Inshoring: the Geographic Fragmentation of Production and Inequality

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Abstract

The advent of information technology facilitates geographic separation of production. Nevertheless, the research on inshoring has been limited, even though the literature on offshoring has flourished. This paper examines inshoring on both empirical and theoretical fronts. Empirically, it shows that business support services are increasingly sent to small localities for cost savings and being separated from their downstream industries. Theoretically, it analyzes welfare impact of inshoring. Contrary to predictions in the offshoring literature, support workers can be better off, primarily because they can benefit from higher urban productivity without bearing urban costs.

JEL: R11; R12; R13; R23

Key words: Inshoring; geographic fragmentation of production; welfare inequality; system-of-cities

1 Introduction

The advent of information technology, including the Internet, has allowed geographic separation of certain production tasks. For instance, lawyers and legal typists used to work in the same building, but now, typists can type a lawyer's dictation miles away from where the lawyer works. In other words, the typing services can be sourced from remote locations, and the consequence is *geographic fragmentation of production.*

To date, much of academic discussion of the above sourcing practice is on *offshoring*, which applies to an international context where businesses relocate some of their production tasks to foreign countries. Nevertheless, this sourcing practice can also take place domestically. For instance, a law firm in New York City may send its typing jobs to North Dakota but India. In the press, such domestic sourcing is often termed *inshoring*[1].

Although the literature on offshoring has flourished[2], inshoring remains an understudied area. However, inshoring deserves research attention. This is because, from a domestic perspective, labor is mobile, and therefore, inshoring may have a different impact from offshoring, which is in an environment with immobile labor.

This paper studies, both empirically and theoretically, the inshoring of business support services, such as customer services and telephone call centers, which is most influenced by progress of information technology. There are four main empirical findings. First, the paper provides clear evidences that business support service industries have been growing substantially faster in smaller localities, and as the result, geographic concentration of these industries has been shifted away from big cities and toward small cities and rural areas. Second, downstream industries of the business support services are identified through an examination of input-output flows. It is found that geographic distribution of the downstream industries has remained stable and has been more concentrated in big cities. Third, further examination suggests a growing trend toward geographic fragmentation of production, that is the separation between the business support services and their downstream industries in different locations. Also, there is an increased tendency for business support workers to be geographically separated from others. Lastly, the study shows that low wages in small localities are the primary reason that attracts the business support

[1] Inshoring includes both outsourcing and in-housing sourcing. The former is involved with procuring goods and services from outside contractors, while the later is not. Although this paper follows the convention and use inshoring this term to avoid possible confusion, one may find that inshoring and outsourcing are really synonymous when he or she considers establishments as firms, which is how economists often think in doing empirical research given the design of U.S. Economic Censuses. In a companion paper of mine (Liao, forthcoming), the geographic fragmentation of production is termed outsourcing.

[2] Researchers, including, but not limited to, Pol Antras, Rechard Baldwin, Luis Garicano, Gene Grossman, Elhanam Helpman and Esteban Rossi-Hansberg have made significant contributions to this literature.

service industries.

Theoretically, a simple general equilibrium model of a system of cities (see Abdel-Rahman and Anas, 2004, for a thorough review and discussion on this type of models) is formulated, and the construction of the model is guided by the above empirical findings. The model comprises large localities that are called cities and small localities that are called rural areas, and it consists of skilled managers who execute managerial work and unskilled clerks who perform support work. The agglomeration of managers in cities creates knowledge spillovers, which attract firms to cities. However, firms face a trade-off between labor costs and remote communication friction, and this is a key element of the model. On the one hand, clerks in rural areas demand less wage compensation, because commuting costs and housing prices are low. On the other hand, these clerks have lower marginal productivity than their urban counterparts, due to the friction caused by remote communication with them. New technologies that lower the friction can increase clerks' marginal productivity in rural areas. As the consequence, support jobs are sent to rural areas by firms through inshoring and separate from managerial jobs. Since labor is mobile, clerks relocate in response to the labor demand shift, and this leads to segregation.

The most surprising theoretical finding concerns welfare impact. The paper shows that the reduction in communication friction leading to inshoring *necessarily* benefits unskilled clerks but has an *ambiguous* welfare impact on skilled managers. Overall, the inshoring *unambiguously* decreases welfare inequality between the two types of workers. While details will be explained later, the basic reason is that the inshoring allows clerks to benefit from higher productivity without bearing urban costs. The above implication is in sharp contrast to the findings in the international trade literature about the impact of offshoring. For instance, Antras, Garicano and Rossi-Hansberg (2004) and Kremer and Maskin (2006) both show that unskilled workers are worse off relative to skilled workers in the origin country in which firms adopt offshoring. This distinction is due to the different model assumptions on labor mobility– workers are mobile domestically but immobile internationally.

On the theoretical front, the paper closest to mine is that of Duranton and Puga (2005) who also analyze geographic fragmentation of production. When communication friction is high, firms integrate managerial and manufacturing functions in the same city, and cities feature sectoral specialization in equilibrium. When communication friction is low, firms separate the two functions in different cities, and cities feature functional specialization in equilibrium. My paper is different. Whereas their paper assumes multiple sectors and homogeneous workers and focuses on change in cities' industrial structure, this paper assumes heterogeneous workers and one single sector and focuses on welfare impact. Additionally, this paper is also related to Liao (forthcoming), but the difference is that this paper focuses on an empirical examination of inshoring and a theoretical analysis of its welfare impact, while that paper introduces a richer model which provides interesting implications for how firms optimize the variety of tasks to be "inshored" and how the inshoring interacts with various local labor and housing markets.

On the empirical front, there have been a few papers on domestic outsourcing, i.e., the use of domestic outside contractors. Abraham and Taylor (1996) show that domestic outsourcing is significant at the national level, and Ono (2007) shows that firms in big cities are more likely to adopt outsourcing. My paper is different from theirs in two aspects. First, this paper analyzes inshoring that includes both outsourcing and in-house sourcing, though it does not attempt to make a distinction between the two subtypes of sourcing. Second, this paper focuses on the process of geographic fragmentation of production, which is not touched on in their papers.

The remainder of this paper is organized as follows. Section 2 presents the empirical findings. Section 3 introduces the model and provides the theoretical analysis. Section 4 concludes.

2 Empirical Findings

This section presents empirical findings using data from County Business Patterns (CBP), Input-Output Accounts (I-O Accounts), and Integrated Public Use Microdata Series (IPUMS). The presentation is organized into five parts. The first part includes a discussion on the data sources and data construction. The second part is an examination of growth and geographic concentration of the industry performing inshored business support services. The third part identifies downstream industries of the business support services and studies where they are. The fourth part includes assessments on geographic separation between the business support service industry and the downstream industries and between business support workers and other types of workers, and the fifth part concerns why small cities attract the business support service industry.

2.1 Data Sources

The CBP is an annual establishment-level microdata in the form of cell counts by employment-size class, industry, and location. The publicly released information includes establishment and employment counts as well as payroll. However, CBP routinely withholds data regarding employment and payroll to meet nondisclosure requirements, and nondisclosure is common for large employment-size classes and small localities. Thus, one would need estimates of employment if the research question concerns employment in a particular industry at a particular location. I follow the approach of Holmes and Stevens (2002) to estimate mean employment by employment-size class. It is assumed that establishment employment follows a log-normal distribution, and a procedure of the generalized method-of-moments is applied to estimate the parameters of this distribution. Holmes and Stevens (2004) provide more information on details and quality of this procedure and the CBP data.

The I-O Accounts, published by the Bureau of Economic Analysis, provide the make and use of commodities by each industry. With detailed information on flows of goods and services in production processes of domestic industries, the I-O Accounts facilitate research on interindustry relationships within the country. This paper makes use of 1997 Benchmark I-O Accounts for a purpose that will be explained later.

