Configurational Economies: The Value of Accessibility in Urban Development

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A B S T R A C T

This research is an effort to understand the theoretical foundations of how the configuration of space is interrelated with the economic properties that sustain the built fabric. The argument is based on unfolding accessibility in two perspectives: As a spatial parameter that understands urban form as a system of relational patterns of connections that organises human activity. And as an economic parameter that can be valued under specific price mechanisms of urban properties. The paper shows a first preliminary study of testing street prices with spatial accessibility measures. The method was to use current house prices with Space Syntax techniques, a spatial analysis tool that outputs measures of connectivity and accessibility represented in a street network. Overall, economy contributes on the shape of our cities that prevail in the spatial relations of the built form, resulting in new configurational economies.

1. Introduction

This research proposes to explore the theoretical framework of how the configuration of the built form is understood from the perspective of urban economics. Spatial configuration and movement focuses on how space is implicated in organising human activity that is

embedded in the real world (Hillier, 2001; 2009). The urban morphological process also underlies a market structure that influences different types of spatial patterns. This implicates a city's needs to constantly evolve and transform through time, seeking for a better quality of life (Jacobs, 1970). The purpose of this research is to bring to the fore how the configuration of space works within the parameters of different economic values. It is an exploration of how street network, an important feature in urban design and spatial planning, functions as a resource that is priced under the globalization of economy. Thus, different urban parameters are studied and related to specific economic properties of the built form. The key question addressed is centred on the relationship between spatial configuration and the economic values that define it. The parameter of spatial accessibility is used as the main backbone to study the intersections of economy and urban space. The assumption is that accessibility has a value within the specific scales that it is defined. Therefore, it is necessary to give a more precise value to accessibility. Markets work as institutions that define a value of a resource. Value itself is a balance between the satisfaction of needs (benefits) and the use of resources (expenditures) that consequently structures space (how we design) and defines place (urbanity). Under these assumptions, it is proposed to use Space Syntax as a method to measure geometric accessibility and economic values through different price mechanisms. The different price mechanisms indicate values at the scales of district area, neighbourhood and street level.

Accessibility can be defined as the simplicity in which activities of the society can be reached, including trade and public services that reflect the needs of the community. Distance measures are the simplest way of measuring accessibility, counting the distance from one location to different opportunities, in which the prime cost is time. Notwithstanding, it is considered accessibility not only as a measure of distance, hence a measure of connectivity, but also a distance that becomes a resource. The cost as a resource relates to the multiplied processes of density, distribution of land uses and the price to those spaces. Thus, the importance that accessibility works as an added value in the spatial structure and within the situated practices of 'good' urban design. The implications of this added value are derived on how the role of institutions affects the built environment. The regulatory system of a city, such as planning policies, acts as a political power over the spatial structure. In this sense, spatial accessibility can be seen also as a 'political' parameter, understanding that the grid implicates also distributional power.

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2. The Syntax of Urban Space

Space Syntax (Hillier and Hanson, 1984; Hillier, 1996) is a methodology for representing the morphology of buildings, open spaces, and streets. As an analytical theory, it measures and identifies changes in the configuration of urban form, using accessibility as a main variable for its analyses. The property of accessibility is crucial in this theory. Space Syntax is concerned about how connections and boundaries of spaces define the way people use and behave within them, and how they relate to one another. From the study of how space impacts on society, the built space is to be understood as relational patterns of connections and interfaces. In *The Social Logic of Space*, Hillier and Hanson (1984) made the distinction that underlying structures of space form patterns of behaviour that carry social meaning, defining it as the *spatial configuration* that governs the distribution of movement. Spatial configuration is in and of itself the primary determinant of movement flows and the co-presence in space. In a nutshell, this is what is called the 'natural movement' theory (Hillier, et al, 1993).

