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What causes Agglomeration? – policy or infrastructure – A study of Indian manufacturing industry

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Abstract

This paper investigates whether industrial dispersal policy is more potent or the natural and agglomeration cost advantages are important in influencing locational choice of a firm. To carry out the analysis, an agglomeration measure given by Ellison and Glaeser is computed for 66 manufacturing industries in 21 major States of India for the year 1997-98. The measure indicates that at the 2-digit level, most Indian industries are excessively diffused. The instrumental variable analysis however shows that the industrial dispersal policy has no impact on the location decision of firms in most specifications. The locational choice seems to be guided by other factors. For industries which are relatively more agglomerated, it is the infrastructure, closeness to coast and labour market pooling has resulted in agglomeration, whereas for industries which are dispersed, it is the nature of the product produced, electricity tariff and per capita energy gap in the State inducing them to disperse, apart from a weak influence of dispersal policy. Analysis at a higher Aggregation also brings forth the role of infrastructure, electricity tariff and nature of product in influencing location choice.

JEL classification: R12, R38

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1. Introduction

The productivity enhancing effect of agglomeration and urbanization is well established. The studies by Moomaw (1981), Nakamura (1985), Henderson (1986), and Ciccone and Hall (1996) have found that the spatial concentration of industrial activity has a significant impact on productivity and growth. On the other hand, studies by Glaeser *et al*. (1992) and Henderson *et al*. (1995) could find relatively less impact of urbanization (or city size) on productivity.[1] However, scanty empirical evidence exists that looks into what causes agglomeration? Given the positive effect of agglomeration on productivity, if the determinants of agglomeration are known, enabling policies can be formulated to steer the productivity growth accordingly. This is all the more important for developing countries which are often saddled with low productivity. A few studies that exist have looked into the causes of agglomeration in developed country settings with the exclusion of developing countries. See for instance, Audretsch and Feldman (1996), Dumais *et al*. (1997), Rosenthal and Strange (2001) among others. Resende and Wyllie (2003) is the only exception that has tried to look the determinants of agglomeration from Brazil – not a developed country.[2]

Incidentally, the theoretical literature is quite rich in enumerating the causes of agglomeration. Location theory developed with contributions from Weber, Thunen, Christaller, Isard among others gives a theoretical framework for studying the location decisions made by firms based on transportation cost and spatial differences in the accessibility of inputs and markets for outputs (Krugman, 1991a). The theoretical work received further impetus in the 1990s with the emergence of the New Economic Geography (NEG), which in the modeling framework, could include both the characteristics of a spatial economy – a) increasing returns; and b) imperfectly competitive markets (Krugman, 1998).[3]

The traditional cumulative causation theorists argued that industrialization follows the classic 'virtuous cycle' principle, according to which new industries locate where industries already exist so as to avail the productivity advantages in existing industrial regions. Important theoretical work by Goldstein and Gronberg (1984), Helsley and Strange (1990) and Glaeser (1999) have highlighted the role of input sharing, labour market pooling and knowledge spillovers respectively in agglomeration. Quigley (1998) in his summary of the theoretical literature on the micro-foundations of agglomeration economies has argued that there are four factors that explain the city size and hence agglomeration. These are: scale economies or indivisibility within the firm; shared inputs in production and consumption; reduced transaction costs from better matching of skill needs and availability; and potential economies and cost savings due to the application of the law of large numbers (*ibid*.: 131-32). For industrial agglomeration, however the first three are more relevant (Johansson and Quigley, 2004: 4). Krugman (1998: 166) also argues that the forces that make manufacturing concentrate in only one region, and act like an external economies – emerge from the three-way interaction among scale economies, transportation costs and factor mobility (i.e., market size effect).

[1] Quigley (1998) has summarized the empirical evidence of increased city size and diversity leading to enhanced productivity.

[2] Lall and Chakravorty (2005) is another study but their focus is on newer investment and not on existing agglomeration as such.

[3] For a brief summary of theoretical literature on NEG, kindly refer Krugman (1998).

The localization economies are a matter of concern to policy makers all over the world. This is because the regions failing to attract dynamic industries are not only characterized by low productivity, but also by lower relative incomes and standards of living (Glaeser, 1998). Ever since the planning era, efforts have been made in India too, by devising incentive policies to influence firms' location decisions. Different policy interventions such as incentives, taxes, subsidies, licenses etc. were aimed to achieve spatial dispersal of industries. The results however have not been desired. Growth biases continue to exist despite these policy incentives. Appendix A gives a synoptic view of different policies formulated to achieve industrial dispersal.

Apart from the use of licenses under Industries (Development and Regulation) Act, 1951, both the Central Government and the State Governments followed a deliberate policy of encouraging industries in backward areas. The Central Government identified few backward districts and offered 25% capital subsidy for industries that were set up in these areas since early 1970s. Various State Governments also offered similar capital incentives, exemption from sales tax levy, subsidies on power rates, cheap developed land, sales tax, loans and other facilities for the growth of industries in these areas. The National Committee on the Development of Backward Areas specifically gave recommendations on creating 100 growth centres with 70 per cent being in backward areas. The various efforts by different State governments did not result in equi-proportional pay-offs in terms of the growth of under-developed or backward areas. In fact, the backward States remained so and most of the growth continued to be imbalanced (GoI, 1991) or rather disparities have increased.[4]

Under this backdrop, this study attempts to see how significant are industrial dispersal policy incentives in affecting agglomeration? Using plant level data for the year 1997-98, from the Annual Survey of Industries (ASI), this paper investigates the locational choices of 66 4-digit manufacturing industries in 21 States in the Indian sub-continent. In order to find the locational choice the paper first calculates the degree of agglomeration in each of the industries and ascertains in which States they are clustered. This is followed by investigating the significance of industrial dispersal policy after controlling for different factors affecting agglomeration using an econometric model.

The analysis yields that the dispersal policy has not been successful in most specifications. Other factors like presence of infrastructure, nearness to coast, and labour market pooling determines the agglomeration for industries which are more agglomerated. For industries which are dispersed, it is nature of the product produced, high electricity tariff and high per capita energy gap that has induced them to disperse. The industrial dispersal policy has only weak influence on dispersion.

The remaining paper is organized as follows: Section 2 reviews the relevant literature. Section 3 gives the analytical framework followed by the methodology employed. The section also gives in brief a measure of agglomeration for the industry. Section 4 gives the data and variables construction along with the issues encountered. Section 5 gives the pattern of industrial clustering in different Indian States using the agglomeration measure. This is followed by results on role of dispersion policy on agglomeration in Section 6. The paper concludes with section 7 giving the scope for future work.

[4] To give an example, the ratio of per capita income between the most industrialized (Maharashtra) and the least industrialized State (Bihar) has increased from 1.8 in 1973-74 to 4.1 in 2000-01. The per-capita income for Maharashtra during the period has increased by over 22 times (from Rs. 1087 to Rs. 23,726, whereas that of Bihar has increased by only 9 times (from Rs. 573 to Rs. 5108 only) (Rs. 45 ≈ 1 US $).

2. Literature Review

There has been a growing literature both theoretical and empirical to establish the causes of agglomeration as well as the effects of agglomeration on productivity. Contributions by Ellison and Glaeser (henceforth EG), (1997) and Maurel and Sedillot (1997) provide strong economic foundations for the plant location decision. The EG paper theoretically develops an agglomeration measure and applies this to the United States data. The paper attempts to find the relation of the measure with natural advantage (captured by state structural characteristics, basic input costs, labour inputs, transportation costs among others) and spillovers (i.e., agglomeration externalities). They find that 20 per cent of geographical concentration can be attributed to natural advantage, whereas spillovers account for 80 per cent of agglomeration.

Similar studies have been conducted for the United Kingdom by Devereux *et al.* (2002) and for France by Maurel and Sedillot (1997). The latter, develops an index based on the EG agglomeration measure. Their measure too attributes the location decision of plants, to the benefits accrued from natural advantage and/or spillovers generated by proximity of other plants in the industry.

Among the studies looking into the determinants of agglomeration, Rosenthal and Strange (2001) use EG index to econometrically estimate the determinants of agglomeration for the U.S. manufacturing. This study has been carried out at three levels; zipcode, county and State. The study finds that the labor market pooling has the most robust effect at all three levels.

Aharonson, Baum and Feldman (2004) study the effects of the determinants of agglomeration for the Biotechnology industry in Canada. The study finds that R&D externalities increase as proximity increases, thereby influencing productivity positively.

The study by Dohse and Steude (2003) also use the EG measure to analyze the spatial concentration of 216 knowledge-based publicly listed firms in the German *Neuer Markt* (New Market) with other firms. The analysis shows that the *Neuer Markt* firms tend to be located in the existing agglomerations of the other firms, i.e. they tend to cluster in rich regions with high labor productivity and high density of economic activity. Zheng (2001) found that presence of diverse activity has led to agglomeration in Tokyo metropolitan area.

With respect to the role of policy in influencing location choice, Holmes (1998) in his study has found that the States in US which follow pro-business policies (measured by the right-to-work or in other words, ban unionism) make significant difference in firms' location decision.

For developing countries, Resende and Wyllie (2003) for the Brazilian industrial situation is the only study that looks into factors affecting agglomeration. The study analyzing the effects of local infrastructure and local incentives finds that the former has positive effects while the latter is insignificant in influencing location decision. Input utilization and knowledge spillovers appear to have positive impact on agglomeration.

In the Indian context, the only study that exists is by Lall and Chakravorty (2005). The study analyzes the contribution of agglomeration factors on the cost implications for the firms in eight industries. The second part of the study looks into the factors that influence location decision of new investment using district level data. The main findings of the study are: the industrial diversity has significant impact on industry profitability, whereas other spatial factors like own industry clustering and market

access have little or no influence on the profitability. The analysis also yields that the private industry seeks primarily profit maximizing locations i.e., the locations having good infrastructure, high labour productivity, whereas the State investment is significantly less oriented towards such locations.

Limitations of existing work

The studies mentioned above are robust, however, there are avenues for further research. The role of the determinants of agglomeration such as local infrastructure and policies etc, in explaining this phenomenon is still not entirely clear. Holmes (1998) and Resende and Wyllie (2003) have obtained different results with respect to incentives. In any case, industrial agglomeration cannot be solely explained in terms of sector-level variables as used by Rosenthal and Strange (2001).

The Indian study by Lall and Chakravorty has looked primarily the implication on agglomeration on the cost at a highly aggregate level i.e., 2-digit, besides looking into the decision of newer investment. The clustering formation is mainly at four-digit or even at five-digit level. The present study looks into the role of industrial dispersal policy in affecting firms' locational choice for 66 manufacturing industries at the four-digit level for 21 Indian states.

