THE SPATIAL BUSINESS LANDSCAPE OF INDIA

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ABSTRACT

India has in the last decade become one of the fastest growing entrepreneurial landscapes in the world. With a total population of almost 1.2 billion inhabitants, it has developed from a rural economy into a highly competitive market. This study analyses the spatial configuration across the country from a regional perspective, offering an assessment of the spatial autocorrelation of business to understand the spatial configuration of what I define as a regional-spatial business landscape. In this study, the patterns of distribution of all the registered Indian businesses are assessed counting a total of 6500 registered businesses from 1850 to 2010, which were geocoded and imported into a Geographic Information System environment. A geostatistical analysis is conducted measuring business growth and performance at a national level by means of a Global Moran’s I calculation and followed by assembling a Local Getis-Ord for regional assessment of correlation of road networks. These local spatial statistics reveal clustering of hot spots within threshold distances of road concentrations, suggesting a positive relation between location of businesses and concentration of road networks. The agglomeration of Indian businesses becomes defined by the importance of road infrastructures to allow commutes and interaction of businesses. As a result, it becomes possible to see that India’s business landscape is far from homogenous, and responds well to Weber’s theory of industrial agglomeration, while predicting possible inter-firm collaboration. These business hubs in the business landscape are assessed at national level through spatial autocorrelation and then regionally diagnosed by identifying hot spots of business location given business density, and bringing to light the precise location of India’s business hubs from a spatial business landscape perspective at present.

Keywords: Business Landscape, GIS, Spatial Analysis, Geostatistics

JEL Classification: Q01, R52

1. INTRODUCTION

1.1. Background

The Indian business has changed dramatically since its economic policy in 1991 (Kohli, 2006). While competition was scarce, restrictions on entering the market were little and mainly guided by an inward looking policy based on self-reliance, resulting from the independence in 1947. As a manifestation of an innate passivism and lack of competition, very few successful cases of entrepreneurship were reported until 1991. Performance of capital goods industries was very poor, causing a great concern given the weak performance of the agriculture sector which had little infrastructural investments. Over the years, control and regulations was tightened to such an extent that the cost and quality structure of Indian products deteriorated and Indian products became non-competitive. Indian goods were not able to be sold in the global market without support of export credit, subsidies and other concessions. Domestic buyers had no option but to buy high-cost-low-quality
goods produced with obsolete technology, leaving the country to pay a high price for its structural rigidity and inefficiency (Montek, 1998). In sum, the prevailing weaknesses in the Indian economy became prominent because of unfavorable external factors (Cerra and Saxena, 2002), but also internal inefficiency to cope with business growth. Production and marketing apparatus did not remain fit to meet the domestic demand and compete in foreign markets. In addition, to carry forward the benefits of new policies on enduring basis, the long term issues of structural rigidity had also to be urgently addressed. This consisted of decontrolling the private sector, reforming the public sector and taking other appropriate measures so as to give competitive edge to the economy. The Government, in view of these developments and compulsions, reformulated its economic strategy and introduced the new economic policy (NEP) of which globalization was an integral part. In 1991, resulting from an aggregate growth in the early to mid-eighties and with the introduced neo-liberalization of markets, a series of reforms opened India’s economy, and gave the private sector much more possibilities of economic sustainability. The government of India liberalized the economy leading to an outstanding change concerning the business landscape which started becoming highly competitive. Indian economy has emerged with remarkable rapidity and is projected to move up and become a $2 trillion dollar economy. This has been possible because of the leading corporate actors who have made a valuable contribution to the development of the Indian economy. Indian organizations therefore have to deal with territorial competition, and move fast to position in an international market. While Indian companies are able to capture market globally, it becomes of utmost importance to define the spatial hubs and distribution of business activity, as well as respond whether businesses show pattern through spatial business agglomeration and communication network, a first positive outlook for a sustainable business landscape. In this sense, this paper proposes an integrated spatial analysis approach based on geostatistical methodologies. The spatial Indian business landscape is understood by assessing first a national spatial autocorrelation technique, after geocoding the entire dataset of Indian registered businesses. In a second stage, and as explored in an important contribution by Datta (2012), the assessment takes the location of road networks into account, correlating these with the geocoded businesses. Finally the business landscape is defined through the existence of business hubs, which are calculated through spatial autocorrelation (Ord and Getis, 2002) approach to understand, not only the relation of road concentration vis-à-vis businesses, but also, the location of business hubs in India.

