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W.P. No. 2011-01-08
January 2011

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AHMEDABAD-380 015
INDIA

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Abstract

Agglomeration economies have been analyzed in the literature as drivers of economic growth, as these contribute to productivity enhancement. The primary objective of this paper is to ascertain the existence of agglomeration economies, and to examine the extent to which these have contributed to productivity growth in India. Two sources of agglomeration economies are distinguished – (i) at the industry level – localization economies of intra-industry linkage; and (ii) at the regional level – inter-industry urbanization economies. Growth accounting framework is used with agglomeration parameters included in the shift term of a general production function, coefficients of which are estimated through panel data regression. I employ state level data for 25 state economies in India for the period 1980-81 to 2006-07. Results provide evidence that urbanization economies tend to exist; however, there is considerable variation in the sources and magnitude of agglomeration economies across sectors. Results indicate that for service sector, the economies of urbanization exist on a lower level of urbanization, whereas for manufacturing, these economies are present at higher levels. Results support regional diversity more than localization, even if some differences can be seen across sectors.

[1] The author is grateful to Prof. Ravindra Dholakia, Prof. Prem Pangotra, and Prof. Tathagata Bandyopadhyay for their valuable guidance and suggestions on an earlier draft of this paper. Any errors remain sole responsibility of the author.
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1 Urbanization and economic growth:

Economic growth and process of urbanization are concomitant, especially in a developing country. Empirical findings have established positive association of urbanization with other socio-economic characteristics. Henderson (2000) has reported a correlation coefficient of 0.85 between GDP per capita, and level of urbanization (percentage) in a cross section of developing countries. Bhagat (2003) reports a correlation coefficient of 0.51 of urbanization with per capita income in Indian states, 0.48 with literacy rate and of -0.49 with infant mortality rate. Many authors have treated rate of urbanization in a region as a driver of regional growth (Mera, 1975; Sachs et al., 2002).

The reason is clear. Economic development is characterized by transformation of agrarian economy into one largely based on industry and service sector activities. These activities thrive in a concentrated environment. High spatial proximity among economic units results in larger information spillovers, lower transportation costs, and more efficiently working labor markets. Link between productivity and agglomeration forms the subject of this paper. It seeks to provide empirical evidence of existence and differences among the agglomeration benefits in industrial and service sectors in the Indian state economies. The paper also attempts to deal with the issue related to the distinction between urbanization and localization, what Rosen, and Resnick (1980) term as the issue of industrial scope. Localization is intra-industrial. The economies arising due to localization are internal to the industry, but external to the firm. Urbanization economies, on the other hand, are inter-industry; they are external both to the firm and the industry, but internal to the region in question. Distinction between these two has a long usage in the literature, a detailed discussion on which is provided in the next section. In this paper, I develop a framework to analyze the impact of urbanization and localization economies on total factor productivity in Indian states.

The paper is structured as follows. Section 2 provides a brief review of the empirical literature on agglomeration and productivity. Section 3 sets out some measures of urbanization and localization, and discusses the data used for estimation. The production function model, measurement of total factor productivity, and related issues are discussed in section 4. Section 5 presents the results of estimation of agglomeration economies, and conclusions are then drawn in the final section.

2 Agglomeration economies:

The concept of agglomeration economies implies that spatial concentration of economic activity generates positive effects on the productivity of economic units located in the region. Agglomeration economies are a form of external economies. The usual classification, introduced by Hoover (1948), and followed by many thereafter, distinguishes between localization and diversity (urbanization) economies. The former is the benefits arising due to clustering of a particular industry at a location, whereas latter refers to the positive effect of industrial diversity of the local system.

Localization economies are external to the firm, but internal to the industry. They emerge due to several reasons, such as: (i) wider buyer-supplier linkages (Venables, 1996) and facilities for the development and local trade of specialized inputs and services (Krugman, 1991; Ciccone & Hall, 1996; Graham, 2009); (ii) availability of larger labor pool with industry specific skill-set (iii) spatial information spill-over's (Glaeser et al, 1992); and, (iv) better availability of public intermediate inputs tailored to the technical needs of the industry in question (Henderson, 1986).

Firstly, the proximity of suppliers and customers, or the backward and forward linkages respectively, help to create a local milieu or network conducive to more effective production and economic growth. High local demand allows a greater number of producers of intermediate inputs to break-even, and an increased variety of intermediate goods in turn makes the production of final goods more efficient. Secondly, the pooled labor market is beneficial, both to the firms, and to the employees. A large local base of a specific industry protects workers from business uncertainty and demand shocks. Local industry concentration generates competitive conditions in the labor market for both the employees and firms. Further, knowledge spillovers, particularly important in the high technology and innovative sectors, may appear in many ways. Knowledge and ideas about new products and production techniques can be transferred by imitation, business interactions, and inter-firm circulation of skilled employees or by informal exchanges. Finally, concentration of industry leads to high demand of public utilities in the region, which are provided more than often by the Government, and sometimes by pooled efforts of the industry. However, it is difficult to establish the direction of causality, as availability of efficient, industry specific infrastructure may also act as a catalyst for concentration of industry in a region.

Urbanization or diversity economies are external to the firms as well as to the industry. They are a function of city size, and of the variety of economic activity present at the same location. The sources of these economies are diverse, such as – (i) Access to supporting services, like transportation, communication, banking, marketing, advertising, legal and accountancy services, etc. (Jacobs, 1969); (ii) larger labor pool with multiple specialization (Scott, 1986); (iii) inter-industry information transfers (Lall et al, 2001) etc.

