

ERIA Discussion Paper Series**No. 486****Industry Agglomeration, Urban Amenities, and
Regional Development in India****Subash SASIDHARAN***Indian Institute of Technology (IIT), Madras^{#§}***Shandre THANGAVELU***Jeffrey Cheah Institute of Southeast Asia, Sunway University
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Abstract: *Industrial agglomeration is an important component to create efficiency and externalities for industrial growth and competitiveness for the Indian economy. In this paper, we examine the spatial location of Indian firms and industry agglomeration at district and township level for the Indian economy. Particularly, we examine the impact of urban amenities in driving the industrial agglomeration in the Indian economy using firm-level data. We carefully control for township-level urban amenities, as well as firm level characteristics in affecting the industry agglomeration. As opposed to previous state- and district-level studies, we examine the impact of urban amenities at a more disaggregated township level for 2011. The study also examines the impact of urban amenities on manufacturing, as well as the services sector. The empirical analysis findings indicate a positive correlation between town-level disparities in industry agglomeration and various amenities, including education, healthcare, energy, transportation, finance, and cultural resources. These results remain consistent when considering alternative measures of agglomeration and conducting sub-sample analyses.*

Keywords: Industrial Agglomeration; Urban Amenities.

JEL Classification: F15; O15

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1. Introduction

The Indian economy has undergone rapid economic development and structural transformation since the onset of open-economy economic reforms that started in the mid-1980s through the New Industrial Policy (NIP). The economic liberalisation policy measures and market-based reforms include greater competition in the domestic economy through more open foreign investment, lower export tariffs, lower import tariffs and licensing on intermediate imports such as parts and components and machineries for key industries, removal of licensing for industries, and more investment and trade facilitation policies. One of the initiatives of the open-economic policy is to induce more economic dynamism across regions and states by incentivising domestic and foreign firms to locate there. To accelerate regional development, in addition to federal level incentives and policies, the state governments also offered tax holidays, subsidies on electricity and energy, and incentives for land lease for foreign investments. Recent evidence indicates that the development and growth of the Indian economy is uneven, with wide income and output disparities (Kathuria, 2016; Hasan, et al., 2017; Bhattacharya and Sakhivel, 2004). The uneven development of states and regions in India poses an important policy challenge of more sustainable and balanced growth. In this paper, we examine the spatial development of the Indian economy incorporating the locational decision of firms and the impact of urban connectivity and infrastructures in creating the regional- and state-level industrial agglomeration. We hope the study will provide more insights on the regional and spatial development of the Indian industrial sector.

Industrial agglomeration impacts the locational decisions of firms in terms of their production and operations, since it creates more externalities, knowledge spillovers, and network economies. Among the agglomeration economies, localisation economies (Marshallian externalities) refer to benefits accruing to the firms from spatial proximity within the same industry. Another benefit of spatial proximity emerges from the knowledge spillovers (Jacobian externalities). Further, industrial agglomeration is driven by state-level economic fundamentals such as human capital, connectivity, soft and hard infrastructure, connectivity to ports and airports, and also investment and business facilitation by both the federal and state government. In this paper, we explore the impact of urban amenities on state-level industrial agglomeration using township-level data. Understanding the factors that drive spatial inequality can assist policy makers to promote regional growth and development. In this study, we use unique and comprehensive town-level data, combined

with the establishment data drawn from the 2013 economic census. The study covers the industrial agglomeration of both manufacturing and service firms accounting for both township-level urban amenities, as well as firm-level characteristics.

Previous studies cite differences in natural endowments, human and physical capital, and economic geography as forces of regional inequality. Firms' location choice is one of the central elements of economic agglomeration and urbanisation and is guided by input availability, input prices, market access, and the level of urbanisation of states and cities (Glaeser, et al., 2015; Krugman, 1991; Fujita, et al., 1999). Firms prefer to locate close to suppliers or customers to create economies of scale. Krugman (1991) and Chen, et al. (2020) highlight that proximity of other firms and also research institutions facilitate knowledge externalities and spillovers. Glaeser, et al. (2015) highlight the importance of cities to create urban networks that spur the growth of the domestic economy and region. Chen, et al. (2020) also highlight the state- and city-level impact of urban amenities such as research institutions on both manufacturing and services industries in East Asia. However, in the case of India, most studies focus on the spatial concentration of economic activities with regard to the role of foreign direct investment (FDI), agglomeration determinants, the role of backward-area development policies, and firm location (Mukim and Nunnenkamp, 2012; Amirapu, et al., 2019; Fernandes and Sharma, 2012).

Several studies highlight the importance of cities and linkages as key drivers of economic development and growth of domestic economies (Glaeser, et al., 2015). In fact, the development of cities and linkages through urban amenities is the key driver of industrial location and agglomerations (Chen, et al., 2020). Thus, cities are considered as the epicentres of industrial activities for both manufacturing and services. In the case of India, since the adoption of the first Five-Year Plan dating back to the 1950s, considerable efforts have been made by the policy makers to devise incentive mechanisms for the spatial location choice of investors and firms. The key dimension of the NIP development strategies introduced in 1985 is to develop regional- and state-level growth as the key drivers of the Indian economic growth and development.

The paper is organised as follows. Section 2 will provide the literature review with respect to locational choice of firms. In section 3, we provide the literature review of industrial agglomeration in India. We provide the empirical model and data construction in section 4. The results of the empirical model are given at section 5. The policy discussions are given at section 6.

2. Literature Review of Amenities in Firm Location

The location choice of the firm and agglomeration of production activities is one of key focus of economic geography. Among the locational determinants, agglomeration economies, which refers to the advantage of locating in the neighbourhood of another firm (Glaeser, 2008) are given prominence by several studies.

The key to firm agglomeration is the role of cities and urban amenities in creating spillovers and externalities (Glaeser, 2007b). In a much-cited study, Glaeser (2011) classified urban amenities into four categories: localised goods and services, aesthetics and physical setting, public services, and speed in terms of transportation. Due to the non-tradable nature of certain services (restaurants, theatres, museums, amusement parks), they are available only for local consumption. To consume such non-tradables, consumers will have to either travel or locate in their vicinity. Glaeser et al. (2001) showed that US counties better equipped with local consumption amenities grew faster. Using a quasi-experimental approach, Falck et al. (2011) demonstrated that cultural amenities are strongly related to the regional share of high-skilled workers. Literature in this area examines the role of natural amenities and architectural design as a determining factor in the spatial location of workers. Usual practice among the studies is to consider the climatic factors as a proxy for natural amenities. Most of the studies conclude that weather matters for the households' decision to migrate (Rappaport, 2007; Rodríguez-Pose and Ketterer, 2012). Other studies report the role of heritage or architectural design, school, transportation, and crime rate on city growth and economic activity (Möller, 2014; Moeller, 2018).

Conventionally, firm location studies mainly concentrate on factors like specialised inputs and FDI; however, firms are increasingly driven to locations due to the availability of amenities, with service sector firms being more oriented in choosing location with better amenities than manufacturing firms. By the assumption of firms as amenity maximisers, Gottlieb (1995) specified two mediums through which such a relationship arises. First, owners of the firm in pursuit of their own utility maximisation prefer to start or move their establishments to amenity-rich centres. Second, workers may be willing to accept lower wages in exchange for residing in locations with quality amenities. However, the findings of the existing studies yield mixed results. Kolko (1999) showed that natural amenities do play a role in determining firm location. Lee and Nathan (2010) used the London Annual Business Survey to show that cultural amenities can become an important driver of innovation, while

Moeller (2018) reported amenity-rich areas positively influence the location of internet start-up firms in Berlin.

3. Review of Industrial Agglomeration in India

In the case of India, empirical studies on industrial agglomeration is relatively recent and generally consider industrial concentration, firm productivity, spatial inequality, and FDI activities. Among the studies exploring the Indian context, Lall and Chakravorty (2005) examined new investments using two-digit, district-level data and found industries tend to concentrate on few districts. The analysis showed that infrastructure, high labour productivity and coastal districts influence private investment. Lall and Chakravorty (2005) further reported that structural reforms in India led to increased spatial inequality and caused regional disparities in income distribution. Fernandes and Sharma (2012) studied determinants of spatial location of firms using state-level data. Their study showed the positive impact of skilled labour on firms' industrial location and entry of new firms, while better infrastructure and governance are also important factors. They also show that liberalisation of FDI significantly reduced spatial concentration, while trade liberalisation measures had no significant effect. A summary of the empirical literature is provided in Table 1. In a similar vein, Kathuria (2016) used the Ellison-Glaeser index of agglomeration for 66 organised sector manufacturing industries in 21 states in India. The agglomeration index reveals a dispersion of industries (nearly 41 industries show dispersion). Further, Kathuria's 2016 analysis using the index to identify drivers of agglomeration revealed infrastructure, proximity to coast, and labour market pooling as the significant determinants of locational choice of firms. Based on aggregate data, Tripathi (2013) report significant positive impact of agglomeration on urban economic growth.

Few studies focus on the relationship between agglomeration and productivity. Lall et al. (2004) used large-scale, nationally representative, plant-level data drawn from the Annual Survey of Industries for 11 manufacturing industries to analyse the agglomeration – productivity link. Lall et al. (2004) measured economies of national urbanisation and localisation using data from the Annual Survey of Industries (ASI). They found negative urbanisation economies (diseconomies) for most of the sectors, while localisation economies turn out to be non-existent. Mitra (2000), using panel data for 15 major states in India in a growth-accounting framework, found evidence of positive urbanisation economies in 11 out of 17 two-digit level industries in India.