The IPUMS is an integrated data source on the American population. In addition to the U.S. Decennial Census of Population and Housing, IPUMS also consists of the American Community Survey (ACS), which is an annual census first initiated in the year 2000. Since IPUMS is not a panel dataset, one needs to take care of or be aware of comparability issues if research is to examine changes across census years.

This research makes use of 1998 and 2006 CBP data, as well as data from the 2000 Census and 2006 ACS. To facilitate comparisons, these data are aggregated to a metropolitan level, at which metropolitan boundaries follow the current metropolitan-area definition, the 2003 Core Based Statistical Areas (CBSA). By this definition, each metropolitan area is a union of a set of counties. This is advantageous as compared to the previous MSA/CMSA definitions. Aggregating CBP data to the CBSA level is simple because county-level information is available. Aggregating IPUMS data is harder, because IPUMS does not have county information and the aggregation is involved with mapping metropolitan areas onto PUMA geographic units. Jaeger et al. (1998) discuss issues and quality of this mapping strategy.

2.2 Growth and Geographic Concentration of Business Support Services

The industry of interest here is the Business Support Services (BSS), NAICS 5614, which is defined in the North America Industrial Classification System as an industrial group that "comprises establishments engaged in performing activities that are ongoing routine, business support functions that businesses and organizations traditionally do for themselves" and is selected for the following reason. A main theme of this paper is the inshoring of day-to-day routines of businesses, and therefore, NAICS 56 is potentially the pool of industries that can be looked at. However, to reflect the inshoring most influenced by the advent of IT and the interest or concern of the American public on offshoring versus inshoring of lower skilled office occupations, the study would not cover industries like logistics, protection services, cleaning, etc., that have a local context and industries like financial planning that are rather skilled. In addition, the study would not cover industries like travel arrangement and personal services that also largely engaged in serving private households. Taking all these into consideration, the most appropriate industry for the purpose of the study is the BSS.

The BSS consists of various sub-industries including Document Preparation Services, Telephone Call Centers, Business Service Centers, Collection Agencies, Credit Bureaus, etc. Since many U.S. industries rely on these services, BSS has been an important industry with about 800 thousand employees. Furthermore, BSS is fast growing. It grew by 21% between 1998 and 2006, while U.S. total employment only grew by 11% during the period.

The BSS is a "low-skilled" industry, as its contents of work have a lower skill requirement. In 2000, only 16 percent of BSS workers had a bachelor's degree, while 23 percent of American workers had the degree. The lower education profile of BSS is because the Office and Administrative Support occupations (the SOC definition), that generally do not require a bachelor's degree, are the backbone of BSS. In 2000, 48 percent of BSS employees were in these occupations, but only 17 percent of American workers were in.

One might have a question on whether BSS data examined here are about inshoring or outsourcing. The NAICS definition of BSS might sound like outsourcing, but the data studied here are, in fact, about inshoring because of the design of Economic Census, the primary source of CBP's industry classification. The Economic Census is conducted on an establishment basis, and each establishment is assigned a separate industry classification based on its primary activity and not on that of its parent company. Thus, BSS establishments identified in CBP can include a customer service center directly owned by a bank.

The maps in Figure 1 illustrate the employment growth in BSS between 1998 and 2006 for each metropolitan area, i.e., city[3]. The year 1998 was the first year that CBP identified BSS, because BSS was not defined in the industrial classification system until 1997. In the maps, cities filled with dots had a growth rate below the mean growth rate during the eight-year period, while cities filled with backslashes had a growth rate above the mean. Panel A highlights BSS growth for the ten biggest cities on a gray background. Nine out of these ten cities had a growth rate below the average. The only exception was Miami, Florida. Panel B highlights BSS growth for other cities with more than one million people on a gray background. Most of these cities also had a growth rate below the mean. Thus, the maps seem to suggest that the growth of BSS was highly concentrated in small cities.

[3] All 360 metropolitan areas identified by the 2003 definition had positive employment in both 1998 and 2006.

[Insert Figure 1 here]

Table 1 presents the growth of BSS employment and the change in the BSS location quotient (LQ) between 1998 and 2006 by city-size class[4]. The LQ is a ratio measuring geographic concentration of economic activity in the area of interest. Here, it is the location's share of U.S. BSS employment relative to the location's share of U.S. total employment. The higher the ratio is, the higher the concentration. If every location has a LQ that equals to 1, then the geographic distribution of the activity is even across locations. As the table shows, overall growth of BSS employment was considerably higher for cities in smaller size classes. While the growth rates were only 4.8% for the ten biggest cities and 8.9% for other cities with more than one million people, the growth rate was 39.6% for cities with a population between a quarter million and one million. For the smallest class, which also includes rural areas in addition to cities with less than a quarter million people, the growth rate was 41.2%. Since the two largest size classes had faster growth in total employment, the geographic concentration of BSS greatly shifted from big cities to small cities and rural areas during this eight-year period, as shown in the table. Particularly, smaller cities with a population between a quarter and one million had already become the places with the highest BSS concentration, and the 10 biggest cities had already featured a weak presence of BSS.

[Insert Table 1 here]

2.3 Downstream Industries of BSS: Who and Where

It is necessary to identify the downstream industries (DIs) of BSS and study where they are, since this paper concerns geographic separation of production. Here, DIs are identified through examining input-output flows using 1997 Benchmark I-O Accounts. Then, geographic concentration of DIs and geographic separation between DIs and BSS are studied.

Table 2 presents the use of BSS as intermediate inputs by industry. The industries are classified by their 2-digit NAICS codes, expect for two 3-digit industries that used BSS much more intensively than did other industries with their superordinate 2-digit NAICS code. This can be viewed in column 7 which reports a ratio on "BSS intensity." This intensity ratio is the share of BSS services used by an industry divided by the share of total value added created by the industry. Those industries with a ratio greater than one used BSS more intensively. The first ten industries in the table are those with an intensity ratio greater than one. They used 80% of the intermediate goods supplied by BSS but accounted for only 47% of the total value added. Thus, these ten industries are considered the DIs: the main users of BSS.

[4] The result is not sensitive to the selection of size classes' threshold values.

[Insert Table 2 here]

To assess upstream-downstream ties between BSS and other industries, it may be more conventional to calculate the value of an industry's BSS inputs per dollar value of the industry's output, as in Ellison and Glaeser (1997). However, the intensity ratio defined above is instead used, because a multiple number of downstream industries need to be identified. The intensity ratio is an advantageous measure in this situation, as it provides an objective cutoff above which the upstream-downstream relationship is strong. Actually, the more conventional measure and the intensity ratio were both calculated for each industry listed in Table 2, and it was found that the correlation between the two measures is above 98%.

Table 3 presents DIs' growth of employment and change in LQ between 1998 and 2006 by city-size class. Unlike BSS, DIs were always more concentrated in larger cities, and the geographic distribution of DIs remained quite constant over the period. These were in stark contrast to BSS's change in geographic concentration.

[Insert Table 3 here]

2.4 Geographic Separation of Production and Workers

Tables 1 and 3 jointly seem to indicate a growing tendency of geographic fragmentation of production, as the upstream BSS increasingly locate in smaller localities and the downstream DIs remain in larger localities. This indication is supported by an examination using Ellison Glaeser Coagglomeration Index (Ellison and Glaeser, 1997), which measures overall degree of geographic clustering or separation for plants in different industries. Ellison, Glaeser and Kerr (2007) prove that, when studies concern coagglomeration of two industries, the Index's formula can be reduced to a special form. In the context of this research, the special form can be written as:

$$\gamma^c = \frac{\sum_j \left(S_{j,BSS} - S_j\right)\left(S_{j,DIs} - S_j\right)}{1 - \sum_j S_j^2} \tag{1}$$

where γ^c is the index value, and $S_{j,BSS}$, $S_{j,DIs}$, and S_j denote location j's share of U.S. BSS, DI, and national employment, respectively. The denominator of the index eliminates the sensitivity to choices of geographic fineness, and the value of the coagglomeration index crucially depends upon the covariance of the locations' employment shares in the two industries. If the index value is greater than zero, then there is more agglomeration of plants among the two industries than what would be expected if each industry was as agglomerated as it is, but each industry's agglomeration locations were independent of the other industry's . Simply put, plants in the two different industries tend to co-locate in the same place. If the value equals to zero, there is no coagglomeration. If the value is negative, then plants in different industries tend to locate in different places.

