 2006 information are included, reflecting social capital, market depth and other factors, as described above. Figure 6 gives a summary of the impact of these extra nine variables on the costs of accommodation. The effect is calculated for each variable on an appropriate scale ('pp' referring to an increase in percentage points).

Neighbourhood age and space

Both a neighbourhood's spaciousness and its maturity have a statistically significant effect on price, and with the expected sign. There is, however, a noticeable gap between the size of the effect in the sales segment and in the lettings segment. A ten percentage point increase in the number of pre-World War I properties in an area increases the typical house price by 3.2%. The impact on rents is marginal (0.1%). Similarly, an increase in the typical size of a property in the neighbourhood by one room boosts houses prices by 6%, but increases rents by just 0.5%.

Figure 6: Effect of neighbourhood level information on accommodation costs



Local labour market

Access to a labour market was highlighted early in the urban economics literature as an important potential determinant of the cost of accommodation. One might expect, then, that it is an amenity that is reflected both in rents and in house prices. This is certainly the case when considering average daily commute: A one kilometre increase in the average commute has a significant negative impact on both house prices (7.2%) and rents (6.5%).

[19] The premium associated with being a "short drive" (2-3km) away from a supermarket varies from 3% in the case of (mid-range) Dunnes Stores and (largely non-city) SuperValu to 14% for (up-range) Superquinn.

Using both the local unemployment rate and the percentage in agriculture, there is again a negative impact on both costs, although the effect is significantly larger in the sales market (e.g. a five percentage point increase in the local unemployment rate is associated with a fall in house prices of 6.4% and a fall in rents of 2.7%).[20]

Social capital
Moving from an area with 10% Irish speakers to one with 60% Irish speakers (i.e. into a Gaeltacht) has a large positive impact on house prices of 10.5% (bearing in mind that the labour market is controlled for). The impact on rents, however, is negative (-3.1%). This may be related to a relatively significant difference in the demographic composition of owner-occupiers and renters. On the other hand, the density of State-provided housing in an area has a relatively small impact on the cost of accommodation: a ten percentage point increase in local authority housing reduces house prices by an average of 0.8% and rents by just 0.1%.

Density and the marriage market
A increase in density by one order of magnitude (on the logarithmic scale) is not associated with higher or indeed lower house prices and has only a marginal effect on rents (-0.3%). However, a ten percentage point increase in the number of single people in an area is associated with a 1.2% reduction in house prices but has no impact on rents. If there were some general cost in both sales and lettings segments to having greater proportions of single people in a neighbourhood (e.g. noisier or less tidy neighbours), this result would be consistent with a countervailing marriage market premium in the lettings segment only.

5. CONCLUDING THOUGHTS

This paper has explored the determinants of the cost of accommodation, including a broad spectrum of amenities specific to locations and to the inhabitants, as well as controls for property characteristics and market conditions. As is consistent with the bulk of the hedonic pricing literature, analysis of the cost of accommodation found that property-, location-and population-specific characteristics all have systematic effects on the cost of accommodation.

Exogenous variables – such as coastline, lakes and rivers – had the clearest effects. Amenities that are less obviously exogenous – such as schools and supermarkets – were associated with a change in accommodation costs, but more systematic work, in particular exploiting supply-side variations, is required to establish the true causal effect. There were interesting differences not only across amenities but also across segments: whereas both owner-occupiers and renters value proximity to jobs, owner-occupiers seem to react more to factors such as coastline, light rail stations and area maturity.

There are obvious limitations to the conclusions that can be drawn from this one study. One issue is the use of asking prices, rather than closing prices: perhaps these models merely measure willingness to ask, not willingness to pay. But even if one believes that the actions of hundreds of thousands and sellers and landlords cannot tell us anything about amenity value without concrete transaction prices, the model has value. With property market information available to the Government via mortgage lending, lease agreements, and tax collection statistics, there are rich datasets at policymakers' disposal.

