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What makes your neighbourhood 'better'?

Socio-economic variabilities of Greater Kuala Lumpur neighbourhoods

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Khazanah Research Institute

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[1] Authors' edit to manuscript: We would like to rectify an error in the previous version of this paper, in which our peer reviewer was incorrectly credited.

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Summary

- Rapid urbanization has profound effects on the demand for services and amenities, not only at the scale of cities and towns, but also at neighbourhoods. Conventional approaches to urban development rely on the equilibrium of supply and demand in property development. The underlying assumptions of rational choice theory and the profit - maximising motives of both households and firms creates uneven rates of urban transformation. This process creates different economic variabilities as well as spatial inequities.

- This working paper proposes a method to analyse economic variabilities at the neighbourhood scale. The 'Greater Kuala Lumpur (GKL) Amenity Space[2]' is a Network model constructed based on the diversity of amenities that are accessible from neighbourhoods.

- The concept of accessibility is important in the study of the comparative advantages of a particular urban location in terms of movement, transport costs and convenience. This paper utilizes the first principles of 'general accessibility' i.e. on the requirements of firms and households to minimize movement costs. This is then overlaid with 'special accessibility' that refers to the economic advantages of co-location i.e., agglomeration economies.

- The GKL Amenity Space exhibits an assortative-ordered network, which suggests the presence of place differentiation based on the structure of amenity co-location. It shows that while all neighbourhoods exhibit a basic structure of 1st-tier amenities – i.e. governmental services, places of worship, places to acquire groceries, schools, public transport, and some others; there are also neighbourhood portrayals of diversified places that seek to satisfy 'higher-order' patterns of consumption. The latter's discretionary consumption patterns are reflected in the presence of 2nd-tier amenities - for example physiotherapy services, veterinary care, jewellery, spa outlets and bowling alleys.

[2] Following C. Hidalgo, Castañer, and Sevtsuk (2020)

- The GKL Amenity Space may be employed as a policy decision-making tool in measuring place differentiation at the neighbourhood scale. It can be utilized by different stakeholders – policymakers, local communities, and real estate developers as a platform to begin having better informed discussions on urban transformation programmes and its inherent trade-offs, in order to further improve neighbourhood vibrancy without necessarily going through the ill-effects of gentrification and local area displacements.

1. Introduction

Malaysia has experienced rapid urbanisation since the 1970's, it is currently more urban than rural. The changes in the definition of 'urban areas' as well as the rural-urban migration have increased the proportion of population residing in urban areas from 33 % in 1970 to 77 % in 2020.[3] Kuala Lumpur was, and still is, at the centre of this phenomenon. In 1970 Kuala Lumpur had a total population of 0.45 million, but in 2020 it has grown to 8.2 million. These population changes affect the demand for services and amenities, not only at the scale of cities and towns, but that of neighbourhoods.

Several studies have focused on the sustainability of cities for supporting the demand for resources and services linked to local area provisions such as roads, electricity, clean water, schools, hospitals, and other critical services[4]. Further studies suggest that the ability to improve the management and delivery of these services is often tied to the resources of governments and local councils, which is partly contingent on the revenue collected within the administrative boundaries[5]. Varying levels of financial funding in urban development generally produces different outcomes in economic variabilities and spatial inequities.

The relationship between local tax collections and real estate values seems to suggest a consolidation of revenues for high-income households in the more affluent neighbourhoods. Conversely, this trend might suggest a vicious cycle of non-investment in low-income neighbourhoods as well. However, what if the economic variabilities of neighbourhoods occur within similar administrative boundaries? The critical difference then lies with private sector investments in the provision of amenities in the areas deemed teeming with economic potential.

There are varied ways of capturing the diverse types of amenities between different neighbourhoods, from linear GIS mapping, fieldwork surveys, and cultural mapping exercises. The second part of this 3-series Working Papers proposes creating an Amenity Mix[6] index with data aggregated based on Google Places API. This index is constructed based on the eigenvectors of a matrix that summarizes the diversity of amenities that are accessible from each neighbourhood.

1.1. Urban Settlements and Development Planning

The size and density of urban settlements create a myriad of positive and negative externalities. Positive externalities include examples such as the reduced costs of provision for public and local infrastructure, clean tap water, effective road systems, and public transportation. Agglomeration of businesses will also provide positive benefits of sharing the pool of labour, consumer demand, and the sharing of information[7]. However, the negative externalities of traffic congestions, poor

[3] CEIC (n.d.) and KRI calculation
[4] Bishop et al. (2000)
[5] Peter Hall (1996)
[6] C. Hidalgo, Castañer, and Sevtsuk (2020)
[7] O'sullivan (1996)

and deteriorating infrastructure, and the concentration of low-income households in the inner-city circle are evident as well. The dualism of 'lived experiences' posed by both positive and negative externalities in smaller parts of cities, (i.e., at the scale of neighbourhoods), has brought the discussion of inequality and space inequities to the forefront of some of the major questions facing urban development.

The ability to construct an idea of development as a 'greater good' for a significant proportion of society is perhaps at the very minimum, problematic. The ideas of urbanization from 1950's structuralism to poverty and inequality in the 1970s have shifted the focus from economic development to poverty alleviation and growth with distribution. Along it came measures such as community-scale intervention with participatory methods. The 1980s-1990s saw the influx of neo-liberalism in the management of cities and the withdrawal of the state as a key player in development. Privatization, liberalization, and deregulations were rife to minimize distortions of state intervention in the economy and to unleash the potential of market forces. The 2000s saw the focus on improving accountability, the rule of law, and the securing of property rights[8].

The 2010s however, saw rapid urbanization in most developing and middle-income countries. Therefore, efforts now are being made to manage and harness urban population changes and their attendant challenges. Efforts to exert development control through spatial planning for the built environment have been a feature of current strategies, against the already weakened position of the state (as compared to the state's influence in the 1950-1970s).

The purpose amongst others is to plan for city-wide infrastructures and local amenities. Many urban planners combined radical normative ideas about creating a better society with attention to specific areas of urban development; namely housing, infrastructure development, and public transport[9]. One of the main impediments to the process of urban development is the regulatory reach of infrastructure planning to the property rights of ownership; to provide guidance on the use of land[10]. To facilitate regulatory reach, formal land institutions are established by the State. It is highly improbable that we can address the questions of provision of infrastructure, housing, and services without the establishment of land institutions to manage the private interests of landowners. These formal institutions will provide the required access to land and effective coordination across urban spaces for the provision of these infrastructures in the most efficacious manner.

2. Places as a typology of consumption

2.1. Neighbourhoods as a catalyst of core and discretionary functionings

The concentration of different business amenities and services creates the 'standard' of living for an area. For ease of reference, we propose that critical services are collectively grouped as 1st tier places, and these are provided for and (or) managed by the local council or the government. On

[8] Fox and Goodfellow (2016)
[9] P. Hall (2002)
[10] McAuslan (1985)

the other hand, 2nd tier places are those that are owned and run by the private sector and characterized as the means to deliver and satisfy local consumption demand.