Table 4 presents values of the coagglomeration index in 1998 and 2006. The first column concerns "coagglomeration" of BSS and DIs in the four city-size classes. Coagglomeration, in fact, may not be a most suitable term here, as localities in the same size class are not adjacent. Rather, the reported values give a sense on whether BSS and DIs are situated in different sizes of cities. Eq. (1) makes it clear that the values are closely related to the information presented in Tables 3 and 4, as those two tables report BSS LQ ($S_{j,BSS}/S_j$) and DI LQ ($S_{j,DIs}/S_j$) which are highly correlated with $S_{j,BSS} - S_j$ and $S_{j,DIs} - S_j$, respectively. As the result, it is not surprising to see a substantial decrease in the index, and the decrease indicates a growing tendency for BSS and DIs to locate in different sizes of cities over the period.

[Insert Table 4 here]

The second column in Table 4 presents the overall level of coagglomeration between BSS and DIs, using metropolitan areas and rural counties' data. The reported numbers are not much different from zero, possibly for two reasons. First, the index's absolute value tends to be small, by construction[5]. Second, the variance of $S_{j,DIs} - S_j$ is small, as DIs are broadly classified. Thus, the important pieces of information here are rather on the sign and change. The index values were negative for both years, but the value in 2006 was substantially lower, indicating that BSS and DIs already tended to locate in different places in 1998, and the tendency had considerably increased since then. Such pattern of decreasing level of coagglomeration could be due to progress of IT that dramatically reduced data transmission costs and allowed the separation of BSS and DIs, since Marshall's theory suggests that saving trade costs is a crucial reason for the coagglomeration of industries with input-output dependency.

Does inshoring result in geographic separation of office and administrative support workers (hereafter referred to as the support workers) from others? Table 4, which suggests geographic fragmentation of production, cannot answer this question, because establishments in BSS not only employ the support workers, and plants in DIs do hire this type of employees. Since CBP does not have occupational information, IPUMS data are used, to calculate support workers' LQ by city size class for getting a sense of the relationship between their concentration and location size and to compute two segregation indexes

[5] See Ellison and Glaeser (1997), and Ellison, Glaeser, and Kerr (2007).

for measuring overall degree of separation between the support workers and other types of workers.

Table 5 presents LQ of the support workers in BSS and DIs put together. This is the location's share of BSS and DIs' support workers relative to the location's share of BSS and DIs' total employment. The table reports this LQ by city-size class by census year and indicates a shift in geographic concentration of the support workers. In 2000, these workers were almost evenly distributed across the four classes, but in 2006, they were more concentrated in smaller locations. Also presented are percentage changes in LQ during the period. Bigger size classes consistently had a smaller percentage change.

[Insert Table 5 here]

To assess the overall degree to which the BSS and DIs' support workers are separated from other types of workers, two measures are used. The first one is the dissimilarity index:

$$Dissimilarity = \frac{1}{2}\sum_{j}\left|\frac{S_j}{S} - \frac{O_j}{O}\right|$$

where S_j and S refer to the number of the BSS and DIs' support workers in location j and the country, respectively, and O_j and O refer to the number of non-support workers in location j and the country, respectively. This index indicates the share of the support workers who would have to relocate in order to achieve an even distribution across cities and rural areas.

The second measure is a correlation index as proposed by Kremer and Maskin (1996). Denoted by λ, the index is defined as:

$$\lambda = \frac{\sum_{j} N_j\left(\Pi_j - \Pi\right)^2}{N\Pi\left(1 - \Pi\right)}$$

where N_j and N refer to BSS and DIs' total employment in location j and the country, respectively, and Π_j and Π refer to support workers' share of N_j and N, respectively. In addition, the 95% confidence interval for this index is

$$\frac{F\left(N-J, J-1\right)_{0.025}}{F\left(N-J, J-1\right)_{0.025} + \frac{1-\lambda}{\lambda}} \leq \lambda \leq \frac{F\left(N-J, J-1\right)_{0.975}}{F\left(N-J, J-1\right)_{0.975} + \frac{1-\lambda}{\lambda}}$$

where J is the total number of locations. This index normalizes the variance of support workers' share of employment across locations by dividing by the variance of worker status (either a support or a non-support worker) of the country. An index of zero indicates that all locations have the same mix of support and non-support workers, and an index of one indicates complete separation.

Table 6 presents time paths of the dissimilarity and correlation indexes. The first two columns are essential and are concerned with geographic separation between the support workers and all other workers in BSS and DIs, put together. The indexes' values reported in these two columns suggest that, although the support workers were still distributed quite evenly across locations, there was a significant tendency toward increasing separation of the support workers from others between 2000 and 2006, since the dissimilarity index increased from 0.050 to 0.064, and the correlation index increased from 0.0034 [0.0031, 0.0038] to 0.0055 [0.0049, 0.0061]. Furthermore, as columns 3 and 4 reveal, the tendency of the separation is stronger, when index calculation only includes office workers in BSS and DIs[6]. Additionally, columns 5 and 6 also suggest the separation among office workers in all industries.

[Insert Table 6 here]

2.5 What Attracts BSS to Small Localities

This section examines why BSS employment grows substantially faster in smaller localities, using the approach below. Firstly, a bivariate regression that indicates a negative relationship between BSS growth and location population is performed, and then, a process of adding explanatory variables is applied to identify the underlying reason for small localities to attract BSS. The logic behind this approach is the following. A researcher can definitely argue that the estimated negative relationship from the bivariate regression is subject to omitted variable bias; there may be an omitted variable, say the wage rate, that is both correlated with BSS growth and location population. Because of the omission, the influence on BSS growth that should be rightly attributed to the wage rate is picked up by location population. If the inclusion of this previously omitted variable does eliminate the impact of location population on BSS growth from the regression, then the researcher can argue that it is the wage rate, which is positively correlated with location population, that accounts for BSS growth, but not location population itself. In other words, the lower wage rate is the underlying reason for smaller localities to attract BSS.

To identify the underlying reason for small localities to attract BSS, three sets of control variables are included to assess three competing hypothesis. The first set of variables, which include the percentage of location employment in DIs in 1998 and the logarithmic change of DI employment between 1998 and 2006, examines whether BSS growth is tied to the proximity of DIs, which use BSS more intensively than do other industries[7]. Such an examination is needed, as one would naturally suspect that the reason for BSS to grow faster in small localities is simply because DIs are there or are growing faster there. This hypothesis is sound, if the inshoring requires physical proximity of BSS to DIs: If DIs must use local BSS,

[6] The office workers include those with a managerial, professional specialty, technical, sales, or administrative support occupation.

[7] The percentage of city employment in DIs is equivalent to the LQ of DIs up to a scale.

then a location with a higher geographic concentration of DIs or a faster DI growth should also have a faster BSS growth during a wave of inshoring of business support services.

The second set of variables is on localization and urbanization economies. There are appealing theories that attribute industrial growth to these external economies, whereby a firm can benefit from innovations and improvements that occur outside the firm but within the locality. Glaeser et al. (1992) test these theories, using CBP data and examining growth determinants for industries in 170 of the largest U.S. metropolitan areas. This paper follows their approach to take into account the influence of several sources of external economies on BSS growth in regression analysis. However, the main purpose here is not on growth determinants of BSS, but on whether taking into consideration these sources of external economies can explain away the negative relationship between location population and BSS growth and thus identify a reason for BSS to grow faster in small localities.

Three variables on external economies are included. The first variable is about specialization, the MAR externality. Marshall (1890), Arrow (1962) and Romer (1986) discuss how knowledge spillovers in a specialized, geographically concentrated industry can lead to faster growth for that industry. The second variable is about diversity. Jacobs (1969) believes that the diversification of geographically proximate industries can stimulate innovation and growth for local industries. The third is local competition (Porter, 1990) which stimulates the pursuit of innovations and improvements as opposed to monopoly.