Table 1: Summary of Industrial Agglomeration Studies in India

Authors	Methodology	Time Period	Data	Findings
Lall and Chakravorty (2005)	Translog cost function	1998–1999	Plant-level data, annual survey of industries	Structural reforms of India lead industrial disparity among regions
Kathuria (2016)	Ordinary least squares and instrumental variable estimation	1995	Plant-level data, annual survey of industries	Impact of industrial dispersal policy on industrial agglomeration is insignificant
Tripathi (2013)	Ordinary least squares	2010	City-wise specifications	Strong positive impact of agglomeration on urban growth in India’s urban system
Mitra (2000)	Stochastic frontier analysis	1992–1993	Centre for Monitoring Indian Economy’s Prowess	A non-linear relationship between firm-level technical efficiency and agglomeration economies
Lall et al. (2004)	Transcendental logarithmic production function	1994–1995	Plant-level data, annual survey of industries	There is positive impact of agglomeration economies in firm-level productivity
Fernandes and Sharma (2012)	Feasible generalized least squares	1980–1999	Plant-level data, annual survey of industries	Decrease in industrial agglomeration due to foreign direct investment liberalisation.

Source: Authors.

4. Empirical Model and Data Construction

In this study, we pool data from several sources. Our main data source is the 6th Economic Census of India, provided by the Central Statistical Organization, which is the census of all the non-agricultural establishments in India. Even though censuses are available for the previously published five rounds, we use the latest round released in 2013. The 6th Economic Census is an extremely useful source to identify the spatial location of establishments in India as it contains location of firms at the state, district, and city/town level. The sample coverage is extremely large, with 58.5 million establishments in 2013, 45.36 million of which belong to the secondary and tertiary sector. For our purpose, we collected establishment data employing 10 or more workers (formal sector) to construct the agglomeration index. Based on the 6th Economic Census, the distribution of establishments by size class of employment show that around 55.86 million establishments (95.50%) had

1–5 workers, around 1.83 million (3.13%) had 6–9 workers, while 0.8 million (1.37%) employed 10 or more workers.

The 6th Economic Census contains information pertaining to key activities of firms in terms of number of employees, and major activity in terms of three-digit industrial classification, sector, source of finance, religion, social group, and ownership. However, the census does not cover key information on output, wages, assets. The analysis carried in this study includes all industries belonging to 71 two-digit industries (24 two-digit manufacturing and 47 two-digit services).

To obtain the town-level characteristics, we rely on the Town Directory of the 2011 Population Census. This dataset provides information pertaining to geography and climatic amenities, demography, infrastructure, and social and educational services. We use this source to obtain town-level amenities and other characteristics as controls. However, linking the economic census with the Town Directory on a one-to-one basis becomes a daunting task since the town code is not same. We used another source, the Socioeconomic High-resolution Rural-Urban Geographic dataset on India (SHRUG),¹ for one-to-one matching. SHRUG provides a unique town-level identifier (*shrid*). Using the unique identifier provided, we could match towns in the 6th Economic Census and 2011 Population Census. After matching, our final dataset contains about 7,498 Indian towns from around districts with at least a population of 5,000 in 2011.

Table 2: Town Size Distribution

Population	Number of Towns	Percentage
5,000–9,999	1,916	29.8%
10,000–99,999	4,185	64.8%
100,000–499,999	327	5%
500,000+	30	0.4%
Total	6,458	100

Source: Town Directory of Population Census 2011.

Table 2 shows the distribution of towns by population. According to the definitions of Census of India, towns in India are classified as either census towns or statutory towns.

¹ SHRUG is released under the Open Data Commons Open Database License and is available for download at http://www.devdata.org/shrug_download/ (accessed 3 August 2021).

Census towns are administrative units that satisfy the following three criteria: (i) minimum population of 5,000; (ii) 75% or more of the male working-age population engaged in non-agricultural activities; and (iii) population density of at least 400 persons per km². Statutory towns are defined as urban-like municipal corporations, municipalities, cantonment boards, notified town area committees, Town Area Committees, Town Panchayat, Nagar Palika. Towns with population of greater than 100,000 are categorised as cities. Table 2 shows that almost 30% of the towns had a population of less than 10,000. There are 373 cities in India, or 5.4% of the total, with a total population of 100,000 or more.

4.1. Measure of Industrial Agglomeration

Among the set of measures and indices constructed to identify industrial agglomeration, the Ellison-Glaeser (1997) index is the most widely applied measure. The Ellison-Glaeser index enables us to capture agglomeration in a region of a particular industry by measuring the concentration of industries at the town level for every 3-digit National Industry Classification (NIC). An inherent advantage of the Ellison-Glaeser index is its ability to consider the number and size of establishments. The Ellison-Glaeser index assumes the profit-maximising behavior of firms, which accounts for the spillovers associated with locating with other firms and natural advantages. The construction of the Ellison-Glaeser index requires estimation of the Spatial Gini Coefficient (G) and the Herfindhal index (H) of industry concentration. In order to obtain these, we need data of each industry in various towns.

Following Ellison-Glaeser (1997), we denote $R = (1, 2, \dots, r)$, which refers to the geographic regions (towns) and s_1, s_2, \dots, s_r , which is the share of each industry j 's total employment in a region (town). We represent x_1, x_2, \dots, x_r as the share of total employment in the respective region (town). Therefore, we can represent the spatial concentration of an industry as:

$$G = \sum_{r=1}^R (s_r - x_r)^2$$

We can obtain the size distribution of establishment by industry with the Herfindhal index (H)

$$H = \sum_{i=1}^N z_i^2$$

Where N is the number of establishments and z_1, z_2, \dots, z_N is the share of each establishment's employment to industry employment. Therefore, we can define the Ellison-Glaeser index as:

$$\begin{aligned} \gamma &\equiv \frac{G - (1 - \sum_{r=1}^R x_r^2)H}{(1 - \sum_{r=1}^R x_r^2)(1 - H)} \\ &\equiv \frac{\sum_{r=1}^R (s_r - x_r)^2 - (1 - \sum_{r=1}^R x_r^2) \sum_{i=1}^N z_i^2}{(1 - \sum_{r=1}^R x_r^2)(1 - \sum_{i=1}^N z_i^2)} \end{aligned}$$

The value of the index provides the strength of agglomeration and varies between -1 and $+1$. If the value of this index is zero, it indicates no agglomeration effects and the location choices are random. On the other hand, any value greater than zero implies that location is dependent on the location choice of other firms. Ellison and Glaeser (1997) considered any industry with $\gamma > 0.05$ as highly concentrated, while those with values in between 0.02 and 0.05 were considered moderately concentrated, and those below 0.02 were regarded as not concentrated. The index can also take negative values, which indicates a greater dispersion of the industry.

4.2. Measures of Urban Amenities

There is no consensus among the studies regarding the precise definition of amenities. In this study, we consider an array of amenities². First is related to the *natural advantages* like climatic characteristics, i.e. maximum and minimum temperature, average rainfall, etc. The second set comprises *education amenities*. We consider different levels of educational facilities in a town, i.e. basic education (primary, secondary), colleges, professional colleges, universities. *Cultural amenities* are captured in terms of their equivalent to the lifestyle amenities that provide scope for leisure activities. In this study, we include movie theaters, sport centres, libraries, and concert halls as factors representing cultural amenities. *Transport amenities* are crucial for the regional growth in India since facilities are unevenly distributed between urban and rural areas. Many cities in India suffer from congestion and moving goods from one place to another leads to iceberg costs according to the tenets of the new economic geography. Therefore, improving transportation facilities increase the linkages between firms in the current market to other markets. On the other hand, reducing the iceberg

² Table A1, A2 and A4 presents the descriptive statistics of components of amenities index. Test results of PCA analysis is provided in Table A3.

costs may make firms agglomerate to one region, exacerbating spatial inequality (Krugman, 1991). Previous studies on industrial agglomeration in India mainly considered the length of the paved roads as proxy for accessibility. We consider road length, bus route distance, and railway stations as the factors measuring transport amenities.

Tables 3 and 4 present the Ellison-Glaeser measure of the 10 most concentrated, moderately concentrated, and least agglomerated industries belonging to manufacturing and services. From the tables, it is evident that the most spatially concentrated three-digit industry in the manufacturing sector is glass and glass products, while in the case of services, it is software publishing. The less-agglomerated industries in manufacturing include food and grain mill products; in the case of services, hospital activities and primary education are the least agglomerated.

Table 3: EG Index and Ranking in Manufacturing Sector

	Highly Concentrated			Moderately Concentrated			Least Concentrated		
EG Rank	NIC3 Digit code	Description	EG Index	NIC3 Digit code	Description	EG Index	NIC3 Digit code	Description	EG Index
1	231	Glass and glass products	0.4492	161	Sawmilling and planing of wood	0.0489	107	Other food products	0.008
2	303	Air and spacecraft and related machinery	0.4297	261	Manufacture of electronic components	0.0457	106	Grain mill products	0.009
3	304	Military fighting vehicles	0.3872	141	Manufacture of wearing apparel, except fur apparel	0.0435	170	Paper and paper products	0.0094
4	301	Ships and boats	0.2892	139	Manufacture of other textiles	0.0427	181	Printing	0.0095
5	268	Magnetic and optical media	0.2870	151	Tanning and dressing of leather	0.0414	202	Other chemical products	0.0099
6	262	Computers and peripheral equipment	0.2815	259	Other fabricated metal products	0.0398	110	Beverages	0.0113
7	309	Transport equipment	0.2321	293	Parts and accessories for motor vehicles	0.0374	239	Non-metallic mineral products	0.0134
8	252	Weapons and ammunition	0.1972	272	Batteries and accumulators	0.0326	162	Products of wood, cork	0.0143
9	302	Railway locomotives and rolling stock	0.1592	279	Other electrical equipment	0.0306	101	Processing and preserving meat	0.0144
10	264	Consumer electronics	0.1297	103	Processing and preserving of fruit and vegetables	0.0272	210	Pharmaceutical	0.0145

EG = Ellison-Glaeser, NIC = National Industrial Classification.