In an earlier report[11], we propose following Beinhocker's thought experiment – A tale of two tribes[12], that wellbeing is less about how much money you have, but rather more about what your money can buy. We suggest that our approach better mirrors Amartya Sen's most widely used interpretation of the concept of well-being[13], which involves three main components i.e. (1) Commodities, (2) Capabilities, and (3) Functionings. In this paper, we further posit that what your money can buy is to a large degree dependent on the type of places that are accessible from where you reside.

"To occur is to take place. In other words, to exist is to have being within both space and time."[14]. Every activity, economic or social, occurs in space and time. Places facilitate functionings – for example offices facilitate people doing work, restaurants facilitate eating or socializing, parks facilitate recreation and exercise, and the list goes on.

The typology of places is also present in the Multidimensional Poverty Index (MPI)[15]. The MPI is an index composed of a range of sub-indicators in the domain of health, education, and standard of living. Each sub-indicator represents a threshold used to determine if an individual, household, or community is deprived or not deprived. The MPI has as one of its sub-indicators 'access to healthcare' or 'school attendance' - both of which are functions of how accessible schools, clinics, or hospitals are. Columbia's MPI[16] even includes 'access to childcare services' as an indication of deprivation. The principles behind the choice of these sub-indicators indicate the relevance of place typology in identifying deprived households.

Mainstream urban studies approach the mechanisms underlying urban development at the micro-level by focusing on the changing determinants of the location, the property-related decisions of firms and households, and the implication these have on the economic and spatial structure of the city.[17] On that basis, explanations of urban land use and value patterns are based on the assumption that all economic actors seek an equilibrium situation at which (ceteris paribus) costs are minimized while profitability/utility is maximised. An important concept in the development of this kind of explanation is 'accessibility', a term referring to the comparative advantages of a particular urban location in terms of movement, transport costs and convenience. Two forms of accessibility are commonly identified; 'special' and 'general'.[18]

'Special accessibility' refers to the economic advantages available to individuals or firms when they locate near to each other; also known as agglomeration economies. On the demand side, Weber's theory of *Industrial Location*[19] explains agglomeration as an optimization process

[11] Hamid, Son, and Ismail (2019)
[12] Beinhocker (2006)
[13] Sen (2001)
[14] Peuquet (2002); Zhong et al. (2012)
[15] Alkire and Foster (2011)
[16] Salazar, Díaz, and Pinzón (2013)
[17] Anas, Arnott, and Small (1998)
[18] Ball, Lizieri, and MacGregor (2012)
[19] Weber (1909)

between sources of input and output market points, while Hotteling's *principle of minimum differentiation* focuses on market capture[20]. The amalgamation of these bodies of literature results in *central place theory* often attributed to Christaller[21] and Losch[22]. On the supply side, agglomeration is often described as a process constrained by knowledge spillovers[23], or of logistical costs[24]. West[25] proposes that there exist a parallel in the way cities' scale to allometric scaling in biological systems – that roads, utility lines and sewages are organized in a direct analogue to the biological network of capillaries that service an organism.

'General accessibility' places an emphasis on the requirements of firms and households to minimize movement costs. Given certain assumptions with regard to the centrality of economic activity (i.e., there is a central marketplace), there exist inherent trade-offs between transportation costs and accessibility. On these grounds, trade-off models have been developed describing the location decisions of economic agents and in turn, the patterns of urban land use- for example either for residential or commercial[26].

However, in an increasingly digitized world, there exist new possibilities in the realm of Big Data Analytics that allow for the analysis of high-resolution data in place typology that validate these existing theories and provide new insights in understanding agglomeration (both 'special' and 'general'). This paper extends the novel work of Castaner[27] in studying the collocation of places at the scale of neighbourhoods for the Greater Kuala Lumpur[28] (GKL) region. But unlike the original study, our objective is to quantify how similar/dissimilar neighbourhoods are based on the types of places contained therein.

3. Research Methodology

3.1. Defining the boundaries of neighbourhoods.

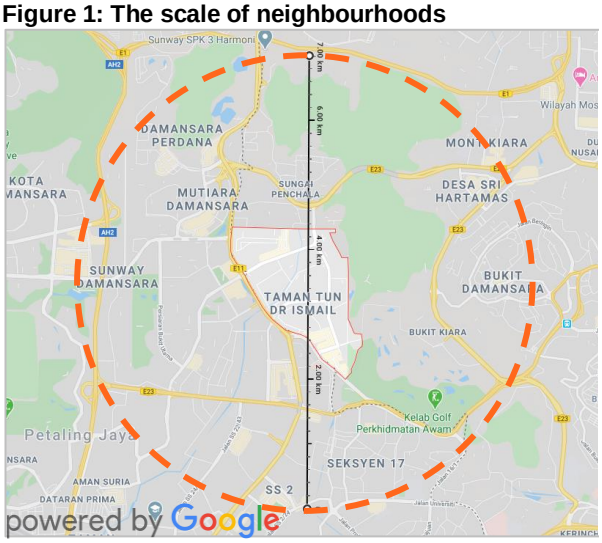
The main difficulty in undertaking a study on neighbourhoods is defining the spatial unit of observation. Neighbourhoods are not administrative units, and its boundaries are not well-defined. We overcome this challenge by utilizing recorded travelling distances of households from a forthcoming research project on social housing[29] as approximations. Households travel a straight line of between 4.5 to 6.3km for work and between 0-3.9km for leisure, school, daily needs and visitations to friends and relatives[30]. On the assumption that 'neighbourhoods' implies commutes other than travelling to work, we have utilized the latter distance with an average of

[20] Hotelling (1929)
[21] Christaller (1933)
[22] Lösch (1944)
[23] Alfred (1890); Arrow (1962); Romer (1986)
[24] Bettencourt et al. (2007); Fujita, Krugman, and Venables (1999)
[25] West (2017)
[26] Alanso (1964)
[27] C. Hidalgo, Castañer, and Sevtsuk (2020)
[28] The area for Greater KL follows the the 11th Malaysian Plan demarcation that consists of Selangor, Putrajaya, Kuala Lumpur and part of Negeri Sembilan.
[29] KRI forthcoming publication on social housing.
[30] At the time of writing, a comprehensive dataset on Malaysian travel time, or Origin-Destination data was not available. One approach of computing distances is the straight-line method.

3.5km as the basis. Furthermore, most urban population in Malaysia travel by private motor vehicles, and only 20 percent[31] of the urban population used public transport and even less walk for their daily needs.

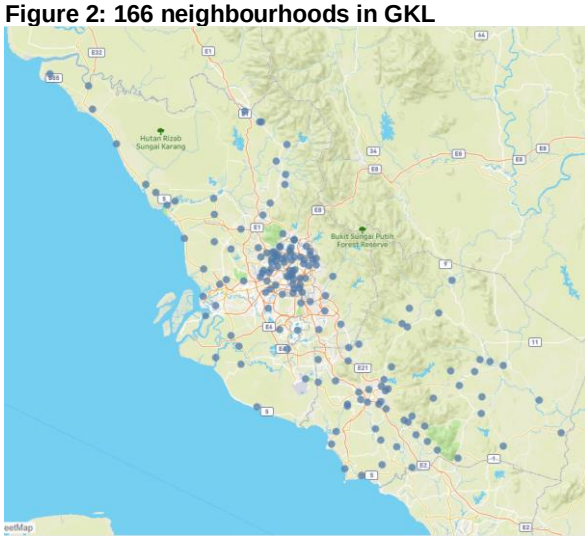
Data was aggregated from the Google Places API containing the name, latitude, longitude and type of place for over 330,000 amenities (i.e. supermarket, florist, restaurant, library, etc.) distributed across 166 neighbourhoods in GKL. The centre of the neighbourhood is given by Google Places API which we define as the centre of neighbourhood X. The centre's latitude and longitude are then utilized to construct a distinct neighbourhood area spanning 3.5 km[32] in radius, covering over 38.5 km^2. This will be considered as 1 neighbourhood.