3. Determinants of Agglomeration

The analytical framework to examine the locational choice of manufacturing firms mainly draws on the findings from the new economic geography (NEG) literature. The underlying argument in this literature is that the production of individual firms is competitive with constant returns to scale, but there are socially increasing returns as aggregate production rises (Quigley, 1998). Krugman (1991a, 1991b), Fujita *et al.* (1999) have analytically modeled increasing returns which originate from both - technological and pecuniary externalities. The technology externality models suggest that inter-firm informational spillovers provide a significant incentive for firms to agglomerate. On the other hand, sharing specialized input factors (like skilled labour), utilizing scale economies in the production of shared inputs and presence of inter-related industries give sufficient pecuniary benefits to firm if they decide to agglomerate (Lall and Chakravorty, 2005: 49). Lastly, according to Krugman (1991a) for industries having high transport to production costs agglomeration near the market centres is always cost reducing.

Evidence exist that firms producing non-standardized differentiated products are more strongly attracted to the core than those producing homogenous goods (Quigley, 1998).[5] Theoretical models looking into the role of product diversity introduced first by Dixit and Stiglitz (1977) have reached a general conclusion that the variety and diversity in consumer goods or in producer inputs can lead to external scale economies despite all individual units earning normal profits (Quigley, 1998: 133).

To sum up, some of the advantages of clustering – positive externalities or economies – arise from transportation costs savings, whereas others are associated with thick market effects such as availability of skilled labour or other specialized inputs for firms, and knowledge or information spillovers across own- and connected industrial sectors. Of all the external effect, labour market

[5] Chinitz (1961: as referred in Quigley, 1998) speculated that an urban environment where many firms are producing heterogeneous goods is more conducive to economic growth than an environment dominated by a few large firms or single industry.

pooling is the most important. It is a phenomenon where clusters of firms create a pooled market for workers with highly specialized skills that are required by these firms (Krugman, 1991b). Such a market works to the advantage of producers (less labor shortages) as well as workers (less unemployment). However, such a labour market pooling may also have a detrimental effect on the long-term employment, as attrition rate may be higher.[6] Apart from high attrition rate, there are congestion costs of increased city size or agglomeration. These include higher rents arising from competition for space, higher commuting costs to more distant residents, and increased air and water pollution (Zheng, 2001; Glaeser, 1998; Quigley, 1998). This implies that the increased productivity gains due to agglomeration are not monotonically increasing. There are efficiency limits to agglomeration and an optimum size beyond which gains start falling. The relevance of the threshold effect becomes clearer in the terminology of Fujita *et al*. (1999). According to them, any firm's location decision is governed by two kinds of forces: centripetal – consisting of linkages, thick markets and knowledge economies, and centrifugal – includes immobile factors, land rent or commuting and congestion and other pure diseconomies.[7]

Methodology

Two broad approaches exist to identify the factors influencing firms' location decision. In the survey based approach, decision makers / firms are asked what factors are important for them for locational choice. The alternate measure use modeling approach to identify the preferences based on a region's characteristics leading to actual location of the firms. Both the approaches, in general, have identified a number of factors including market access, infrastructure availability, agglomeration economies, state incentives or regulations in influencing agglomeration (Hanushek and Song, 1978; Webber, 1984; McCann, 1998). The survey based approach, however, has revealed that there is a significant contribution of random element in the locational choice. Studies by Mueller and Morgan (1962); Calzonetti and Walker (1991) have found personal reasons, chance and opportunity explain the locational choice nearly half the time. The present study follows the revealed preference based approach.

The analytical framework above indicates that the agglomeration in a region is interplay of centripetal and centrifugal forces. These forces are represented by the agglomeration externalities, natural and cost advantages, infrastructure – physical and human capital and governance. The natural and cost advantages, governance and infrastructure are at the State-level whereas the agglomeration externalities usually pertain to the industry. Thus, the factors influencing agglomeration (γ) will be:

γ_{ij} = f(Natural Cost Advantage$_i$, Transport cost Advantage$_i$, Agglomeration Externalities$_j$, Governance$_i$, Industrial Environment$_i$, Infrastructure$_i$, Industrial Dispersion Policy$_i$)

The empirical model used for the analysis is:

$$\text{Gamma } (\gamma)_{ij} = \alpha + DP\beta + I\delta + S\lambda + D\eta + \varepsilon_{ij}$$

[6] This is being presently felt in the software industry in Banagalore, India where units are shifting to smaller places like Chandigarh, Coimbatore etc. so as to stem this attrition.

[7] In this context, it is important to note that NEG could so far model only linkages and factor mobility, other centripetal and centrifugal forces are yet to be modeled in a unified framework (Fujita and Krugman, 2004).

The expression looks into the effect of Dispersion Policy Variables (DP) on the agglomeration of industry j in State i after accounting for industry-specific variables (included in Matrix I) and State-specific variables (included in Matrix S). D represents the industry dummies to account for industry-specific heterogeneity and ε_{ij} is the error term. A more detailed account of these variables is given in the next section.

Computation of Agglomeration Measure – EG Index

The present study uses Ellison-Glaeser (1997) index as the agglomeration measure. It is a measure of the agglomeration in a region within one industry. Earlier studies such as Krugman (1991a) and Audretsch and Feldman (1996) have used spatial Gini coefficient (defined as $G = \sum_i (s_i - x_i)^2$ where x_i and s_i are location's share of total employment and employment in a particular industry) as a measure of agglomeration. The main drawback of the Gini coefficient is that a positive value of G does not imply that an industry is over-concentrated. For capital intensive industries like refineries, or steel, a high G would be due to its industrial structure and not due to the agglomerative forces.

The EG index measures the degree to which an industry 'j' is geographically concentrated conditional on its industrial concentration and is given by

$$\gamma_j = \frac{G - \left(1 - \sum_i X_i^2\right) H}{\left(1 - \sum_i X_i^2\right)(1 - H)}$$

where G is the Gini coefficient i.e. = $\sum_i (S_i - X_i)^2$ and S_i and X_i are the share of industry's and aggregate manufacturing employment in area i. H is the Herfindahl Index, $\sum_k Z_k^2$, where Z_k is the k^{th} plant's share on industry's employment.

From above, it is clear that with increase in G i.e., the raw geographical concentration measure, gamma (γ) increases. This implies that the more manufacturing units locate in one region, the higher would be the agglomeration strength. The subtraction of H is a correction that accounts for the fact that the raw geographic concentration of employment in an industry is expected to be larger in industries consisting of fewer larger plants if locations were chosen completely at random. The way index is constructed, it is clear that it is comparable across industries, across countires and over time regardless of plants' size distribution (Barrios *et al*., 2005).

In general, the index takes values between minus one and plus one. A highly agglomerated industry is that which has Gamma (γ) larger than 0.05. Between 0.05 and 0.02 is a moderately agglomerated industry and between zero and less than 0.02 is a randomly dispersed industry and gamma below zero implies excessively diffused industry (Ellison and Glaeser, 1997).

Since agglomeration indexes are constructed at the sector-level (γ_j), if w_{ij} is the share of j^{th} sector employment in State i, the agglomeration index for an industry in State S (γ_{ij}) would be:

$$\gamma_{ij} = \gamma_j * w_{ij}$$

4. Data and Variables

The study uses plant level data for the year 1997-98, from the Annual Survey of Industries (ASI) published by the Central Statistical Organization (CSO) for 66 manufacturing industries at the four-digit level. The role of industrial dispersal policy in influencing locational choice of these industries is studied in 17 major States and 4 Union Territories (UTs).[8] The States and UTs selected are: Andhra Pradesh, Assam, Bihar, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal, Chandigarh, Damn & Diu, Delhi, and Pondicherry.[9] It is to be noted that the choice of 1997-98 is not arbitrary. It is governed by availability of data for other variables supposed to have an impact on agglomeration. Appendix B gives a list of manufacturing industries used at two- and four-digit level.

The calculation of EG Index requires distribution of employment of each industry in each State. This is available from the ASI publication, but only for industries at a two-digit level. Using data at such an aggregated level would render the results meaningless, as, for example, it clubs two different industries like plastics and rubber into one aggregate industry. For robustness, data pertaining to a more dis-aggregated level say five-digit or even four-digit level is required. In absence of data on employment at higher disaggregated level, the value of manufacturing output for each industry in each State is used as a proxy instead of employment.

Using Value of Output instead of Employment for EG index - Implication

Agglomeration index computed using employment data gives the extent of the labor employed in an industry. The usage of 'value of output', however, shifts the focus away from labor alone, towards other factors of production. Since the calculation of the index is in terms of ratios, the actual working of the equation is not affected. The interpretation of gamma however changes. While the gamma that uses employment data attributes the agglomeration to labor market pooling and information spillovers through labor, this cannot be alleged for gamma computed using value of output. The agglomeration as computed using value of output, accounts for a mix of labor market pooling, spillovers related to labor markets as well as the spillovers with respect to capital technology or one of the two. For example, in gamma computed using value of output, high agglomeration could be due to highly capital intensive production techniques, with very little labor as in the case of refinery or steel industry. In this case the agglomeration externalities would be high due to other reasons, say demonstrative spillovers, rather than labor spillovers. This however need not always be the case, as for Hosiery or Handloom industry, the high agglomeration due to high value of output can also be attributed to labor. Thus, while interpreting the results, above distinction needs to be kept in mind.

Computing industry-wise agglomeration

The initial data covered nearly 5000 industries for 21 States at the five-digit industry level, which are clubbed into 79 four-digit level industries. From this, the Gini coefficient (G) is calculated using the method given in previous section. The CMIE (Centre for Monitoring Indian Economy) publication

[8] Union Territory (UT) means that the area is under the direct administration of the Government of India. A UT in India is similar to the District of Columbia in US. It is to be noted that Delhi is no longer a UT, but till late 1990s, it was. Since the present study uses data for the year 1997-98, it has been considered as a UT.

[9] The study henceforth designates all 17 States and UTs as States. These 21 States account for over 98% of the population and nearly 99% of manufacturing output in the country, and are therefore representative.

gives 'product-wise' information regarding the Herfindahl index (H-index). To make this compatible with the requirements of the agglomeration measure, each product is matched with the ASI 4-digit industry classification. Due to non-availability of H-index for a number of products groups, the agglomeration index could be computed for only 66 four-digit level industries instead of 79 industries.