A well functioning infrastructure of transportation and communication offer transfer savings for firms. Moreover, the proximity of markets and easy access to specialized services such as financial, legal, advisory etc. facilitate the operations of firms and enable them to allocate their resources more effectively without having to provide all required services on their own. As Jacobs (1969) concludes, "the urban environment yields a greater return on new economic knowledge and encourages innovation."

2.1 Past studies:

The literature on Agglomeration economies is wide and tries to capture mainly two aspects. One is the comparatively recent strand of literature identifying the sources of agglomeration externalities and verifying their genuine existence (Ellison & Glaeser, 1997). Further, there is a long-standing body of work, stretching back over 30 years, which has sought to determine whether agglomeration economies, either internal or those of urbanization or localization, have induced higher productivity in industries, or more specifically, in manufacturing industries (Graham, 2009).

The earliest empirical studies of agglomeration tended to focus on estimation of urbanization economies for the manufacturing sector as a whole. Most of these studies examine the impact of urbanization economies on labor productivity. A number of US studies also used city (or Metropolitan Statistical Area – MSA) population to represent urbanization yielding the following estimates of the urbanization elasticity: Kawashima (1975) 0.20 (elasticity of output with respect to city size), Moomaw (1981) 0.03 (elasticity of output with respect to city size), Moomaw (1985) 0.07 (elasticity of average labor productivity with respect to city size), and Sveikauskas et al. (1988) 0.01 (elasticity of average labor productivity with respect to city size).

The other main source of urbanization economy studied in the literature is economic diversity. Urban diversity can yield external scale economies through the variety of consumer and producer goods. Empirical studies by Bostic et al. (1997), Garcia-Mila, and McGuire (1993) show that diversity in economic activity has considerable bearing on the levels of regional economic growth. The later type of benefit is particularly important in developing countries, where most manufacturing industries thrive on low skills and low wages but abundant local labor forces.

There is extensive empirical literature supporting the positive effects of localization economies (Henderson 1988, and Ciccone and Hall 1996). In a study of Korean industry, Henderson et al. (1999) estimate scale economies using city level industrial data for 1983, 1989, and 1991-93, and find localization economies of about 6 to 8 percent.

Nakamura (1985), Henderson (1986) and Henderson (2003) distinguish urbanization and localization effects within the same model. Nakamura (1985) estimates the effect of localization economies on the productivity of 20 manufacturing industries. He quotes an un-weighted average elasticity of productivity with respect to industry size of 0.05. This compares to an average city-size elasticity of 0.03, and thus Nakamura (1985) concludes that the effects of localization tend to be more significant than urbanization. Henderson (1986) also finds weak evidence of urbanization economies using industry level data for US MSAs and Brazilian cities but does find positive localization economies.

Studies focusing on presence and magnitude of agglomeration economies in India are limited. First such attempt was made by Shukla (1988), where she estimates the overall elasticity of manufacturing (and some sub-sectors) with respect to level of urbanization. Lall et al (2001) measure economies of urbanization and localization at the national level using data from the Annual Survey of Industries for 11 sub-sectors of manufacturing sector. They find negative urbanization economies (diseconomies) for most of the sectors, and, localization economies turn out to be non-existent. Mitra(2000), using panel data for 15 major states in India, in growth accounting framework, find evidence of positive urbanization economies in 11 out of 17 two-digit level industries in India.

None of the studies focuses on agglomeration economies in service sector in India. Since service sector now contributes significantly to total output, and has a significant share in employment, analysis of productivity improvements in the sector is likely to provide meaningful insights. The benefits of agglomeration, of either localization or diversity, are likely to accrue to service sector as well. The other contribution of the present study is inclusion of all the 25 Indian state economies[3] in the analysis. Generalization of results is becomes more meaningful when the dataset represents all the states.

3 Data: Measuring urbanization and localization:

In this section, I describe the measures of agglomeration, and the data available for estimation. List of parameters used in past studies for measuring localization and urbanization is long, and the choice here is based on convenience of data availability, more than anything else.

3.1 Urbanization

In this study, I use level of urbanization, and urban diversity as measures of urbanization. Scale economies emanate from the overall size (not only number of economic units, but also population, income, output, and wealth), and diversity of the urban area.

3.1.1 Level of urbanization

Level of urbanization is defined as the proportion of population living in urban areas[4]. Past studies, more than often, have used urban size (urban population) as a variable. However, since the size of Indian states varies enormously, I decide to use level of urbanization, rather than using just urban population as a proxy. Lall et. al. (2001) use urban density (urban population per

[3] Delhi is not included, as it is the capital state, having very different socio-political characteristics than other states. Out of the other 28 states, I have clubbed the data pertaining to years after their formation, of newly carved out 3 states, namely Uttarakhand, Jharkhand, and Chhattisgarh, with their parent states, Uttar Pradesh, Bihar, and Madhya Pradesh respectively.

[4] According to Census of India, an urban area is defined as one having the following three characteristics: (i) population size of 5000 or more; (ii) density of at least 400 persons per square kilometer; and (iii) at least 75% of the male workers to be engaged outside agriculture (Sivaramakrishnan et. al, 2007)

square kilometer area) as a measure of urbanization for studying the impact of urbanization economies on manufacturing sector productivity in India. However, I feel that density is more a function of geographical size of the region, rather than concentration of economic activities per se. I use state level total and urban population data from three census studies in India, done in 1981, 1991, and 2001. I have interpolated the total and urban population numbers for the years in between 1981 to 1991, and 1991 to 2001, using their compound annual growth rates.