Figure 1: The scale of neighbourhoods



Note:
A visualisation of the extent of TTDI.
Visualised using Google Maps web app.

Figure 2: 166 neighbourhoods in GKL



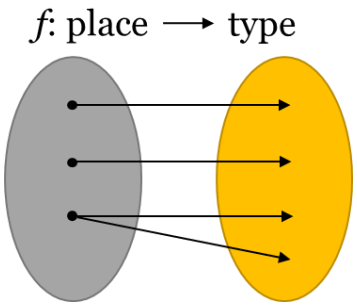
Note:
A visualisation of the 166 neighbourhoods in GKL.
Visualised using Tableau and Mapbox

3.2. Correspondence between neighbourhood – place – type.

It is noteworthy that while most amenities exhibit a one-to-one relationship in mapping amenities to types, certain amenities exhibit one-to-many relationships. We have not made any refinements to the latter as certain amenities do exhibit many 'types'. For example, McDonalds can be categorized as both 'restaurant' and 'café', or Family Mart can be both 'grocery store' and 'eatery'.

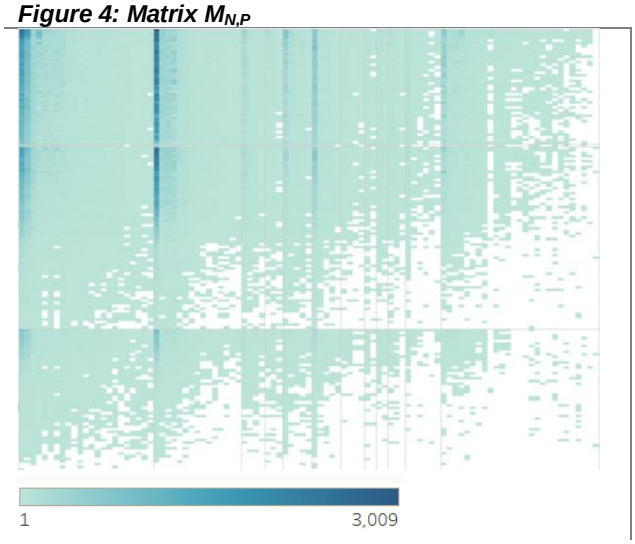
[31] Malaysian National Transport Policy (NTP) 2019-2030, (2019), Ministry of Transport
[32] The 3.5 km radius is derived from a conurbation study of communities in social housing in Kuala Lumpur.

Figure 3: Place – type mapping



The first step of our analysis begins with the construction of matrix $M_{N,P}$. $M_{N,P}$ summarizes the incidence of each place type, by neighbourhoods. A graphical representation of matrix $M_{N,P}$ is summarized in Figure 4 as follows:

Figure 4: Matrix $M_{N,P}$



To describe the distribution of places across neighbourhoods, we have constructed Lorenz curves and GINI coefficients, by place types across the GKL region to generate a ranking of place type 'specialization'[33]. A full table can be viewed in Appendix 1: Lorenz and GINI by place types A low GINI coefficient represents 'unspecialized' places which are present in many neighbourhoods. Among others, these include restaurants, eateries, places of worship, convenience stores, clinics and gas stations.

On the other hand, a high GINI coefficient represents places which are concentrated in just a few neighbourhoods. Apart from a few place types such as 'rv_park'/'campsite' – recreational vehicle parks and campsites, or zoos which are only accessible from one or two neighbourhoods, these places include aquariums, stadiums, museums, physiotherapists, train stations, libraries, liquor stores and art galleries.

[33] Krugman (1991)

3.3. The Principle of Relatedness

Following the approach adopted in our earlier report[34] based on the principle of relatedness[35], the next step computes Revealed Comparative Advantage (RCA)[36] for each neighbourhood and place type pair. RCA is conventionally used in the context of international trade; and is used to indicate whether a certain country exports more than its fair share of a certain product.

However, the mathematical definition of RCA takes on the functional form of a concentration ratio. Let $X_{n,p}$ be defined as the count of place type p, found within a 3.5km radius of neighbourhood n. Then RCA is formally defined as follows:

$$\boldsymbol{RCA_{n,p}} = \frac{\boldsymbol{r}}{\boldsymbol{R}} = \frac{\boldsymbol{X_{n,p}} \Big/ \sum_{\boldsymbol{n}} \boldsymbol{X_{n,p}}}{\sum_{\boldsymbol{p}} \boldsymbol{X_{n,p}} \Big/ \sum_{\boldsymbol{n,p}} \boldsymbol{X_{n,p}}}$$

In the context of place typology,

> **r** = neighbourhood n's share of place p relative to the total amount of places in the neighbourhood.
> **R** = ratio of GKL's total amount of place p relative to GKL's total places

For example, say that a certain 'urban' neighbourhood has a total of 10,000 places within its vicinity, and out of this amount, 300 are cafés ($r = \frac{300}{10{,}000} = 0.03$). Let's further hypothesize that GKL has a total of 10,000 cafés, out of 500,000 places in GKL ($R = \frac{10{,}000}{500{,}000} = 0.02$). RCA for cafés in this neighbourhood would be ($RCA = \frac{0.03}{0.02} = 1.5$) which means that this neighbourhood has 1.5 times the GKL fair share of cafés, indicating a high degree of concentration in the amount of cafés in the particular neighbourhood.

RCA is subsequently used to generate the bi-partite Neighbourhood – Place type matrix:

$$\boldsymbol{M_{T,P}} = \begin{bmatrix} \cdot & \cdot & \cdots \\ \cdot & \cdot & \cdots \\ \vdots & \vdots & \ddots \end{bmatrix}$$

Where $\boldsymbol{M_{N,P}}$ is a discrete variable with two states, $\boldsymbol{M_{N,P}} \in \{0,1\}$.

$$\boldsymbol{M_{T,P}} = \begin{cases} \boldsymbol{1}, & \boldsymbol{RCA_{T,P} \geq 1} \\ \boldsymbol{0}, & \boldsymbol{otherwise} \end{cases}$$

Matrix $\boldsymbol{M_{N,P}}$ is employed to compute, for all i^{th} – j^{th} product pairs, a proximity value defined as follows:

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[34] Hamid, Son, and Ismail (2019)
[35] C. A. Hidalgo et al. (2018); (2007); C. A. Hidalgo and Hausmann (2009)
[36] Balassa (1965)

$$\phi_{ij} = \mathbf{min}\{\boldsymbol{P}(\boldsymbol{RCA_i}|\,\boldsymbol{RCA_j})|\boldsymbol{P}(\boldsymbol{RCA_j}|\boldsymbol{RCA_i})\}$$

More precisely:

$$\phi_{i,j} = \mathbf{min}\,\{\frac{\sum_T \boldsymbol{M_{T,i}}\boldsymbol{M_{T,j}}}{\sum_T \boldsymbol{M_{T,i}}}|\frac{\sum_T \boldsymbol{M_{T,i}}\boldsymbol{M_{T,j}}}{\sum_T \boldsymbol{M_{T,j}}}\}$$

ϕ_{ij} computes the minimum of two probabilities for a symmetric matrix. This is done to ensure a symmetric adjacency matrix and as a more stringent measure that minimizes false positives.