1.2. The Spatial Business Landscape
Globalizing markets have found unique challenges and opportunities, following territorial competitiveness (Boschma, 2002). Territorial competitiveness may be defined as the ability a territory may have to achieve high growth rates over time, building on the standards of living of its inhabitants (Poot, 2000). As pointed out by Cappellin (2003), the local endowment of intellectual capital, does follow a spatial rationale that can be measured, enhancing thus competition in a given region, and boosting territorial competitiveness by channeling innovation through communication and agglomeration of sectors at local and regional level (Cainelli, 2008).

The district level of innovation capability of business performance, gains thus a geographical context of its undermining relation to space and territorial competitiveness that should find a compromise between location and geographic models (Krugman, 1999). A good example of the integration within competition and the spatial rationale is the application to the model of the Porter’s Diamond (Porter, 1990) where growth may be assessed by (i) factors and conditions for growth, (ii) the firm strategy, (iii) the demand conditions and (iv) supporting industries, are all dimensions that have an intrinsic geographic dimension.
These dimensions are all closely linked to location of business where as a result spatial agglomeration and environmental constraints result in positive or negative externalities that increase or decrease business performance (Rey, 2001). Understanding the spatial topology and underpinning the business landscape is thus a fundamental asset to monitor and boost the sustainable growth of business from a territorial perspective. This is linked to the concept of clusters that emerge from the equilibrium of place, and the socio-economic determinants that generate growth. From a Geographical perspective, this process may be seen as what is defined as the first law of Geography where Tobler states that “everything is related to everything else, but near things are more related than distant things”, an intrinsic relation exists over performance and space which allows for spatial analysis (Miller, 2004). One of the main reasons is the existence of spatial association creating causality between aggregations of clusters over space and giving place to more complex evidence found in spatial autocorrelation where complexity also arises from the differences between autocorrelation in time (Cliff and Ord 1970, Vaz et al., 2013). The techniques found in spatial analysis and in particular in geostatistics to understand the locational patterns of businesses is therefore of utmost importance. In the case of India, as pointed out by Datta (2012), businesses do become more competitive and find fewer obstacles in production with enhancement of highways and extending the road infrastructures. The assessment of the business landscape, must consider therefore the creation of new road infrastructures concerning the business landscape, in particular in a country where market oriented reforms are supporting economic growth (Ghate et al., 2013). This leads to the importance of rendering a geographical proxy in understanding the patterns of territorial competitiveness, resulting in better local synergies which enable business performance (Porter, 2000) while generating sustainable entrepreneurial ecosystems (Pitelis, 2012). The spatial results of these changes may be identified by the occurrence of agglomeration and scale economies to explain why business tend to join, taking advantage from this proximity. In recent times however, a vast theoretical framing was developed to extend the reasons why organizations are getting closer, linked by common interests to ease the present challenges of growing competitiveness. Most of these arguments are related to organization theory, fitting in the area of clusters and networking analyses. After the emergence of the concept of clustering to designate a new concept of geographical and institutional proximity among companies, Porter and Sölvell (1998) also explained that a cluster offers the adequate environment for the development of a common language, social bounds, norms, and values as an advantageous social capital. This implies an intrinsic geographical dimension where similar values allow increasing performance and become part of the business landscape. The cognitive rationale assessed by Pouder and John (1996), who explained that within a cluster, managers and decision-makers share many cognitive references, perceptions and experiences that facilitate growth. If all entities within the cluster share the same propensity for combined growth then one can expect that the whole cluster will show such patterns of creation and innovation leading to increased competitive levels among companies and, territories, leading to the generation of entrepreneurial ecosystems as part of a community (Cohen, 2006). This phenomenon reflects not only a better capacity to face competitiveness but also more mobility for goods, services, capital, information and technology with intensification of exchanged knowledge and, consequently, creating more added value. As outlined by Karlsson (2008), “resource-based” models emphasize the importance of labor supply in knowledge-intensive business as their primary location factors. Skills promote sustainable competitive advantages, increasing the expertise level of regions or countries, in particular when clusters accumulate different forms of knowledge. In this context, not only the theories of agglomeration of firms, i.e. clustering, internal economies of scale and size of the potential internal and external market regions, are used as the main factors to explain the effect of spatial clustering of firms. Knowledge
flows also justify the intensification of clustering advantages, promoting networking systems and increasing external economies to add up to the internal economies of scale. A given cluster may face both internal and external risks: Internal threats can originate in rigidities develop as a consequence of the obsolescence of technologies, of inadequate infrastructure, but also of the long lasting deficient conditions of labor’s training and education or even in the inflexibility of the governance and regulatory systems (Porter, 1990b). External pressures are much more difficult to surpass and include economical and financial crises, abrupt technological changes, and alterations in political strategy or regulations (Karlsson, et al. 2005).