Indeed, the primary aim of this paper is not to definitively set out the value of particular amenities. Rather, it is to show the value in exploiting the rich information for policymakers contained in Ireland's property market. This is particularly pertinent given that the huge fiscal deficit has necessitated a fundamental reorganisation of Ireland's public expenditure and revenues. The allocation of public resources could benefit significantly from incorporating rigorous estimates of the private benefit enjoyed by households from amenities such as transport, education and culture.

Clearly, additional future research will be needed to provide such rigorous estimates. Two particular strands present themselves, expanding the dataset to include additional amenities, and exploiting "supply-side variation" to ensure the robustness of conclusions derived. Two other strands of research will also be outlined.

Expanding the dataset
There are firstly a range of factors not included in the above model that may have an impact on the cost of accommodation. In addition to supplementary house-specific characteristics,[21] another set of variables that can be included in future work relates to exogenous location-specific characteristics.

[20] It should be remembered that these are local unemployment rates for Q2 2006 and, given the significant change in labour market conditions over the period, can only be treated as a once-off relative ordering of neighbourhoods.

For example, one could consider including additional educational amenities, not only the location of secondary schools, but also school quality metrics, Irish-language schools and the location of the most exclusive fee-paying secondary schools, or a large number of additional environmental amenities, including disamenities from energy and industry (cement factories, landfills, waste treatment, mobile phone masts), and amenities such as cultural heritage sites, and urban/rural green space (which could, for example, "explain away" some of the maturity and spaciousness effects). There are also additional transport amenities, such as the road network, bus services, airports and seaports, and extension in the rail infrastructure, such as new Luas stations and the proposed Dublin Metro North, and other location-specific amenities, such as hospitals, prisons and stadiums. Lastly, there are further endogenous neighbourhood characteristics that could be included. One obvious endogenous amenity not included is neighbourhood crime, which can be mapped at a station level.

Exploiting supply side variation

In order to be more certain of the causality of the relationship between an amenity and the cost of accommodation, a range of robustness checks and use of exogenous variation in supply where possible would be required. Robustness checks could include an analysis of the premium for primary schools by bedroom number or taking account of Census information on the percentage of families in a neighbourhood with young children. Other checks of robustness include exploiting the huge change in property market conditions between 2006/2007 and 2010/2011, to see if the implicit price associated with certain amenities varies with the property market cycle, perhaps in line with expected capital gains.

Ultimately, though, estimating the price effects of a particular amenity is first-stage analysis in the Rosen framework. Understanding the underlying demand curve, the second stage, relies on exogenous variation in supply. With the amenities included above, and with other amenities suggested in the previous paragraph, there are numerous variations in supply that might enable analysis of underlying demand. These include the establishment and closure of schools, the extension of the Luas light rail system and the opening of new motorways and bypasses. Ireland's "catch-up" growth path over the last generation actually makes it an unusually rich source of supply-side variations: very few countries have seen the innovations in transport infrastructure, for example, that Ireland has over the past decade.

Return on real estate

It was mentioned earlier that the presence of both sales and lettings prices information is unusual. This offers another significant area of potential research, namely on the yield associated with property as real estate (the investment aspect of choice of residence, rather than the consumption aspect). Many of the results presented above indicate that a greater range of amenities is factored in to prices than into rents. This is in line with prior expectations, either that search costs in the property market that cap renters' willingness to pay for what could be classed as secondary amenities, or that buyers factor in future capital gains, which increases their willingness to pay relative to renters. Both stories would mean that yields should be systematically higher in areas with more renters. Nonetheless, pairwise correlations (not shown) present a paradox: yields were systematically lower in areas with more renters. Developing a better understanding of how the return on real estate affects households' decisions of where to live will also enable policymakers to make more informed decisions.

[21] It will be possible, for a subset of properties, to include exact size expressed in square metres and overall lot size -this may help explain one finding not shown above, namely there is a surprisingly small premium of two-bedroom over one-bedroom properties outside the major cities. Two more that may capture a property's quality are its age and its energy efficiency rating; again it is possible in future research to run subsamples of the dataset with these variables included. Other factors, such as a property's orientation, its views and features such as balconies, en suite bathrooms or underfloor heating, are typically included in a property's description, a source of information that has not been used to date.