Movement is understood as the way to predict how people move and tend to use space dependant on configuration (Penn, et al, 1993). The structure of the street network determines movement, and because street networks (grid configuration) shapes movement it also generates land use patterns. In the changes of street connectivity attracting more people, this tends to attract retail and other land uses that depend on the volume of pedestrian traffic, and consequently the density of pedestrian movement and uses are multiplied, a process called 'movement economy' (Hillier, 1996a). If movement economies are based on the 'multiplier effect' that results from movement flows, determined by the configuration of the grid, then it is proposed that spatial configuration can determine price. Configuration, movement and land use patterns make an ordered and logical process of urban form (Penn, et al, 1998). If we add to this logical process the value of the multiplied effects then the value of urban design establishes in the understanding of how a city should work and not what a city should be. Spatial accessibility modulates, distributes and accommodates the generation of movement, a core issue nowadays in urban planning and design (Peponis, et al, 1997).

As a geometrical property that is transformed in representations of movement, accessibility is measured in its 'spatial integration', a method for estimating the potential

movement in a street network. As a form of analysis, integration[1] measures spatial accessibility using the basic element as the segment of the street between junctions. For instance, let us consider the movement economy theory. Hillier (1996a) argues this theory through the spatial distribution of retail, making it the most common non-residential land use. It is argued that the main attractors of movement are not the shops themselves only, but the structure of the grid itself acts as the prime determinant of movement flow. Both shops and major flow of people are found in more integrated streets. The presence of shops attracts people but they cannot change the integration value of that street (segment), since it is purely a spatial measure of the position of the segment or line in the grid. It can be that the shops were selectively located on integrated segments, which 'naturally' carry the highest volume of movement flow. Therefore, the relationship of this process is between grid (street network) and movement, and location in the grid has a crucial effect.

3. The Configurational Logic of Economies

In the practice of urban design and architecture there is always a quality-seek purpose that gives meaning and value to what is produced. From the perspective of economic value, this can be formed in different ways in urban design. For instance, the economic value on producing high returns of investments and even rental returns, placing developments above local competition at little cost, helping deliver more higher densities, contributing to more productive workforces, creating urban regeneration and place marketing, creating mixed-use elements to promote better quality of life, and so on. All these ideas, many of them applied in current research (CABE, 2001) are practical views in which spatial value is directly linked with an economic one. In the case of urban planning, this has much to do with the decision-makers that act on delivering a good initiative to how a city should develop. Both design and planning have much to do with new theories of urbanism that dictate how a city should be. However, it is the how the city functions that gives meaning to its spatial forms. Thus, accessibility, namely the connectivity of urban spaces, is studied as an urban parameter in two dimensions: spatial and economic.

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[1] The analysis marks measurements of patterns of line connectivity that is called 'integration', which can be the global or local measurement that gives an average on all other lines within the whole configuration (Hillier and Hanson, 1984).

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3.1 Accessibility as Spatial Parameter

Current research (Marcus, 2010) proposes an analytical theory of urbanism relating urban form and urban life with the social aspect to what the author calls *urbanity*. By introducing Space Syntax analysis, the importance of Marcus' research is that it gives an added value to the relation of accessibility and diversity, namely a *spatial capital* (2010, p.9). It is form of measuring urbanity: the higher accessibility, and higher diversity, the higher spatial capital. Following the idea of accessibility and spatial value, the idea of diversity is also relevant. Measuring diversity informs how spatial properties, socio-economic, and cultural processes work together, relating how the community perceives space (Penn & Perdikogianni, 2005). This has economic implications because it comprehends diverse spatial properties in the urban network. There is a variety sense of behaviours (socially, culturally and economically) that space itself gives information on how people perceive the built environment (Wilson, 2000). The value of accessibility, in the terms of diversity, is an understanding of macro socio-economic processes in the city.