Source: Authors' calculation based on the sixth Economic Census (2013).

Table 4: EG Index and Ranking in Services Sector

EG Rank	Highly Concentrated			Moderately Concentrated			Least Concentrated		
	NIC3 Digit code	Description	EG Index	NIC3 Digit code	Description	EG Index	NIC3 Digit code	Description	EG Index
1	872	Residential care activities	0.5668	642	Activities of holding companies	0.0476	861	Hospital activities	0.0025
2	582	Software publishing	0.3148	692	Accounting, bookkeeping and auditing; tax consultancy	0.0450	851	Primary education	0.0027
3	783	Human resources provision and management	0.2641	802	Security systems service activities	0.0446	852	Secondary education	0.0029
4	711	Architecture and engineering activities;	0.2416	731	Advertising	0.0440	551	Short term accommodation	0.0033
5	712	Technical testing and analysis	0.2412	469	Non-specialised wholesale trade	0.0432	641	Monetary intermediation	0.0036
6	749	Other professional, scientific and technical activities	0.2320	871	Nursing care facilities	0.0427	561	Restaurants and mobile food service	0.0036
7	813	Landscape care and maintenance service activities	0.2287	951	Repair of computers and communication equipment	0.0376	853	Higher education	0.0036
8	774	Leasing of nonfinancial intangible assets	0.2171	631	Data processing, hosting and related activities; web portals	0.0367	531	Postal activities	0.0039
9	702	Management consultancy activities	0.2053	591	Motion picture, video, and television programme activities	0.0361	451	Sale of motor vehicles	0.0045
10	493	Transport via pipeline	0.1986	799	Other reservation service	0.0352	869	Other human health activities	0.0046

EG = Ellison-Glaeser, NIC = National Industrial Classification.

Source: Authors' calculation based on the sixth Economic Census (2013).

Table 5: Degree of Agglomeration for Manufacturing (NIC two-digit)

Industry code (NIC 2 Digit)	No. of 3 Digit Industries	Least Concentrated (<0.02)		Moderately Concentrated ($0.02 < EG < 0.05$)		Highly Concentrated (>0.05)	
Food	8	4	50.00	2	25.00	2	25.00
Beverage	1	1	100.00	0	0.00	0	0.00
Tobacco	1	1	100.00	0	0.00	0	0.00
Textiles	2	1	50.00	1	50.00	0	0.00
Apparel	3	0	0.00	1	33.33	2	66.67
Leather	2	0	0.00	2	100.00	0	0.00
Wood products	2	1	50.00	1	50.00	0	0.00
Paper	1	1	100.00	0	0.00	0	0.00
Printing and reproduction of recorded media	2	1	50.00	0	0.00	1	50.00
Coke and refined petroleum products	2	0	0.00	0	0.00	2	100.00
Chemicals	3	1	33.33	0	0.00	2	66.67
Pharmaceuticals	1	1	100.00	0	0.00	0	0.00
Rubber and Plastics	2	1	50.00	1	50.00	0	0.00
Other non-metallic mineral products	2	1	50.00	0	0.00	1	50.00
Basic metals	3	1	33.33	2	66.67	0	0.00

Industry code (NIC 2 Digit)	No. of 3 Digit Industries	Least Concentrated (<0.02)		Moderately Concentrated (0.02<EG>0.05)		Highly Concentrated (>0.05)	
Fabricated metal products	3	1	33.33	1	33.33	1	33.33
Computer, electronic and optical products	8	0	0.00	1	12.50	7	87.50
Electrical equipment	6	0	0.00	3	50.00	3	50.00
Machinery	2	1	50.00	1	50.00	0	0.00
Motor vehicle	3	0	0.00	1	33.33	2	66.67
Other transport equipment	5	0	0.00	0	0.00	5	100.00
Furniture	1	1	100.00	0	0.00	0	0.00
Total	63	18	(28.57%)	17	(26.98%)	28	(23.33%)

NIC = National Industrial Classification.

Source: Authors' calculation based on the sixth Economic Census (2013).

Table 6: Degree of Agglomeration of Service Activities (NIC two digit)

Industry code (NIC 2 Digit)	No. of 3 Digit Industries	Least Concentrated (<0.02)		Moderately Concentrated (0.02<EG>0.05)		Highly Concentrated (>0.05)	
Wholesale and retail trade and repair of motor vehicle	4	4	100.00	0	0.00	0	0.00
Wholesale trade, except of motor vehicles	7	4	57.14	3	42.86	0	0.00
Wholesale trade, except of motor vehicles	9	4	44.44	3	33.33	2	22.22
Land transport and transport via pipelines	3	1	33.33	1	33.33	1	33.33
Water transport	2	0	0.00	0	0.00	2	100.00
Air transport	2	0	0.00	0	0.00	2	100.00
Warehousing	2	2	100.00	0	0.00	0	0.00
Postal and courier activities	2	2	100.00	0	0.00	0	0.00
Accommodation	3	2	66.67	0	0.00	1	33.33
Food and beverage service	3	3	100.00	0	0.00	0	0.00
Publishing activities	2	1	50.00	0	0.00	1	50.00
Motion picture	2	0	0.00	2	100.00	0	0.00
Broadcasting	2	1	50.00	0	0.00	1	50.00
Telecommunications	4	0	0.00	2	50.00	2	50.00
Computer programming	1	0	0.00	0	0.00	1	100.00
Information service	2	0	0.00	1	50.00	1	50.00

Industry code (NIC 2 Digit)	No. of 3 Digit Industries	Least Concentrated (<0.02)		Moderately Concentrated (0.02<EG>0.05)		Highly Concentrated (>0.05)	
Financial service	4	3	75.00	1	25.00	0	0.00
Insurance	3	2	66.67	0	0.00	1	33.33
Other financial activities	3	2	66.67	1	33.33	0	0.00
Real estate activities	2	0	0.00	2	100.00	0	0.00
Legal and accounting activities	2	1	50.00	1	50.00	0	0.00
Management consultancy	2	0	0.00	0	0.00	2	100.00
Architecture and engineering	2	0	0.00	0	0.00	2	100.00
Scientific research and development	2	0	0.00	1	50.00	1	50.00
Advertising and market research	2	0	0.00	1	50.00	1	50.00
Other professional technical activities	3	0	0.00	0	0.00	3	100.00
Veterinary activities	1	1	100.00	0	0.00	0	0.00
Rental and leasing	4	1	25.00	1	25.00	2	50.00
Employment activities	3	0	0.00	0	0.00	3	100.00
Travel agency	2	1	50.00	1	50.00	0	0.00
Security and investigation activities	3	1	33.33	1	33.33	1	33.33
Services to building	3	0	0.00	0	0.00	3	100.00
Office administrative	4	1	25.00	1	25.00	2	50.00
Education	5	5	100.00	0	0.00	0	0.00

Industry code (NIC 2 Digit)	No. of 3 Digit Industries	Least Concentrated (<0.02)		Moderately Concentrated ($0.02 < EG < 0.05$)		Highly Concentrated (>0.05)	
Human health activities	3	3	100.00	0	0.00	0	0.00
Residential care	4	1	25.00	2	50.00	1	25.00
Social work	2	0	0.00	2	100.00	0	0.00
Creative, arts and entertainment	1	1	100.00	0	0.00	0	0.00
Libraries, archives, Museums	1	1	100.00	0	0.00	0	0.00
Gambling and betting	1	0	0.00	0	0.00	1	100.00
Sports activities	2	0	0.00	1	50.00	1	50.00
Activities of membership organisations	3	1	33.33	0	0.00	2	66.67
Repair of computers	2	0	0.00	1	50.00	1	50.00
Other personal services	1	1	100.00	0	0.00	0	0.00
Total	120	50	41.67	29	24.17	41	34.17

NIC = National Industrial Classification.

Source: Authors' calculation based on the sixth Economic Census (2013).

Tables 5 and 6 present the proportion of two-digit industries' agglomeration. It is evident from Table 5 that industries that include coke and refined petroleum, along with other transport equipment, are the most highly concentrated in manufacturing since the whole industry falls under the >0.05 category. The least-concentrated industries include beverage, tobacco, paper, pharmaceuticals, and furniture, all of which have a value of less than 0.02.

4.3. Pattern of Location of Industries – Top Five Towns

We obtain the pattern of each industry's location by taking the product of the Ellison-Glaeser index with the employment share of that particular town in the respective industry. This value can provide information about the concentration of an industry in a particular town. Table 7 shows the concentration of three-digit industry location and reveals that it tends to cover few towns in a particular state: greater Mumbai in Maharashtra, Delhi Municipal Corporation in Delhi, Noida in Uttar Pradesh, and Bengaluru in Karnataka. As an illustration, in Andhra Pradesh, air- and spacecraft-related machinery, computers and peripheral equipment, technical testing and analysis are located in the greater Hyderabad Municipal Corporation. However, in the state of Gujarat, we observe different industries concentrated in different towns (Surat city for glass products, shipbuilding in Kandla and Bhavnagar). In the case of shipbuilding, coastal towns are the preferred locations while in the case of military equipment, we observe concentration in border regions.