Factors influencing Agglomeration – variable construction

The previous section indicates that a number of factors affect agglomeration. The industrial policies including industrial dispersal policy pursued in India were an attempt to counter these agglomerative forces so as to have a balanced regional growth.[10] As mentioned earlier, since early 1970s suitable policy incentives in the form of subsidized loans, land at cheap rates, income tax rebates etc. were given to industries provided they locate in backward area and later on dedicated efforts were made to create industrial growth centres in backward areas. To given an example, the Industrial dispersal policy report recommended setting up of 100 growth centres in 1980 with 70 coming in industrially backward states (GOI, 1980). The present study, thus uses 'backward area of a State as a percentage of total area' (BAreaprct) as an indicator of how much the state was backward in early 1990s. A high percentage of backward area implies that larger area of the State is covered under incentives. The study conjectures that if the dispersal policy has worked, the variable would have negative effect on the agglomeration.

Control for Natural Advantage and Transportation costs

Previous studies by Rosenthal and Strange (1991) and Resende and Wyllie (2003) have used energy and water expenses as measures of natural cost advantages. A low share of these in the total expenditure would indicate the natural cost advantage and hence inducement to agglomeration. Since expenses masquerade inefficient usage, the physical infrastructure with respect to water and energy can give a better idea of availability and hence natural cost advantage. The present study thus, wherever possible uses physical infrastructure variables rather than the expenses.

Three variables have been employed in the present study to account for natural cost advantage. Since availability of a good harbour has a catalytic role for production activity, a coastal state (Coastalstate) is likely to have a natural advantage (Fujita and Krugman, 2004). Similarly, a State having significant per capita energy gap (EnerGap) implies that units in the State have to depend on captive sources for power, which may increase their cost. In the similar vein, percentage of area having ground water level below 10 m (Waterlevel10m) would indicate water scarcity. To the extent that industries agglomerate because of their inclination to be close to the sources of their energy, water and natural resources, the coefficient of Coastalstate would tend to be positive and that of EnerGap and Waterlevel10m negative.

Among the earlier known factor influencing location decisions is the cost of transporting output (and inputs) (Krugman, 1991a). Two variables have been used that reflect the transportation cost influence. Industries would prefer locating in a State having high percentage of surfaced to total roads (Surface2totroad), as this would lower the per-unit cost of transportation. Similarly, industries that

[10] This is succinctly put in industrial dispersal report of 1980 which stated that "…. Public policy cannot ignore the advantages of agglomeration and hence the aim of policy must be to develop viable industrial growth centres in backward regions" (GOI, 1980).

produce highly perishable product (Perishable) face high product transportation costs per unit distance, hence will seek to locate close to their markets. Thus, the former variable would have positive influence on the agglomeration decision and the later variable would have negative influence.

Control for Agglomerative Externalities

Role of industrial diversity on productivity and subsequent economic performance has been studied extensively (see for example, Glaeser *et al*., 1992; Henderson *et al*., 1995). Zheng (2001) based on his analysis of metropolitan area of Tokyo has concluded that economies of agglomeration in the area have arisen because of spatial concentration of diverse activities in the area. Two variables have been used for agglomerative externalities resulting from input sharing and labour market pooling. A large industrial activity measured as number of factories per unit area (Factoryperarea) and workers in these establishments (Workerperarea) would reflect the availability of pool of workers and diverse industrial activities. The gains from sharing inputs however are more if industries produce more manufactured inputs.[11] If pooling is possible, an industry benefits by agglomerating, because it is better able to hire workers with industry-specific skills. It is to be noted that the diversity impact on agglomeration is not unidirectional, as studies have found diseconomies of agglomeration due to increased diverse activities (see for example, Zheng, 2001).

Industry diversity though represents the prevailing Input-output relationships conducive to agglomeration; firms belonging to same industries can also agglomerate to benefit from knowledge spillovers. To account for the knowledge spillovers, two variables have been used. A more skilled labour force in an industry engenders large spillovers. This has been computed in the study as a ratio of employees to workers (Employ2worker) in the industry. The variable also measures labour market pooling effect, as has been used by Rosenthal and Strange (2001). A high proportion of the variable indicates greater share of supervisory and support in production, which reflects that production is not a matter of routine.[12] Similarly, industries like electronics, pharmaceuticals, etc., which are more R&D intensive tend to have a larger spillovers. Sufficient evidence exists in support of this. Jaffe *et al*. (1993) show that a new patent is much more likely to cite a patent that is close spatially. Dumais *et al*. (1997) using cross industry patents, find some support that new plants are more likely to locate near industries that are linked intellectually or spent more on R&D. Ideally we should have used, an output indicator – patents generated in an area, in absence of the data on patents, the variable used is an ordered variable depending on the R&D intensity (RD1) of the industry. In this context, it is important to mention that both labour market pooling and knowledge spillovers tend to reduce over time if there is no movement / migration of people in the long-run (Fujita and Krugman, 2004: 162).

Control for Governance and Industrial Environment

In general, the same models that predict that cities or agglomerated areas are good for legal activities, suggest that cities will be centers for crimes as well, because criminals can benefit from various agglomeration effects (Glaeser, 1998: 152). Glaeser and Sacerdote (1996) find that 25% of the urban

[11] Production processes require three types of inputs – manufactured, natural and non-manufactured. The latter includes finance, accounting, legal services, insurance, communication, transportation, maintenance and repair.

[12] Apart from Employ2worker ratio, Rosenthal and Strange (2001) have used percentage of workers with Doctorates, Master's degrees and Bachelor's degrees as indicators of labour market pooling. Due to non-availability of data, the present study could not use this variable.

crime effect can be attributed to higher returns to crime in cities, perhaps due to scale economies in stolen goods or a greater market of potential victims. From locational choice point of view, a high crime rate reflects poor governance in the city or agglomerated areas.[13] This would have a dampening effect on the locational decision of the firm. With respect to governance, three variables have been used – a State's share of crime vis-à-vis all India crime (Crime2AIcrim); crime rate – share of violent crime to the total crime in the State (Crime2violcrime); and a dummy for four North Indian states (BIMARU), which are characterized by relatively poor law enforcement and infrastructure – both physical and human, high illiteracy and entrenched caste system. Together these four states are called BIMARU (Bihar, Madhya Pradesh, Rajasthan and Uttar Pradesh) States, the literal meaning of which is 'sick'.

Presence of strong Labor Unions in a State indicates huge bargaining power in the hands of the workers, which would exert a negative effect on locational choice and hence agglomeration. Holmes (1998) has found that production activities are much higher in States which have policies to discourage unionism. The two variables accounting for this labour unionism and industrial environment as used in the study are - average number of disputes per factory (Disputeperfactory) and average number of workers involved in disputes per factory (Disworkerperfactory). Since labour unionism raises input costs, the study expects that the higher the input costs in a particular State, the less likely the firm is to agglomerate in that State.

Control for Infrastructure and enabling environment

The availability of Infrastructure, and other facilitating environment say lower electricity tariff, induces firms to agglomerate. The presence of large number of Industrial Training Institutes (ITIs) that are ready source of semi-skilled and skilled workforce to Indian industry may also motivate industries to locate in a particular region. The present study uses Infrastructure index of the State (Infraindex), Electricity Tariff for industrial use (ElecTar), and number of ITIs per factory (ITIperfactory) as variables reflecting infrastructure and enabling environment. The study conjectures positive influence of infrastructure index and ITIperfacotry on agglomeration and negative influence of high electricity tariff.

Another feature of Indian federalism that may have caused agglomeration is the presence of union territories (UTs). These UTs offer excise duty rebates besides other benefits to firms so as to influence their location decision. Present study uses a dummy to segregate UTs from other States and expects a positive coefficient for the variable. Apart from this, the loan disbursed per factory (Loanperfactory) in a State can be a policy decision so as to influence locational choice. If more loans have been disbursed in the past per factory then it gives an incentive to a firm to locate in that area.

It is to be noted that for some of the factors like Factoryperarea and Workerperarea, *a priori* it is difficult to envisage the relation. This is because the effect could go either way. If a state has already large number of factories per unit area, it may attract more due to spillover, greater division of labour and other external economies (Glaeser, 1998; Krugman, 1998). On the other hand, a large

[13] There seem to be a potential endogeniety – whether lower crime influences a firm's decision to locate in an area or greater concentrated industrial activity leads to more crime. The study tests for the endogeneity of crime using number of factories in the area, but finds no evidence.

agglomeration may increase costs for the firms including labour mobility and hence may deter further agglomeration (Fujita and Krugman, 2004; Glaeser, 1998).

The independent and control variables as hypothesized above are measured at the end of year 1996-97 to ensure that decision choice is measured prior to the actual decision. Table 1 gives the definition, source and expected sign of variables used. Table 2 gives the summary statistics of different variables. The econometric model finally used for the analysis, with parenthesis giving expected sign is as follows:

$\gamma_{ij} = \alpha$ (-)β_1Prctbackarea$_j$ (-)δ_1Perishable$_i$ (?)δ_2Factoryperarea$_j$ (+)δ_3Employ2worker$_i$ (+)δ_4RD$_i$ (+)λ_1Coastalstate$_j$ (-)λ_2EnerGap$_j$ (-)λ_3Waterlevel10m$_j$ (+)λ_4Surfac2totalroad$_j$ (-)λ_5Crime2AIcrim$_j$ (-)λ_6Crime2violcrim$_j$ (-)λ_7BIMARU$_j$ (-)λ_8Disputeperfactory$_j$ (-)λ_9Dayslostperfactory$_j$ (-)λ_{10} ElecTar$_j$ (+)λ_{11}Infraindx$_j$ (+)λ_{12}ITIperfactory$_j$ (+)λ_{13}Workerperarea$_j$ (+)λ_{14}UT$_j$ (+)λ_{15}Loanperfactory$_j$ + η_iIndustry_dummies + ε_{ij}

Table 2: Summary Statistics of Variables (N = 1386)

	Variable	Mean	Standard Deviation	Minimum	Maximum
Natural Advantage					
1	Coastalstate	0.48	0.50	0	1
2	EnerGap	34.26	33.76	0	119.30
3	Waterlevel10m	57.89	27.32	15.55	94.44
4	Waterdeficit	31.11	26.63	0.00	83.58
Transportation Costs Advantages					
5	Surface2totroad	0.61	0.25	0	1
6	Perishable	0.20	0.40	0	1
Agglomeration Externalities					
7	RD1	1.16	2.11	0	9
8	Employee2Worker	1.34	0.12	1.194	1.712
9	Factoriesperarea	0.79	1.97	0.00	8.82
10	Workersperarea	31.65	67.93	0.12	289.94
Other Factors					
Labour Relations / Unionism – Industrial Environment					
11	Disputperfactory	0.0074	0.0086	0	0.038
12	Dayslostperfactory	76.69	138.17	0.00	662.20
Governance					
13	Crime2AIcrime	4.7	4.41	0	16.5
14	Crime2violcrime	24.9	9.76	11.8	48.7
15	BIMARU	0.24	0.43	0	1
Infrastructure					
16	ITIperFactory	0.05	0.04	0.00	0.15
17	ElecTar (Rs./100Kwhr)	146.23	44.36	46.60	210.94
18	Teleden	3.54	3.08	0.60	15.40
19	Infraindex	155.37	144.05	74.08	730.62
Special Policy Initiatives					
20	UT	0.19	0.39	0	1
21	Loanperfactory (Rs. 000)	1.06	1.03	0.03	4.82
Industrial Dispersal Policy					
22	BAreaprct	50.22	32.00	0.00	100.00