Similarly, I extrapolated the total and urban population in the states during the period 2002-2006, using the compound annual growth rate of urban population during 1991-2001. I have also adjusted the census data, measured as on April 1, to mid- financial year values (as on October 1). I then calculated the level of urbanization for each state, in each year, by dividing the urban population by the respective total population.

3.1.2 Diversity:

In order to capture the effects of inter-industry agglomeration, I include an indicator of diversity as a summary measure of urbanization economies accruing across all industry sectors, and provide benefit to all firms in the region. Jacobs (1969) argues that important knowledge transfers occur across industry sectors, and diversity in the local industry mix is important for these transfers. He argues that cities are breeding grounds of innovative ideas as diversified knowledge is concentrated and shared in cities. Cities promote the development of new products, as new ideas emerge, and can be tested through varied processes in the cities.

Therefore, industries with Jacobs's type externalities tend to cluster in more diverse and larger areas. The benefits of locating in a large diverse area go beyond the technology spillover argument. Firms in larger diverse areas have better access to business services, such as banking, advertising, and legal services. In this study, I use the Herfindahl index to measure the degree of economic diversity in urban areas of each state. The Herfindahl index of region r (H_r) is the sum of squares of employment shares of all the industries present in region r (Lall et.al. 2001). Specifically

$$H_r = \sum_{i=1}^{n} \left(\frac{E_{ir}}{E_r}\right)^2$$

Where, E_{ir} is the employment in industry i in region r, and E_r is the total employment in region r. Unlike measures of specialization, which concentrate on one industry, the diversity measure considers the industry mix of the regional economy. The largest value of H_r is one, when the entire regional economy is dominated by one single industry, and the smallest value is (1/n). Thus, a higher value of the index signifies a lower level of diversity in the regional economy. Therefore, for a more intuitive interpretation of diversity measure in the model, H_r is subtracted from unity. That is:

$$D_r = 1 - H_r$$

3.2 Localization:

There are several measures used in the literature to indicate localization of particular industry in a region, e.g. own industry employment, number of own industry establishments etc. However, a unit-dimensional measure such as number of establishments might not be able to represent localization justifiably. Therefore, I use Location Quotients (LQs) as an indicator of localization of economic activity. LQ is a widely used measure in regional economics, to find out the economic base of a region. It is the ratio of employment share (or output) of a sector in the region to the nation (or any reference economy) as a whole. A value of LQ greater than one shows high domination of the sector in the regional economy.

$$LQ_{ir} = \frac{E_{ir}/E_r}{E_{in}/E_n}$$

Where E represents employment, subscripts i, r, and n represent industry, region, and nation (reference economy) respectively. Primarily I expect localization economies to be positive; however, empirical analysis in the next section will help in determining the exact sign and magnitude of these economies for industries and services in India.

4 Estimation:

In the growth accounting literature, agglomeration economies are measured as a part of the Hicksian efficiency term, which represents a shift in the production function (Mitra, 2000). I have attempted to measure the contribution of agglomeration economies to the total factor productivity for the states and sectors in India. The analytical framework for the empirical estimation is presented below:

Let the production function[5] for the regional economy be:

$$Q = A(U, t).F(K, L) \quad \ldots\ldots (1)$$

Where Q denotes gross output, U is a vector of agglomeration factors, K capital, and L labor input. The term A (U, t) is the standard Hicks-neutral efficiency function that allows for exogenous shift in production function. This technology may exhibit diminishing, constant, or increasing returns to scale. Agglomeration economies will be manifested as an outward shift in the production function (Hulten et. al. 2006).

Assuming that the terms in the production function above are multiplicative:

$$Q_{i,t} = A_0 . e^{\sum_{k=1}^{p} \gamma_k . U_{i,t,k}} . F(K_{i,t}, L_{i,t}) \quad \ldots\ldots (2)$$

Where subscript t denotes time, and i denotes region. The parameter A_0 indicates the initial level of productive efficiency; γ is the parameter of interest here, measuring the size of agglomeration economies arising due to urbanization.

The Hicksian shift term, A (U, t) is measured in the growth accounting literature with the help of Solow model of residual total factor productivity growth. Total factor productivity is defined as the ratio of output to the direct inputs, used in the process of production (Hulten et.al. 2006). Therefore:

$$TP_{i,t} = {Q_{i,t}}/{F(K_{i,t}, L_{i,t})} = A_0 . e^{\sum_{k=1}^{p} \gamma_k . U_{i,t,k}} \quad \ldots\ldots (3)$$

Therefore, measurement of total factor productivity across regions, over time provides us with the required data and framework for the measurement of agglomeration economies.

[5] I refrain from using a trans-log production function for the study, because it relies on actual observations to estimate cost shares. However, in India, GSDP data is marred with measurement errors. Also, data on capital input is not directly available, therefore using its estimates based on certain assumptions, to estimate cost shares is not advisable (See Appendix 2).

4.1 Measuring Total Factor Productivity:

The first step in estimating $TP_{i,\,t}$ follows Solow in measuring productivity as a residual output not attributable to the inputs of labor and capital. Analytically, the Solow residual is the growth rate of output less the growth rate of inputs weighted by their relative shares. This yields the expression:

$$\frac{\delta \ln TP}{\delta t} = \frac{\delta \ln Q}{\delta t} - \pi_k . \frac{\delta \ln K}{\delta t} - \pi_l . \frac{\delta \ln L}{\delta t} \qquad \text{...} (4)$$

Each term on the right side of equation (4) can be measured or imputed from published data, yielding an estimate of Total factor productivity growth that can in turn be used, in the context of equation (3) to estimate the size of agglomeration economies.