Essentially, ϕ_{ij} measures the extent to which place types are related to one another. When places are co-located in certain vicinities, information on place relatedness is codified in the ϕ_{ij}, and its structure described as the Amenity Space[37].

Figures 4 and 5 below visualizes the structure and distribution of Matrix ϕ_{ij}.

Figure 5: Adjacency Matrix, ϕ_{ij}

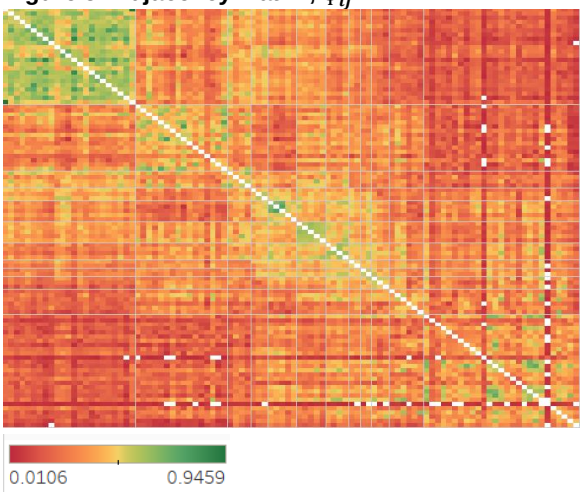


Figure 6: Histogram of ϕ_{ij}

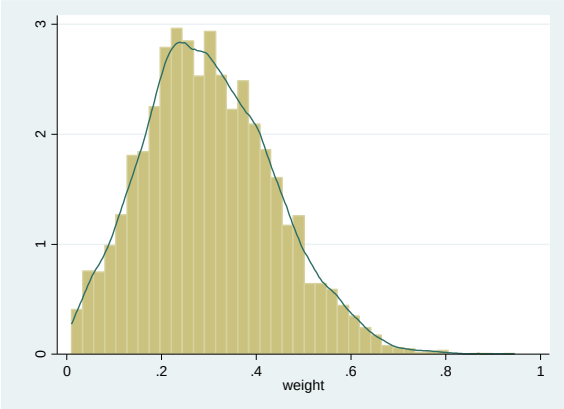
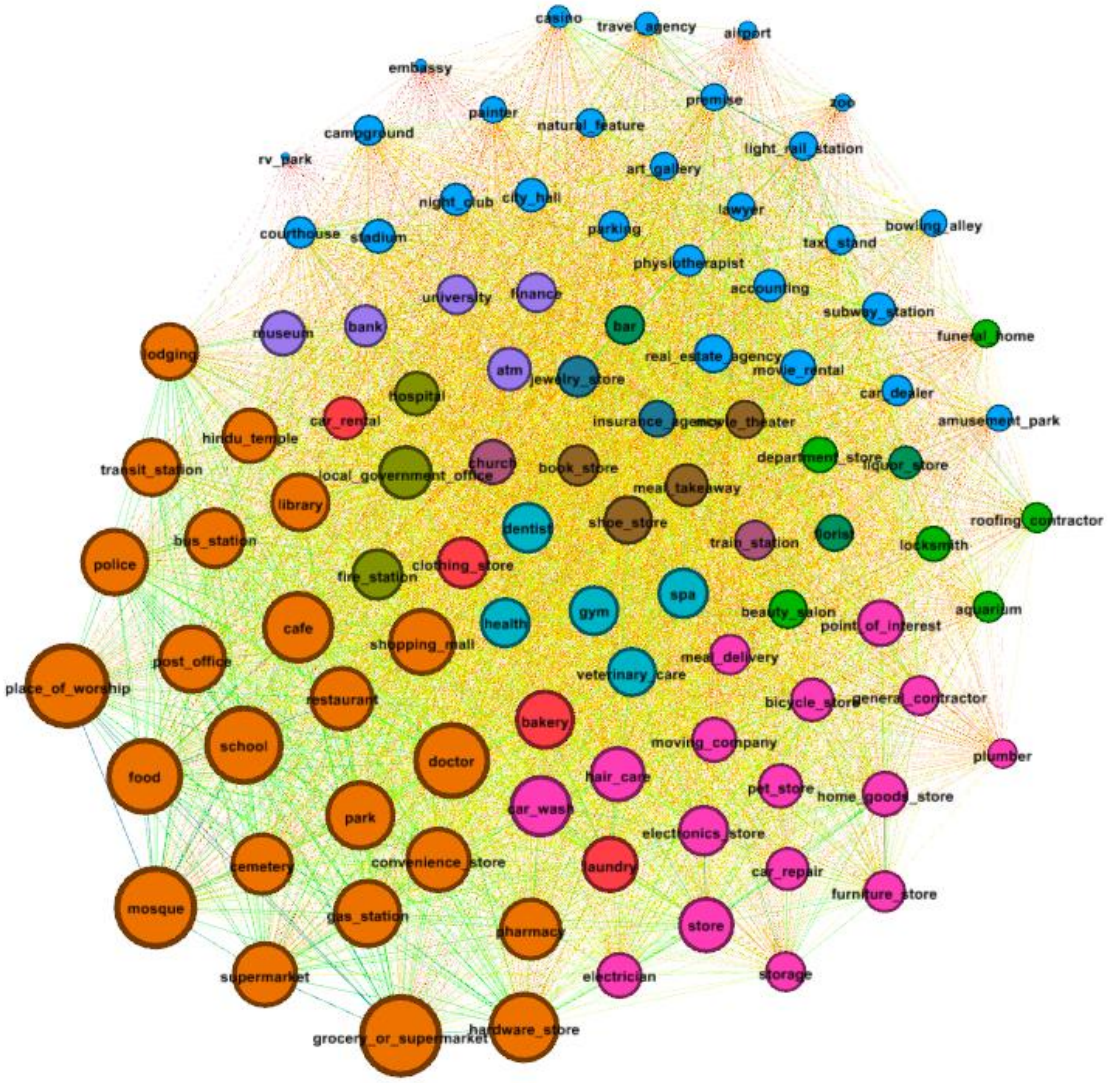


Figure 7 presents the Amenity Space of GKL in Network form.

Figure 7: GKL Amenity Space

[37] C. A. Hidalgo and Castañer (2015)



The nodes of the Network represent place type classification. Each node is sized according to its average degree, computed along its edge weights, ϕ_{ij}. Each node is colored based on community groupings obtained from employing Blondel's Algorithm[38]. Blondel's algorithm clusters places together based on their co-location in neighbourhoods.