Table 7: Pattern of Location of Highly Localised Industries at NIC 3-Digit Level

NIC 3	Town	State	NIC 3	Town	State
Manufacturing			Service		
Glass and Glass Products (231)	Firozabad	Uttar Pradesh	Software Publishing (582)	Manapakkam	Tamil Nadu
	Surat	Gujarat		Noida	Uttar Pradesh
	Bengaluru MNP	Karnataka		Ahmadabad	Gujarat
	Noida	Uttar Pradesh		Sas Nagar	Punjab
	Bhimpore	Daman Diu		Delhi MC	Delhi
Air- and Spacecraft-related Machinery	Hyderabad MC	Andhra Pradesh	Human Resources Provision	Burla	Odisha
	Hyderabad MC	Andhra Pradesh		Ozhukarai	Puducherry

NIC 3	Town	State	NIC 3	Town	State
Manufacturing			Service		
(303)	Bengaluru MNP	Karnataka	and Management (783)	Basti	Uttar Pradesh
	Hyderabad MC	Andhra Pradesh		Noida	Uttar Pradesh
	Thane	Maharashtra		Ranchi	Jharkhand
Military Fighting Vehicles (304)	Jalandhar Part	Punjab	Architecture and Engineering Activities; (711)	Bengaluru MNP	Karnataka
	Ludhiana	Punjab		Greater Mumbai Part	Maharashtra
	Bengaluru MNP	Karnataka		Delhi MC	Delhi
	Doraha	Punjab		Pune	Maharashtra
	Pimpri Chinchwad	Maharashtra		Greater Mumbai Part	Maharashtra
Building of Ships and Boats (301)	Kochi Part	Kerala	Technical Testing and Analysis (712)	Bengaluru MNP	Karnataka
	Mormugao	Goa		Vadodara	Gujarat
	Kandla	Gujarat		Hyderabad MC	Andhra Pradesh
	Bhavnagar	Gujarat		Thiruvananthapuram	Kerala
	Greater Mumbai Part	Maharashtra		Gandhidham	Gujarat
Magnetic and Optical Media (268)	Ambarnath	Maharashtra	Other Professional, Scientific and Technical Activities (749)	Noida	Uttar Pradesh
	Noida	Uttar Pradesh		Greater Mumbai Part	Maharashtra
	Greater Noida	Uttar Pradesh		Vadodara	Gujarat
	Jaipur Part	Rajasthan		Hyderabad MC	Andhra Pradesh
	Delhi MC	Delhi		Pune	Maharashtra
Computers and Peripheral Equipment (262)	Noida	Uttar Pradesh	Landscape Care and Maintenance Service Activities (813)	Greater Mumbai Part	Maharashtra
	Hyderabad MC	Andhra Pradesh		Greater Mumbai Part	Maharashtra
	Tambaram	Tamil Nadu		Ranchi	Jharkhand
	Nashik	Maharashtra		Govindgarh	Rajasthan
	Pune	Maharashtra		Panchkula	Haryana
Transport Equipment	Jalandhar Part	Punjab	Leasing of Nonfinancial	Ujjain	Madhya Pradesh

NIC 3	Town	State	NIC 3	Town	State
Manufacturing			Service		
(309)			Intangible Assets		
	Ludhiana	Punjab	(774)	Nadiad	Gujarat
	Chandigarh	Chandigarh		Coimbatore	Tamil Nadu
	Kalka	Haryana		Dausa	Rajasthan
	Panchkula	Haryana		Nuzvid	Andhra Pradesh
Weapons and Ammunition (252)	Armapur Estate	Uttar Pradesh	Management Consultancy Activities (702)	Bengaluru MNP	Karnataka
	Dhaulpur	Rajasthan		Greater Mumbai Part	Maharashtra
	Gajraula	Uttar Pradesh		Greater Mumbai Part	Maharashtra
	Jammu	Jammu Kashmir		Noida	Uttar Pradesh
	Greater Mumbai Part	Maharashtra		Vadodara	Gujarat
Railway Locomotives and Rolling Stock (302)	Ludhiana	Punjab	Transport Via Pipeline (493)	Guwahati Part	Assam
	Jamalpur	Bihar		Telhara	Maharashtra
	Hussainpur	Punjab		Kirandul	Chhattisgarh
	Ajmer	Rajasthan		Dinhata	West Bengal
	Kolkata	West Bengal		Rajauli	Bihar
Consumer Electronics (264)	Hardwar	Uttarakhand	Freight Air Transport (512)	Tambaram	Tamil Nadu
	Noida	Uttar Pradesh		Alandur	Tamil Nadu
	Delhi MC	Delhi		Greater Mumbai Part	Maharashtra
	Greater Mumbai Part	Maharashtra		Pallikal	Kerala
	Delhi MC	Delhi		Navi Mumbai	Maharashtra

NIC = National Industrial Classification.
Source: Authors.

4.4. Construction of Urban Amenities

The Indian population census provides rich data about several town-level amenities. We obtained the data from the town directory, 2011 Census (GoI, 2011). Since there is considerable

heterogeneity among the towns in terms of basic amenities, we need to derive an appropriate measure that incorporates several indicators reflecting the extent of amenities in a town (city). To capture this effect, we constructed the composite index of amenities inclusive of all the indicators. We construct a composite index of amenities using principal component analysis (PCA). For our purpose, we consider 30 indicators under seven broad categories (climate, culture, education, energy, finance, health, transportation) to construct the amenity index. Table 8 presents the description of the variables included in the estimation of the composite index.

Table 8: Variable Description

Variables	Description
School	The number of primary, middle, secondary, senior secondary schools (government and private)
Degree College	The number of arts, science, and commerce colleges (government and private)
Management Institute	The number of management colleges and institutions
Polytech	The number of polytechnic institutions that providing certificate or diploma in any technical subject (government and private)
Vocational	The number of vocational training institutes, including industrial training institutes
Non-Formal Training Institute	Non-vocational education centres established by central and state governments
Allopathic Hospital	The number of allopathic hospitals
Alternative Medicine Hospital	The number of alternative medicine hospitals such as ayurveda, unani, and homeopathy
T.B. Hospital	The number of tuberculosis clinics
Dispensary	The number of dispensaries and health centres
Family Welfare Centre	The number of family welfare centres that provide check-up and counselling for pregnant and married women.
Non-Government Medicine Shop	The number of shops that sells drugs and medicines
Nationalised Bank	The number of nationalised banks
Private Commercial Bank	The number of private banks (Indian and foreign)
Co-operative Bank	The number of co-operative banks which belongs to its members who are both owners and customers.
Credit Society	The number of agricultural and non-agricultural society.

Variables	Description
Auditorium	The number of auditoriums and community halls where meetings, social function are organised
Library and Reading Rooms	The number of libraries and reading rooms
Cinema Theatre	The number of cinema theatres
Stadium	The number of stadiums
Domestic Electricity	The number of domestic electricity connections
Industry Electricity	The number of industry electricity connections
Commercial Electricity	The number of commercial electricity connections
Bus Route	The distance of bus route services, in km
Pucca Road	The length of pucca roads, in km
Kutch Road	The length of kutch road, in km
Sea Port	The number of seaports
Airport	The number of Airports
Temperature	The average of minimum and maximum temperature, in degree Celsius
Rainfall	Rainfall in mm

Source: Authors.

Most often, a challenge faced by empirical researchers while constructing amenity measures is the presence of many variables and the multicollinearity among them. Table 9 presents the results of the PCA³. If we try to include all the variables (in the present case, 30 variables) in the regression, many of them turn out to be insignificant or generating counterintuitive signs. By contrast, failing to include them will lead to significant loss of information. To overcome this, we resort to the PCA, which provides a robust analysis accounting for the collinearity of the variables. PCA allows evaluation and measurement of multiple town-level amenities into seven distinct categories, which were combined to produce town-level amenity indices (first principal component scores as identified in Table 9).

³ Figures A1 and A2 presents the scree plot of the PCA.

Table 9. Component Score Coefficient of the Indicators Pertaining to Various Components of the Amenities

Variables	Edu	Health	Finance	Culture	Energy	Transport	Climate
School	0.529						
Degree College	0.39						
Management Institute	0.436						
Polytech	0.501						
Vocational	0.337						
Non-Formal Training	0.118						
Allopathic Hospital		0.467					
Alternative Medicine		0.406					
Tuberculosis Hospital		0.37					
Dispensary		0.371					
Family Welfare		0.439					
Non-Government		0.388					
Nationalised Bank			0.568				
Private Commercial			0.557				
Co-operative Bank			0.486				
Credit Society			0.362				
Auditorium				0.574			
Library and Reading				0.435			
Cinema Theatre				0.573			
Stadium				0.392			
Domestic Electricity					0.601		
Industry Electricity					0.526		
Commercial					0.602		
Bus Route						-0.027	
Pucca Road						0.537	
Kutch Road						0.584	
Sea Port						0.326	
Airport						0.513	
Temperature							0.707
Rainfall							0.707

Note: The figures indicated in the table are the factor loadings.

Source: Authors.

4.5. Methodology

We estimate the following model to capture the impact of amenities on the spatial concentration of industries.

$$EG_{j,r} = \alpha + \beta Amenities_r + \gamma Z_r + \vartheta X_D + \theta SD Dummy + e_{j,r} \quad (1)$$

where $EG_{j,r}$ is the Ellison-Gleaser (1997) index, as discussed earlier. We use the Ellison-Gleaser measure of agglomeration as the dependent variable to capture the entity's decision to locate in a given town (city). $Amenities_r$ denotes the amenity index obtained through PCA. We capture the following amenities: climate, education, finance, culture, energy, and transportation. Z_r denotes market access proxied by the log of population of the town, while X_D is the vector of the district-level controls. We include state dummies (SD dummy) to capture state-level heterogeneity. Since this study is intended to establish whether amenities in a given town (city) influence the location choice of entities, we conduct the empirical analysis at the broader NIC 2-digit level. Further, empirical analysis using lower-level disaggregation at the 3-digit industries is carried and the results are reported in the appendix.