The problem lies in the fact that in India, factor shares data at the state level is not available. For manufacturing sector alone, factor shares can be calculated with the help of Annual Survey of Industries Data, however, even it requires a lot of attention and care to derive those. For the purpose of this study, I have relied on the methodology suggested by Dholakia (1985) (See Appendix 1).

Using the national level values of π_k and π_l based on Dholakia (1985), I proceeded to measure the total factor productivity growth (TFPG) for all the states, for all the years from 1980 to 2006. I used equation 4 to arrive at the estimates of TFPG. I used net capital stock at real (1993-94) prices, and no. of workers employed as capital and labor variables in the equation 4.

Further, I have estimated the level of total factor productivity, following the trans-log index procedure, developed by Jorgenson and Nishimizu (1978), and extended by Hulten et. al. (2006). This method computes total factor productivity in each state in some base year as the output of the state relative to the output of all-India, less the inputs in the state, relative to all-India, weighted by the relative cost shares:

$$\frac{\dfrac{\ln \frac{TP_i}{TP_n} = \ln \frac{Q_i}{Q_n} - \overline{\pi_k} \ln K_i}{K_n} - \overline{\pi_L} \ln L_i}{L_n} \qquad \text{..} (5)$$

Where $\overline{\pi_k} = \frac{(\pi_K^i + \pi_K^n)}{2}$; $\overline{\pi_L} = \frac{(\pi_L^i + \pi_L^n)}{2}$

However, due to the lack of state level data on relative factor shares, I have assumed that factor shares remain constant across states, and applied the same national level figures.

Since total factor productivity is an index number, it must be normalized to the base value of some year and place. Following Hulten et.al. (2006), I have assumed 1980 as the base year, and average level of total factor productivity across states is taken as the base value. Using these values, I have converted the total factor productivity values for all states in 1980 to indexed values. These values are then grown at the average annual growth rate of TFPG.

4.2 Measuring the impact of Agglomeration economies on Total factor productivity:

After arriving at the estimates of TFP, I proceed to estimate the elasticity of output with respect to agglomeration parameters. The parameters of equation 3 are estimated by regressing the annual estimates of total productivity levels by state, on each states own agglomeration parameters, time, and a constant term.

Continuing from equation 3, I take logs and write:

$$\ln TP_{i,t} = \ln A + \sum_{k=1}^{p} \gamma_k U_{i,t,k} \qquad \text{.. (6)}$$

Or more specifically

$$\ln TP_{i,t,k} = \ln A_k + \gamma_{1k}.U_{it} + \gamma_{2k}.U_{it}^2 + \gamma_{3k}.Div_{it} + \beta_k.LQ_{itk} \qquad \text{...................... (7)}$$

Where i, t, and k denote state, year, and sector respectively. U represents the level of urbanization, Div represents diversity index, LQ represents location quotient of the sector in the state. γ_i's and β are coefficients of urbanization and localization economies respectively.

5 Results and Discussion:

The parameters of the above equation are estimated using the sample of 675 observations – 27 years and 25 states for 2 main sectors, manufacturing, and services. Service sector is further divided into 3, namely (i) Trade, hotel, and restaurants; (ii) Transport, storage, and communication; and (iii) other services – including banking and financial services; real estate, ownership of dwellings, and business services; and public administration and defense. A fixed effect approach[6] was used to allow for differences in the initial levels of technical efficiency among the states. After an initial positive contribution to TFP, urban population scale may also represent diseconomies[7], in terms of congestion, and rising land cost (Carlino, 1979). I have also included square of the level of urbanization in the estimation, as a factor of agglomeration, to capture the diseconomies. Sector wise results are presented in table 5.1.

With regard to agglomeration economy of urbanization, I examine the estimated coefficients γ_1 and γ_2 for the 4 sectors included in the analysis. From table 5.1, it can be seen that γ_1 is positive for transport, and other services sectors, while it is negative for manufacturing and trade sectors. A coefficient of -0.09 for manufacturing sector suggests that a one percent increase in level of urbanization results in 9% reduction in level of total factor productivity. However, I have included an urban square term in the regression, to capture the non-linearity of the relationship. For manufacturing sector, urbanization economies measured by level of urbanization depict a U shape (figure 5.1).

[6] The appropriateness of fixed effect approach was verified by the use of Hausman test, results of which are not presented here.
[7] According to Mills (1967), "…as the city's population grows, efficient production of goods requires the use of somewhat more land as well as somewhat higher structures. At least this is true of any production function that has diminishing returns to factor proportions. Consequently, as a city grows, it moves out as well as up, and this entails diseconomy in transportation resources."

Table 5.1: All states - Panel data estimation					
		Manufacturing	**Trade**	**Transport**	**Other Services**
1	Intercept	1.570 (9.83)*	1.426 (12.48)*	-1.292 (-6.79)*	0.79 (6.35)*
2	Urban	-0.090 (-10.52)*	-0.032 (-5.16)*	0.0645 (5.34)*	0.0218 (3.47)*
3	Urbanization square	0.0012 (11.22)*	0.00011 (1.45)	-0.001 (-6.19)*	-0.00036 (-4.12)*
4	Diversity	0.773 (5.01)*	0.375 (3.33)*	2.0121 (7.86)*	
5	Localization	-0.230 (-4.38)*	-0.170 (-6.20)*	-0.584 (-12.09)*	-0.19 (-8.19)*
	R_square	0.7923	0.8748	0.8040	0.9134