2. METHODS

The present study assesses the distribution of business location in India using autocorrelation techniques and defining what I call regional business topography. The usage of volunteered geographic information is of crucial importance to understand the dynamics with large set and complex sets of spatial data such as the location of business in relation to the distance of road networks. The distance of road networks as well as the location of business and their intrinsic relations to nearest neighbour, allowed generating an understanding of the key hotspots that are currently of major importance for India’s business performance, sharing information on the regional scope of changing economies. From a dynamic perspective, it is quite probable that distance from main commutes continues to be of key importance for India’s business development. The methodology proposes a spatial influence in autocorrelation of location of all types of business in India, area of utmost importance. The combination of spatial analysis techniques with geocoded information and VGI will play major importance for combinatory analytics of economic landscapes and defining at country level tendencies for economic performance and relations of industry and business sectors. In this sense, Geographic Information Systems can play a key role in better understanding the influence of location and combination of other derived spatial variables in relating for the potential of business topographies at country level. The present study has furthermore advanced in a new type of understanding of spatial information: a combinatory approach to VGI datasets with entrepreneurial ecosystems and the relation to areas where little data is available. These combined methodologies support novel tools to assess and interpret spatial change over time, and augment the possibilities of creating functional synergies in the interdependencies and generated value of business hubs located in the entrepreneurial ecosystems. The combination of the database management carried out in geocoding the registered businesses for India as discussed above, combined with OpenStreetMap data sets for road networks, allowed for a spatial interpolation of the impacts of road networks on the location of businesses India. This may be considered the data dimension (Figure 6) where the usage of volunteered geographic information (VGI) data sets allows to have an accurate perception of existing infrastructures conveniently mapped.
The Spatial Business Landscape of India

2.1. Study area
The study was applied to India, the seventh-largest country by area and the second-most populous country in the world, with over 1.2 billion people. India holds a total area of 3,287,263 km, and has an estimate total GDP for 2012 of $4.7 trillion. India lies atop the minor Indian tectonic plate, and holds a very diverse geomorphology. With elevation ranging from Kanchenjunga, with an elevation of 8,586 m, bordering Nepal and the Indian ocean at sea-level 0 m. Average annual temperatures vary greatly between north and south of India. North India holds Alpine climate, while south-east India has tropical wet and west India majorly has Tropical wet. As per the World Bank report, the precipitation average was of 1083mm in 2009, where 80% are supplied during this season, a four-month period and becomes one of the Earth’s most wet seasons with highest precipitation indices. The diversity of the landscape and concentration of urban regions, create a fairly large division between urban and rural areas. This division between urban regions is further enhanced by the location of the business landscape that was matched spatially via a geocoding process. In this sense, geographic information systems become powerful tools to add and describe based on mailing datasets by mapping information about spatial distribution. This process is called geocoding, and holds one of the critical elements as having an address range where latitude / longitude of a corresponding point may be added. This is a challenging task, and rates of accuracy must be compared as to match if the constructed spatial data sets to match correct addresses. This is done by an accuracy assessment based on a random sample of the distributions, and a search of matching these samples to geographical space and the accurate information of roads and spatial metadata. The dataset consisted of a total of 6674 businesses, organized by Company Name, Latitude, Longitude, Province, District, City and Year of Incorporation. The databases were structured as to have a unique identifier per field, adding on candidate keys that allow the geocoding regarding the location of businesses. Finally, accuracy was tested for a random sample of 100 businesses; where metadata and text information was queried as to allow the validity of the assembled data structure once geocoded (Figure 1).
The now spatial dataset was then aggregated through the primary key to other relevant information, such as the case of the year of incorporation and profit after tax (PAT), from 1990 to 2010. This counts as one of the main advantages of the constructed data sets, as it became a solid support for understanding not only the morphology of India’s business landscape, but also have a spatially-explicit dataset correlating important business variables from a locational standpoint.