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APPENDIX

Table 2: ***Sample Sizes for Amenities (000s), using Buffer Variables***

Variable	Sales 1	Sales 4	Sales 5	Rental 1	Rental 4	Rental 5
on_coast_urb	7.6	6.3	4	39.9	28.4	12.1
n1_coast_urb	56.2	39.9	30	153.7	101.3	37.2
n2_coast_urb	43.2	32.9	25.7	187.3	125.8	48.4
on_coast_rur	18.5	6.8	4.3	15.1	9.5	4
n1_coast_rur	65.2	30	22.4	52.7	32.3	13
n2_coast_rur	34	17	13.5	30.6	18.6	7.5
vn_lake	5.8	2.5	1.6	7.2	4.8	1.9
n1_lake	46.6	20.1	14.2	41	25.5	10.9
n2_lake	79.8	37.4	26.7	69.3	44.8	16.9
vn_Station_urb	5	2.4	1.5	18.7	10.5	4.3
n1_Station_urb	33	24.3	18	146.6	91.6	36.9
n2_Station_urb	72.5	56.2	44.5	212.5	147.9	54.3
n3_Station_urb	29.6	23	17.5	78.3	55.5	19.5
vn_Station_rur	7.4	1.9	1.3	5.7	3.4	1.4
n1_Station_rur	64.9	23.5	16.5	60.3	37	14
n2_Station_rur	70.3	50.8	39.2	86.5	65.1	23.5
n3_Station_rur	16.1	8.8	6.8	18.3	10.8	4.5
vn_Track_urb	15.1	10.2	7.1	63.6	40.4	16.5
n1_Track_urb	43	32.4	24.3	152.1	100.4	37.9
n2_Track_urb	63.8	49.3	39.6	182.2	123.9	46.3
vn_Track_rur	31.8	12.5	9.5	28.5	18	6.8
n1_Track_rur	74.1	36.1	26.5	75.4	49.7	18.9
n2_Track_rur	59.6	36.9	28.2	67.3	46.9	17.4
vn_LuasA	2.3	1.6	1	13.1	8.2	3.1
n1_LuasA	10.9	8.1	5.8	67.6	41.2	18.1
n2_LuasA	22.6	18.8	14.7	105.8	73.5	27.4
n3_LuasA	17.5	13.7	11.2	58.9	40.4	13.3
vn_LuasB	0.7	0.4	0.3	6.7	4.4	1.9
n1_LuasB	5.1	3.8	2.7	43.6	30	12.2
n2_LuasB	21.1	15.5	10.9	139.2	88.8	35.2
n3_LuasB	13	10.6	8.6	47.5	32.7	12.2
vn_primsch_5	10.5	5.8	4.3	28.1	17.8	7.6
n1_primsch_5	15.9	11.9	9.4	44.9	32.5	12.7
n2_primsch_5	32.8	27.5	20.4	88.5	62.5	21.9
vn_primsch_4	16	12.1	8.7	58.7	40.2	14.8
n1_primsch_4	25	20.8	16	92.7	65.4	26.4
n2_primsch_4	54.4	45.3	34.8	157.9	107.2	39.1
vn_primsch_3	4.9	1.3	1.1	3.2	1.1	0.4
n1_primsch_3	2.6	2	1.6	3.9	3.1	1.1
n2_primsch_3	11.8	7.7	5.9	16.6	10.7	3.7