The aspect of urban morphology in accessibility comes from the idea of the fringe-belt model proposed by Conzen in his analysis of Alnwick (1960) through the contributions of J.W.R. Whitehand (1972), bringing this concept together with economic theories. Initially, the fringe belt model was based on the idea that the city as a physical entity has been created by a series of growth periods, rapid or slow growth. As a result, distinctive regions emerge at the edge of an urban area and then embedded within it. This is what Conzen (1960; 1969) describes as *"a belt-like zone originating from the temporarily stationary or very slowly advancing of a town and composed of a characteristic mixture of land-use units initially seeking a peripheral location."* (p. 125) The major contribution comes from Whitehand (1972). He linked the concept of fringe-belt to neo-classical economics 'trade-off' model (land rent theories), showing the relationship between bid rent and distance from the edge of the built-up area. He employs the concept of bid rent curves to explain why demand for land varies across an urban area. The relation of the concept of 'fringe-belts' and valuing accessibility makes an important association of concepts to think about. Institutional land uses (i.e. hospitals, universities, parks, jails), in contrast of residential uses, tend to be more representative of fringe belts. The aspect of time is crucial to understand how fringe belts tend to develop. Whitehand (1972; 2003; 2006) argues that during an economic boom in housing

there is a high probability of dwellings being assigned to sites closer to the edge of the built-up area and institutions to more distant sites. Inversely, during an economic slump there is a high probability of institutions being assigned to sites closer to the built-up area. From this perspective, we can think of accessibility as a factor that provides a buffer or shock absorber for property prices against economic shocks. Location becomes a fundamental element in this framework (Lloyd, et al, 1972).

Integrated and segregated street patterns, as understood in Space Syntax literature (Penn, et al, 1998: Hillier, et al, 1993, 1999b, 2005, 2007) also respond to how markets behave depending on the structure of the grid. Markets behave according to what the demand and supply needs are informing at a specific location and proximities. For instance, main roads that tend to have higher accessibility and higher diversity of uses will have specific markets regulated for specific purposes. In contrast from secondary roads, these tend to be more segregated from the built-up area. Neighbourhoods tend to be more private, resulting in a more segregated spatial location. However, segregation does not necessarily mean a negative outcome of markets. It is the market itself that positions on what it is more profitable depending on its location. Neighbourhoods will respond to a higher value of accessibility not only in terms of the street network but also in terms of accessible services by being more segregated. Markets will locate themselves in such areas for specific purposes. Fringe-belts establish a relation of urban morphology and access to land. The value depends on how spatial accessibility reacts under the formation of fringe-belts according to market behaviour.

3.2   Accessibility as Economic Parameter

Land use theory of classical economists such as David Ricardo (1817) and Henrich von Thunen (1826), and in the context of modern cities (Alonso, 1964; Fujita, Krugman and Venables, 1999), deal with the spatial trade-offs of how different groups of land place different values on a city's geometric accessibility. Ricardo's rent model (1817) was based mainly on average fertility rates. The most fertile land was used preferentially because it produces more food than land of poorer quality. Therefore, it acquires a higher rent. The less fertile land receives no rent, until demand increases to make it worthwhile. Von Thunen's (1826) proposition was based on Ricardo's model with the contribution of balancing between land and transportation costs. Alonso's model (1964), similar in many ways to Von Thunen's, is grounded on the *bid rent theory*, which describes how the urban user seeks central locations but is willing to accept to be located further away from the city centre if rents are lower in

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compensation. Alonso's contribution establishes the quantity of land required and the variations of income used on land and transport costs, as well as goods and services. In summary, Alonso's model describes the spatial patterns of land value. The model produces the equilibrium of distance from the Central Business District (CBD), meaning the central area of a city and size of land occupied by mainly three land uses: residential, firms, and agriculture. These land theory models are different explanations of spatial patterns of distribution of land uses that are influence by location value and the accessibility to those different uses. Accessibility offers a value that can be measurable in terms of how different types of land use are priced depending on their location and proximity to the most central or dense part of the city. Residential property is usually priced in this way. With the premise that CBD can be the most integrated area in a city, it can be assumed that if we measure accessibility in relation to neighbourhood pricing, then its value is dependable on the size of the plot (more land) for less price with higher cost of transportation (more distance = far away from CBD = less integrated spaces).