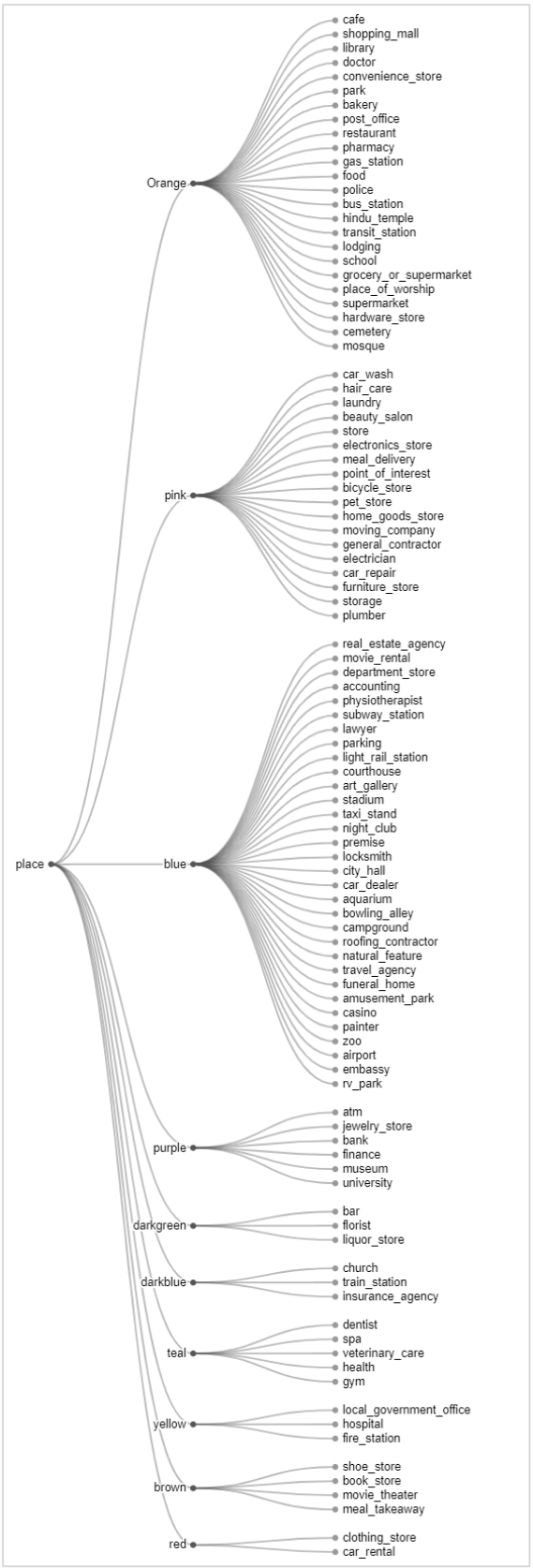
It is noteworthy that this version of the GKL Amenity Space differs from that proposed by Castaner and Hidalgo as this version was not processed using the Maximum Spanning Tree[39] (an algorithm that optimizes for the maximum weight out of all spanning trees).

Figure 8 below describes the community clusters in the form of a tree diagram.

Figure 8: Tree Diagram of Community Groups

[38] Blondel et al. (2008)

[39] This is also often done to remove clutter and visualize the 'backbone' of a network.



The structure of the network is that of an assortative-ordered network (high within group links and linear group hierarchy). Firstly, the types of places coloured in orange in the GKL Amenity

Space is observed across all neighbourhoods irrespective of it being in an urban or rural area. The types of places clustered in the orange community range from government services (police, post offices, doctors), places of worship, places to acquire groceries (convenience stores, supermarkets), schools, transport, and some others. These places form the basic structure of neighbourhoods.

3.4. Method of Reflections

The method of reflections (MOR) was developed as an index to measure product-country complexity[40]. Here, we employ the method of reflections on a matrix of neighbourhoods-place types as described as $M_{N,P}$ above. The first step in applying the MOR is the definition of initial conditions (of iteration step 0, I=0) as follows:

$$\kappa_{N,0} = \sum_{P}^{n} M_{N,P}$$

$$\kappa_{P,0} = \sum_{N}^{n} M_{N,P}$$

In short, the initial conditions of the MOR is simply the row and column sum of matrix $M_{N,P}$. Next, for I ≥ 1, the following *k-reflections* along the neighbourhoods and place types are iteratively computed as follows:

$$\kappa_{N,I} = \frac{1}{\kappa_{T,0}} \sum_{P}^{n} M_{N,P}.\kappa_{P,I-1}$$

$$\kappa_{P,I} = \frac{1}{\kappa_{P,0}} \sum_{N}^{n} M_{N,P}.\kappa_{N,I-1}$$

Fundamentally, the MOR is an iterative process of computing the average value of the previous level (I-1) linked nodes as first defined in matrix $M_{N,P}$. The initial conditions represent the *diversity* of neighboorhoods ($\kappa_{N,0}$) and the *ubiquity* of place types ($\kappa_{P,0}$). The subsequent iteration at I=1, quantifies the average ubiquity of place types ($\kappa_{N,1}$) and the average diversity of neighbourhoods ($\kappa_{P,1}$). Table 1 below defines the interpretation for the first three pairs of interactions according to the MOR[41]:

Table 1: Interpretation of (k=3)-iterations

DEFINITION	DESCRIPTION: SHORT SUMMARY (QUESTION FORM)

[40] C. A. Hidalgo and Hausmann (2009)
[41] Ibid.

$\kappa_{N,0}$	Number of place types accessible from neighbourhood N *(How many place types are accessible from neighbourhood N?)*
$\kappa_{P,0}$	Number of neighbourhoods having place type P *(How many neighbourhoods have place P?)*
$\kappa_{N,1}$	Average ubiquity of place types accessible from neighbourhood N *(How common are the place types accessible from neighbourhood N?)*
$\kappa_{P,1}$	Average diversification of neighbourhoods containing place type P *(How diversified are the neighbourhoods that contain place type P?)*
$\kappa_{N,2}$	Average diversification of neighbourhoods with a place type structure similar to N *(How diversified are neighbourhoods that have similar place type structure to N?)*
$\kappa_{P,2}$	Average ubiquity of place types in neighbourhoods that contain place type P *(How ubiquitous are the place types contained in neighbourhoods that contain P?)*

As each iteration recursively incorporates lower levels of reflections, the MOR allows for the characterization of the structure of place types by neighbourhoods. Along higher levels of reflections/iterations, it becomes increasingly more difficult to interpret variables, as higher order reflections increasingly encompass information from all previous level iterations.

Figure 10 and Figure 9 below demonstrates convergence in the rank order of neighbourhoods and places when the iterative process is undertaken to compute a generalized measure of diversity and ubiquity, while Figures Figure 11 and Figure 12 describes the top 25 most diverse neighbourhoods and top 25 most uncommon places by rank as a result of employing the MOR.