Table 3: ***Model III, including Neighbourhood Characteristics***

Variable	Sales II	Sales III	Rental II	Rental III
on_coast_urb	0.144***	0.133***	0.069***	0.069***
n1_coast_urb	0.080***	0.071***	0.041***	0.039***
n2_coast_urb	0.031***	0.038***	0.014***	0.014***
on_coast_rur	0.051***	0.048***	0.032***	0.034***
n1_coast_rur	−0.011*	−0.012 * *	0.018***	0.020***
n2_coast_rur	−0.018***	−0.016***	0.017***	0.019***
vn_lake	0.077***	0.071***	0.025***	0.027***
n1_lake	0.016***	0.012 * *	0.026***	0.025***
n2_lake	−0.025***	−0.027***	−0.006*	−0.006*
vn_river_urb	−0.060***	−0.029***	0.020***	0.019***
n1_river_urb	−0.092***	−0.054***	0.008*	0.007
n2_river_urb	−0.091***	−0.050***	−0.003	−0.002
vn_river_rur	−0.079***	−0.067***	−0.012***	−0.014***
n1_river_rur	−0.067***	−0.056***	−0.007*	−0.008*
n2_river_rur	−0.049***	−0.043***	−0.006	−0.007*
vn_Station_urb	0.067***	0.043***	0.047***	0.040***
n1_Station_urb	0.027***	−0.003	0.037***	0.034***
n2_Station_urb	0.008	−0.020***	0.034***	0.030***
n3_Station_urb	−0.001	−0.021***	0.021***	0.018***
vn_Station_rur	0.081***	0.088***	0.049***	0.045***
n1_Station_rur	0.027***	0.037***	0.039***	0.035***
n2_Station_rur	0.021***	0.027***	0.033***	0.029***
n3_Station_rur	0.042***	0.030***	0.033***	0.028***
vn_Track_urb	−0.051***	−0.041***	−0.040***	−0.038***
n1_Track_urb	−0.024***	−0.013 * *	−0.022***	−0.020***
n2_Track_urb	−0.019***	−0.017***	−0.019***	−0.019***
vn_Track_rur	−0.002	−0.007	−0.000	−0.001
n1_Track_rur	0.005	0.002	0.003	0.002
n2_Track_rur	0.017***	0.014***	0.012***	0.011***
vn_LuasA	0.050***	0.055***	0.018 * *	0.019***
n1_LuasA	0.034***	0.030***	0.017***	0.018***
n2_LuasA	0.038***	0.030***	0.019***	0.016***
n3_LuasA	0.099***	0.077***	0.036***	0.031***
vn_LuasAIC	0.034*	0.011	0.011	0.013
n1_LuasAIC	0.000	−0.001	−0.011 * *	−0.010 * *
n2_LuasAIC	−0.042***	−0.029***	−0.021***	−0.023***
n3_LuasAIC	0.028***	0.008	0.001	−0.008
vn_LuasAPR	0.193***	0.121	0.035 * *	0.031*
n1_LuasAPR	0.088***	−0.007	0.072***	0.064***
n2_LuasAPR	0.083***	0.043***	0.009	0.013 * *
n3_LuasAPR	−0.160***	−0.126***	−0.047***	−0.035***
vn_LuasB	0.229***	0.156***	0.036***	0.036***
n1_LuasB	0.203***	0.151***	0.067***	0.065***
n2_LuasB	0.072***	0.054***	0.021***	0.020***
n3_LuasB	0.052***	0.038***	0.021***	0.016***
vn_LuasBPR	−0.142***	−0.102 * *	0.046***	0.044***
n1_LuasBPR	−0.048***	−0.046***	−0.006	−0.005
n2_LuasBPR	−0.018	−0.024*	−0.022***	−0.024***
n3_LuasBPR	−0.051 * *	−0.040 * *	−0.012	−0.010
vn_primschac5	0.016***	0.010 * *	0.000	−0.000

Continued on Next Page. . .