From a geographical perspective, the *Central Place Theory* (Christaller, 1933; Losch, 1954, Krugman, 1995; Openshaw, et al, 2003) proposes the relationship between size and the distribution of settlements within a system. It is about how settlements are located in relation to one another, the size market that a central place can control, and why central places function in different typologies (town/city/village). Furthermore, in regards to how markets operate depending on the 'threshold' and 'range' how accessible they are to each other is August Losch's (1954) theory of spatial competition and firm location. These are also models that comprehend how in different scales spatial accessibility can be explored and studied: at a global level (street network), local level (neighbourhood) and address level (street).

3.3 Pricing Space Across Scales

The syntax of accessibility is based on how we can understand the configuration of space in all its forms: space, society, culture, environmental, and economic. According to Webster (2009), *"if accessibility could be priced, it could be allocated more efficiently."* (p.6) Therefore, there must be a price to access these resources. It is impossible to price all accessibility. However, one consideration that Webster brings out is to consider an important public good to this matter: connectivity. Land value, for example, is a good indicator of pricing spatial accessibility because it derives from a general connectivity. Webster's

proposition makes the difference between general accessibility (spatial) and special accessibility (economic). In these terms, access deals with the role of markets and institutions. Therefore, accessibility supply can be priced through different price mechanisms in specific accessibility measures. Following these ideas, it is argued that different people demand for different connectivity and needs. Different uses and places make distinctive economic values (Desyllas, 2004; Webster, 2002). Thus, acquiring a more precise value of accessibility can reflect how economic and political processes impact on the spatial patterns of urban form.

In order to understand the configuration of economies it is also necessary to unfold the specific economies that are in question. To do this, we must start from the foundations of what accessibility implies. Hansen (1959) described this concept as a means to measure relative nearness or proximity of one place/person to all other places/persons. Often, accessibility is seen as a measure of cost of getting from one destination to another, a trade-off of benefits received once the destination is reached. Batty (2009) argues that there are several issues that make important the measure of accessibility. Firstly, he proposes that measuring accessibility is a matter of scale. Secondly, there is a difference between measuring the accessibility of how individuals behave in respect to economic and social activities, and how individuals implicitly react to the physical infrastructure. The physical structure is mainly what we consider as the street network and the clusters of buildings. In this sense, scale is important from activities to infrastructure, where movement, opportunities, and interactions take place and relate to each other. This process of economic and social activities, studied across scales, is what this paper proposes as a *configuration of economies*. Defining specific measures of accessibility, depending on the scale that is studied, can represent how the configuration of space functions as an economic force that deals with how individuals react through space: market structure, decision-making processes that points to regulation policies and valuing access as a resource, a public good to be designed and planned in a sustainable fashion.

4. Case Study

The research proposes the City of Cardiff, Wales, UK as an area of study due to its many different stages of urban development and re-development over time. The evolution of Cardiff develops since the industrial revolution, having different periods of boosting development followed by periods of stagnation. From the domination of the coal trade, Cardiff reached its

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economic peak as the *coal metropolis* (Daunton, 1977), the biggest coal trading port in Wales. Despite the long, slow death of the coal industry in South Wales, the service sector became dominant during and after the inter-war period and continued to ensure Cardiff's growth, ensuring the city's role as a regional capital (Hooper & Punter, 2006). In its physical structure, Cardiff's growth over time responded to a continuing processes of growth by decentralising. The process of growth was brought in the outer areas of the city, accomplished by extensions of the borough's boundaries. The decentralisation occurred because habitants lived in two parishes, which had constituted the town in the mid nineteenth century. Recent planning and urban regeneration policies tried to stem this flow, in terms of attracting residents back to the City Centre and Cardiff Bay (Hooper & Punter, 2006; Thomas, 1994). The form in which this decentralisation took place was due to the response of housing affordability. The city constructed large areas of low-density council housing from the late 1920s until 1960s, predominantly on the west and east side of the central area. This was accomplished by the suburban growth of private housing developed in the north of the city. The distinctive footprint in the configuration of the city reflects this process of decentralised growth.