Note: *and ** show significance at 1% and 5% levels respectively. Figures in parentheses are values of t statistic

Figure 5.1 shows the results of estimation, where LQ and diversity index are kept constant at their average levels. It is clearly visible from the figure that although there are negative externalities for manufacturing sector initially, after achieving a threshold level of urbanization equal to 37-38%, there are positive returns to urbanization, in terms of increasing level of total factor productivity. For the initial 10% level of urbanization, the elasticity of total factor productivity with respect to level of urbanization lies between 8.2-6.4%. It reduces to 4.2%-1.9% when level of urbanization increases from 20% to 30%. After 37-38% level of urbanization, there are positive externalities up to 2.9% as level of urbanization reaches 50%. At a lower level of urbanization, other supporting services do not develop much to help in cost reduction. Besides the local labor market is also not concentrated enough to provide the benefits of competition. This shows that manufacturing units benefit by locating in very large urban areas, and not in small cities.

For trade sector however, both the urban and urban square coefficients are negative, showing a continuous decline in the level of total factor productivity with increase in urbanization. This shows that there are negative externalities from concentration to trade sector. The elasticity of total factor productivity with respect to level of urbanization reduces with increase in level of urbanization. For the initial 10% level of urbanization, the value of this elasticity lies between 3.1%-2.9 percent. However, it reduces to 2.5% to 2.3% as the level of urbanization rises from 30% to 40%. Results from other empirical studies support these findings. Combes (2000) suggests that higher levels of concentration produce information spill-over and larger input and output market size. This is important for traditional manufacturing more than services such as metal-working, smelting, automobile industry, manufacturing of machine tools etc. These industries require specific inputs, and their buyers are also specific.

Mitra (2000) analyzes agglomeration economies in total factor productivity for Indian manufacturing industry. He found that for the manufacturing sector overall, there is a U shaped relationship between level of urbanization and total factor productivity. Magnitude of the coefficient of level of urbanization found by Mitra (2000) is -0.035, and that of square of level of urbanization is 0.00011, values which are consistent with the estimates. At the sub-sector level Mitra (2000) found that the relationship holds for sectors such as woolen textiles, jute textiles, machinery other than transport, and rubber, petroleum, and coal products.

For transport and other services sectors, relationship between urbanization and level of total factor productivity represents an inverse U shape (Figure 5.1[8]). This means that initially these sectors benefit by locating in smaller cities, and not by very large metropolitan areas. Initially, at lower levels of urbanization, existence of these services generates information spillovers, and backward-forward linkages with other activities. Therefore, the level of elasticity of total factor productivity with respect to level of urbanization lies between 6.3% to 4.6% for transport sector and 2% to 1.2% for other services, as level of urbanization increases up to 10%. However, at higher levels of urbanization, negative impacts of congestion, such as high costs due to competition for skilled labor, exhaustion in terms of product and process innovations etc. lead to reduction in level of total factor productivity. For transport sector, the negative elasticity lies between 0.2 to 3.3% when level of urbanization increase past 32-33%, and reaches 50%. For other services, the negative elasticity for similar range of urbanization is 0.01% to 1.3%.

[8] For other services sector, I have used equation without diversity index as a parameter of agglomeration to control for multi-co linearity.

These results for service sector are supported by studies from Combes (2000) and Rattso and Stokke (2010). Combes (2000) found impact of agglomeration economies declining with increasing concentration. He explains,” dispersive effects of price competition on output are reflected in services like wholesale trade, the middleman business, renting of personal goods, and insurance. High competition among firms means higher land-rent or higher wages for skilled labor; this decreases the local firms’ survival rate.” Similarly, Rattso and Stokke (2010) found lower economies of urbanization for service sector for regions in Norway. They conclude,” urbanization benefits to service sector expansion are not much. Consumption led expansion of urban services (as in Norway) carries limited agglomeration effects.”

Urbanization economy with respect to diversity is positive for all the sectors. This shows that increase in the level of diversity leads to backward and forward linkages, and information spillovers cause technological progress to happen faster. However, for trade sector these results are contradictory, as a higher level of urbanization will lead to greater diversity, and the signs of the coefficients of these two with respect to level of total factor productivity for trade sector are opposite.