Here, specialization in a location is measured by the percentage of the location's employment in BSS, and diversity in location j is measured by the formula below:

$$Diversity_j = -\sum_{i \neq BSS} x_{ij}^2$$

where x_{ij} indicates industry i's share of location j's total employment. This measure is the sum of the squares of the location's employment shares for all industries except BSS multiplied by negative one. A higher value of this measure indicates greater diversity. Lastly, local competition of a location's BSS is the number of establishments per worker in BSS in the location divided by ditto in the country. If this measure is greater than one, the degree of competition in the location is stronger than the national average.

The third set of variables is about local labor market conditions. The variables include wages and measures on labor suitability, and the data are from the 2000 Census. Documented in various sources, the primary reason for offshoring is to access low-cost labor. Possibly, this is also a key motive behind inshoring. Thus, locations' average wage rates are considered. Specifically, these are the average hourly wages of workers in the Office and Administrative Support occupations, the backbone of BSS[8].

A more suitable labor force composition may attract BSS. Following Glaeser and Kerr (2008), two measures of labor suitability are used. Classifying workers' educational attainment into 14 categories according to the groupings of the 2000 Census, the first measure is defined as

$$Suitability_j = -\sum_k \left| L_k^{BSS} - L_{k,j}^{ALL} \right| \tag{2}$$

where the subscript k indicates the category of educational attainment and the subscript j indicates the location. L_k^{BSS} is the percentage of BSS national employment in category k, and $L_{k,j}^{ALL}$ is the percentage of location j's total employment in category k. Multiplying the summation by negative one, a higher value indicates that, in terms of educational attainment, the location's labor-force composition is more suitable for BSS. The second measure considers 476 occupations as classified by SOC, and its construction uses the same formula as (2) except that the subscript k instead indicates occupation.

Table 7 provides summary statistics for the above variables used in the regression analysis, and Table 8 presents the correlation matrix. From the matrix, one can see that some variables, such as the average hourly wages, are indeed considerably correlated with both the BSS employment growth and location population. This potentially creates an opportunity for omitted variable bias to apply.

[Insert Table 7 here]

[Insert Table 8 here]

Table 9 presents regression results. The method of estimation is weighted least squares (WLS) as the Breusch-Pagan test constantly rejects the homoscedasticity assumption of OLS. The regressions include state fixed effects that control for unobservable characteristics like state policies and regional environment[9]. The regressions only consider metropolitan areas with more than 250,000 people, due to two limitations of CBP and IPUMS data. First, because of nondisclosure, information from CBP is of limited value for narrowly defined industries in small geographic areas (Holmes and Stevens, 2004). Specifically, industrial employment information used here is derived from the estimates of a log-normal distribution when CBP withholds actual information. Because nondisclosure is common for less populated areas, measurement error may be a problem if the regressions also included rural areas and those rather small metropolitan areas. The second limitation arises from the design of PUMA geographic areas that are the basic geographic units of 2000 Census and 2006 ACS. The PUMAs must contain at least 100,000 people

[8] Using the average hourly wages of all BSS employees or all wage and salary earners yields a similar result.

[9] Among the 166 metropolitan areas with more than 250,000 people, 22 of them (not necessarily big cities) cross state lines. I consider these 22 metropolitan areas as being in the state in which their central city is located.

but can cross county lines. Thus, census information can be coarse for smaller metropolitan areas that follow a county-based definition, like CBSA. Taking the two limitations into consideration, it is decided to include only those metropolitan areas with more than 250,000 people. The results in Table 9 still shed light overall, given the data, presented in any other tables of this paper, all change monotonically in the dimension of location size. Nevertheless, the regressions are repeated and metropolitan areas with more than 100,000 people are included. The results are still similar to those in Table 9 and are reported in Table A1 in the appendix.

[Insert Table 5 here]

The first column of Table 9 shows a significant negative relationship between BSS employment growth and city size. As explained, this could be due to omitted variable bias, and including the three sets of control variables introduced earlier into the regressions allows us to identify which one of the three hypotheses is most plausible in explaining this negative relationship.

The results from Table 9 suggest that lower wages may be the main reason for small cities' success in attracting BSS. As shown in columns 2 and 3, including DI concentration and growth makes little difference to the coefficient of log city size, and including sources of external economies only modestly reduces the coefficient. However, column 4 shows that adding local labor market conditions eliminates the impact of city size on BSS growth almost entirely, and the remaining impact is insignificant. This may be primarily due to the inclusion of the wage rate variable, as it is indicated that a one dollar decrease in the average hourly wage is significantly associated with an extra 16 percent growth of BSS employment, while the effects of the two labor suitability measures are both insignificant.

Column 4 also indicates that the DIs' concentration has insignificant effect on BSS growth. This is not surprising, given tremendous progress in IT and dramatic decrease in communication costs have made a great many business support functions "virtual." Since DIs can inshore the support functions to remote places, a location with a strong presence of DIs need not necessarily have a faster BSS growth during a wave of BSS inshoring. Nevertheless, DIs' growth has a somewhat significant (a 0.10 p-value) positive effect on BSS growth, perhaps because some BSS functions, like copy centers, still more or less have a local context. Thus, a place that atracts DIs might also attract some BSS.

How do localization and urbanization economies affect BSS growth? Glaeser et al. (1992) show that the initial concentration of an industry has a significant negative effect on the industry's growth, while urban diversity and local competition have significant positive influence over the growth. The estimates in column 4 are consistent with their findings.

In summary, the results in Table 9 suggest that BSS grows faster in small cities mainly because support workers are less expensive there. This finding is consistent with the common view that the primary purpose of inshoring/offshoring/outsourcing is to reduce costs.

3 Theoretical Analysis

This section examines impact of inshoring using a simple system-of-cities model in which large institutions called city developers organize cities. This modeling approach is introduced by Henderson (1974) and is widely adopted in the literature. Henderson, as well as other researchers, has argued that the existence of city developers is not an unrealistic assumption, at least for developed countries. With a key element being that firms face a trade-off between labor costs and remote communication friction, the model presented in this section delivers the paper's empirical findings and has implication on welfare inequality. Nevertheless, the implication can also be generated by other modeling approaches such as self-organization. This point will be discussed later.

3.1 Model

For simplicity, assume a large economy that can facilitate a continuum of cities. The model economy has one unit of workers; ϕ units of them are managers, and the rest are clerks. The workers first choose where to live and then inelastically demand one unit of residential land and participate in the local labor market. Their preferences are linear in consumption of a numeraire.

The producers of the numeraire are in cities. They use a Cobb-Douglas production technology which is constant return to scale in two inputs: managers and clerks. Assuming perfect competition, each city has a representative producer with the production function:

$$Y = AH^{a} \left(L + \tau L_r\right)^{1-\alpha}$$

where H and L denote the numbers of managers (skilled workers) and clerks (unskilled workers) in the city, respectively, and L_r denotes the number of clerks who are outside the city and perform the inshored clerical work for the producer. Inshoring is subject to an iceberg cost due to communication friction: Only a τ proportion of the work can be delivered. The larger the proportion is, the better the technology.

The capital letter A, in the above production function, denotes the level of knowledge spillovers which is a function of the total number of managers in the city:

$$A = H^{\gamma}$$

where γ is a parameter on the curvature of this function. It is assumed that only managers–the skilled workers–can contribute to the level of the spillovers. The empirical literature supports this assumption (see Rosenthal and Strange, 2004). It is also assumed that the spillovers only exist locally. Although one might suspect that the advent of information technology could jeopardize the validity of this assumption, empirical literature such as Gaspar and Glaeser (1998) finds that the local context of knowledge spillovers may remain important, because IT and face-to-face communication are not substitutes but complements.