2.2. The Volunteered Geographic Information dimension

The removal and editing of peripheral roads was carried out in ArcGIS 10 and from overlaid high resolution satellite imagery, which permitted a visual disaggregation of road types. Without the aid of Volunteered Geographic Information (VGI), this study would have been impossible given the complexity and the quantity of road networks for India, and the difficulty in manually digitising the commute systems for the entire country. In this sense, VGI played a major role in incorporating the business landscape in terms of geocoding of the 3561 addresses of registered businesses. The existence of VGI repositories contribute for a fundamental change in the way we deal with spatial information, but must also be handled carefully as to guarantee the quality and credibility of such datasets (Flanagin and Metzger 2008). However the notion of a collective spatial repository allows for panoply of available spatial information which in most of the cases seems to be fairly accurate concerning the topological and spatial characteristics of certain features, such as commutes and motorways when compared to traditional sources of spatial data (Haklay, 2010). The main motivation
of VGI resides in the transversal profiles of users and the quantity of active volunteers, contributing as ‘human sensors’ (Goodchild, 2007) leading to a better understanding of the geographical and spatial reality at different scales. This may be of extreme importance for business performance, where the spatial dimension at may represent the social perception of importance and priorities in embedding as VGI components spatial information. In the case of India, comparison with higher resolution imagery through exporting the vector polylines corresponding to the road networks to Google Earth, allowed for an assessment of the quality and accuracy of the volume of present road networks in India. The secondary road networks as well as unclear classifications were discarded.

![Figure 3 – OpenStreetMap filtered road networks in India](image)

2.3. Spatial autocorrelation

2.3.1. Global Moran’s I statistic

Clustering of the Indian business landscape was assessed by using global and local spatial autocorrelation statistics. A spatial weight matrix was defined over a radius of 1km, using a rook contiguity filter, corresponding to an adjacency matrix for each region given the limits of the area. The assumption of this was that i) closer businesses within the administrative region tend to interact at a closer spatial proximity and, ii) road networks are used for communication with businesses farther away leading to iii) existing of business hubs located in functional metropolitan regions where business activity must be given territorial competition more intense. A Global Moran’s I (Equation 1) statistic was conducted testing the null hypothesis (Ho) of no significant clustering of businesses in India.
\[ I = \frac{\sum_{j=1}^{n} \sum_{i=1}^{m} w_{ij}(x_i - \bar{x})(x_j - \bar{x})}{\sum_{j=1}^{n} (x_j - \bar{x})^2} \]

(1)

Where \( w_{ij} \) corresponds to a binary weight matrix defined with the weight of one, given a contiguity of adjacency for any value that holds and any value without adjacency as \( 0 \). The product of the distance is defined as for any location in distance to relation to its mean. This holds as a statistic for assessing the entire spatial distribution of adjacency formed for the region, having led to a Moran’s I of 0.206 suggesting that the business landscape is highly clustered in certain spatial hubs. This result confirmed the existence of significant clusters over the region, refuting the result of Ho for no autocorrelation for India. A closer analysis was thus conducted to assess the regional dimension of spatial business distribution as discussed in the following section.