Table 1: Factors influencing Agglomeration (γ) – Definition and Source

	Category	Definition	Source
1	Natural Cost Advantage	Coastal State (Coastalstate) = 1 if State has coastline; 0 otherwise.	
		Energy Gap (EnerGap)- State-wise per capita energy deficit in Kwh.	Indiastat
		Water Level (Waterlevel10m) - %age of Villages having ground water Level > 10m	Ministry of Water Resources
		Water Deficit (Waterdeficit) - %age of towns & cities with water level < 100 lpcd)	Central Pollution Control Board
2	Transportation Cost Advantage	Surfaced Roads (Surface2totroad) - % of Surfaced to Total Roads in the State	Press Information Bureau
		Perishable= 1 if industry produces perishable product; 0 otherwise	ASI/ Capitaline
3	Agglomeration Externalities	Innovation potential of industry (RD1 = 0-9) – RD1 = 1– 0<Rdi<0.01%, 2- 0.01<RDi<0.5%; 3- 0.05<RDi<0.1%; 4- 0.1<RDi<0.25%; 5- 0.25< RDi<0.5%; 6- 0.5<RDi<1.0%; 7- 1.0<RDi< 2.5%; 8- 2.5<RDi<5.0%; 9- Rdi>5.0%	Capital line
		Labour Market Pooling (Employee2Worker) - Employees to worker ratio	ASI data
		Factories (Factoryperarea) – Number of Factories per unit area	ASI data
		Workers (Workerrperarea) – Number of Workers per unit area	ASI data
4	Industrial Environment	Disputes (Disputperfactory) - Number of Disputes per Factory	ASI data
		Days Lost (Dayslostperfactory) – Days lost due to disputes per Factory	ASI data
5	Governance	Crime Share (Crime2AIcrime) - Ratio of Crime in the State to All India Crime	Ministry of Home Affairs
		Crime Rate (Crime2violcrime) - Ratio of Violent Crime to Total crime in the State	Ministry of Home Affairs
		BIMARU = 1 for Bihar, MP, UP, Rajasthan State; 0 otherwise	
6	Infrastructure	ITIs (ITIperfactory) – No. of ITIs per Factory in the State	Ministry of Labour & Employment
		Electricity Tariff (ElecTar)# - Electricity tariff for Industrial users in Rs./100Kwh	Indiastat
		Teledensity (Teleden)- No. of telephones per 100 persons	Indiastat
		Infrastructure index (Infraindex) – Index of infrastructure based on 9 parameters	CMIE
7	Special Policy Benefits	Union Territory (UT) (1= if UT; 0 otherwise)	
		Loans (Loansperfactory) - Assistance by IDBI in Rs. 10 million per factory	Indiastat
8	Industrial dispersal	Backward Area (BAreaprct) (backward area as a percentage to total area in the State)	

Note: # - 1 US $ = Rs. 45 (approx.). For the variables for which Indiastat is the source, the actual source could be reply to a question in Indian Parliament or a report or corresponding Ministry website etc.

5. Agglomeration in Indian Industry

In this section, we first discuss the results pertaining to the agglomeration measure and see pattern of agglomeration for various industries in different States. Table 3 gives the EG measure (γ) of 15 the most and the least agglomerated industries. The measure (γ) shows that at the State level, the most localized four-digit industry is the Services Activities related to Printing. This is followed by the extractive industries in which location decisions are based on the availability of the raw materials, like metals and certain chemicals etc. This general trend of most agglomerated industries in Indian context is somewhat similar to the trends of the U.S. and the French manufacturing industries as found by Ellison and Glaeser (1997) and Maurel and Sedillot (1999).

From the table, it is clear that the extractive industries and the traditional industries are the most localized industries. The industries having higher potential of informational spillovers, like the pharmaceutical industries also fall in the category. The least localized industries are those producing perishable products mainly food products like fruits and vegetables, bakery products, grain mill products, soft drinks etc. Other industries that lie in this category are cutlery, ceramics etc. for which transportation costs for a given volume are high. This too follows the pattern found in the U.S. and the French manufacturing industries.[14]

Table 3: Ranking of Industries and EG index

Industry Code	Description	Gamma value	Gamma Rank
15 Most localized Industries			
2222	Service activities related to printing	0.583	1
2891	Forging, pressing, stamping & roll-forming of metal; powder metallurgy	0.581	2
2892	Treatment & coating of metals; general mechanical engineering	0.290	3
1920	Footwear	0.212	4
2022	Builders' carpentry and joinery	0.212	5
1722	Carpet and rugs	0.183	6
1911	Tanning and dressing of leather	0.181	7
2519	Other rubber products	0.143	8
1532	Starches and starch products	0.142	9
1810	Wearing apparel, except fur apparel	0.130	10
1512	Processing and preserving of fish and fish products	0.122	11
2811	Structural metal products	0.116	12
2732	Casting of non-ferrous metals	0.103	13
2423	Pharmaceuticals, medicinal chemicals & botanical products	0.09	14
15 Least Localized Industries			
1532	Grain mill products	-0.177	52
2411	Basic chemicals except fertilizers and nitrogen compounds	-0.203	53
2691	Non-structural non-refractory ceramic ware	-0.204	54
1513	Processing and preserving of fruit and vegetables	-0.207	55
1712	Finishing of textile.	-0.225	56
1912	Luggage, handbags, and the like, saddlery and harness	-0.231	57
2899	Other fabricated metal products	-0.266	58
2520	Plastic products	-0.271	59
2699	Other non-metallic mineral products	-0.367	60
2720	Basic-precious and non-ferrous metals	-0.381	61
1554	Soft drinks; production of mineral waters	-0.418	62
1541	Bakery products	-0.473	63
2893	Cutlery, hand tools and general hardware	-0.489	64
1600	Tobacco products	-0.502	65
2813	Steam generators, except central heating hot water boilers	-0.513	66

Table 4 shows what proportion of each of the industries at two- and three-digit level is agglomerated. This categorization based on γ is same as used by Ellison and Glaeser and Maurel and Sedillot in their

[14] As discussed earlier, the raw Gini coefficient does not take into account the industrial structure. The results though not reported, the divergence is reflected in different ranks of Gini and γ. The divergence is more significant when industries are diffused as indicated by the correlation coefficient. The correlation coefficient between γ and G for the least agglomerated industries is 0.44 as against 0.89 for more agglomerated industries.

studies. From the table, it is clear that the food industry (i.e., industry code 15) is dispersed industry since approximately 90% of the industry comes under less than 0.02 category (i.e. least agglomerated). On the other hand, apparel industry (i.e., industry code 18) is highly agglomerated as it has a gamma value greater than 0.05. This is well substantiated by the data, which shows that Tirupur, a town in Tamil Nadu supplies nearly 60% of the country's apparel output. Accordingly one can interpret other industries too. From the table, it is clear that at 4-digit level, 22 industries (i.e., nearly one third) are highly agglomerated, whereas 36 industries (i.e., nearly 54%) are dispersed. At 3-digit level, the number of agglomerated industries falls to 21% and highly dispersed industries increase to 67%. This implies that the agglomeration decreases as one moves from 4- to 3- digit industries. This is because, as industries become aggregated into broader and fewer categories, spatial patterns of establishment locations ultimately approach that of the entire economy, causing gamma to shrink to zero. Figure 1 using a histogram gives a synoptic view of the range of agglomeration for different industries. From the figure, it can be inferred that a sizeable number of industries are excessively diffused in India and few industries are highly agglomerated.

Table 4: Degree of agglomeration of the industries at 3- and 4-digit level

2-digit Industry code	No. of 4-digit Industries	Nature of industries at 4-digit				No. of 3-digit Industries	Nature of industries at 3-digit			
		0>γ	0<γ< 0.02	0.02<γ <0.05	γ > 0.05		0>γ	0<γ< 0.02	0.02<γ <0.05	γ > 0.05
15	16	13	1	0	2	5	5	0	0	0
16	1	1	0	0	0	1	1	0	0	0
17	4	1	0	2	1	2	1	0	0	1
18	1	0	0	0	1	1	0	0	0	1
19	3	1	0	0	2	2	1	0	0	1
20	4	0	1	0	3	2	0	1	0	1
21	3	1	2	0	0	1	1	0	0	0
22	2	1	0	0	1	1	0	0	0	1
23	1	1	0	0	0	1	1	0	0	0
24	9	5	0	1	3	3	2	0	1	0
25	3	2	0	0	1	2	2	0	0	0
26	8	4	0	0	4	2	2	0	0	0
27	4	2	1	0	1	3	2	0	0	1
28	7	4	0	0	3	2	1	0	1	0
TOTAL	**66**	**36 (54%**	**5 (8%)**	**3 (5%)**	**22 (33%)**	**28**	**19 (67%)**	**1 (4%)**	**2 (7%)**	**6 (21%)**

Note: The industry codes and description are given in Appendix B. Figure in parenthesis gives percentage of total industries.

It will be interesting to compare agglomeration in India, where policies were enacted to coerce the industries to diffuse, with a country where such coercive factors may be less in action. The US is one such country having less policy intervention to influence firm's location decision process. Table 5 compares the agglomeration of manufacturing industries in India vis-à-vis US at the 2-digit level. The table throws interesting differences.[15] Four out of the total 15 2-digit industries in India, namely Apparel, Tanning, Furniture and Printing, are highly agglomerated, whereas in US only 2 industries

[15] While interpreting the results, it needs to be kept in mind that despite firms being classified in the same industry sector, the firms in India and US are likely to produce different product varieties.

(Tobacco products and Textiles) are highly agglomerated. A large number of Indian manufacturing industries (9 out of 15) are excessively diffused as gamma is less than zero, but in case of US, a significant proportion of the industries (12 out of 15) have low concentration and none of the industry is excessively diffused. There are two possible reasons for different agglomeration patterns in India and US: a) high mobility of labour in US (unless dictated by the natural resource availability); and b) influence of dispersal policy. The US because of a common language has high mobility of labour unlike India (or even Europe). As a result, firms can co-locate, where other firms are located and can still attract workforce from any part of the country. Excessive dispersion in Indian context is also reflection of the fact that the dispersal policy may have worked.