Figure 9: Ranking on Generalized measure of Neighbourhood Diversity

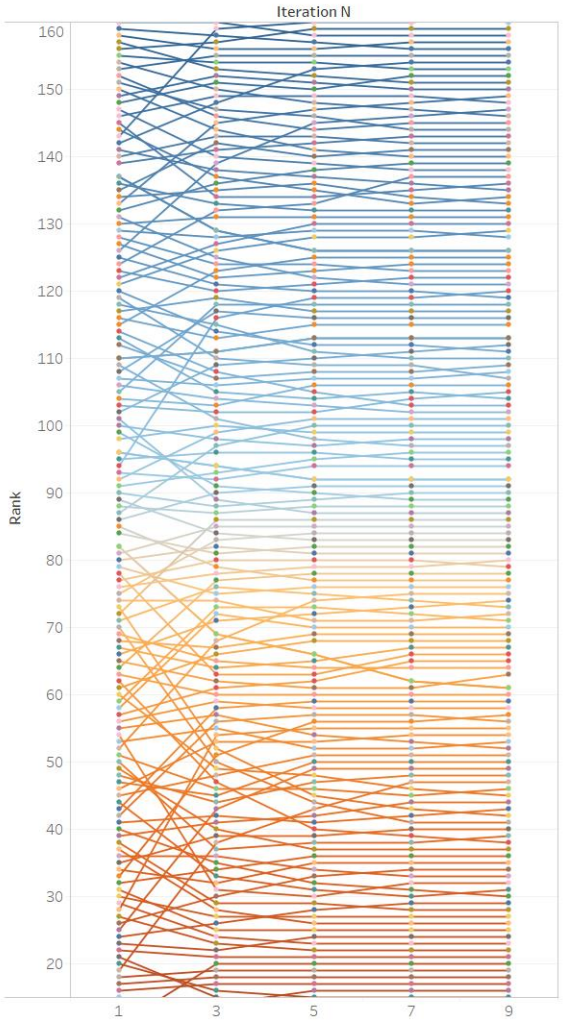


Figure 10: Ranking on Generalized measure of Place Ubiquity

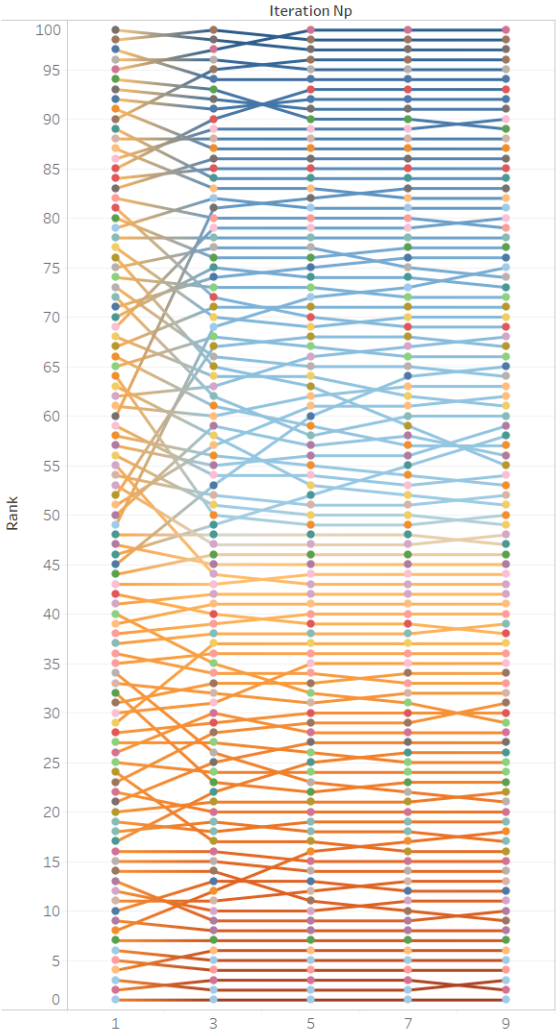


Figure 11: Top 25 most varied neighbourhoods by rank

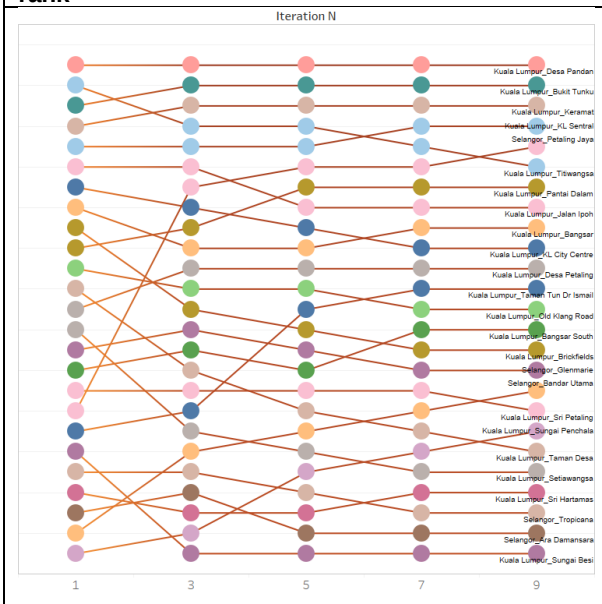
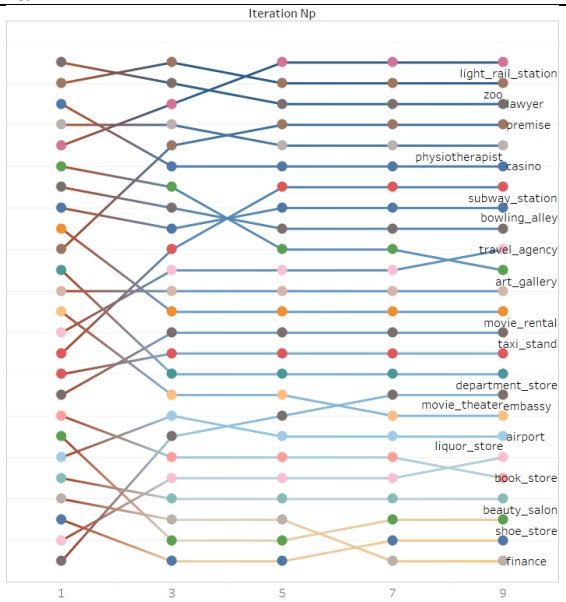
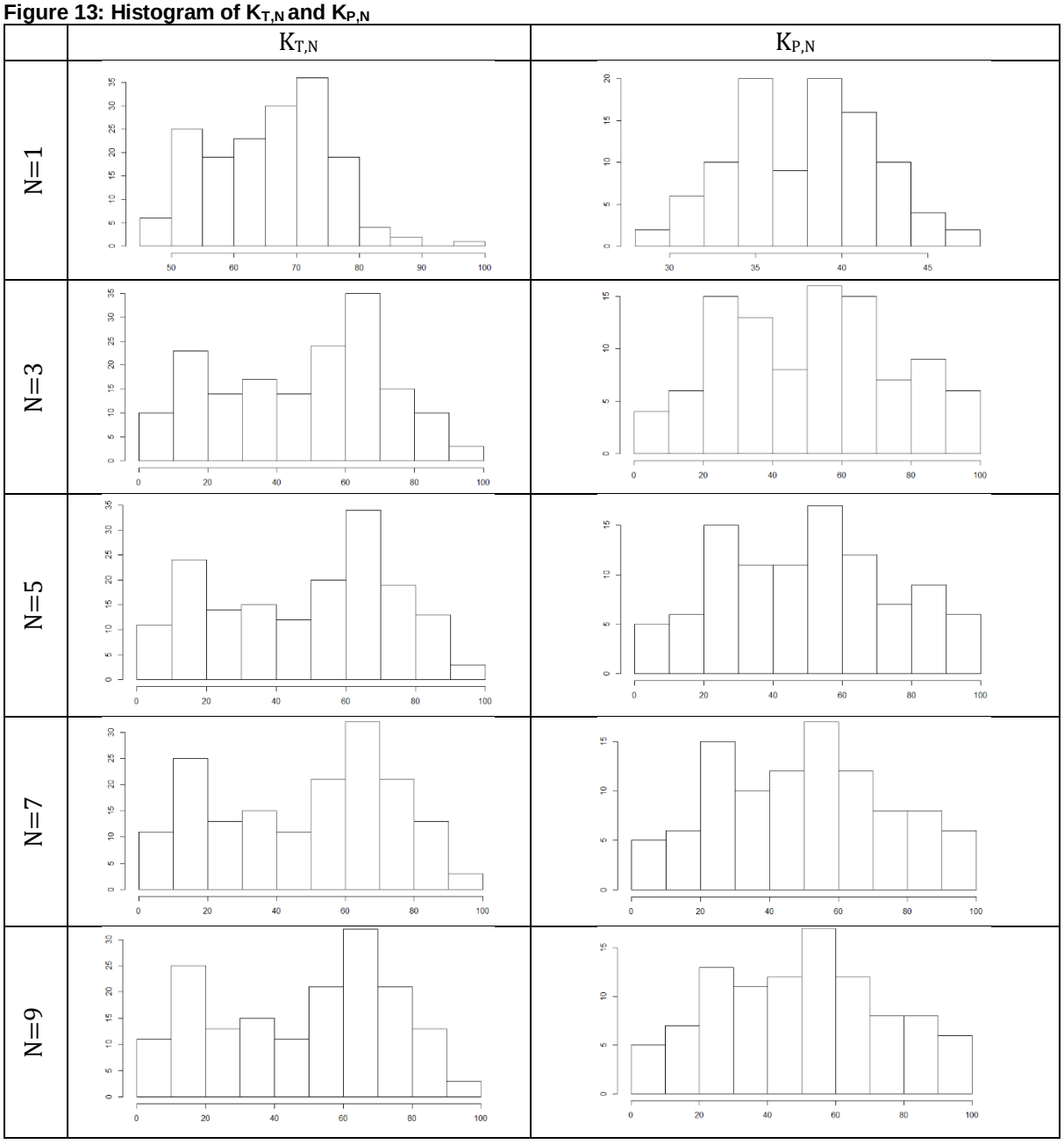