Regarding land use, there is an infinite supply of land on a real line on which monocentric cities can be set up. Each city has a central business district (CBD) in which the production takes place, and residential land is on both sides of the CBD. Workers living in the city pay rent for the one unit of land that they occupy, and they commute between home and the CBD. Let c denote the commuting cost, in terms of the numeraire, per unit of land for a round trip. Let N denote the city population. The city edges are $\frac{N}{2}$ units away from the CBD, and the total commuting cost in the city is:

$$TCC = 2\int_{0}^{\frac{N}{2}} czdz = \frac{cN^2}{4}$$

where z indicates a home location. Thus, cz is the commuting cost for the worker who lives z units away from the CBD. The total commuting cost (i.e., city's total congestion cost) is increasing in city size.

Rural areas are land outside the cities. Because rural areas are inexhaustible and their size is of measure zero, workers living there pay zero rent and zero commuting cost.

Competitive developers set up cities. The sunk cost is zero because rural rent is zero. The representative developer owns city's land and earns rent. The developer has to decide the numbers of managers and clerks that it wants to include in its city. It guarantees utility levels and factor prices (wages) to attract workers and numeraire producers, respectively. It offers a transfer denoted by κ to attract managers who contribute to the city's knowledge spillovers, due to competition with other developers for managers[10]. The developer's profit equals its total revenue from rent minus its total expenditure on transfers. Later, this profit maximization problem will be explained in more details.

One limitation of system-of-cities models is that they work only in a range of parameter values, and

[10] The city developer could also offer a transfer to the clerks. However, the equilibrium value of this transfer will equal zero because clerks do not contribute any spillovers to the city. Thus, I abstract this option from the model.

virtually all researchers focus on symmetric equilibria. To focus on the interesting case, the model of this paper makes three assumptions about parameter values: (i) $\alpha > \frac{1}{3}$, (ii) $\gamma \in \left(\frac{1-\alpha}{2}, \alpha\right)$ and (iii) $\phi > \frac{2\gamma-(1-\alpha)}{2\gamma}$. These assumptions ensure that the equilibrium is unique and symmetric and has a finite city size and positive welfare for both types of workers. Secondarily, if $\gamma < \frac{1}{3}$ and $\phi < \frac{\alpha-\gamma}{1-\gamma}$ are additionally assumed, the welfare of managers will be higher than that of clerks.

Let w_h, w_l and w_{lr} denote the wages of city managers, city clerks and rural clerks, respectively, and let μ denote the total number of cities endogenously formed. Then, the equilibrium and the types of equilibrium outcomes can be defined as follows:

Definition 1 *The equilibrium consists of an allocation (H, L, L_r, N, μ), a price vector (w_h, w_l, w_{lr}) and a transfer κ and satisfies the following conditions: (i) workers maximize utility, (ii) producers maximize profit, (iii) city developers maximize profit, and (iv) the below market clearing conditions hold*[11]

$$\begin{aligned} N &= H + L \\ \phi &= H\mu \\ 1-\phi &= L\mu + L_r\mu \end{aligned} \tag{3}$$

Definition 2 *The economy is completely integrated if all clerks live in cities and are with managers. In this case, $L_r = 0$. The economy is completely segregated if all clerks live in rural areas and are away from managers. In this case, $L = 0$. The economy is partially segregated if clerks are in cities as well as rural areas.*

In this model, the equilibrium maximizes social welfare which is equal to aggregate output minus aggregate commuting cost. The equilibrium is optimal because city developers internalize the knowledge spillovers–the externality–through transfer payments. This is a standard feature of system-of-cities model.

3.2 Equilibrium Analysis

This section studies the equilibrium and includes an analysis on how decreased communication friction leads to geographic fragmentation of production and affects welfare. A quick comparison between two

[11] The second condition implies that managers all live in cities because managerial jobs are only available in cities. The third condition implies that clerks who perform inshored work all live in rural areas because they want to save on commuting costs and rent.

limiting cases, $\tau = 1$ and $\tau = 0$, facilitates discussion on the intuition of key results, while the solution and analysis for the general case, $\tau \in (0, 1)$, is also included.

3.2.1 Compare Two Limiting Cases

In the equilibrium, workers must be indifferent as to where to live. Therefore, the urban cost of living, the sum of commuting costs and rent, must be the same everywhere within the city. Given a population N, the urban cost of living is

$$\text{Urban cost of living} = \frac{cN}{2}$$

since the worker living at the city edge pays zero rent and $\frac{cN}{2}$ commuting costs. By the indifference condition, the rent is $c\left(\frac{N}{2} - z\right)$ for land z units away from the CBD. Thus, the total rent earned by the city developer is

$$\text{Total rent} = 2\int_0^{\frac{N}{2}} c\left(\frac{N}{2} - z\right) dz = \frac{cN^2}{4}$$

$\tau = 1$ In this case, inshoring is frictionless. All clerks strictly prefer living in rural areas, because they can earn as much as if they were in cities and they need not pay the urban cost of living. Thus, $L = 0$ and $H = N$. The city developer's profit maximization problem is

$$\begin{aligned} \underset{\{H,L_r,\kappa\}}{MAX} \quad & \frac{cH^2}{4} - \kappa H \\ s.t. \quad & V_h = w_h + \kappa - \frac{cH}{2} \\ & w_h = \alpha H^{\gamma+\alpha-1} L_r^{1-\alpha} \\ & w_{lr} = (1-\alpha) H^{\gamma+\alpha} L_r^{-\alpha} \end{aligned}$$

where V_h is the indirect utility of managers. (The indirect utility of clerks is $V_l = w_{lr}$ in this case.) The three constraints are "no-incentive-to-leave constraints" solved from the workers' and firms' optimization problems. The intuition of these constraints is as follows: The developer must guarantee managers a utility level, such that managers will not do better if they live elsewhere. Moreover, the developer must guarantee wage rates, which have to be low enough so that the producer is willing to locate in the city and have to be high enough so that workers are willing to work for the city's producer. Through competition, the guaranteed levels are equal among developers in different cities, and the developers simply take these levels as given.

Solving the first order conditions of the developer's problem and using $L = 0$ and (3), we have

$$\kappa = \gamma H^{\gamma} \left(\frac{1 - \phi}{\phi} \right)^{1-\alpha} \tag{4}$$

This rate of transfer internalizes the externality of knowledge spillovers, because it equals the difference between the social and private marginal productivity. Thus, the First Welfare Theorem holds. In addition, the developer earns zero profit in the equilibrium because of free entry. This zero profit condition and (4) together imply that

$$H = \left(\frac{4\gamma}{c} \right)^{\frac{1}{1-\gamma}} \left(\frac{1 - \phi}{\phi} \right)^{\frac{1-\alpha}{1-\gamma}} \tag{5}$$

Then, (3), (5) and $L = 0$ determine the equilibrium allocation which, in turn, determines the equilibrium wages and transfer.

$\boldsymbol{\tau = 0}$ Inshoring clerical work is impossible in this case. All clerks must live in cities, and $L_r = 0$. The developer's profit maximization problem is

$$\begin{aligned} \underset{\{H,L,\kappa\}}{MAX} \quad & \frac{c\,(H+L)^2}{4} - \kappa H \\ s.t. \quad & V_h = w_h + \kappa - \frac{c\,(H+L)}{2} \\ & V_l = w_l - \frac{c\,(H+L)}{2} \\ & w_h = \alpha H^{\gamma+\alpha-1} L^{1-\alpha} \\ & w_l = (1-\alpha)\, H^{\gamma+\alpha} L^{-\alpha} \end{aligned}$$

Solving the equilibrium is analogous to the case of $\tau = 1$. After deriving

$$H = \phi^{\frac{2}{1-\gamma}} \left(\frac{4\gamma}{c} \right)^{\frac{1}{1-\gamma}} \left(\frac{1 - \phi}{\phi} \right)^{\frac{1-\alpha}{1-\gamma}} \tag{6}$$

the rest of the solution can be determined.