The different agglomeration pattern across the two countries is reflected in a high negative correlation coefficient for the gamma, which is -0.71. Looking closely at Table 5 indicates that tobacco products is an outlier – as it is highly agglomerated in US, but excessively diffused in India. The correlation however falls to -0.09 if we do not include Tobacco products. Both - a high concentration and a diffused industrialization have different implication for the productivity and growth.

Table 5: Agglomeration of manufacturing industries at 2 digit level – India vs. US

Code	Industry	γ_{Ind}	Nature of Agglomeration	γ_{US}	Nature of Agglomeration
15	Food products and beverages	-0.10692	D	0.00347	L
16	Tobacco products	-0.50236	D	0.19457	H
17	Textiles	0.005512	L	0.09410	H
18	Wearing apparel	0.130533	H	0.01159	L
19	Tanning	0.054393	H	0.01513	L
20	Wood	0.013966	L	0.01168	L
202	Furniture	0.116946	H	0.01212	L
21	Paper	-0.00636	D	0.00844	L
22	Printing	0.291618	H	0.00527	L
23	Petroleum products	-0.13326	D	0.03605#	M
24	Chemicals	-0.0435	D	0.01047	L
25	Rubber & misc. plastic products	-0.09254	D	0.00385	L
26	Non metallic mineral products	-0.05312	D	0.00357	L
27	Basic metals	-0.07228	D	0.01438	L
28	Fabricated metals	-0.00379	D	0.00447	L

Source: For US, Rosenthal and Strange (2001: 197)

Note: # - includes Refining also; $\gamma>0.05$ – highly concentrated (H); $0.05>\gamma>0.02$ – concentrated (M); $0<\gamma<0.02$ – not very concentrated (L); $\gamma<0$ – excessively diffused (D). The categorization is as per EG (1997).

5.2 Pattern of Location for 20 most agglomerated industries

The pattern of location of each of the industries is obtained through the product of each industry's agglomeration index and the industry's share of manufacturing in each State and is given by $\gamma_j * w_{ij}$. Table 6 gives a summary of the top four States where 20 highly localized industries are located in. From the table, we can discern two distinct features. First, the extractive or natural resource based industries like Iron and Steel, Cement, and Lime and Plaster, are found in those States where the raw material is found in abundance. Second, the localization pattern of the some of traditional industries like leather, footwear, wearing apparel and carpentry, are more or less determined by the historical specialization of some regions. For example, the leather industry in and around Chennai (TN) and Kanpur (UP) attributes its origin mainly to the pre-independence era when the units were set up to

supply leather goods to British Army. The four States which house most of these industries are Maharashtra, Gujarat, Tamil Nadu and Andhra Pradesh. Of the 20 most agglomerated industries, Maharashtra houses 15, whereas Gujarat and Tamil Nadu have 14 and 12 of these industries respectively.

Table 6: Pattern of Industrial Location in India

Industry Code/Description	State 1	State 2	State 3	State 4
Processing and preserving of fish and fish products	Kerala	A.P.	Gujarat	T.N.
Manufacture of starches and starch products	T.N.	A.P.	Gujarat	Maharashtra
Manufacture of prepared animal feeds	A.P.	Gujarat	Maharashtra	U.P.
Preparation and spinning of textile fiber including weaving of textiles.	T.N.	Gujarat	Maharashtra	Rajasthan
Manufacture of carpet and rugs	W.B.	Kerala	Haryana	Rajasthan
Manufacture of cordage, rope, twine and netting	T.N.	Maharashtra	Punjab	Gujarat
Manufacture of wearing apparel, except fur apparel	T.N.	Delhi	Karnataka	Maharashtra
Tanning and dressing of leather	T.N.	U.P.	Punjab	W.B.
Manufacture of footwear	T.N.	Haryana	U.P.	W.B.
Saw milling and planing of wood	W.B.	Maharashtra	U.P.	Kerala
Manufacture of builders' carpentry and joinery	T.N.	Maharashtra	Bihar	W.B.
Service activities related to printing	Maharashtra	Haryana	Kerala	A.P.
Manufacture of plastics in primary forms and of synthetic rubber.	Gujarat	Maharashtra	U.P.	Kerala
Manufacture of pesticides and other agro chemical products	Gujarat	Maharashtra	A.P.	T.N.
Manufacture of pharmaceuticals, medicinal chemicals & botanical products	Maharashtra	U.P.	Gujarat	A.P.
Manufacture of other rubber products	Delhi	Kerala	Haryana	Maharashtra
Manufacture of cement, lime and plaster	Rajasthan	A.P.	T.N.	Gujarat
Casting of iron and steel	Maharashtra	W.B.	Gujarat	T.N.
Casting of non-ferrous metals	Punjab	T.N.	Gujarat	U.P.
Forging, pressing, stamping and roll-forming of metal; powder metallurgy	Maharashtra	H.P.	A.P.	Assam

Note: A.P.- Andhra Pradesh; T.N. - Tamil Nadu; U.P. - Uttar Pradesh; M.P.- Madhya Pradesh; H.P.- Himachal Pradesh; W.B.- West Bengal;

6. Role of Dispersion Policy in influencing Agglomeration – Econometric Results

This section presents the results from the econometric analysis. First a simple OLS model is run to investigate the role of dispersal policy after controlling for factors affecting agglomeration. Three variants of the models are considered – the basic OLS formulation with an intercept, basic model with sector level dummy variables at the 2- and 3-digit levels. The inclusion of industry dummies is warranted because omission of industry attributes could bias our estimates as has been the case in earlier studies (Rosenthal and Strange, 2001; Resende and Wyllie, 2003). The Breusch-Pagan tests show the presence of heteroskedasticity for all the variants.[16] The models are estimated with correction for heteroskedasticity. It is to be noted that model could not use all the variables as variables like crimeshare (Crime2AIcrim), crimerate (Crime2violcrim) and BIMARU are found to be correlated. Similarly, variables such as Waterlevel10m, Waterdeficit etc. were found to be highly correlated with other variables, hence could not be used. Table 7 reports the results.

Both the natural cost advantage variables – State adjoining a coastline (Coastalstate) and per capita energy gap (EnerGap) come out with appropriate sign but are not significant in any variants of the

[16] The χ^2 values for the three variants are 423.11, 835.56 and 861.23 respectively.

model. The variable affected by transportation cost – Persihable (row 4) becomes significant only with 2-sector dummy suggesting that for a perishable product, production would be scattered as hypothesized rather than agglomerating in an area. Agglomeration externalities variables – RD1 (row 5) and employ2workr (row 6) are also not significant in any variant, though the later always attains positive sign as expected. Similarly, governance and industrial environment are not found to have any impact on agglomeration. Among infrastructure variables, only ElecTar (row 8) has any impact on the agglomeration. A state having high electricity tariffs discourages agglomeration. The incentive / policy related variables encouraging agglomeration (i.e., UT and Loanperfactory) are not significant. The main variable of interest – industrial dispersal policy (i.e. BAreaprct) (row 13) has come up with the right sign but statistically is not significant. Based on OLS results, it seems only electricity tariff and kinds of product produced are influencing agglomeration decision of a firm. In fact, most of the variation in agglomeration is explained by the Industry heterogeneity.

Table 7: Role of Industrial Dispersal Policy in influencing Agglomeration (N = 1386) (method – Heteroskedasticity Corrected OLS) (4-digit industries)

		Without industry dummies		With 2 digit industry dummies		With 3 digit industry dummies	
	Variable	**Co-efficient**	**t-values**	**Co-efficient**	**t-values**	**Co-efficient**	**t-values**
1	Coastalstate	0.000546	0.37	0.000675	0.45	0.000617	0.42
2	EnerGap1	-5.72×10^{-06}	-0.27	-5.50×10^{-06}	-0.26	-5.60×10^{-06}	-0.27
3	Surfac2totroad	-0.00083	-0.23	-0.00089	-0.24	-0.00087	-0.24
4	Perishable	0.000869	0.38	-0.0026*	-2.06	-0.00173	-1.04
5	RD1	1.03×10^{-05}	0.03	-0.00014	-0.43	-7.4×10^{-05}	-0.21
6	Employ2workr	0.011819	0.63	0.012118	0.65	0.011983	0.64
7	Crime2violcrime	5.24×10^{-05}	0.81	5.07×10^{-05}	0.79	5.15×10^{-05}	0.81
8	Electtar	-3.4×10^{-05}*	-2.31	-3.4×10^{-05}*	-2.37	-3.4×10^{-05}*	-2.38
9	Loanperfactory	-0.00031	-0.47	-0.00026	-0.41	-0.00028	-0.44
10	ITIfact	-0.00381	-0.17	-0.00603	-0.27	-0.00503	-0.23
11	Disputperfactory	-0.08672	-0.87	-0.08755	-0.88	-0.08717	-0.88
12	UT	-0.00091	-0.34	-0.00131	-0.47	-0.00113	-0.41
13	BAreaprct	-3.51×10^{-06}	-0.11	-4.26×10^{-06}	-0.14	-3.92×10^{-06}	-0.13
14	Infraindx	2.55×10^{-06}	0.53	3.22×10^{-06}	0.65	2.92×10^{-06}	0.59
15	Constant	-0.01279	-0.61	-0.01484	-0.71	-0.01159	-0.55
16	R-square	0.0048		0.0394		0.0559	
17	F value	2.46 (0.002)		4.22 (0.00)		5.16 (0.00)	

Note: * indicates significance of variable at minimum 10% level.

One of the reasons for insignificant OLS results could be the possible endogeneity of some variables. Since concentration of production is self-reinforcing i.e., firms chose to produce in regions with good infrastructure and access to markets, but infrastructure and access to markets tended to be good in regions in which many firms chose to produce (Harris, 1954). From policy perspective, this creates a peculiar situation where even concerted policy interventions in backward regions may not work. This implies that there could be an endogeneity problem and OLS estimates may not be consistent. We undertake exogeneity tests along the lines of Hausman (1978). For the purpose, we considered per capita income of the State and Teledensity as variables explaining Infrastructure index (Infraindx).

The Wu-Hausman F test for endogeneity gives the values as 3.93 (p-value = 0.047) for the specification without sector dummies, 4.05 (p-value = 0.044) with 2-digit dummies and 4.07 (p-value = 0.044) with 3-digit dummies indicating the presence of endogeneity. Table 8 reports the instrument variable (IV) results. Pre-testing using Pagan Hall tests show the presence of heteroskedasticity for each of the variants.[17] The models are thus estimated with correction for heteroskedasticity.