Figure 12: Top 25 most diverse place types by rank



In applying the MOR, it is clear that as the number of iterations, I→∞, each variable will converge to a particular value and that the rank-order of both neighbourhoods and place types achieves a 'saturation point'. Holding this in mind, the next step of our analysis traces the distribution of both $\kappa_{N,I}$ and $\kappa_{P,I}$ over the recursive iteration regime.

Figure 13: Histogram of $K_{T,N}$ and $K_{P,N}$

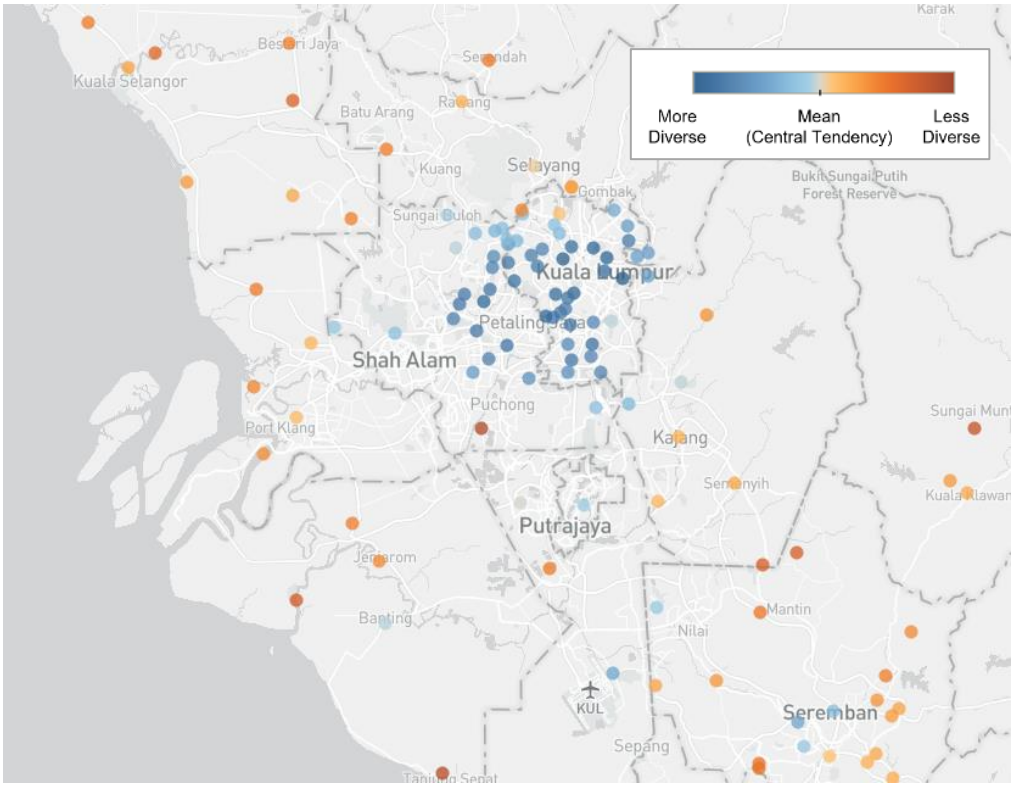


4. Discussion of Findings

This paper is an attempt to utilise GKL as a case study to provide a baseline of the type of amenities present in neighbourhoods. The study did not consider the level of income and real estate values of the neighbourhoods[42].

The most important finding from the structure of the GKL Amenity Space is that it demonstrated an assortative-ordered network (high within group links and linear group hierarchy). This means the types of places coloured in orange in the GKL Amenity Space are observed in all neighbourhoods irrespective of its location, be it urban or sub-urban. The amenities clustered are governmental services (police, post offices, doctors), places of worship, places to acquire groceries (convenience stores, supermarkets), schools, transport, and some others. These places form the basic structure of neighbourhoods. In other words, the 'baseline' amenities of GKL are a balance of both 1st and 2nd tier amenities.

Figure 14: Geographical Distribution of Place Diversity, by neighbourhood



[42] This will be explored in our forthcoming paper and report.

We observe the economic variabilities of neighbourhoods when we perform MOR. Table 2 provides a qualitative comparison between more diverse and less diverse neighbourhoods.