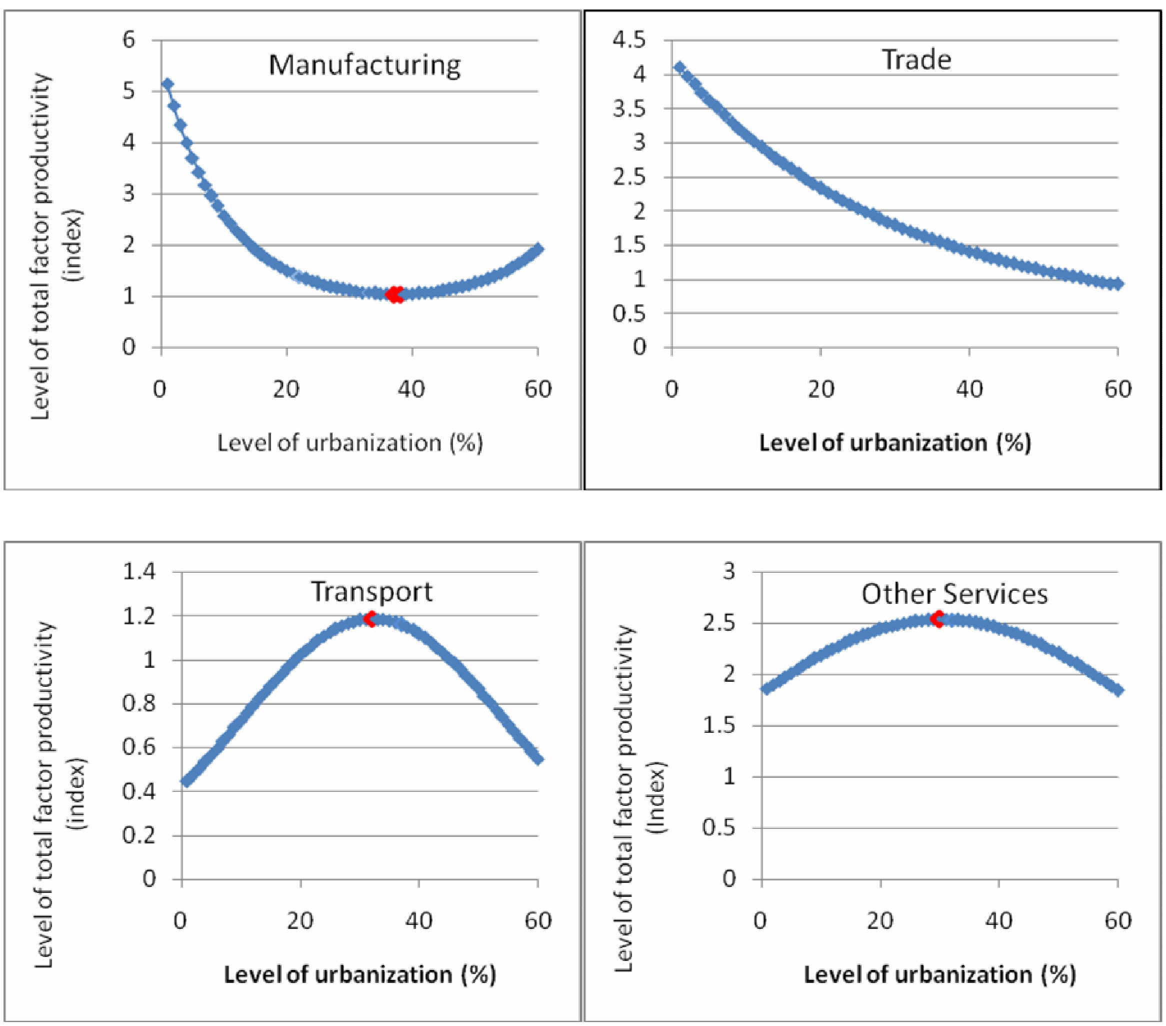
Positive diversity economies for manufacturing sector are supported by Jacobs (1969) as he mentions that knowledge spill-over are more persistent across industries. Glaeser et. al. (1992) also support this hypothesis for U.S. manufacturing data at city level. They have found that it is diversity which leads to high employment growth in manufacturing industry rather than specialization. Paci and Usai (2006) found positive externalities of diversity for productivity growth in Italy for manufacturing as well as service sectors.

Combes (2000) has found positive diversity externalities for services as well as industry, and the magnitude of these is higher for the former than the later. He explains, “In services, inputs are fairly diversified, and outputs are not specific to given sectors or given type of consumers. Firms consequently benefit from facing a great variety of sectors located in the same place, because of both supply and demand linkages.”

Results of estimation for localization economies are similar across sectors. For all the sectors in the study, there are negative localization economies. Coefficient of location quotient parameter bears negative sign in all the sectors. However, value of the coefficient lies between the highest -

0.584 for transport sector, to the lowest -0.13 for other services sector. Several empirical studies have found specialization diseconomies, e.g. Glaeser et. al (1992), Combes (2000) etc. Combes (2000) explains that for most of the services (retail trade, consulting, financial and insurance services, education and social work) and some of the manufacturing industries (e.g. pharmaceutical industry); the negative specialization effect can be explained in terms of a product's life-cycle. Products or here more particularly services, first develop at a few places, and then diffuse across space." For other manufacturing sectors he explains," these sectors usually have a declining share in employment, and higher specialization reflects lower flexibility and adaptability of products, and regions with lower specialization are better able to reconvert their activities."

Figure 5-1: Total factor productivity and level of urbanization



Similarly, Graham (2009) found negative elasticity of localization for labor productivity in service sector (especially retail and public services). He suggests that the reason could be intense price competition due to localization, resulting in less turn-over per unit sold. He further suggests that these results might also reflect reduced tendency of these services to localize. He asserts, "Retail and public services tend not to have strong tendencies towards localization for the reason that they have to serve a market dispersed according to the geography of the population. So they will tend to benefit from concentration of people rather than like activities."

6 Conclusion:

In this paper, I have attempted to establish the existence and estimate the magnitude of agglomeration economies across sectors in India. I have used level of urbanization and diversity as measures of urbanization, and location quotients as a measure of localization, to test for transmission of spatial externalities across space. The estimation analysis is based on a general production function model, using growth accounting framework for 25 states in India over 27 years, across 4 sectors.

Results support the hypothesis that urbanization economies tend to exist, and vary significantly across sectors. For service sector, the economies exist on a lower level of urbanization, whereas for manufacturing, these economies are present at a higher level. I find positive urbanization externalities for manufacturing, transport, storage, and communication, and other services sectors, in varying magnitudes. The elasticity of productivity with respect to diversity is positive, however, the magnitude varies across sectors. The fact that I do not find positive localization economies for services seems reasonable because services such as banking, real estate, business services, etc. often locate close to the consumer, and have typically low tendency to localize. A further state level estimation of these economies is warranted with adequate length of data over-time, so that the regional differences in the magnitude of these externalities, and their resulting impact on regional growth differential can be brought out.