Table 3: ***Model III, including Neighbourhood Characteristics*** **(Continued)**

Variable	Sales II	Sales III	Rental II	Rental III
n1_primschac5	0.004	−0.002	0.001	0.001
n2_primschac5	0.014***	0.015***	0.005***	0.004 **
vn_primschac4	−0.018***	−0.014***	−0.009***	−0.008***
n1_primschac4	−0.016***	−0.012***	−0.003	−0.003
n2_primschac4	−0.004*	−0.009***	−0.002	−0.003*
vn_primschac3	0.023***	0.026***	−0.017*	−0.018*
n1_primschac3	−0.001	−0.000	−0.005	−0.006
n2_primschac3	0.010***	0.013***	−0.000	−0.001
pcpreww1		0.317***		0.007
avsize		0.058***		0.005***
pcunemp		−1.321***		−0.539***
pcagri		−0.488***		−0.060*
ldensity		0.000		−0.003***
pcgaelgoir		0.199***		−0.062
pcsingle		−0.117***		−0.001
avcomm_km		−0.007***		−0.007***
pclahousing		−0.076***		−0.005
Region Effects	YES	YES	YES	YES
Period Effects	YES	YES	YES	YES
Size/Type Effects	YES	YES	YES	YES
Facility Effects	YES	YES	YES	YES
R-squared	0.821	0.827	0.856	0.857
N	213613	213735	201609	201609
*** p<0.01, ** p<0.05, * p<0.1				

VOTE OF THANKS PROPOSED BY NIALL O'HANLON, CENTRAL STATISTICS OFFICE

I congratulate Ronan for his analysis and propose the vote of thanks. As a property price index compiler myself I can appreciate the very considerable amount of work that has gone into Ronan's analysis. He has constructed a wonderfully rich dataset by combining data on advertised prices and rents, and the associated property characteristics with diverse data on five categories of amenities;

- Market depth
- Transport
- Human capital
- Social capital
- Environment

This allows Ronan to estimate the effects of various examples of these amenities on sale and rental prices. These effects in turn should help better inform the estimate of private benefit from public goods.

This type of data linking or matching offers enormous potential for policy analysis. Even official statisticians are beginning to focus on linking and matching as supplementary or even alternative approaches to more traditional survey based methods. As more administrative data becomes available for analysis the focus on data linking grows. Rarely does a single administrative source provide the statistician, economist or analyst with everything he needs. Take my own experience of house price index compilation: The CSO Residential Property Price Index is compiled using data on mortgage drawdowns supplied by the main mortgage lenders. An obvious weakness here is that cash based transactions are excluded (although there is no evidence yet that the price development of cash based purchases generally is significantly different from mortgage based purchases). So why not use stamp duty data from the Revenue Commissioners, or data collected by the Property Registration Authority? Well, these data do not capture the characteristics of transacted properties and so cannot be used in isolation to compile mix adjusted indices – single administrative sources do not often tell the full story.

Data matching and linking offer possibilities however. The CSO expected to receive monthly feeds of stamp duty data from June 2012. It is planned to link these to Building Energy Rating (BER) certificate data compiled by the Sustainable Energy Authority Ireland to identify the characteristics of properties and to plot size information held by the Property Registration Authority. These expanded datasets can in turn be linked to small area statistics from the derived from the Census. Ronan's work does point the way forward!

However, this matching won't be easy. Neither the Revenue Commissioners nor Sustainable Energy Authority of Ireland currently geocode their data so matching by address will be a challenge. The absence of a national system of postcodes doesn't help of course. But because we are coming late to postcodes we have an opportunity to get their design right. Letterbox or location specific postcodes would fundamentally change our ability to link data and of course to conduct spatial analysis – so we live in hope!

The data from daft.ie that Ronan uses is geocoded and in his paper we can see the opportunities afforded by spatial analysis. Typically property price index compilers confine their analysis to spatial correlations – grouping neighbouring properties where their close proximity appears to result in similar price trends. We do not necessarily know that the drivers behind these spatial impacts are.

Ronan's analysis digs deeper and identifies various amenities and quantifies their impacts on prices and rents. We could debate the appropriateness of the relative importance of the amenities Ronan looks at but I think this would be missing the point. Could we ever agree the composition of the most appropriate list? I am not very enthusiastic about the married/unmarried ratio or the Gaeltacht indicator – they are far less intuitive to me than other indicators presented. But I do understand and value what Ronan is doing – it is exciting work. Let us not get too hung up on the amenities used as the underlying idea and ambition are excellent. The possibilities for further development and refinement of this study are endless. The CSO's Administrative Data Centre is, among others, working very hard to make various administrative datasets publicly accessible. But getting the wider statistical infrastructure (like postcodes) right is vital.