Table 2: Amenities present in More diverse vs Less diverse neighbourhoods

Amenities	More diverse Neighbourhoods	Less Diverse Neighbourhoods
Services	Legal/Law practices Physiotherapy Financial services Beauty Salons	Medical practices (doctor) Moving companies Storage companies
Leisure	Casinos[43] Bowling alleys Art galleries Movie theatres Zoo	Open parks Public libraries
Consumption	Book Stores Liquor stores Shoe stores Department stores	Supermarkets Restaurants Cafes Bakeries Convenience stores Hardware stores
Mobility	LRT stations Taxi stands Airport	Bus stations

Other amenities of higher magnitude in the less diverse neighbourhoods are cemeteries, Hindu temples, and mosques.

These findings have implications on both households and improvements in real estate development. For households, the size and composition of amenities is based on the functional area of the neighbourhoods rather than the administrative area. There is a common acceptance of the idea that the general quality of urban life[44] depends on the types of amenities considered most important to households' locational decisions and quality of life. If the 1st tier places are supported by local fiscal conditions and are present to degree that is adequate, then this should create the impetus for the market to capitalize on 2nd tier places. However, we find that the 2nd tier amenities are varied to a degree that is significant at the neighbourhood scale but within the same administrative boundary.

[43] Casinos in the context of GKL refer to lottery outlets
[44] Hiller & Lerbsy, 2014

Furthermore, earlier studies of "people follow jobs" have been supplanted with the trend that "jobs follow people"[45]. This strengthens the motivation for creating neighbourhoods that are more attractive and diverse. Studies in major cities (of the developed world) have shown that neighbourhood residences' preferences include high levels of diversity for global/local goods services and supply, high-quality housing, and high-quality jobs with better working conditions[46]. This diversity in services and goods (amenities) supplied are contingent on the level of private investments and locational choices of businesses.

This begs the question of investment in the built environment by the private sector. Land and built improvements influence the ground rent that landlord can demand. On the other hand, since land and building are inseparable, the price at which buildings change hands reflects the ground rent level. While land might be permanent, the buildings are not, but they generally have a long turnover period in terms of the physical built form as well as in value. Therefore, if an area is in a less desirable condition; the combination of private property rights, the ground rents and the long turnover period in building life cycle, would necessitate large capital outlays for area improvements. In the end, some neighbourhoods are profitable to develop while others are not. If this is the case, should the State intervene to incentivize the growth of a more diverse set of amenities? Would it create a major distortion to the real estate market? Or should the State simply ensure adequate supply of the 1st tier places (those that facilitate basic functionings) and let neighbourhoods develop at their own pace?

Perhaps the more important question to ask is whether these economic and spatial differences matter? If the composition of amenities (amenity mix) in both the 'richer' or 'poorer' neighbourhoods create an operating environment that is suitable and affordable to the local populace, then would it matter that these variabilities exist? These are questions that we will explore in greater depth in our forthcoming report.

5. Conclusion and Further Remarks

It is suggested that the approach adopted in this paper can contribute to the literature on urban transformation through its empirical description of the higher/ lower variabilities of the amenity mix at the scale of neighbourhoods. The patterns of economic variabilities can be evaluated, replicated (to the downside of being monotonous?) and scaled-up to other neighbourhoods when the utility gained by all parties are maximized.

The results can also provide inputs to hedonic pricing and spatial equilibrium models; in terms of creating an index measuring the utility provided by the composition of local goods available. When the individual's utility is positive, it will be termed as 'amenities', and the reverse will be termed 'dis-amenities'. A value is attached to the bundle of (dis) amenities and in a metrics strictly related to changes in the individual's utility.

[45] Andreoli and Michelangeli (2015)
[46] Albouy and Stuart (2014)

Finally, the GKL Amenity Space may be employed as a policy decision-making tool in measuring place differentiation at the neighbourhood scale. It can be utilized by different stakeholders-policymakers, local communities and real estate developers as a platform to begin having better-informed discussions on urban transformation programmes and the inherent trade-offs, in order to further improve neighbourhood vibrancy without necessarily going through the ill-effects of gentrification and local area displacement.

6. Appendix

6.1. Appendix 1: Lorenz and GINI by place types

This appendix summarizes the results from constructing Lorenz curves in the distribution of place types across neighbourhoods. The GINI coefficient of each place type is summarized as below. A higher GINI coefficient signifies concentration/specialization of a particular place in few neighbourhoods, while values closer to 0 indicate that the place is spread out and not localized.

No	Industry	GINI
1	rv_park	0.49
2	embassy	0.43
3	campground	0.42
4	zoo	0.41
5	airport	0.38
6	amusement_park	0.38
7	bowling_alley	0.37
8	courthouse	0.36
9	natural_feature	0.32
10	casino	0.31
11	funeral_home	0.31
12	aquarium	0.31
13	stadium	0.28
14	light_rail_station	0.28
15	museum	0.27
16	painter	0.27
17	city_hall	0.27
18	roofing_contractor	0.26
19	taxi_stand	0.26
20	department_store	0.25
21	train_station	0.24
22	physiotherapist	0.23
23	subway_station	0.23
24	fire_station	0.22
25	library	0.22
26	liquor_store	0.22
27	parking	0.21
28	art_gallery	0.21
29	locksmith	0.19
30	cemetery	0.19
31	bar	0.18
32	university	0.18
33	hindu_temple	0.18

No	Industry	GINI
34	hospital	0.18
35	night_club	0.18
36	storage	0.18
37	lawyer	0.18
38	plumber	0.17
39	police	0.17
40	meal_takeaway	0.17
41	movie_rental	0.17
42	electrician	0.17
43	travel_agency	0.17
44	shoe_store	0.17
45	moving_company	0.16
46	bicycle_store	0.16
47	veterinary_care	0.16
48	hardware_store	0.16
49	real_estate_agency	0.15
50	car_rental	0.15
51	movie_theater	0.15
52	mosque	0.15
53	premise	0.14
54	lodging	0.14
55	park	0.14
56	local_government_office	0.13
57	meal_delivery	0.13
58	florist	0.13
59	supermarket	0.13
60	pet_store	0.13
61	car_repair	0.13
62	bank	0.13
63	church	0.13
64	post_office	0.13
65	car_dealer	0.12
66	bus_station	0.12

No	Industry	GINI
67	book_store	0.12
68	beauty_salon	0.11
69	accounting	0.11
70	transit_station	0.11
71	dentist	0.11
72	jewelry_store	0.11
73	spa	0.11
74	gym	0.10
75	grocery_or_supermarket	0.10
76	car_wash	0.10
77	finance	0.10
78	furniture_store	0.10
79	insurance_agency	0.10
80	bakery	0.10
81	atm	0.09
82	laundry	0.09
83	gas_station	0.09
84	pharmacy	0.09
85	hair_care	0.09
86	shopping_mall	0.08
87	place_of_worship	0.08
88	home_goods_store	0.07
89	clothing_store	0.07
90	doctor	0.07
91	electronics_store	0.07
92	general_contractor	0.06
93	school	0.06
94	cafe	0.06
95	convenience_store	0.05
96	health	0.05
97	store	0.04
98	restaurant	0.04
99	food	0.03

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