Table 8: Role of Industrial Dispersal Policy in influencing Agglomeration - (N = 1386) (method – Heteroskedasticity Corrected Instrumental Variables) (4-digit industries)

		Without industry dummies		**With 2 digit industry dummies**		**With 3 digit industry dummies**	
	Variable	**Co-efficient**	**t-values**	**Co-efficient**	**t-values**	**Co-efficient**	**t-values**
1	Coastalstate	0.000846	0.5	0.000978	0.58	0.00092	0.55
2	EnerGap	-7.93×10^{-06}	-0.39	-7.72×10^{-06}	-0.38	-7.81×10^{-06}	-0.39
3	Surfac2totroad	-0.00218	-0.47	-0.00224	-0.48	-0.00222	-0.48
4	Perishable	0.000841	0.37	-0.00261*	-2.07	-0.00175	-1.05
5	RD1	-2.5×10^{-05}	-0.07	-0.00018	-0.55	-0.00011	-0.33
6	Employ2workr	0.012376	0.64	0.012681	0.66	0.012548	0.66
7	Crime2violcrime	3.82×10^{-05}	0.53	3.65×10^{-05}	0.51	3.72×10^{-05}	0.52
8	Electtar	-3.4×10^{-05}*	-2.31	-3.4×10^{-05}*	-2.37	-3.4×10^{-05}*	-2.38
9	Loanperfactory	-0.00028	-0.44	-0.00023	-0.37	-0.00025	-0.4
10	ITIfact	-0.00709	-0.29	-0.00935	-0.38	-0.00837	-0.35
11	Disputperfactory	-0.07022	-0.78	-0.07103	-0.79	-0.07068	-0.79
12	UT	-0.00196	-0.56	-0.00236	-0.66	-0.00219	-0.62
13	BAreaprct	1.69×10^{-07}	0.01	-5.76×10^{-07}	-0.02	-2.52×10^{-07}	-0.01
14	Infraindx	7.54×10^{-06}	0.98	8.23×10^{-06}	1.05	7.93×10^{-06}	1.02
15	Constant	-0.01312	-0.62	-0.0152	-0.71	-0.01195	-0.56
16	R-square	0.0046		0.0392		0.0557	
17	F value	2.22 (0.0057)		4.23 (0.00)		5.12 (0.00)	
18	Wu-Hausman F Test for Endogenity	3.93 (0.047)		4.05 (0.044)		4.07 (0.044)	
19	List of instruments	Coastalstate, EnerGap1 Surfac2totroad, Perishable, RD1 Employ2workr, UT, Crime2violtcrim, Electtar, ITIfact, Loanperfactory, Pcinc, Disputperfactory, BAreaprct, Teleden					

Note: * indicates significance of variable at minimum 10% level.

The results using IV estimation hardly change as the one obtained in OLS estimation. A higher electricity tariff (row 8) discourages firms to agglomerate in a State, whereas perishable product (row 4) induces firms to disperse when 2-digit industry dummy is included. The agglomeration externalities, natural advantage, governance and incentives to firms in UTs and loan given per factory do not seem to influence agglomeration of industries. The industrial dispersal policy as proxied by percentage of backward area (row 13) does not seem to have any effect on agglomeration.

One probable reason for many of the variables not influencing agglomeration is that Indian industry in general is either highly agglomerated or highly diffused (see Table 5 and Figure 1). Pooling all the industries together might be nullifying the effect of industrial dispersal policy and other variables. To get an insight into the role of dispersal policy, it is necessary to do the analysis separately for two

[17] The χ^2 values for the three variants are 40.74, 63.56 and 69.28 respectively.

categories of industries – category 1 where industries are concentrated (i.e., with gamma, $\gamma > 0$)[18] and category 2 where industries are excessively diffused (i.e., gamma $\gamma \leq 0$).

Role of Dispersion Policy – for Agglomerated and highly Diffused industries

Tables 9 and 10 report the results with industries divided in two categories. Like earlier, the analysis is carried out for each variant of the model – with and without industry dummies, and correcting for heteroskedasticity problem, if any.

Table 9: Role of Industrial Dispersal Policy in influencing Agglomeration for agglomerated industries (Gamma > 0) - (N = 461) (method –Instrumental Variables) (4-digit industries)

		Without industry dummies		With 2 digit industry dummies		With 3 digit industry dummies	
	Variable	**Co-efficient**	**t-value**	**Co-efficient**	**t-value**	**Co-efficient**	**t-value**
1	Coastalstate	0.007234*	2.27	0.006575*	2.24	0.005753*	2.17
2	EnerGap	4.55×10^{-05}	1.37	5.93×10^{-05}#	1.54	6.28×10^{-05}*	1.81
3	Surfac2totroad	-0.01758*	-1.78	-0.01461*	-1.83	-0.01659*	-2.08
4	Perishable	0.008096	1.23	0.002745	1.1	0.004656#	1.46
5	RD1	0.000455	0.76	0.000446	0.99	0.000556	1.37
6	Employ2workr	0.059945	1.37	0.046443#	1.43	0.047568*	1.69
7	Crime2violcrime	-0.00014	-1.24	-0.0002#	-1.47	-0.00028#	-1.47
8	Electtar	-2.34×10^{-06}	-0.09	3.65×10^{-06}	0.11	9.23×10^{-07}	0.03
9	Loanperfactory	-0.00038	-0.26	-0.0003	-0.2	-0.0016	-0.8
10	ITIfact	-0.10508*	-2.06	-0.10839*	-2.32	-0.10018*	-2.3
11	Disputperfactory	-0.04092	-0.22	-0.03563	-0.16	0.03238	0.16
12	UT	-0.01922*	-2.46	-0.01305*	-2.09	-0.01138*	-2.38
13	BAreaprct	1.05×10^{-05}	0.16	6.66×10^{-05}	0.78	2.96×10^{-05}	0.39
14	Infraindx	3.39×10^{-05}*	2.06	2.78×10^{-05}*	1.92	1.82×10^{-05}#	1.48
15	Constant	-0.06238	-1.29	-0.04875	-1.32	-0.04106	-1.31
16	R-square	0.0691		0.25		0.37	
17	F value	2.32 (0.0042)		1.44 (0.078)		3.33 (0.000)	
18	Wu-Hausman F Test for Endogenity	6.23 (0.013)		4.1 (0.043)		3.47 (0.063)	
19	List of instruments	Coastalstate, EnerGap1 Surfac2totroad, Perishable, RD1 Employ2workr, UT, Crime2violtcrim, Electtar, ITIfact, Loanperfactory, Pcinc, Disputperfactory, BAreaprct, Teleden					

Note: * and # indicate significance of variable at minimum 10% and 15% level respectively; The χ^2 values as given by Pagan Hall tests for the three variants are 40.74, 63.56 and 69.28 respectively. Each is significant at 1% level thereby indicating the presence of heteroskedasticity.

Interesting results emerge when the sample is divided in these two categories. Inclusion of industry dummies increases the explanatory powers of the models, the results are discussed for these variants only. The results are more or less same with inclusion of 2- or 3-digit dummies for the two categories. For relatively agglomerated industries (Table 9), the natural advantage of being a coastal State (row 1), infrastructure index of the state (row 14) and realization of agglomeration externalities through labour market pooling (row 6) results in agglomeration. On the other hand, crime rate in the State (row 7) discourages agglomeration. Interestingly, the incentives to firms in UTs (row 12) have not contributed to increased agglomeration, other factors seem to dominate. The dispersal policy (row 13) seems to have no effect on dispersion. Some of the variables like per capita energy gap (row 2),

[18] Ideally, we should have taken γ>0.02 as a cut-off for agglomerated industries. Unfortunately, this leaves only 33 observations falling in the category, hence very few degrees of freedom, which is not amenable for analysis.

percentage of surfaced roads (row 3), and ITIs per unit factory (row 10) have come up with the opposite sign. The possible explanation is that having a well developed harbour and coastline may partly offset the need for surfaced roads. Providing more ITIs per factory may only increase the quantity of semi-skilled worker, but may have less influence on the quality of those. The industrial environment and innovation spillovers variables, though come up with the right sign are not statistically significant from zero.

Table 10: Role of Industrial Dispersal Policy in influencing Agglomeration for dispersed industries (Gamma ≤ 0) (N = 925) (Heteroskedasticity corrected OLS) (4-digit industries)

		With 2 digit industry dummies		With 3 digit industry dummies	
	Variable	**With agglomeration externalities (1)**	**Without agglomeration externalities (2)**	**With agglomeration externalities (3)**	**Without agglomeration externalities (4)**
1	Coastalstate	-0.0047* (-4.09)	-0.0047* (-3.64)	-0.0046* (-4.10)	-0.0046* (-3.63)
2	EnerGap	$-6.0\text{x}10^{-05}$*(-2.94)	$-6.0\text{x}10^{-05}$*(-3.15)	$-6.0\text{x}10^{-05}$* (-3.09)	$-6.3\text{x}10^{-05}$* (-3.29)
3	Surfac2totroad	-0.00067 (-0.37)	-0.0016 (-0.66)	-0.00055 (-0.3)	-0.0015 (-0.62)
4	Perishable	-0.0065* (-5.58)	-0.0064* (-5.59)	-0.0098* (-6.23)	-0.0098* (-6.41)
5	RD1	-0.0007* (-1.99)		-0.0007* (-2.07)	
6	Employ2workr	-0.015* (-1.84)		-0.015* (-1.86)	
7	Crime2AIcrime/ Crime2violtcrim	-0.00012 (-0.54)	0.000076 (1.2)	-0.0001 (-0.51)	0.000078 (1.26)
8	Electtar	$-3.4\text{x}10^{-05}$ (-1.39)	$-5.8\text{x}10^{-05}$* (-4.51)	$-3.5\text{x}10^{-05}$#(-1.46)	$-5.9\text{x}10^{-05}$* (-4.64)
9	Loanperfactory	-0.00045 (-0.69)	-0.00057 (-1.35)	-0.00042 (-0.65)	-0.00057 (-1.36)
10	ITIfact	0.055* (3.02)	0.058* (3.54)	0.054* (3.06)	0.057* (3.6)
11	Disputperfactory	0.052 (0.76)	0.011 (0.13)	0.055 (-0.8)	0.012 (0.15)
12	UT	0.0077* (4.02)	0.007* (4.68)	0.0076* (4.07)	0.007* (4.64)
13	BAreaprct	$-1.7\text{x}10^{-05}$(-0.76)	$-3.5\text{x}10^{-05}$# (-1.5)	$-1.7\text{x}10^{-05}$ (-0.73)	$-3.4\text{x}10^{-05}$# (-1.46)
14	Infraindx	$-1.76\text{x}10^{-06}$ (-0.47)	$-4.22\text{x}10^{-06}$ (-1.07)	$-1.5\text{x}10^{-06}$ (-0.40)	$-4.1\text{x}10^{-06}$ (-1.04)
15	Constant	0.023* (2.37)	0.0067* (1.99)	0.03*(3.01)	0.013* (3.7)
16	R-square	0.26	0.24	0.30	0.28
17	F value	12.02 (0.0)	11.66 (0.0)	9.25 (0.00)	8.78 (0.00)
18	Wu-Hausman F test for Endogeneity	0.95 (0.33)	0.03 (0.86)	0.94 (0.33)	0.04 (0.85)

Note: Same as Table 9. For Models 1 and 3, Crime2AIcrim has been used instead of Crime2violtcrim as an indicator of governance. The χ^2 values as given by Breusch-Pagan test are 960.72, 845.92, 962.17 and 842.23 respectively with significance at 1% level, indicating presence of heteroskedasticity.