5. Empirical Results

This section discusses the results of the empirical analysis. Tables 10 and 11 report the fixed-effect results of the regression model for the manufacturing and services sector. We introduce the various amenity variables in a step-wise manner. In all the specifications, we control for the town (city) population, presence of special economic zone, and a dummy for coastal districts. The significance of the amenity variable (column 8, Tables 8 and 9) suggests that amenities do influence the manufacturing and services location in town areas. Regarding each individual amenity variable, the coefficient is statistically significant at 1% for both manufacturing and services. In the case of individual amenities related to healthcare facilities, we find a significant effect only for services sector location. Surprisingly, for the natural amenity variable (climate), the results indicate no significant evidence.

Apart from the amenity variables, we also control for other factors influencing agglomeration such as market access, presence of special economic zone, and coastal areas. Regardless of the sector (manufacturing and services), the coefficient of the measure of market access (ln Population) is positive and statistically significant. However, we do not find proximity to coastal areas providing any significant effect, which is in line with Kathuria's 2016 results. By contrast, the special economic zone (SEZ dummy) generates positive and significant agglomeration economies. This finding is consistent with the argument that

locations with SEZ generate productivity gains which promote agglomeration (Wang, 2013; Busso, et al., 2013).

Estimates for the individual industry classes, NIC 10–31, for manufacturing and service (NIC 45–79) are reported in Tables 12 and 13⁴. The effect of education is significant for eight industry classifications in manufacturing and all industry classification in services except for NIC 62 and 87. The effect of the health amenity is positive and significant in just four industry classes in manufacturing, while the trend in services is similar to that of education amenity. The coefficients of the finance amenities are positive and significant in all the service industry classes except one, while it is significant only in 10 out of 21 industry classes in manufacturing. As emphasised in the literature, the presence of cultural infrastructure (cinemas, theatres, museums, galleries, stadiums) influences firm location. The cultural amenities are found to be significant in influencing the location choice of the services, especially creative industries. Surprisingly, in our case, we find that the cultural amenities are positive and significant in 23 industry classes in the service sector and 15 industry classes in manufacturing. This result aligns with the argument that high-capital workers prefer to live in high-amenity places with cultural attractions (Kotkin, 2000).

The effect of energy amenity is more profound for both services and manufacturing. However, the less profound impact of transport amenities in the case of manufacturing is puzzling, with just six of the industry classes turning up with positive and significant coefficients. The effect of climate is positive and significant for just two out of the 21 industry classifications in manufacturing, while it is positive and significant only for four industry classifications in the services sector. This finding is similar to the overall result that climatic factors do not play a significant role in influencing the location of establishments.

⁴ We also carried out the same exercise using the 3 digit NIC for manufacturing and services (See Table A5 and A6).

Table 10: Industry Agglomeration and Amenities (NIC 2-digit manufacturing)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	EG	EG	EG	EG	EG	EG	EG	EG
Education	0.255** (0.112)							
Health		0.0997 (0.0733)						
Finance			0.284*** (0.0544)					
Culture				0.310*** (0.0661)				
Energy					0.874*** (0.100)			
Transportation						0.945*** (0.136)		
Climate							-0.0117 (0.161)	
Overall Amenities								0.739*** (0.117)
Ln(Population)	1.448*** (0.295)	1.628*** (0.281)	1.295*** (0.268)	1.218*** (0.279)	0.474 (0.292)	0.785*** (0.290)	1.804*** (0.250)	0.685** (0.306)
SEZ	0.647*** (0.125)	0.650*** (0.125)	0.660*** (0.125)	0.658*** (0.125)	0.627*** (0.125)	0.669*** (0.125)	0.645*** (0.125)	0.660*** (0.125)
Costal District	-0.236 (0.993)	-0.323 (0.993)	-0.380 (0.992)	-0.210 (0.992)	-0.170 (0.991)	0.0175 (0.993)	-0.313 (1.010)	-0.176 (0.992)
State Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	EG	EG	EG	EG	EG	EG	EG	EG
Constant	-14.34***	-16.18***	-12.57**	-12.00**	-6.163	-12.16**	-17.67***	-6.705
	(5.474)	(5.390)	(5.352)	(5.401)	(5.415)	(5.316)	(5.410)	(5.541)
Observations	15,398	15,398	15,398	15,398	15,398	15,398	15,398	15,398
R-squared	0.009	0.009	0.011	0.010	0.014	0.012	0.009	0.012

EG = Ellison-Glaeser, NIC = National Industrial Classification, SEZ = special economic zone.

Standard errors are reported in parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Source: Authors.

Table 11: Industry Agglomeration and Amenities (NIC 2-digit services)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	EG	EG	EG	EG	EG	EG	EG	EG
Education	1.955*** (0.175)							
Health		1.181*** (0.115)						
Finance			1.540*** (0.0851)					
Culture				1.056*** (0.102)				
Energy					2.013*** (0.159)			
Transportation						0.452** (0.213)		
Climate							-0.0598 (0.220)	
Overall Amenities								2.800*** (0.182)
Ln(Population)	-0.0535 (0.471)	0.577 (0.451)	-0.131 (0.428)	0.642 (0.447)	-0.332 (0.467)	2.244*** (0.463)	2.743*** (0.400)	-1.612*** (0.488)
SEZ	2.153*** (0.200)	2.209*** (0.200)	2.249*** (0.200)	2.190*** (0.200)	2.108*** (0.200)	2.147*** (0.201)	2.136*** (0.201)	2.215*** (0.200)
Costal District	-1.538 (1.529)	-2.075 (1.530)	-2.823* (1.524)	-1.875 (1.529)	-1.897 (1.528)	-1.655 (1.534)	-1.739 (1.549)	-1.947 (1.526)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	EG	EG	EG	EG	EG	EG	EG	EG
State Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-0.440	-7.275	1.274	-6.623	1.474	-24.10***	-26.23***	15.50**
	(7.264)	(7.130)	(7.018)	(7.141)	(7.219)	(6.992)	(7.054)	(7.385)
	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	25,952	25,952	25,952	25,952	25,952	25,952	25,952	25,952
R-squared	0.013	0.012	0.020	0.012	0.014	0.008	0.008	0.017

EG = Ellison-Glaeser, NIC = National Industrial Classification, SEZ = special economic zone.

Note: Standard errors are reported in parentheses. *p < 0.1; **p < 0.05; ***p < 0.01.

Source: Authors.

Table 12: Amenities and Agglomeration by Manufacturing Industry

NIC2	Education	Health	Finance	Cultural	Energy	Transport	Climate
10	0.0449***	0.0189***	0.0325***	0.0266***	0.0747***	0.0185**	0.00591
11	0.160**	0.0962	0.0525	0.122***	0.117*	0.0865	-0.031
12	-0.0859	-0.0633	-0.0613	0.00944	-0.106	-0.041	0.324***
13	-0.0475	0.0327	0.023	0.0824**	0.123**	0.168**	-0.130*
14	0.291	0.198	0.476***	0.395***	1.210***	0.406	-0.04
15	0.502***	0.0825	0.280***	0.0263	0.895***	1.399***	0.0373
16	0.0262	0.133***	0.0398	0.0304	0.0414	-0.00709	-0.146
17	0.100**	0.0329	0.0705***	0.0740**	0.158***	0.0486	0.102
18	0.169***	0.0906***	0.151***	0.215***	0.276***	0.0125	-0.0179
19	-1.009	-0.821	0.117	0.0929	1.165	-3.904	-7.403
20	0.0524	0.0346	0.0815*	0.0764	0.142*	-0.0537	0.2
21	0.133	0.12	0.188***	0.206***	0.270***	-0.0652	0.581*
22	0.106***	0.0335	0.0989***	0.115***	0.288***	0.219***	0.0151
23	0.11	-0.101	0.0311	0.0818	-0.044	-0.679	-0.0399
24	0.0599	0.0134	0.0225	0.0520*	0.297***	0.0417	0.0634
25	0.159***	0.0906***	0.0967***	0.222***	0.411***	0.181***	0.0477
26	-1.236	-0.385	0.298	1.777**	2.136*	-2.333	1.704
27	0.881***	0.0236	0.232***	0.197**	0.708***	0.0703	0.0597
28	0.208	0.025	0.145*	0.228**	0.379***	0.049	0.32
29	-0.265	0.0281	-0.008	1.744***	0.695	0.447	1.808
30	0.0225	4.267	2.317	-0.313	9.630**	53.35***	-2.159
31	-0.04	0.0042	0.0316	0.094	0.0722	-0.0347	0.12

Note: 2-digit manufacturing sectors consist of: 10 Manufacture of Food Products; 11 Manufacture of Beverages; 12 Manufacture of Tobacco products; 13 Textiles; 14 Wearing apparel; 15 Leather and related products; 16 Manufacture of wood products; 17 Paper and paper products; 18 Printing & recorded media; 19 Coke & refined petroleum; 20 Chemicals and chemical products; 21 Pharmaceuticals; 22 Rubber & Plastics; 23 Non-metallic Mineral ; 24 Basic metals; 25 Fabricated metals; 26 Computer, electronic & optical; 27 Electrical equipment; 28 Machinery and equipment; 29 Motor Vehicles, trailers and semi-trailers; 30 Other transport equipment; 31 Furniture. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Source: Authors.