7 References:

Bhagat, R B. 2003. Urbanization in India: a Demographic Reappraisal. International Union for Scientific Study of Population, p.p.1-17.

Bostic, R. 1997. Urban productivity and factor growth in the late 19th century. *Journal of Urban Economics*, *4*, p.p. 38-55.

Carlino, G.A. 1979. Increasing Returns to Scale in Metropolitan Manufacturing. Journal of Regional Science, 19, p.p. 363-374.

Ciccone, A. & R. Hall. 1996. Productivity and the density of economic activity. American Economic Review, 86, p.p. 54-70.

Combes, P.P. 2000. Economic structure and local growth: France, 1984-1993. Journal of Urban Economics, 47, p.p. 329-355.

Dholakia, R. H. 1985. Regional Disparity in Economic Growth in India. Himalaya Publishing House, Bombay.

Ellison G. & E. Glaeser. 1997. Geographic concentration in US manufacturing industries: A dartboard approach. Journal of Political Economy, 105, p.p. 889-927.

Garcia-Mila, T., & T. McGuire. 1993. Industrial mix as a factor in the growth and variability of state's economies. *Regional Science and Urban Economics*, *23,* p.p. 731-748.

Glaeser, Edward L., Kallal, Hedi D., Scheinkman, Jose A., & Andrei Shleifer. 1992. Growth in Cities. The Journal of Political Economy, 100 (6), p.p. 1126-1152.

Graham, D.J. 2009. Identifying urbanization and localization externalities in manufacturing and service industries. Papers in Regional Science, 88(1), p.p. 63-84.

Henderson, J. 1986. Efficiency of resource usage and city size. Journal of Urban Economics, 19, p.p. 47-70.

Henderson, J.V. 1988. Urban development: Theory, fact, and illusion. New York: Oxford University Press.

Henderson, V., Lee, T., & J.Y.Lee. 1999. Externalities and Industrial De-concentration under rapid growth, mimeo, Brown University.

Henderson, V. 2000. How urban concentration affects economic growth. World Bank Policy Research Working Paper No. 2326.

Henderson, V. 2003. Marshall’s scale economies. Journal of Urban Economics, 53, p.p. 1-28.

Hoover, E.M. 1948. The Location of Economic Activity. New York: McGraw Hill.

Hulten C.R., Bennathan E. and S. Srinivasan .2006. Infrastructure, Externalities, and Economic Development: A Study of Indian Manufacturing Industry. Mimeo, World Bank.

Jacobs, Jane. 1969. The Economy of Cities. New York: Vintage.

Jorgenson, D.W., & M. Nishimizu. 1978. U.S. and Japanese Economic Growth, 1952-1974: An international Comparison. Economic Journal, 88(352), p.p. 707-726.

Kawashima, T. 1975. Urban agglomeration economies in manufacturing industries. Papers of the Regional Science Association, 34, p.p. 157-175.

Krugman, P. 1991. Increasing returns and economic geography. Journal of Political Economy, 99(3), p.p. 483-499.

Lall, S., Z. Shalizi, & U. Deichmann. 2001. Agglomeration Economies and Productivity in Indian Industry. The World Bank Publication.

Mera, K. 1975. Income Distribution and Regional Development, University of Tokyo Press.

Mitra, A. 2000. Total Factor Productivity Growth and Urbanization Economies: A Case of Indian Industries. Review of Urban and Regional Development Studies, 12(2), p.p. 97-108.

Moomaw, R.L. 1981. Productivity and city size: A review of the evidence. Quarterly Journal of Economics, 96, p.p. 675-688.

Moomaw, R.L. 1985. Firm Location and City Size: Reduced Productivity Advantages as a Factor in the Decline of Manufacturing in Urban Areas. Journal of Urban Economies, 17, p.p. 73-89.

Nakamura, R. 1985. Agglomeration Economies in Urban Manufacturing Industries: A Case of Japanese Cities. Journal of Urban Economies, 17, p.p. 108-124.

Paci, R. & S. Usai. 2006. Agglomeration economies and growth- The case of Italian local labor systems, 1991-2001. Working Paper CRENoS 200612, Centre for North South Economic Research, University of Cagliari and Sassari, Sardinia.

Rattso, J. & H.E. Stokke. 2010. Migration and dynamic agglomeration economies: Time-series evidence from Norway. Norwegian research council.

Rosen, K.T. & M. Resnik. 1980. The size distribution of cities: an examination of the Pareto law and primacy. Journal of Urban Economics, 8, p.p. 165-186.

Sachs, J. D, N. Bajpai & A. Ramaiah. 2002. Understanding Regional Economic Growth in India. CID Working Paper No. 88, Harvard University, March.

Scott, A. J. 1986. Industrialization and Urbanization: A Geographical Agenda. Annals of the Association of American Geographers, 76(1), p.p. 25-37.

Shukla, V. 1988. Urban development and regional policy in India: An econometric analysis. Himalaya Publishing House, Mumbai.

Sivaramakrishnan K.C., Kundu A., & B.N. Singh. 2007. Handbook of urbanization in India. New Delhi: Oxford university press.

Sveikauskas, L., Gowdy, J., & M. Funk. 1988. Urban productivity: City size or industry size. Journal of Regional Science, 28, p.p. 185-202.

Venables, A. 1996. Equilibrium locations of vertically linked industries. *International Economic Review, 49*, p.p. 341-359.