However, for industries which are highly dispersed (Table 10), the results indicate that perishable product (row 4), high electricity tariff (row 8) and high per capita energy gap (row 2) in the State induce firms to disperse. Number of ITIs per factory (row 10) in the State enables industries to agglomerate. The policy inducement to UTs (row 12) attracts industries to agglomerate. Surprisingly, coefficients of both the agglomeration externalities variables – RD1 (row 5) and Employ2worker (row 6) have come out contrary to expectation. Since these industries are by nature dispersed, the relevance of knowledge spillovers and/or labour market pooling for them may not be very high. This is because diffusion mechanism is related to proximity and gains from both of these occur in a narrowly defined geographical area (Johansson and Quigley, 2004; Jaffe *et al.*, 1993). Moreover, both labour pooling and spillovers tend to plateau unless there is constant movement of people. For industries, which are

already dispersed, this movement may be restricted.[19] The analysis was however repeated without the knowledge spillovers and labour market pooling variables, the other variables and their significance levels hardly change (Columns 2 and 4, Table 10). Interestingly the industrial dispersal variable (row 13) becomes negatively significant at 15% level thereby reflecting that the policy is partly successful in dispersing the industries. With respect to variables representing infrastructure index (row 14), it is found to have no impact on the agglomeration.

Role of Dispersion Policy – At higher aggregation of industries

Since availability of infrastructure or ITIs or high electricity tariff or policy variables like backward area development or incentives to firms in UTs do not distinguish between industries and all industries equally benefit (or suffer), in the next stage analysis is repeated by aggregating the industries at 3- and 2-digits respectively. Table 11 reports the results.

Table 11: Role of Industrial Dispersal Policy in influencing Agglomeration for higher aggregation of Industries – Econometric results (method –Instrumental Variables)

		Aggregation at 3-digit level (N = 588)		Aggregation at 2-digit level (N = 294)	
	Variable	**Co-efficient**	**t-values**	**Co-efficient**	**t-values**
1	Coastalstate	0.000559	0.33	0.001593	0.54
2	EnerGap1	-1.6×10^{-05}	-0.77	7.03×10^{-07}	0.03
3	Surfac2totroad	-0.00314	-0.71	-0.00501	-0.64
4	Perishable	-0.00449*	-2.85	-0.00587*	-2.62
5	RD1	-0.00094*	-2.14	-0.00152*	-1.95
6	Employ2workr	0.013523	0.79	0.028186	0.88
7	Crime2violcrime	1.29×10^{-05}	0.17	-5.18×10^{-07}	0.001
8	Electtar	-3.1×10^{-05}*	-1.91	-4.3×10^{-05}*	-1.62
9	Loanperfactory	2.33E-05	0.04	0.000121	0.13
10	ITIfact	-0.01537	-0.61	-0.04815	-1.1
11	Disputperfactory	-0.02425	-0.24	-0.07835	-0.44
12	UT	-0.00514	-1.32	-0.01042	-1.39
13	BAreaprct	-3.2×10^{-05}	-0.96	-3.7×10^{-05}	-0.64
14	Infraindx	1.22×10^{-05}#	1.54	2.04×10^{-05}#	1.46
15	Constant	-0.012	-0.63	-0.0224	-0.65
16	Industry dummies	Yes		Yes	
17	R-square	0.15		0.18	
18	F value	4.0 (0.000)		2.39 (0.0003)	
19	Wu-Hausman F Test for Endogenity	7.02 (0.008)		4.81 (0.029)	
20	List of instruments	Coastalstate, EnerGap1 Surfac2totroad, Perishable, RD1 Employ2workr, UT, Crime2violtcrim, Electtar, ITIfact, Loanperfactory, Disputperfactory, BAreaprct, Pcinc, Teleden			

Note: * and # indicate significance of variable at minimum 10% and 15% level. The χ^2 values as given by Pagan Hall tests for the two variants are 57.99 and 39.54 with significance at 1% level.

Irrespective of aggregation, results indicate that infrastructure index (row 14), electricity tariff (row 8) and nature of the product (row 4) determine whether to agglomerate or disperse. Most other variables including the industrial dispersal policy variable (row 13) have no impact on agglomeration.

[19] Author's personal interviews during 1997 with machine tools manufacturers operating in both categories – dispersed and working in an agglomerated area - substantiate this. The firm which is dispersed and located in a chemical belt has often found difficulty in attracting skilled people, whereas firms located in the machine tool hub of the country are more innovative and are able to benefit from labour market pooling.

Incidentally, the agglomeration spillover variable (RD1) has come out to be negatively significant. The spurious sign for R&D could also be because we have used input measure rather than the output measure as used in studies by Dumais *et al*. (1997) and Jaffe *et al*. (1993). Still, the plateau effect of knowledge spillovers is tested using a square term for R&D. The results though not reported indicate the diminishing role of R&D spillovers at 3-digit level aggregation. At 2-digit aggregation, however R&D has no influence on agglomeration.

It is to be noted that some industries like bakery products, grain mill products, soft-drinks, etc. are inherently diffused in nature, as the cost of transporting per unit of output would be extremely high. In other words, firms producing these products would locate near the market and incentives are not intended to influence their locational choice. Subsequently as a robustness check, we carry out the analysis for only those industries which produce non-perishable product. The results (not reported) hardly change then the one we obtained earlier in Table 8.

Discussion

The analysis thus indicates that the industrial dispersal policy has no impact on the location decision of firms. Other factors seem to guide the locational choice. For industries which are relatively more agglomerated, it is the infrastructure index, labour market pooling and nearness to coast line has dictated agglomeration, whereas for industries which are dispersed, it is the nature of the product, high electricity tariff and per capita energy gap that have induced them to disperse. Presence of ITIs by providing skilled and semi-skilled labour, and surfaced roads, by reducing per unit transport cost facilitates agglomeration for these industries. Aggregation at 2- and 3- digit level however brings forth the role of infrastructure index and high electricity tariff and nature of product in influencing location choice. The industrial dispersal policy seems to have no influence. Based on the results, one can say that the backward area development policies pursued by the Indian government to disperse the industries seem to have made no impact.

A low explanatory power of different models though is quite common in such studies, yet it implies that the models could not identify all factors that influence industrial location decisions. As argued, there are both random and nonrandom factors that need to be included. The non-random local factors include local or state-level industry-specific policy initiatives to attract certain industries (tax initiatives, subsidies, reduced sales tax, location of industry-specific free trade zones etc.) and some intangibles like culture, entrepreneurship and initiatives (Lall and Charavorty, 2005: 68). Personal preference and/or chance are among the random elements to be included, which incidentally requires carrying out a primary survey. Another reason the study could not find significant explanation to the agglomeration factors is because the study did not distinguish between private and the State capital. Private capital seeks profit maximizing or efficient location that already has necessary infrastructure and economies of agglomeration, whereas location decision of State capital are governed by a mix of efficiency, equity and security considerations.

7. Conclusions and Scope for further work

This study has attempted to see the role of industrial dispersal policy in influencing the locational choice of manufacturing firms in the Indian context. In order to do so, the study computes the degree

of agglomeration using an agglomeration measure given by Ellison and Glaeser for 66 manufacturing industries in 21 major States (17 States and 4 Union Territories) of India.

Agglomeration index at the 2-digit level, indicates that most Indian industries are excessively diffused; thereby pointing out that the attempts made by the Government to disperse the industrial units may have worked. However, with respect to 41 industries, which are found to be highly dispersed, the results need to be looked with caution. Even if a State may be showing high industrialization and having all the industries, they may be spread over few districts only, as in the case of Gujarat, Maharashtra, Andhra Pradesh or West Bengal.

The study then looked at the role of industrial dispersion policy in influencing clustering using an econometric model that accounts for endogeniety and heteroskedasticity, if any. The econometric results indicate that the dispersal policy has not been successful in most specifications, other factors like presence of infrastructure, nearness to coast, and labour market pooling determines the agglomeration for industries which are more agglomerated. For industries which are dispersed, it is nature of the product produced, high electricity tariff and high per capita energy gap that has induced them to disperse. The industrial dispersal policy only weakly influences dispersion. Presence of ITIs by providing skilled and semi-skilled labour and surfaced roads, by reducing per unit transport cost however, facilitates agglomeration in dispersed industries. Aggregation across industries has brought forth the role of infrastructure index and high electricity tariff and nature of product in influencing location choice. Based on the results, one can say that the policies pursued by Indian government to disperse the industries do not have significant impact when other agglomerative and dispersive forces are accounted for.

The results have important policy implications. Since dispersal policy has not worked, State and Central governments need to look for other avenues to achieve balanced growth. Results indicate that it is not the dispersal policy, rather the availability of infrastructure – physical and human capital that would induce firms to locate in an area. The key to reducing regional disparity is putting efforts in providing electricity, roads, investing in technical and higher education among others.

The present study though sheds light on industrial clustering in India, has a number of avenues for further research. A major limitation of the present study is the spatial unit for which analysis has been carried out. Since locational choice is exercised at scale much smaller than the State level, the analysis can be extended by looking the factors at lower spatial unit, say at the district/county level.[20] Using State-wise industry-specific incentives can shed more light on the role of policy initiatives. Since mid-nineties, the extensive use of public interest litigation by different interest groups has brought environmental governance as an important factor in locational decision. Including environmental governance as a variable affecting locational choice is a logical extension of present work. Another area of future research is to delve into the dynamics of agglomeration over time to learn more about what induces a cluster to be formed and then eventually dissolve in different regions.

[20] Though one can find agglomeration at the district level, but the result may still be looked with caution, as the policies to attract industries are often at the State level and not at the district level.