2.3.2. Local Getis-Ord Analysis

The Local statistic was calculated by first defining business density. This was carried out by counting the locations of businesses into each administrative level. A higher administrative level was used to define business density, dividing the total number of businesses in the administrative region by the area in kilometres concerning each administrative boundary. This allowed to define business density at a spatial level and allowed to calculate the geostatistic, defining the location of business hubs in the Indian business landscape to determine local clusters (Getis and Ord, 1992). The calculation of the local statistic was calculated for each tehsil level (similar to western parishes) as smallest unit of administrative space in India was carried out by using the rook contiguity weight matrix calculated earlier, and correlated with the density of road networks per parish.

\[ G_t^*(d) = \sum_j w_{ij}(d)x_j / \sum_j x_j \]

(2)

Where \( w_{ij} \) is the spatial weight matrix following a 1 km distance (d), and \( x_j \) is assumed as 1 when the distance of one tehsil to another is within the expected otherwise, is assumed as 0. The existence of local clusters of businesses in India originated spatial hotspots at regional level. This aided in understanding that at regional level, there are a series of well-defined hotspots in India where business concentration exists, leading to clear and very distinct spatial concentrations on the business landscape (Figure 4).
3. RESULTS

3.1. Correlation of road networks and the Indian business hubs
This step led to the analysis of distance from businesses, as a correspondence to a nearest neighbour analysis where an initial distance was calculated to ensure the existence of at least one neighbour. The confidence interval for this distance for calculating a Local G autocorrelation index corresponded to 180 km, ensuring the confidence interval needed for an autocorrelating neighbour within the area (Figure 5).
The Moran autocorrelation index proved that at a distance of 250 km there is a greater likelihood in forming a cluster between sites, suggesting the existence of Hot and Cold spots in India for Business activity.

3.2. Dominating features of the Indian business hubs
Besides the impact that clustering has upon the efficiency of business performance, there is also a correlation of these on the readiness of companies to innovate. As largely accepted, innovation is a complex activity profiting from knowledge and in particularly from new knowledge – this resulting from a cumulative and re-interpretative process. Part of this knowledge, reaching the firm from external sources (Cassiman and Veugelers, 2002 and 2006), serves as a crucial factor to promote innovation activity (Rosenberg and Frischtak, 1986). Over the last decades, the importance of knowledge generated outside the firm for its own use has increased significantly, but the simple contact to external sources of knowledge is not enough to generate success and, in particular, to sustain innovative activities.

Many authors described external knowledge flows as an aid to strategic decision-making at the firm level (Cohen and Levinthal, 1989). But the firms have a certain absorptive
capacity that limits them or enhance them when facing external knowledge (Bapuji et al., 2011). The concept of networks, further to clustering, facilitates the absorptive capacity of the firm making its external knowledge base a result of other factors such as: the density of firms clustered in a given geographical area; the sector of activity; the social ties; the nature of the exchanged knowledge, for example (Gordon and McCann, 2000).

It is also important to emphasize that firms exposed to the same amount of external knowledge flows differ in their ability to identify and exploit such flows (Giuliani and Bell, 2005). Thus, both the amount and effect of external knowledge flows are unequally distributed across the population of firms of a same cluster and the absorptive capacity of a company can still be a source of a firm’s competitive advantage. A firm’s absorptive capacity depends on its existing knowledge stock, much of which is embedded in its products, processes and people (Escribano et al, 2009).

4. CONCLUSIONS

It is expected that this trend will continue over time, developing hubs for business and entrepreneurial activity for the future generations of Indian entrepreneurs.

This is then converted into shapefiles to allow incorporation in a GIS environment and spatially relevant information at local level to India and offering additional research datasets that can be integrated (Ridwan et al., 2012). While this allows some of the geovisualization capabilities of the Indian distribution of businesses, it is important to note that one of the most interesting challenges resides in understanding the underlying patterns of business location from a geostatistical perspective, adding on the road networks and spatial proximity to urban hubs, the spatial distribution both of profit at regional level, as well as the calculated spatial autocorrelation coefficient.

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