Table 13: Amenities and Agglomeration by Services

NIC2	Education	Health	Finance	Cultural	Energy	Transport	Climate
45	0.0613***	0.0291***	0.0362***	0.0246***	0.0627***	0.0319***	-0.00381
46	0.104***	0.0448***	0.0728***	0.0439***	0.102***	0.0240***	0.00109
47	0.0503***	0.0266***	0.0509***	0.0249***	0.0654***	0.0266**	-0.00103
49	0.211***	0.137***	0.135***	0.0758***	0.157***	0.0318*	0.0125
50	7.472**	5.061**	3.279***	2.053	5.544**	0.854	4.437
51	9.994*	7.028**	4.368**	4.834*	9.074	-6.047	10.62
52	0.108***	0.0529***	0.0735***	0.0464***	0.116***	0.105***	0.0503**
53	0.0958***	0.0500***	0.0927***	0.0514***	0.112***	0.0251***	0.012
55	0.0678***	0.0400***	0.0480***	0.0282***	0.0681***	0.0293***	-0.00022
56	0.0764***	0.0460***	0.0791***	0.0426***	0.0841***	0.0247***	0.000268
58	1.884***	1.365***	1.114***	1.232***	2.118***	0.127	0.35
59	2.198***	1.742***	1.890***	1.421***	2.321***	0.12	1.611
60	2.209*	1.408*	1.756***	0.531	3.228***	0.564	2.429
61	0.322***	0.207***	0.338***	0.253***	0.375***	-0.00911	0.0643
62	2.407	0.33	2.229**	1.463	3.214*	-1.194	-0.984
63	5.164***	2.954***	3.807***	3.131***	5.335***	0.828	1.947
64	0.0932***	0.0479***	0.102***	0.0461***	0.111***	0.0373***	0.00246
65	0.316***	0.179***	0.248***	0.178***	0.292***	0.122***	0.0422
66	0.302***	0.196***	0.257***	0.166***	0.305***	0.0833**	0.0907*
68	0.513***	0.371***	0.592***	0.550***	0.791***	-0.0305	-0.0367
69	2.696***	1.476***	1.900***	1.486***	2.441***	0.57	0.716
70	4.379***	3.474***	3.016***	2.322***	4.079***	0.414	-0.506
71	23.58*	17.33*	13.32**	12.13	23.06*	13.33	-35.83
72	2.029**	1.372**	1.832***	0.681	3.327***	-1.271	5.806*
73	8.699***	6.378***	5.149***	4.040***	7.531***	1.654	10.05
77	0.0746*	0.041	0.0737***	0.039	0.101***	-0.0138	-0.00984
78	4.924***	4.143***	3.730***	2.424***	5.026***	-0.382	8.006*
79	0.792***	0.466***	0.580***	0.341***	0.726***	0.0537	-0.0208

Note: 2-digit NIC service sector consists of: 45 Wholesale and retail trade and repair of motor vehicle; 46 Wholesale trade, except of motor vehicles; 47 Retail trade, except of motor vehicles; 49 Land transport and transport via pipelines; 50 Water transport; 51 Air transport; 52 Warehousing and support activities for transport; 53 Postal & courier activities; 55 Accommodation; 56 Food and beverage service; 58 Publishing activities; 59 Motion picture; 60 Broadcasting; 61 Telecommunications; 62 Computer programming, consultancy and related activities; 63 Information service; 64 Financial service; 65 Insurance; 66 Other financial activities; 68 Real estate activities; 69 Legal and accounting activities; 70 Management consultancy; 71 Architecture and engineering; 72 Scientific research and development; 73 Advertising and market research; 77 Rental and leasing; 78 Employment activities; 79 Travel agency. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Source: Authors.

5.2. Robustness Checks

We use an alternative measure, the Hoover-Balassa coefficient (popularly known as the location quotient) to analyse the industrial concentration in a specific area. Location quotient (LQ) is commonly used to understand the industrial concentration in a specific region with reference to a larger region (province/state/nation). An advantage of this measure is the ease of computation and consistent comparison across regions and industries. For a given industry i in a region (town) r , it is defined as

$$LQ_{ir} = \frac{\gamma_{ir} / \sum_i \gamma_{ir}}{\sum_r \gamma_{ir} / \sum_i \sum_r \gamma_{ir}}$$

where γ denotes the total employment. If the value of the LQ is greater than 1, then the industry under consideration has a greater share of regional employment than in the overall nation, and vice-versa if an LQ is less than 1. If the value of LQ is equal to 1, then the industry has the same share of employment in the region as the nation. The results of the regression model are presented in Tables 14 and 15. The results are similar to the previous ones with Ellison-Glaeser except for the finding that climate has a significant and positive effect on the agglomeration in the manufacturing. However, we notice that our control variables' (lnpopulation and SEZ dummy) coefficients are reversed when we use the location quotient as a measure of agglomeration.

In Tables 16 and 17, we report the results of the regression using data for towns with more than 10,000 population. We notice from this set of regression results that the findings are qualitatively similar to the main result. In particular, we observe that natural amenities (climate), which was insignificant in the main model, is significant in the case of the services sector.

Table 14: Amenities and Alternative Measure of Agglomeration (Manufacturing)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	LQ	LQ	LQ	LQ	LQ	LQ	LQ	LQ
Education	0.0577* (0.0332)							
Health		0.00755 (0.0217)						
Finance			0.0437*** (0.0161)					
Culture				0.00861 (0.0196)				
Energy					0.0598** (0.0297)			
Transportation						0.0434 (0.0404)		
Climate							0.149*** (0.0475)	
Overall Amenities								0.0709** (0.0347)
Ln(Population)	-2.330*** (0.0874)	-2.263*** (0.0833)	-2.328*** (0.0795)	-2.266*** (0.0828)	-2.340*** (0.0868)	-2.296*** (0.0859)	-2.253*** (0.0741)	-2.357*** (0.0908)
SEZ	-0.291*** (0.0371)	-0.291*** (0.0372)	-0.289*** (0.0371)	-0.291*** (0.0371)	-0.293*** (0.0371)	-0.290*** (0.0371)	-0.290*** (0.0371)	-0.290*** (0.0371)
Costal District	1.062*** (0.294)	1.041*** (0.294)	1.033*** (0.294)	1.044*** (0.294)	1.052*** (0.294)	1.057*** (0.294)	0.867*** (0.299)	1.055*** (0.294)
State Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	32.95***	32.29***	32.97***	32.33***	32.97***	32.43***	31.01***	33.23***

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	LQ	LQ	LQ	LQ	LQ	LQ	LQ	LQ
	(1.620)	(1.596)	(1.585)	(1.600)	(1.607)	(1.576)	(1.601)	(1.642)
Observations	15,398	15,398	15,398	15,398	15,398	15,398	15,398	15,398
R-squared	0.086	0.085	0.086	0.085	0.086	0.085	0.086	0.086

LQ = location quotient, SEZ = special economic zone.

Note: Standard errors are reported in parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Source: Authors.

Table 15: Amenities and Alternative Measure of Agglomeration (Services)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	LQ	LQ	LQ	LQ	LQ	LQ	LQ	LQ
Education	0.160*** (0.0209)							
Health		0.0709*** (0.0137)						
Finance			0.0799*** (0.0102)					
Culture				0.0654*** (0.0121)				
Energy					0.158*** (0.0190)			
Transportation						0.117*** (0.0253)		
Climate							-0.0190 (0.0261)	
Overall Amenities								0.191*** (0.0217)
Ln(Population)	-1.762*** (0.0561)	-1.663*** (0.0538)	-1.682*** (0.0512)	-1.663*** (0.0533)	-1.774*** (0.0556)	-1.662*** (0.0551)	-1.533*** (0.0476)	-1.830*** (0.0583)
SEZ	0.0179 (0.0239)	0.0208 (0.0239)	0.0223 (0.0239)	0.0198 (0.0239)	0.0142 (0.0239)	0.0191 (0.0239)	0.0163 (0.0239)	0.0218 (0.0239)
Costal District	0.243 (0.182)	0.205 (0.182)	0.169 (0.182)	0.217 (0.182)	0.214 (0.182)	0.260 (0.182)	0.241 (0.184)	0.212 (0.182)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	LQ	LQ	LQ	LQ	LQ	LQ	LQ	LQ
Constant	23.87***	22.89***	23.17***	22.96***	23.93***	22.38***	21.86***	24.60***
	(0.865)	(0.850)	(0.839)	(0.851)	(0.860)	(0.832)	(0.839)	(0.881)
	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	25,952	25,952	25,952	25,952	25,952	25,952	25,952	25,952
R-squared	0.052	0.051	0.052	0.051	0.053	0.051	0.050	0.053

LQ = location quotient, SEZ = special economic zone.

Note: Standard errors are reported in parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Source: Authors.

Table 16: Agglomeration and Amenities for Towns with Population >10, 000 (Manufacturing)

VARIABLES	(1) EG	(2) EG	(3) EG	(4) EG	(5) EG	(6) EG	(7) EG	(8) EG
Education	0.156 (0.124)							
Health		0.0443 (0.0799)						
Finance			0.256*** (0.0587)					
Culture				0.287*** (0.0732)				
Energy					0.837*** (0.110)			
Transportation						0.885*** (0.148)		
Climate							0.0385 (0.197)	
Overall Amenities								0.676*** (0.130)
Ln(Population)	2.120*** (0.389)	2.300*** (0.367)	1.804*** (0.349)	1.730*** (0.363)	0.765** (0.386)	1.221*** (0.377)	2.398*** (0.321)	1.108*** (0.406)
SEZ	0.509*** (0.159)	0.507*** (0.159)	0.535*** (0.159)	0.530*** (0.159)	0.514*** (0.159)	0.547*** (0.159)	0.501*** (0.159)	0.546*** (0.159)
Costal District	0.111 (1.165)	0.0465 (1.164)	-0.0269 (1.163)	0.157 (1.164)	0.227 (1.162)	0.403 (1.164)	0.00730 (1.181)	0.191 (1.163)
Constant	-22.00*** (6.736)	-23.86*** (6.582)	-18.46*** (6.523)	-17.94*** (6.595)	-9.731 (6.653)	-16.83*** (6.494)	-25.11*** (6.566)	-11.54* (6.852)
Observations	13,324	13,324	13,324	13,324	13,324	13,324	13,324	13,324
R-squared	0.010	0.010	0.011	0.011	0.014	0.012	0.009	0.011

EG = Ellison-Glaeser, SEZ = special economic zone.