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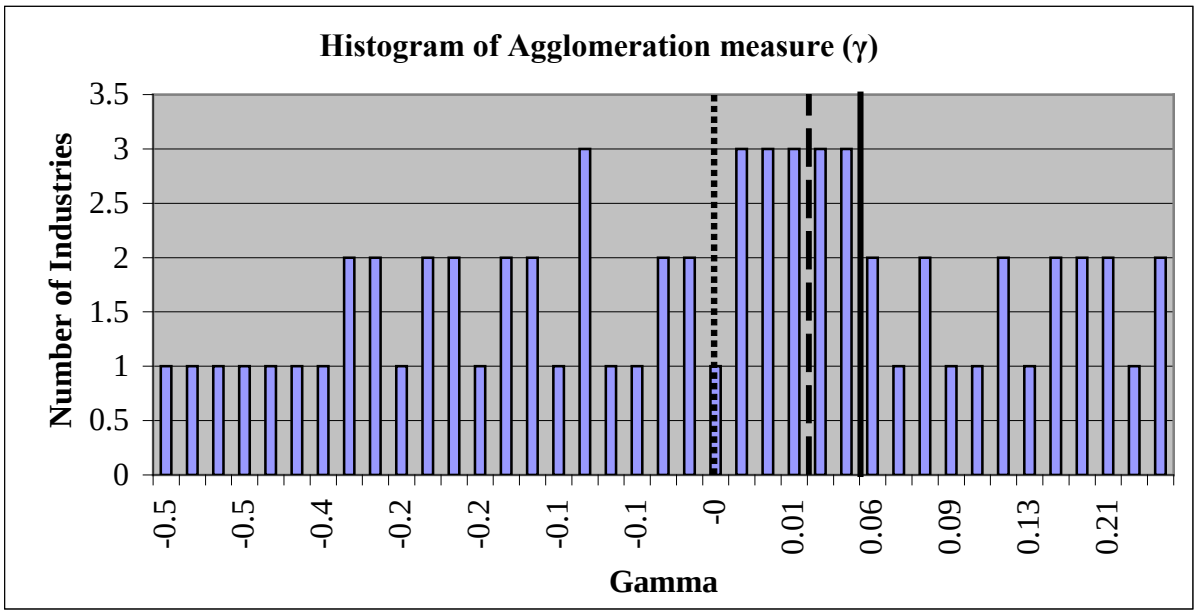

Figure 1: Histogram of Agglomeration Measure of Different Industries

Notes: Industries beyond the 'bold' line are highly agglomerated, industries before the 'dotted' line are excessively dispersed, between 'dashed' and 'bold' line are agglomerated and between 'dotted' and 'dashed' are randomly dispersed.

Appendix A – Policies towards Industrial Dispersal

Since independence, there have been significant attempts, made by the Central Government and the State Governments to aid the economy in the growth and development of industries. The Industrial Policy Resolution of 1956 and the Statement on Industrial Policy of 1991 provide the basic framework for the overall industrial policy of the Government in regard to the manufacturing industries.[21]

In 1956, the Freight Equalisation policy on steel and coal was formulated. This was a means of making the industrially backward States more competitive. The Central Government of India (GoI) absorbed any differences in transport costs, for different locations. This plan however backfired. It benefited the Northern States, like Punjab, in the country, at the cost of the Eastern States, like West Bengal, that are thought to have lost their natural advantage. This scheme was later withdrawn by the GoI in 1992 under the New Economic Policy.

In the initial stages of the country's development, growth of industry was regulated through the granting of industrial licences and other industrial approvals. There was evident discrimination in favor of the backward States. The Industries (Development and Regulation) Act, 1951 was the principal legislation providing the legal basis for industrial licencing. In practice, licenses were granted to encourage geographical diversity, rather than industrial efficiency. Apart from the use of licenses, both the Central Government and the State Governments tried to follow a deliberate policy of encouraging industries in backward areas.

The Central Government identified a few backward districts in early 1970s and offered 25% capital subsidy for industries that were set up in these areas. Various State Governments also offered similar capital incentives, exemption from sales tax levy, subsidies on power rates, cheap developed land, sales tax, loans and other facilities for the growth of industries in these areas.

In July 1969, an Industrial Licensing Inquiry Committee was appointed to examine the shortcomings in licensing policy. The Committee realised that the licensing policy had not succeeded in attaining its goal, instead resulted in inefficiency. The Industrial Policy Statement drawn in 1973, among other issues, permitted large industries to start operations in rural and backward areas with a view to developing those areas and enabling the growth of small industries around. In 1980, prompted by the Hazari Committee Report (1977), the Industrial Licensing Policy was set up. At the same time, the Planning Commission came up with recommendations to disperse the industries in industrially backward areas.[22] After 1980, an era of liberalisation started, and the trend was gradually to dilute the strict licensing system and allow more freedom to the entrepreneurs. The industrial policy announced on 24th July 1991 substantially dispensed with industrial licensing.[23] However, the benefits to industrial units locating in backward areas are still continuing. To give an example, the Income Tax (Amendment) Act 1998 (7 of 1998) among other exemptions has provided tax holiday for units in backward districts. The amendment provides for a five year tax holiday to undertakings located in the notified industrially backward districts of category 'A' and a three-year tax holiday to undertakings located in the notified industrially backward districts of category 'B'; subject to the condition that such undertakings begin to manufacture or produce articles or things or to operate cold storage plant or plants at any time during the period from 1 October 1994 to 31 March 1999. In both the cases, the tax holiday period will be followed by the benefit of deduction of 25% of profits (30% in case of companies) for five years to the eligible undertakings.[24]

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[21] A brief description of industrial policy pursued till the mid-1990's is given in the Handbook of Industrial Policy (2000).

[22] Refer http://planningcommission.nic.in/reports/publications/pub_inddis.pdf for planning commission report on Industrial Dispersion.

[23] Report of the National Commission on Labor (2000): Industrial Development and Progress after Independence (Source: www.labour.nic.in/lcomm2/2nlc-pdfs/Chap3.pdf accessed April 2005)

[24] Source: Justice and Law, Ch. 26 in *India 2000* (http://www.indianembassy.org/indiainfo/india_2000/chapters/chp26.pdf accessed January 2007).

Despite these efforts of planners and policy initiatives, there is still concentration of units in few States only. Table A1 gives the concentration of industries in different States. From the table, we can see that most manufacturing industries are located in Maharashtra (14), Tamil Nadu (5), Gujarat (4) and Andhra Pradesh (3).

Table A1: **Concentration of industries in States.**

Industry Code	Industry (Descriptive)	States in which concentration of units exist in 2003
15	Food products and beverages	Andhra Pradesh
16	Tobacco products	West Bengal, Uttar Pradesh, Andhra Pradesh
17	Textiles	Tamil Nadu
18	Wearing apparel	Tamil Nadu
19	Tanning	Tamil Nadu
20	Wood	Kerala
21	Paper	Maharashtra
22	Types of media	Maharashtra, Tamil Nadu
23	Coke, petroleum products	Maharashtra
24	Chemicals	Gujarat, Tamil Nadu, Maharashtra
25	Rubber	Maharashtra
26	Non metallic mineral products	Andhra Pradesh
27	Basic metals	Maharashtra, Gujarat
28	Fabricated metals	Maharashtra
29	Machinery & Equipment	Maharashtra, Gujarat
30	Office machinery	Maharashtra
31	Electrical machinery	Maharashtra
32	Radio/ T.V.	Karnataka, Maharashtra
33	Medical instruments	Maharashtra
34	Motor vehicles	Maharashtra
35	Other transport equip	Punjab
36	Furniture	Maharashtra
37	Recycling	Gujarat

Source: ASI Data, 2003.

Appendix B - The list of Manufacturing Industries used in analysis

ID	2-digit Industry	4-d ID	4-digit Industry
15	Food products and beverages	1511	Production, processing & preservation of meat, fish, fruit, vegetables, oil, fats.
		1512	Processing and preserving of fish & fish products
		1513	Processing and preserving of fruit and vegetables
		1514	Vegetables and animal oils and fats
		1520	dairy products
		1531	Grain mill products
		1532	starches and starch products
		1533	prepared animal feeds
		1541	bakery products
		1542	Sugar
		1543	Cocoa, chocolate and sugar confectionery
		1549	Other food products n.e.c.
		1551	Distilling, rectifying and blending of spirits
		1552	Wines
		1553	Malt liquors and malt
		1554	Soft drinks; production of mineral waters
16	Tobacco products	1600	Tobacco products
17	Textiles	1711	Preparation and spinning of textile fiber including weaving of textiles.
		1712	Finishing of textile
		1722	Carpet and rugs
		1723	Cordage, rope, twine and netting
18	Wearing apparel	1810	Wearing apparel, except fur apparel
19	Tanning & dressing of leather; leather goods	1911	Tanning and dressing of leather
		1912	Luggage, handbags, and the like, saddlery and harness
		1920	Footwear
20	Wood & cork & wood products, except furniture;	2010	Saw milling and planing of wood
		2021	Products of wood, cork, straw and plaiting materials
		2022	Builders' carpentry and joinery
		2023	Wooden containers
21	Paper and paper products	2101	Pulp, paper and paper board
		2102	Corrugated paper & paperboard & of containers of paper & paperboard
		2109	Other articles of paper and paperboard
22	Publishing, printing & reproduction of	2221	Printing
		2222	Service activities related to printing
23	Coke,petroleum product	2320	Refined petroleum products
24	Chemicals and chemical products	2411	Basic chemicals except fertilizers and nitrogen compounds
		2412	Fertilizers and nitrogen compounds
		2413	Plastics in primary forms and of synthetic rubber.
		2421	Pesticides and other agro chemical products
		2422	Paints, varnishes and similar coatings, printing ink and mastics
		2423	Pharmaceuticals, medicinal chemicals and botanical products
		2424	Soap & detergents, perfumes and toilet preparations
		2429	Other chemical product n.e.c.
		2430	Man-made fibers
25	Rubber and plastics products	2511	Rubber tyres and tubes; retreading and rebuilding of rubber tyres
		2519	Other rubber products
		2520	Plastic products
26	Other non-metallic mineral products	2610	Glass and glass products
		2691	Non-structural non-refractory ceramic ware
		2692	Refractory ceramic products
		2693	Structural non-refractory clay and ceramic products
		2694	Cement, lime and plaster
		2695	Articles of concrete, cement and plaster
		2696	Cutting, shaping and finishing of stone
		2699	Other non-metallic mineral products n.e.c.
27	Basic metals	2710	Basic Iron & Steel
		2720	Basic-precious and non-ferrous metals
		2731	Casting of iron and steel
		2732	Casting of non-ferrous metals
28	Fabricated metal products, except machinery and equipment.	2811	structural metal products
		2812	Tanks, reservoirs and containers of metal
		2813	Steam generators, except central heating hot water boilers
		2891	Forging, pressing, stamping and roll-forming of metal; powder metallurgy
		2892	Treatment and coating of metals; general mechanical engineering
		2893	Cutlery, hand tools and general hardware
		2899	other fabricated metal products n.e.c.