Comparison To facilitate comparison, I attach a subscript 1 to the equilibrium elements derived from the $\tau = 1$ case and a subscript 0 to those from the $\tau = 0$ case. A new technology that increases the proportion of deliverable inshored services from 0 to 1 not only leads to geographic separation of production tasks, but also has effects on segregation, city size, average rent, output and welfare.

Increasing τ from 0 to 1 changes the economy from complete integration to complete segregation.

This is because when $\tau = 1$, rural clerks can earn as much as if they were in cities, but they need not pay commuting costs and rent. Thus, clerks strictly prefer rural areas to cities.

The city size gets bigger when τ increases from 0 to 1, because

$$N_1 = H_1 > \phi^{\frac{1+\gamma}{1-\gamma}} H_1 = \frac{1}{\phi} H_0 = N_0$$

given $\phi \in (0, 1)$. Since the First Welfare Theorem holds, we can use the social planner's view to explain why city size increases. The intuition is as follows: Adding a manager into the city when a clerk leaves, the city size does not change, and the total commuting cost stays the same. However, there are more knowledge spillovers in the city, because the population of managers has increased. As the result, the marginal benefit of agglomeration increases and outweighs the marginal cost of congestion at the original city size. Thus, city size should increase by adding even more managers. The bigger city size then implies a higher average rent in the city and higher aggregate output of the economy.

As τ increases from 0 to 1, clerks are strictly better off because

$$V_{l1} = H_1^{\gamma} (1 - \alpha) \left(\frac{1 - \phi}{\phi} \right)^{-\alpha} > H_0^{\gamma} (1 - \alpha) \left(\frac{1 - \phi}{\phi} \right)^{-\alpha} - \frac{cN_0}{2} = V_{l0}$$

In the new equilibrium, clerks not only save on commuting costs and rent by living in rural areas, but also earn higher wages, because the higher level of knowledge spillovers makes producers more productive. However, managers may be either better or worse off. Although managers earn higher wages at $\tau = 1$, they also have to pay a higher urban cost of living. In a numerical example with $\alpha = 0.66$, $\phi = 0.5$ and $\gamma = 0.2$, the new technology makes managers worse off.

Nevertheless, increasing τ from 0 to 1 unambiguously decreases welfare inequality, defined as the ratio of managers' welfare to clerks', because

$$\frac{V_{h1}}{V_{l1}} = \frac{\alpha + \gamma - 2\gamma}{1 - \alpha} \frac{1 - \phi}{\phi} < \frac{\alpha + \gamma - 2\gamma\phi}{1 - \alpha - 2\gamma (1 - \phi)} \frac{1 - \phi}{\phi} = \frac{V_{h0}}{V_{l0}}$$

Here, $\frac{1-\phi}{\phi}$ reflects how welfare inequality depends upon the economy's relative supply of clerks to managers, and the change in the ratio from $\frac{\alpha+\gamma-2\gamma\phi}{1-\alpha-2\gamma(1-\phi)}$ to $\frac{\alpha+\gamma-2\gamma}{1-\alpha}$ reflects the impact on welfare inequality when τ increases from 0 to 1.

To see this, let us consider the following facts. First, both types of workers earn a constant share of economy's aggregate output. This is α for managers and $1 - \alpha$ for clerks. Second, aggregate urban cost of living is a constant proportion, 2γ, of the aggregate output. Half of this cost is aggregate congestion (commuting costs), and the other half is aggregate rent which eventually becomes part of managers' income through developers' transfer payments.

Third, when the economy is completely integrated ($\tau = 0$), all workers share equally the aggregate urban cost of living. Thus, a ϕ proportion of this cost is paid by managers, and the rest $1 - \phi$ proportion is paid by clerks. However, when the economy is completely segregated ($\tau = 1$), the entire aggregate urban cost of living is paid by managers, while clerks do not pay any. This is why the new technology decreases welfare inequality.

In summary, the new technology that facilitates inshoring benefits clerks, because it allows them to access the high productivity in cities without paying the urban cost of living. Eliminating communication friction makes the marginal productivity of rural clerks as high as their urban counterparts, and living in rural areas saves on urban living costs. This generates the sorting of clerks into rural areas and leads to complete segregation. Because accommodating clerks, who do not contribute to knowledge spillovers, in cities is no longer a constraint, cities are able to increase in size and productivity (knowledge spillovers). Through inshoring, rural clerks can further benefit from this additional higher productivity. On the other hand, managers may not necessarily benefit from the sorting. Although they can obtain higher incomes, they must also pay higher urban living costs. Finally, welfare inequality is mitigated, because there is redistribution in who pays the aggregate congestion costs and who is the ultimate source of developers' transfer payments; clerks do not pay these at all after the sorting.

One might suspect that the above welfare implication is driven by the functions of city developers. With transfer payments, managers are seemingly landlords since they ultimately receive all rental revenues. Thus, one might suspect that welfare inequality is mitigated just because clerks no longer need to "subsidize" managers as τ increases from 0 to 1. Below, I quickly show that this suspicion is not borne out by using an alternative modeling approach — *self-organization*, which is typically found in the literature, e.g., Anas (1992) and Venables (2005). Under this approach, sorting is created through atomistic decisions of workers and firms, but not actions of large institutions like city developers. Here, I briefly sketch a model of self-organization and discuss its solution.

Assume no city developers, *distribute each city's rental revenue to all of its residents equally* (as is assumed in many models), translate the utility function in the previous model by x units, and keep everything else the same as in the previous model. Recall that the model economy is large and can facilitate a large number of cities in equilibrium. This implies that, in equilibrium, cities are symmetric and managers and clerks must be indifferent between established cities and a potential city with ε or an infinitesimal number of managers (see Henderson, 1974, for a discussion of this fact). Therefore, we can use this indifference condition of managers to pin down the equilibrium number of managers in established cities. Then, the potential city's ratio of managers to clerks can be adjusted to hold the indifference condition of clerks. It is not difficult to verify that mangers' indirect utility is x in both $\tau = 0$ and $\tau = 1$ cases, but the equilibrium number of managers in established cities increases when τ increases from 0 to 1. Then, it is readily seen that clerks' indirect utility is increased and welfare inequality is mitigated when τ increases from 0 to 1 because, by living in rural areas, clerks benefit from not only saving the commuting costs but also the higher productivity of firms (due to more knowledge spillovers) in the new equilibrium with frictionless inshoring.

3.2.2 General Case

The solution for the general case in which $\tau \in (0,1)$ and the propositions about how a marginal increase in τ affects the model economy are presented here for the sake of completeness. The intuition of the propositions is fairly similar to that in the previous discussion.

For this general case, the developer's problem can be written as:

$$
\begin{aligned}
\underset{\{H,L,L_r,\kappa\}}{MAX} \quad & \frac{c\,(H+L)^2}{4} - \kappa H \\
s.t. \quad & V_h = w_h + \kappa - \frac{c\,(H+L)}{2} \\
& V_l = w_l - \frac{c\,(H+L)}{2} \\
& w_h = \alpha H^{\gamma+\alpha-1}\left(L+\tau L_r\right)^{1-\alpha} \\
& w_l = (1-\alpha)\, H^{\gamma+\alpha}\left(L+\tau L_r\right)^{-\alpha} \\
& w_{lr} = \tau\,(1-\alpha)\, H^{\gamma+\alpha}\left(L+\tau L_r\right)^{-\alpha} \\
& H \geq 0;\ L \geq 0;\ L_r \geq 0
\end{aligned}
$$

The non-negative constraints are not binding when the value of τ is in the following range:

$$
(\underline{\tau}, \bar{\tau}) = \left(\frac{(1-\alpha) - 2\gamma\,(1-\phi)}{(1-\alpha)}, \frac{(1-\alpha)}{(1-\alpha) + 2\gamma\left(\frac{1-\phi}{\phi}\right)} \right)
$$

When $\tau \in (\underline{\tau}, \bar{\tau})$, the equilibrium is characterized by partial segregation: Clerks can be found in cities as well as rural areas. The equilibrium is characterized by complete integration when $\tau \leq \underline{\tau}$ and complete segregation when $\tau \geq \bar{\tau}$.