Note: Standard errors are reported in parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Source: Authors.

Table 17: Agglomeration and Amenities for Towns with population >10,000 (NIC2_Services)

VARIABLES	(1) EG	(2) EG	(3) EG	(4) EG	(5) EG	(6) EG	(7) EG	(8) EG
Education	1.774*** (0.0760)							
Health		1.069*** (0.0496)						
Finance			1.459*** (0.0354)					
Culture				0.975*** (0.0441)				
Energy					1.864*** (0.0686)			
Transportation						0.164* (0.0920)		
Climate							0.207** (0.101)	
Overall Amenities								2.649*** (0.0787)
Ln(Population)	1.177*** (0.233)	1.914*** (0.221)	0.907*** (0.205)	1.949*** (0.219)	0.782*** (0.230)	4.050*** (0.229)	4.270*** (0.195)	-0.715*** (0.241)
SEZ	0.549*** (0.0954)	0.599*** (0.0957)	0.680*** (0.0933)	0.583*** (0.0956)	0.511*** (0.0950)	0.508*** (0.0966)	0.499*** (0.0965)	0.642*** (0.0943)
Costal District	2.937*** (0.693)	2.303*** (0.694)	1.485** (0.677)	2.451*** (0.694)	2.557*** (0.690)	2.537*** (0.702)	2.264*** (0.708)	2.552*** (0.685)
Constant	-13.47*** (3.675)	-21.79*** (3.591)	-9.484*** (3.457)	-20.67*** (3.597)	-10.57*** (3.635)	-42.56*** (3.558)	-45.43*** (3.554)	6.412* (3.708)
	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	23,066	23,066	23,066	23,066	23,066	23,066	23,066	23,066
R-squared	0.053	0.050	0.097	0.051	0.061	0.031	0.031	0.076

EG = Ellison-Glaeser, SEZ = special economic zone.

Note: Standard errors are reported in parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Source: Authors.

6. Policy Discussion

This paper provides the evidence of the effect of town-level amenities on industrial agglomeration effects in India. We combine the economic census and the population census to create a unique data set at the city or town level. The results of the empirical analysis suggest that amenities like education, health, energy, transportation, finance, and cultural avenues are positively correlated with the town-level differences in industry agglomeration. The results are robust to alternative measure of agglomeration and sub-sample analysis.

The study highlights the importance of urban amenities and role of cities to create agglomeration effects in the domestic economy. The agglomeration and spillover effects are critical to enhance the competitiveness and productivity of existing industries but also to support the creation new creative industries and firms. This will be critical for the development of the Indian economy.

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Appendices

Table A1: Descriptive Statistics of the Components of the Amenities Index

Variable	Obs	Mean	Std. Dev.
Education			
School	7,952	44.29	193.27
Degree College	7,952	1.95	6.86
Management Institute	7,952	0.29	3.40
Polytech	7,952	0.23	1.34
Vocational	7,952	0.50	4.14
Non-Formal Training Institute	7,952	1.85	14.16
Health			
Allopathic Hospital	7,952	0.71	2.72
Alternative Medicine Hospital	7,952	0.37	0.96
T.B. Hospital	7,952	0.37	0.91
Dispensary	7,952	1.65	14.61
Family Welfare Centre	7,952	0.81	2.63
Non-Government Medicine Shop	7,952	26.63	166.13
Finance			
Nationalised Bank	7,952	4.86	35.17
Private Commercial Bank	7,952	1.67	17.35
Co-operative Bank	7,952	1.52	9.02
Credit Society	7,952	7.80	92.68
Cultural			
Auditorium	7,952	2.28	8.22
Library and Reading Rooms	7,952	2.56	13.07
Cinema Theatre	7,952	1.06	4.67
Stadium	7,952	0.83	7.04
Energy			
Domestic Electricity	7,952	8,687.24	53,265.51
Industry Electricity	7,952	290.76	3,695.76
Commercial Electricity	7,952	1,444.18	10,068.96
Transportation			
Bus Route	7,952	0.67	10.25

Pucca Road	7,952	48.54	397.81
Kutchha Road	7,952	13.08	45.93
Sea Port	7,952	0.01	0.07
Airport	7,952	0.02	0.16
Climate			
Temperature	7,952	25.17	6.76
Rainfall	7,952	1,105.85	1,023.79

Source: Authors.

Table A2: Results of the Principal Component Analysis Education

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	3.065	2.081	0.511	0.511
Comp2	0.984	0.190	0.164	0.675
Comp3	0.794	0.127	0.132	0.807
Comp4	0.668	0.348	0.111	0.918
Comp5	0.319	0.149	0.053	0.972
Comp6	0.170	.	0.028	1.000

Principal components (eigenvectors)

Variable	Comp1	Unexplained
School	0.529	0.143
Degree College	0.390	0.535
Management Institute	0.436	0.418
Polytech	0.501	0.231
Vocational	0.337	0.651
Non-Formal Training Institute	0.118	0.958

Health

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	2.567	1.662	0.428	0.428
Comp2	0.904	0.104	0.151	0.579
Comp3	0.800	0.163	0.133	0.712
Comp4	0.637	0.076	0.106	0.818
Comp5	0.561	0.030	0.094	0.911
Comp6	0.531	.	0.088	1.000

Principal components (eigenvectors)

Variable	Comp1	Unexplained
Allopathic Hospital	0.467	0.441
Alternative Medicine Hospital	0.406	0.577
T.B. Hospital	0.370	0.649
Dispensary	0.371	0.647
Family Welfare Centre	0.439	0.505
Non-Government Medicine Shop	0.388	0.614

Finance

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	2.363	1.474	0.591	0.591
Comp2	0.889	0.344	0.222	0.813
Comp3	0.545	0.342	0.136	0.949
Comp4	0.203	.	0.051	1.000

Principal components (eigenvectors)

Variable	Comp1	Unexplained
Nationalised Bank	0.568	0.237
Private Commercial Bank	0.557	0.268
Co-operative Bank	0.486	0.442
Credit Society	0.362	0.691

Culture

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	2.013	1.173	0.503	0.503
Comp2	0.839	0.117	0.210	0.713
Comp3	0.722	0.297	0.180	0.894
Comp4	0.425	.	0.106	1.000

Principal components (eigenvectors)

Variable	Comp1	Unexplained
Auditorium	0.574	0.337
Library and Reading Rooms	0.435	0.620

Cinema Theatre	0.573	0.339
Stadium	0.392	0.692

Energy

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	2.386	1.916	0.795	0.795
Comp2	0.470	0.326	0.157	0.952
Comp3	0.144	.	0.048	1.000

Principal components (eigenvectors)

Variable	Comp1	Unexplained
Domestic Electricity	0.601	0.139
Industry Electricity	0.526	0.340
Commercial Electricity	0.602	0.135

Transportation

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	1.467	0.420	0.293	0.293
Comp2	1.047	0.047	0.209	0.503
Comp3	1.000	0.213	0.200	0.703
Comp4	0.786	0.086	0.157	0.860
Comp5	0.701	.	0.140	1.000

Principal components (eigenvectors)

Variable	Comp1	Comp2	Unexplained
Bus Route	-0.027	0.092	0.990
Pucca Road	0.537	-0.445	0.370
Kutchra Road	0.584	-0.331	0.386
Sea Port	0.326	0.735	0.279
Airport	0.513	0.380	0.462

Climate

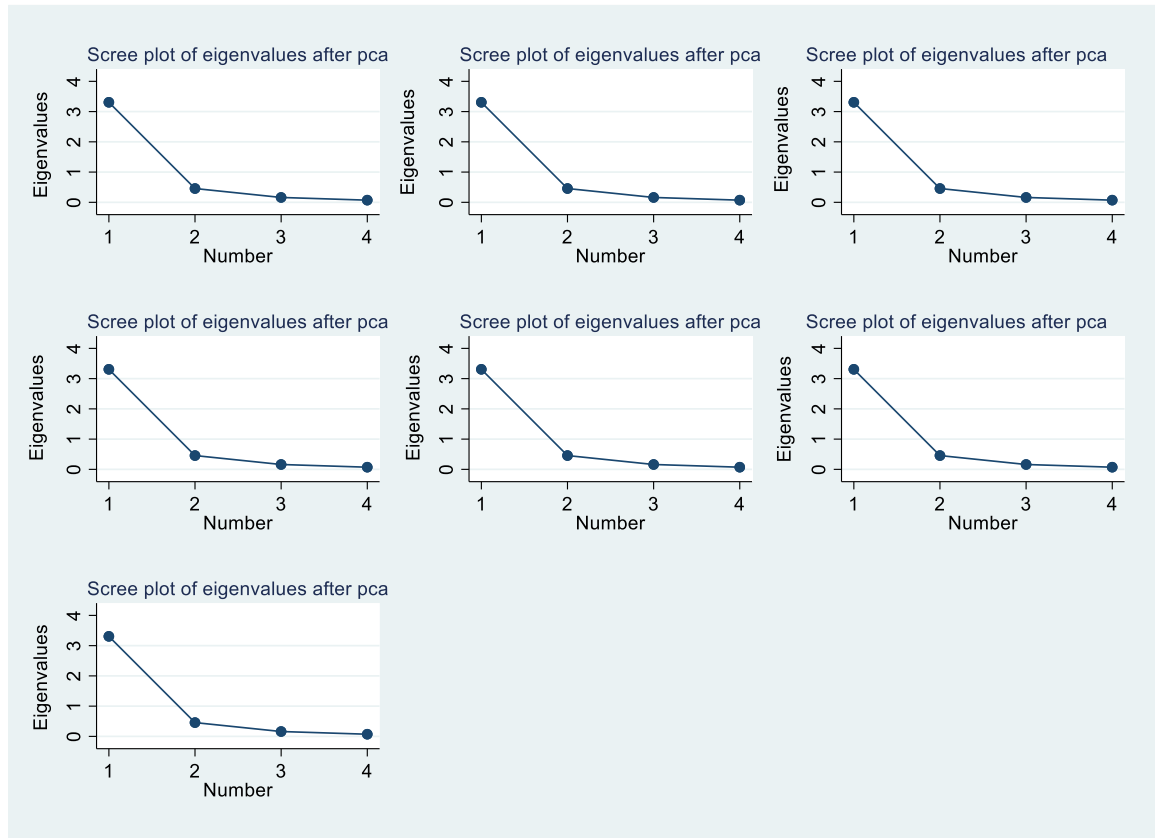
Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	1.174	0.348	0.587	0.587
Comp2	0.826	.	0.413	1.000

Principal components (eigenvectors)

Variable	Comp1	Unexplained
Temperature	0.707	0.413
Rainfall	0.707	0.413

Source: Authors.