Future developments sought to have an industrial expansion with the reclamation and redevelopment of the waterfront strip in 1977. The urban regeneration in the city was to highlight the theme of the dockland redevelopment, institutionalised in the form of the Cardiff Bay Development Corporation (Thomas, 1992). Cardiff faced a radical transformation also in its population that made it an attraction as a job market. New developments arise such as the Millennium Stadium and the Bay Area redevelopment, mainly for residential usage. In addition, the booming of retail activity of major shopping malls in the city centre made Cardiff an important capital for urban competitiveness and economic growth (City and County of Cardiff, Unitary Development Plan, 2001).

5. Method

The method used is set out in two parameters: Firstly, the urban structure is understood as a system of streets, individual spaces that are visible from one end to the other without obstruction. Those individual "axial spaces" (Penn, 2003) are straight lines, which represent a possible path of movement, over a map of an urban settlement. Each street is considered as a segment line that creates a segment map. In every urban settlement, there are three factors:

origin, destination, and the series of spaces that pass through one another (Hillier, 1996b). In order to measure the degree of integration[2] or segregation the average depth of a space to all other spaces in the system is calculated. In every segment map, each line (street) has an integration value assigned to it. In Space Syntax terminology, an integrated line is more accessible because it can be reached easily from other lines in the system (Hillier and Hanson, 1984; Hillier, 1996b; 1999b; Hillier and Iida, 2005; Hillier, et al, 1993). These measures can be 'global', denoted as *Rn* where the measure is up to 'n' radius, and 'local' where measures are calculated at specific radius.

Figure 1: City of Cardiff, Wales, UK – Street network in segment angular integration, Rn.

Having constructed a segment map of the city of Cardiff (Figure 1) and making a survey of observation-based land uses, it is then examined a preliminary analyses of street pricing, making a sample of 30 streets delimited in the city centre and Cardiff Bay. Sample area is as

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[2] Integration measures the *to-movement* potential to a destination, that is, it refers to a system of origins, how easy is to get from one segment to the other. Choice refers to the measuring of *through-movement*, that is, the choices of routes, how accessible is to pass through a segment in a trip (Hillier, 2009, p.4; Hillier & Iida, 2005, p.557).

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follows:

1. Data is according to database called Mouseprice.co.uk, which is regulated by Land Registry index house prices. (Land Registry, http://www.landregistry.gov.uk/ Accessed: September 15, 2010)

2. Mouseprice.co.uk defines their street ranking values in the following terms:

   a. *Most expensive street* as the street with the highest average property value in the postcode district.

   b. *Most commercial street* as the street with the lowest percentage of residential properties in the postcode district.

   c. *Most residential street* as the street with the highest number of residential properties in the postcode district.

5.1.1 Preliminary Findings

The preliminary results reveal how street prices correspond to different gradients of integration, at global and local level. Figure 2 shows the main streets, highlighted in red, to be well connected within the whole urban system. At a metric radius of 800m (Figure 3), the street network shows a more locally accessible connection between the city centre (red circle) and the Bay Area (blue circle). The first results show that the most expensive streets are also the most segregated ones with the highest turnover rates. Therefore, it can be implied that more private streets tend to be highly valued. In contrast, the least expensive streets show to be highly commercial, locating in the more accessible and integrated street lines in the network. The street prices where measured at a global level (Rn), in which the type of use and the typology of the road was taken into account in order to measure accessibility in the whole urban network. The results (Figure 4) show that the most integrated streets are retail and business uses rather than residential. An interesting feature is that residential properties that are located in commercial streets are located in more integrated or accessible locations but with a much lower price than those that are in segregated areas (Figure 5).