Solving the developer's problem, we have

$$\kappa = \gamma H^{\gamma} \left(\rho + \tau \left(\frac{1-\phi}{\phi} - \rho \right) \right)^{1-\alpha} \tag{7}$$

and

$$H = \left(\frac{4\gamma}{c} \right)^{\frac{1}{1-\gamma}} (1+\rho)^{\frac{-2}{1-\gamma}} \left(\rho + \tau \left(\frac{1-\phi}{\phi} - \rho \right) \right)^{\frac{1-\alpha}{1-\gamma}} \tag{8}$$

where ρ denotes the ratio of clerks to managers in the city. The equilibrium value of this ratio is a decreasing function in τ:

$$\rho = \frac{1-\alpha-2\gamma\frac{\tau}{1-\tau}\frac{1-\phi}{\phi}}{2\gamma-1+\alpha} \ , \quad \forall\tau \in (\underline{\tau}, \bar{\tau}) \tag{9}$$

Together with (3) and the first order conditions of the producer's profit maximization problem, the above three equations, (7), (8) and (9), determine the equilibrium allocation, wages and transfer. The next two propositions concern the impact of a marginal increase in τ when $\tau \in (\underline{\tau}, \bar{\tau})$.

Proposition 1 *When $\tau \in (\underline{\tau}, \bar{\tau})$, a marginal increase in τ increases the number of clerks in rural areas. In addition, city size and average rent increase.*

Proof. Let θ denote the total number of clerks in rural areas. We have $\theta = 1-\phi-\rho\phi$. Since $\frac{\partial\rho}{\partial\tau} < 0$, we have $\frac{\partial\theta}{\partial\tau} > 0$. Next,

$$\frac{\partial N}{\partial \tau} = \frac{(1+\gamma)(1-\phi)-(1-\alpha)(1-\tau)}{(1-\gamma)(1-\tau)(\phi-\tau)} N$$

It is not difficult to verify that $\forall\tau \in (\underline{\tau}, \bar{\tau})$, $\frac{\partial N}{\partial\tau} > 0$. Since the city population increases in τ, so will the average rent. ■

Proposition 2 *When $\tau \in (\underline{\tau}, \bar{\tau})$, a marginal increase in τ decreases the welfare inequality.*

Proof. For the aggregate urban cost of living, $\frac{\phi}{1-\theta}$ proportion is paid by managers and the rest $\frac{1-\phi-\theta}{1-\theta}$ proportion is paid by urban clerks. Thus, the welfare inequality can be written as

$$\frac{V_h}{V_l} = \frac{\alpha+\gamma-\frac{\phi}{1-\theta}2\gamma}{1-\alpha-\frac{1-\phi-\theta}{1-\theta}2\gamma}\frac{1-\phi}{\phi}$$

Clearly, $\frac{\partial V_h/V_l}{\partial\tau} < 0$, since $\frac{\partial\theta}{\partial\tau} > 0$. ■

4 Conclusion

This paper examines inshoring. Empirically, the paper shows that the industry performing inshored business support services grows substantially faster in small localities than it does in big cities. The industry is increasingly separated from its downstream industries geographically, and there is also a growing tendency toward geographic separation of the support workers from others. The examination of growth determinants suggests that the primary reason for the small localities' success may be the less expensive support workers there.

This paper presents a simple general equilibrium model that predicts the empirical findings. More importantly, the model suggests that inshoring benefits support workers relative to managers and thus mitigates welfare inequality. This implication is in stark contrast to the offshoring literature, which often predicts that offshoring may make domestic support workers worse off. Despite certain stylization, the model does shed light on how inshoring could affect where people live and how well they live, and both these results are obtainable under self-organization, an alternative modeling approach. The possibility for support workers to work for urban firms without bearing urban costs is the key.

The result on welfare inequality relies on the assumption of mobile labor. If workers cannot move, urban support workers will get hurt when new technology shifts the demand for support workers to rural areas. Then, the welfare impact will be in line with the offshoring literature.

The model in this paper considers only one source of externality. If other sources of externality such as neighborhood effect are important, then moving to rural areas may not necessarily benefit support workers as they may miss out on the positive interactions that are only available in the city, and, in the long run, the segregation might have adverse impact on the economy's productivity. Future research could consider this possibility.

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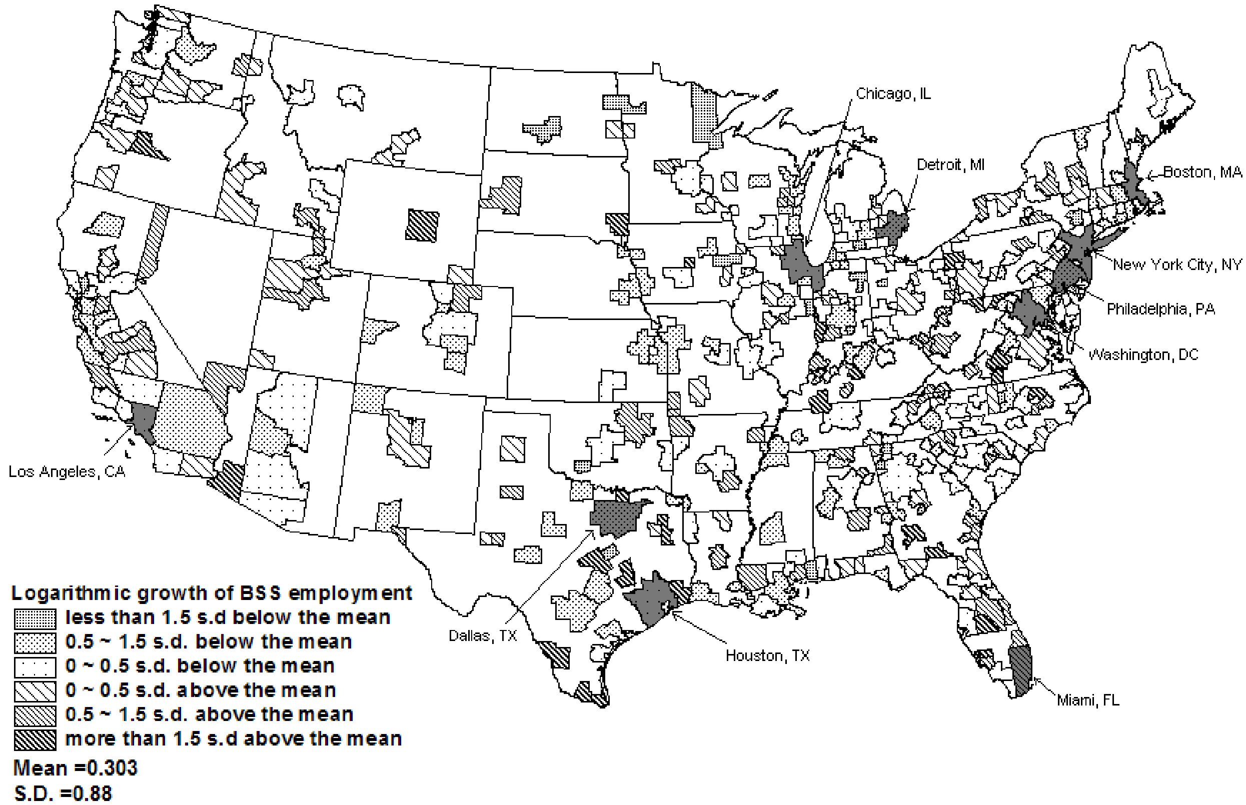
Figure 1: Growth of BSS employment by city, 1998 ~ 2006

Panel A: The ten biggest cities are on a gray background



Panel B: Cities not the top ten but with one million people or more are on a gray background