To conclude, I congratulate Ronan on his work and I look forward to more of his analysis.

DISCUSSION

Frances Ruane: I would like to thank Ronan Lyons for such a stimulating and timely paper. I have some questions and one comment. 1 - You used distance from a school as being a relevant measure – I wonder if it is not the availability of schools in the area that may not be more relevant? This would represent choice to parents and may make one house more attractive than another. 2 - I wonder if the mismatch between the local supply and demand for rental housing might have an effect on the price of houses in that area? 3 - In relation to house occupancy, would you tell us a little more about what is covered in areas such as West Cork where there is a strong tourism sector? For example, are rents averaged over the whole year? 4 - Finally, a comment – it seems to me that your research points yet again to the need for a postal code system which would support all research that has a locational dimension. We have been waiting for this for over two decades!

Noel O'Gorman: I would ask the author to comment on the possibility of using the house-price model, with the associated data-base, to support a *self-assessment* approach to a residential property tax levied on house (or site) value. Could it be used, for example, to generate a ready-reckoner for valuation? In relation to possible 'amenities' to include in the model, he suggested consideration of 'population density' as a variable to differentiate urban and rural location, or to capture amenity associated with a neighbourhood; the choice of the geographical unit to use might, however, be problematic.

Orla Doyle: Is it possible to measure the impact of the quality of schools rather than distance from schools on house prices/rents? The Sunday Times Guide to Secondary Schools by Murphy and McConnell (2006) provides information on proxies for school quality.

Michael Terry: With my recent experience of selling two properties I achieved only 66% of the original Estate Agents recommended price - the initial price quoted on the housing web sites. In the meantime I have failed to get any seller to reduce their asking price by more than 10%. It is my experience that the bulk of houses for sale at the moment are rented properties requiring a major overhaul before being suitable for human habitation. In effect, there is a shortage in the market for houses suitable for immediate occupation.

Bill Keating: I would like to congratulate the author on a very interesting paper that deals with a matter of interest to a wide range of persons. It passes the first test to be applied to any paper in that the findings by and large accord with common sense. I would like to raise a few points. It seems sensible to me that there would be a premium for being close to a primary school but a lesser one if a house is very close since traffic, etc. would cause problems. I wonder, therefore, why the same does not apply in the case of most of the supermarket chains. Perhaps the availability of a car park is the difference.

The author is correct to point out the possibility of certain cross-over effects. Thus, for example, some of the premium attached to proximity to a Luas line may be down to the more general features of the areas in question. I feel the same applies to the Gaeltacht factor. In areas like West Kerry the premium is probably down to the location rather than the language. In the case of Kerry and West Cork, I suspect the lesser effect for rentals is simply a demand issue. As regards other possibilities for investigation, I would suggest proximity to public parks and to hospitals. In the case of the latter, it may be a factor in the case of lettings in particular due to the demand from staff on short-term assignments. Lastly, perhaps more attention could be paid to the influence of postal codes in Dublin.

Lorcan Sirr: it might be instructive to overlay some demographic information over Ronan's analysis to see at what age and stage in life people are purchasing properties and what type. It could be instructive to see if people are purchasing different types of property in different age brackets and for what reasons. This could then be used to inform policy at national (planning and development legislation, finance, housing policy) and local level (development plan) to determine what types of property we need, rather than accepting the sometimes inappropriate types of property we are provided with. This is especially pertinent given the ageing nature of Ireland's population, and particularly the over 65 group.

Duncan Cleary: Other sources of information could include building and land use types, for example industrial estates/ factories etc. and their proximity, and also the use of geological data, currently available from the Geological Survey of Ireland, which may be helpful in trying to quantify the amenity of areas.