**Figure 2:** Cardiff Bay and City Centre Centre at Rn (global integration).
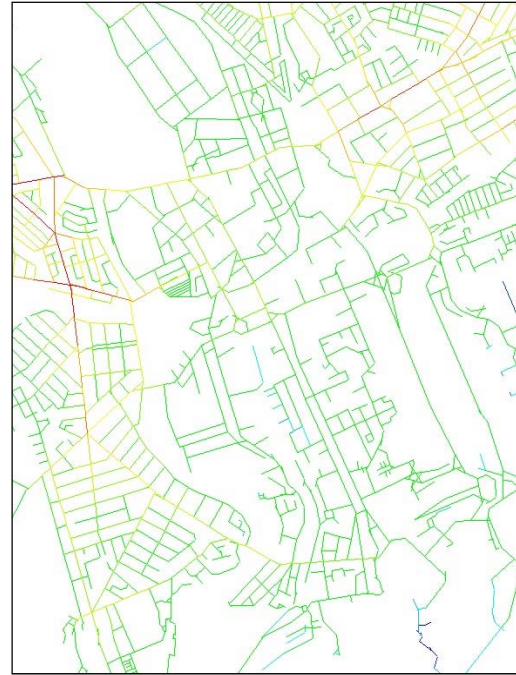
**Figure 3:** Cardiff Bay and City at R800m (local integration).

6. Scope and Limitations of the Study

This first stage of the research has shown how spatial accessibility functions under the pricing of streets. The sample data is limited only to the most dense and central part of the city of Cardiff, in which the number of commercial uses is higher than residential ones. However, the properties that Mouseprice.co.uk gives are residential house prices that are located in streets that are more or less of commercial usage. Using a GIS platform, current research is being conducted to enhance these first results. The first set of variables was to use residential property values, using council tax band as a proxy. Council tax is a form of taxation that is undertaken by the Valuation Office Agency (VOA), part of the UK government agencies. The value of the property is divided by bands, which are used in turn to calculate the council tax to be paid. Recent studies applied in the city of London (Chiaradia, et al, 2009a, 2009b) have shown that there is a direct correlation between council tax bands and spatial integration values. The purpose for considering council tax banding is to examine how property is priced depending on its location and the price paid (or sold prices) that are made. Results correlating this dataset have shown that purely domestic dwellings are strongly related to their accessible integration values. The higher the value of the property the more accessible or integrated its location within the whole street configuration. Another variable was to use price paid dataset