Visaria, P. 1998. Workforce and employment in India, 1961-1994. Mimeo, International Association of Income and wealth, Government of India.

Appendix 1: Measuring factor shares at the state level

Dholakia (1985) describes why it is different to apply the growth accounting framework to inter-region, within a country comparisons, as against the international comparisons, because in the former case, there is a common national market for factors of production. Especially, capital as a factor of production can be assumed perfectly mobile within a country. Therefore, it can be assumed that marginal product of capital remains uniform across states in India. Labor mobility however, is somewhat restricted by cultural and institutional barriers. As a result, wage rate vary significantly across regions, depending on average productivity of labor among other factors such as qualitative differences. However, several empirical studies have shown that average productivity of labor is an important determinant of wage rate. Dholakia (1985) has therefore assumed that marginal product of labor varies proportionately to average product of labor, an assumption, which leads to a constant labor share across states in India.

I have tested the assumptions above, with cross-section data for 25 Indian states included in the study, over the period 1980-81 to 2006-07. The preliminary test supported both the hypothesis for Indian data. Therefore I used the constant relative shares of labor and capital for further analysis. Relative share of labor (β) is 0.4798, and relative share of capital is ($1 - \beta$) 0.5202.

Appendix 2: Measurement of labor and capital inputs

State capital stock

State level data on capital employed in production is not available in public domain in India. Past studies have relied on individual scholars' efforts to estimate capital stock at the state level. From 1988, Central Statistical Organization (CSO) has started publishing capital stock data for the Indian economy as a whole at the sectoral level. First such estimates were provided in 1988, pertaining to the year 1981. I have made use of this all India data to come up with state level capital stock estimates across sectors. The crucial underlying assumption that I have to make is that the sectoral capital-output ratio remains the same for all the states in India in each year. I have tried to widen the sectoral classification as much as possible, in order to increase the representation of the true characteristics of the sector. However, I admit that it is a heroic assumption to make, and limits the accuracy and reliability of results.

I have obtained net capital stock data from National Accounts Statistics published by CSO for the years 1980-2006, and converted it to 1993-94 prices. I then calculate the capital-output ratios (CORs) for all the sectors in all years for the Indian economy, and apply these sectoral CORs to estimate the net capital stock data at state level in various sectors. The estimates thus obtained are used in the general production function estimation to estimate total factor productivity index. The sectoral classification used for estimating net capital stock is as follows: (1) Agriculture; (2) Forestry and Logging; (3) Fishing; (4) Mining and Querying; (5a) Manufacturing Registered; (5b) Manufacturing Unregistered; (6) Construction; (7) Electricity, Gas, and Water supply; (8a) Railways; (8b) Transport by other means; (8c) Storage; (8d) Communication; (9) Trade, hotels, and restaurants; (10) Banking and insurance; (11) Real estate, ownership of dwellings, and business services; (12) Public administration, and defense ; (13) Other services.

Labor input:

Data for labor input at state level in India is available from two main sources, census studies, undertaken in every 10 years, and survey reports of National Sample Survey Organization (NSSO). Generally, in growth accounting studies, labor input is measured as total man-hours worked, which is considered to be a more realistic and accurate measure than the number of workers employed. However, actual employment figures on an annual basis covering all sectors of the economy and number of hours or even days worked are not available in India, even at all-India level. Annual employment figures are published only for the organized sector; number of person-days worked is available only for manufacturing industries, only from the Annual Survey of Industries. As part of the NSSO surveys, average person-days employed data is available only for usually occupied workers, as per the data collected through the daily status approach. However, that data is also not reliable for generating an annual series, largely due to the presence of self employed and unpaid family workers in the Indian economy. Due to these limitations, in the present study, estimated number in the workforce is used as the measure of the quantity of labor input.

The data available from the two above-mentioned sources shows wide variations[9]. Three census results are available for the period of the current study, in 1981, 1991, and 2001. The definitions of main, marginal and non-workers were same across these censuses. However, in order to ensure the inclusion of unpaid family farm workers, the phrase "including unpaid work on farm or in family enterprise" was added from 1991 onwards (Sivasubramonian, 2004). There were differences in the geographical coverage also. Census 1981 was not conducted in Assam, and Jammu and Kashmir was not included in 1991.

Within the period of this study, five survey reports from NSSO are available, in the years 1983 (38th round), 1987-88(43rd round), 1993-94(50th round), 1999-2000(55th round), and 2005-06(62nd round). Out of the three approaches used by NSSO for data collection, the usual status approach (or activities of the previous year) is considered as comparable to the census results (Sivasubramonian, 2004).

As per the analysis, done by Sivasubramonian (2004), worker population ratios as per the successive census results, show a declining trend in the years 1971, 1981, and 1991, and then return to the previous levels of 1961. These results do not match with the NSSO estimates, which

[9] For a detailed discussion on these differences, see Sivasubramonian (2004).

are consistent with the 1961 census. Visaria (1998) has pointed out, "it hardly needs any persuasion to accept that the estimates of WPRs could not be fluctuating downwards in the Census years 1971, 1981, and 1991, and returning to the former level, comparable to the 1961 Census, whenever NSSO conducted its quinquennial surveys. There is little doubt that the NSS investigators have done better than more than million Census enumerators."

In view of this, the present study uses the NSSO estimates from the five quinquennial surveys. Based on these periodic estimates, using inter-period rates of growth, annual estimates of the number in the workforce have been obtained.

The age composition of the workforce could not be considered in the present study, due to inconsistency of the data availability across NSSO reports. The reports in 1983 and 1987-88 do not report the age-distribution of workforce at the state level.