Figure A1: Scree Plot



Source: Authors.

Table A3: Test Results for the Principal Component Analysis

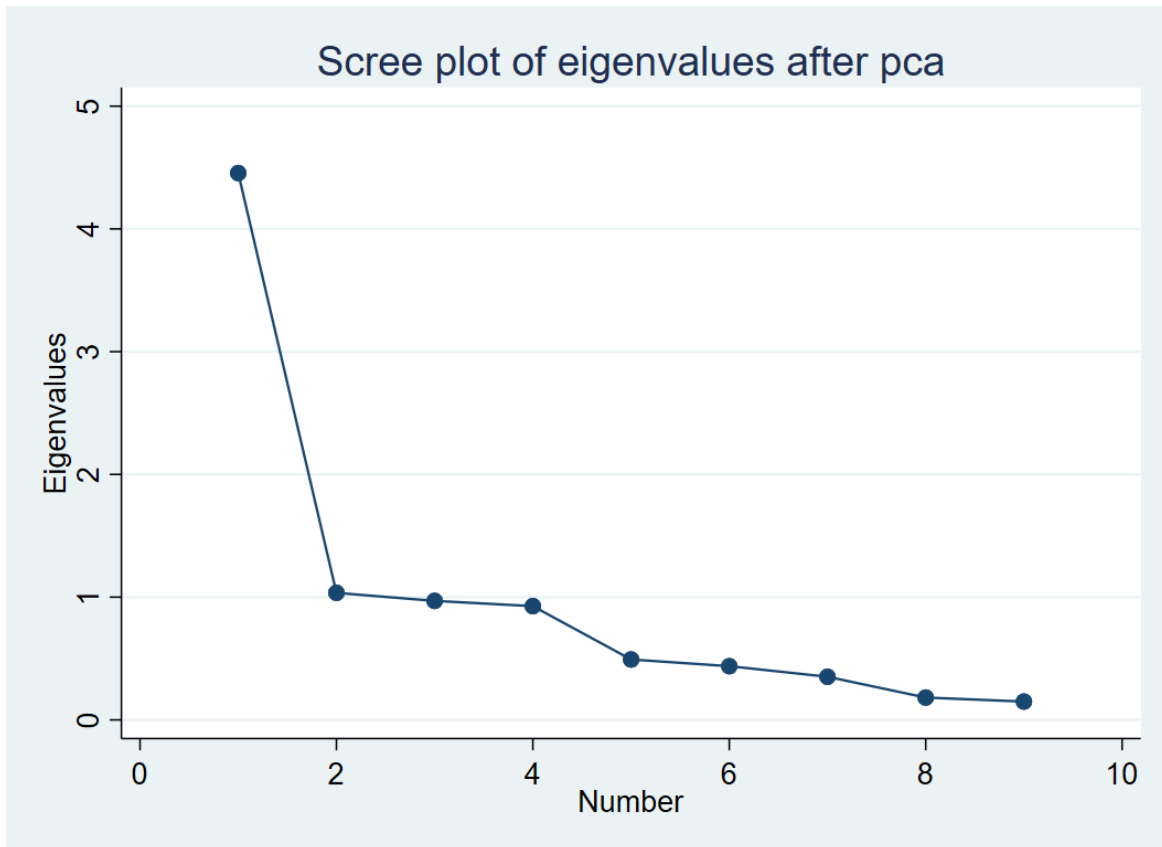
Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	4.455	3.420	0.495	0.495
Comp2	1.035	0.066	0.115	0.610
Comp3	0.970	0.043	0.108	0.718
Comp4	0.927	0.435	0.103	0.821
Comp5	0.492	0.055	0.055	0.875
Comp6	0.438	0.086	0.049	0.924
Comp7	0.352	0.169	0.039	0.963
Comp8	0.182	0.033	0.020	0.983
Comp9	0.149	.	0.017	1.000

Principal components (eigenvectors)

Variable	Comp1	Comp2	Unexplained
Education	0.438	-0.080	0.139
Health	0.374	-0.025	0.377
Finance	0.391	-0.083	0.310
Cultural	0.394	0.006	0.309
Energy	0.429	-0.109	0.169
Transportation1	0.385	-0.018	0.339
Transportation2	0.111	0.426	0.757
Climate	0.020	0.716	0.468
Education	0.125	0.529	0.640

Source: Authors.

Figure A2: Scree Plot of Eigenvalues



Note: Scree Plot shows the number of favorable factors.
Source: Authors.

Table A4: Descriptive Statistics of the Amenities Index

Variable	Obs	Mean	Std. Dev.	Min	Max
Amenities	7,952	7.15E-10	2.101059	-1.69931	84.66411

Source: Authors.

Table A5: Amenities and Agglomeration (NIC3_Manufacturing)

VARIABLES	(1) EG	(2) EG	(3) EG	(4) EG	(5) EG	(6) EG	(7) EG	(8) EG
Education	-0.293 (0.802)							
Health		-0.408 (0.531)						
Finance			0.322 (0.354)					
Culture				0.680 (0.478)				
Energy					2.131*** (0.691)			
Transportation						1.790* (0.993)		
Climate							0.274 (1.355)	
Overall Amenities								1.067 (0.821)
Ln(Population)	9.337*** (2.392)	9.676*** (2.260)	8.082*** (2.161)	7.399*** (2.237)	4.846** (2.376)	6.682*** (2.325)	8.841*** (1.990)	6.922*** (2.481)
SEZ	4.586*** (1.021)	4.558*** (1.022)	4.625*** (1.021)	4.628*** (1.021)	4.553*** (1.020)	4.659*** (1.021)	4.596*** (1.021)	4.633*** (1.021)
Costal District	-5.667 (8.354)	-5.427 (8.346)	-5.644 (8.346)	-5.250 (8.347)	-4.854 (8.346)	-4.604 (8.360)	-5.871 (8.516)	-5.292 (8.347)
Constant	-86.24* (46.26)	-89.07* (45.47)	-73.47 (45.25)	-67.00 (45.54)	-45.53 (45.88)	-68.25 (44.99)	-83.63* (45.66)	-62.15 (46.81)
State dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	19,254	19,254	19,254	19,254	19,254	19,254	19,254	19,254
R-squared	0.005	0.005	0.005	0.005	0.006	0.005	0.005	0.005

EG = Ellison-Glaeser, NIC = National Industry Classification, SEZ = special economic zone.

Note: Standard errors are reported in parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Source: Authors.

Table A6: Amenities and Agglomeration (NIC3_Services)

VARIABLES	(1) EG	(2) EG	(3) EG	(4) EG	(5) EG	(6) EG	(7) EG	(8) EG
Education	2.662*** (0.272)							
Health		1.632*** (0.182)						
Finance			1.860*** (0.122)					
Culture				1.469*** (0.160)				
Energy					2.785*** (0.241)			
Transportation						0.145 (0.347)		
Climate							0.0614 (0.412)	
Overall Amenities								3.713*** (0.279)
Ln(Population)	2.169*** (0.824)	3.226*** (0.784)	2.085*** (0.748)	3.320*** (0.776)	1.530* (0.816)	6.430*** (0.805)	6.602*** (0.689)	-0.155 (0.855)
SEZ	5.226*** (0.350)	5.324*** (0.351)	5.393*** (0.350)	5.280*** (0.350)	5.153*** (0.350)	5.196*** (0.351)	5.193*** (0.351)	5.333*** (0.350)
Costal District	-	-	-	-	-	-	-	-
	7.957*** (2.732)	9.304*** (2.733)	10.07*** (2.728)	8.707*** (2.732)	8.441*** (2.730)	8.459*** (2.739)	8.588*** (2.766)	8.746*** (2.728)
Constant	-22.43 (14.03)	-34.09** (13.78)	-19.84 (13.65)	-32.96** (13.79)	-18.17 (13.93)	- (13.57)	- (13.66)	1.305 (14.22)
State dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	36,287	36,287	36,287	36,287	36,287	36,287	36,287	36,287
R-squared	0.013	0.013	0.017	0.013	0.014	0.011	0.011	0.016

EG = Ellison-Glaeser, NIC = National Industry Classification, SEZ = special economic zone.

Note: Standard errors are reported in parentheses. *p < 0.1; **p < 0.05; ***p < 0.01.

Source: Authors.

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