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(sold house prices) in relation to the typologies of dwellings and their tax banding (Narvaez, et al, 2010).
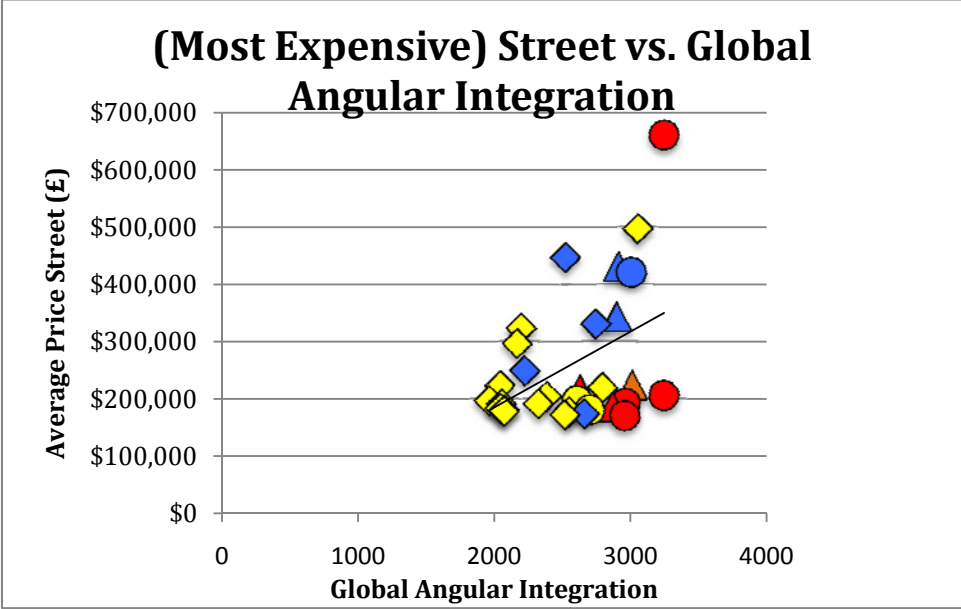
Figure 4: Most Expensive Streets Vs. Global Angular Integration. (circle) Primary roads; (triangle) Secondary roads; (diamond) Local streets, private roads. Colours represent types of use: (yellow) Residential; (blue) Businesses; (red) Retail.
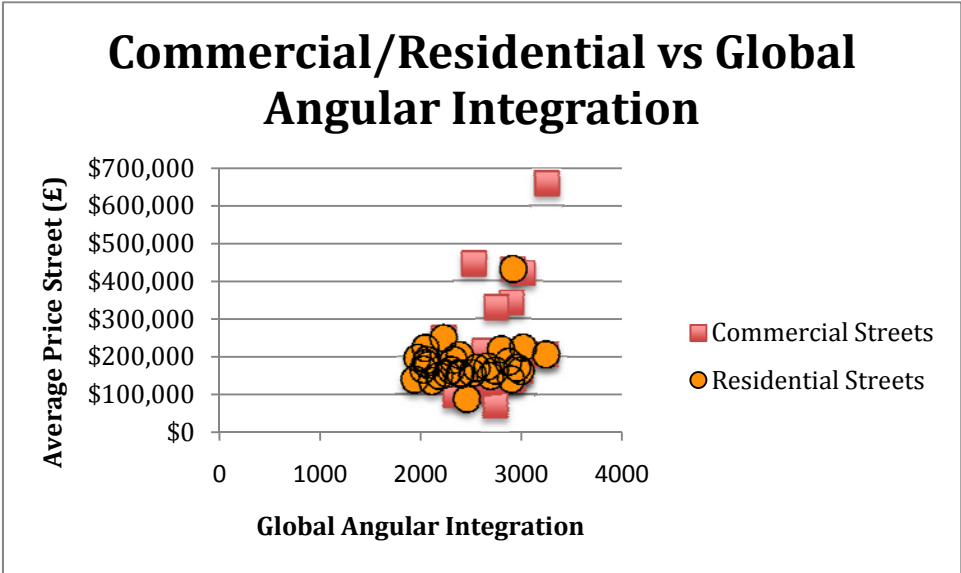
Figure 5: Commercial and Residential Streets. Comparison of values of global integration (Rn) with commercial and residential street prices.

7. Conclusion

The purpose of this paper is to give a theoretical background and first preliminary study of how the value of accessibility is important to understand socio-economic processes. The sample test shows a general scope of how street pricing affects on different degrees of integration. Recent results propose future studies to elaborate hedonic modelling in order to see the objectives proposed: accessibility at different urban scales in relation to the different price mechanisms that function as a parameter of specific markets. The aim is to analyse economic values at different scales of the urban network, specifically in neighbourhood, block and street. At these different scales, the various price mechanisms are explored along with the planning policies addressed in the area. It is not the intention of this research to examine the regulatory processes of the city but to think how planning applications inform the local changes and decisions that have a distributional effect in the configuration of the city. Transactions comprise an economic trade and a decision-making process of how individuals seek their own gain within a market. Therefore, it is noted that economic parameters also denotes political implications. This can be delimited by the role of institutions and the value of accessibility that comprises the distributional power, its economic value, and the better quality of urban design and planning practices.

8. Acknowledgement

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