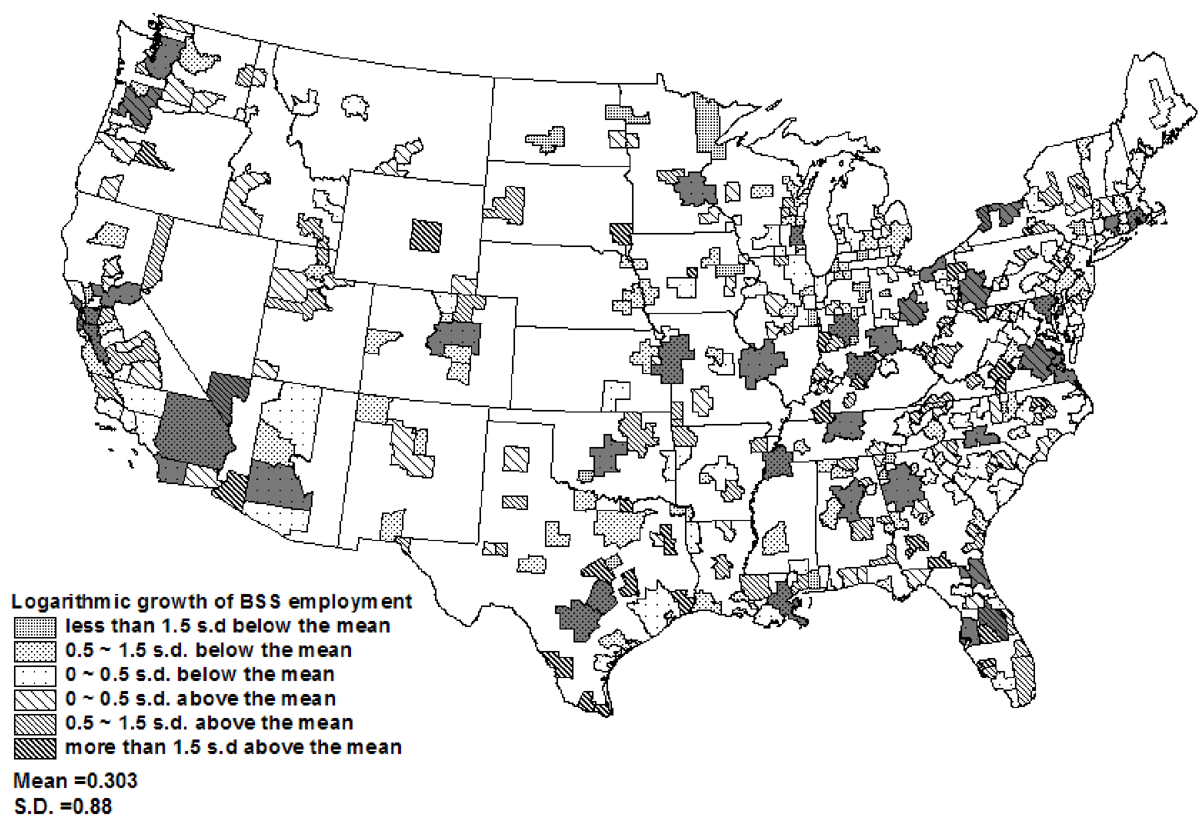


Table 1: Growth of BSS Employment and LQ

BSS employment (thousands)			
Size class \ Year	1998	2006	% growth
10 biggest cities	188	197	4.8%
1,000k ~ 4,390k	223	243	8.9%
250k ~ 1,000k	136	190	39.6%
rural areas ~ 250k	90	127	41.2%
Total Employment (thousands)			
Size class \ Year	1998	2006	% growth
10 biggest cities	29,649	32,934	11.1%
1,000k ~ 4,390k	31,504	35,435	12.5%
250k ~ 1,000k	20,764	22,932	10.4%
rural areas ~ 250k	24,465	25,376	3.7%
BSS LQ			
Size class \ Year	1998	2006	% change
10 biggest cities	1.06	0.92	-12.9%
1,000k ~ 4,390k	1.18	1.06	-10.6%
250k ~ 1,000k	1.10	1.28	16.6%
rural areas ~ 250k	0.61	0.77	25.7%

Table 2: Use of the BSS as Intermediate Inputs, 1997

		Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
NAICS	Industry	Intermediate use of BSS (millions)	Percentage of the total intermediate use of BSS	Cummulative percentage of the total intermediate use of BSS	Value added (millions)	Percentage of total value added	Cummulative percentage of total value added	BSS intensity (column 2 divided by column 5)
52	Finance and Insurance	5358	14.2	14	612350	8.8	9	1.6
42	Wholesale Trade	4715	12.5	27	503890	7.2	16	1.7
62	Health Care and Social Assistnace	4156	11.0	38	502908	7.2	23	1.5
54	Professional, Scientific, and Technical Services	4035	10.7	48	535786	7.7	31	1.4
44	Retail Trade	3773	10.0	58	442995	6.4	37	1.6
334	Computer and Electronic Product Manufacutring	2397	6.3	65	156565	2.2	39	2.8
51	Information	1970	5.2	70	351782	5.0	45	1.0
813	Religious, Grant Making, Civic, Professional and Similar	2082	5.5	75	57138	0.8	45	6.7
61	Educational Services	936	2.5	78	59049	0.8	46	2.9
71	Arts, Entertainment and Recreation	689	1.8	80	82714	1.2	47	1.5
33A	Manufacturing 33 except 334	1242	3.3	83	495550	7.1	54	0.5
53	Real Estate and Rental and Leasing	1139	3.0	86	599139	8.6	63	0.4
48	Transportation and Warehousing 48	783	2.1	88	198165	2.8	66	0.7
23	Construction	707	1.9	90	323862	4.6	71	0.4
32	Manufacturing 32	704	1.9	92	345308	5.0	76	0.4
81A	Other Services Except Public Administration and 813	477	1.3	93	194197	2.8	78	0.5
56	Adminstrative and Support and Waste Management…	651	1.7	95	245056	3.5	82	0.5
72	Accomodation and Food Services	518	1.4	96	220757	3.2	85	0.4
31	Manufacturing 31	481	1.3	97	200559	2.9	88	0.4
22	Utilities	403	1.1	98	154381	2.2	90	0.5
49	Transportation and Warehousing 49	266	0.7	99	95071	1.4	91	0.5
93	Owner-occupied Dwellings	203	0.5	100	516730	7.4	99	0.1
21	Mining	111	0.3	100	72171	1.0	100	0.3
11	Agriculture, Forestry, Fishing, and Hunting	3	0.0	100	9477	0.1	100	0.1
	Total intermediate use of BSS	37799						
	Total value added				6975600			

Table 3: Growth of DI Employment and LQ

DI employment (thousands)			
Size class \ Year	1998	2006	% growth
10 biggest cities	16,792	19,335	15.1%
1,000k ~ 4,390k	16,805	19,542	16.3%
250k ~ 1,000k	10,907	12,600	15.5%
rural areas ~ 250k	12,097	13,027	7.7%
DI LQ			
Size class \ Year	1998	2006	% change
10 biggest cities	1.06	1.06	-0.2%
1,000k ~ 4,390k	1.00	1.00	-0.5%
250k ~ 1,000k	0.99	0.99	0.7%
rural areas ~ 250k	0.93	0.93	-0.1%

Table 4: Coagglomeration of BSS and Dis

Ellison and Glaeser Coagglomeration Index	1998	2006
Coagglomeration: four city size class level	0.00233	0.00042
Coagglomeration: MAs and rural counties level	-0.00007	-0.00013

Table 5: Support Workers LQ

Size class \ Year	2000	2006	% change
10 biggest cities	0.99	0.97	-2.3%
1,000k ~ 4,390k	1.00	0.99	-1.0%
250k ~ 1,000k	1.01	1.03	2.5%
rural areas ~ 250k	1.01	1.03	2.7%

Table 6: Separation of the Support Workers from Others

	Among all workers in BSS and DIs		Among office workers in BSS and DIs		Among office workers in all industries	
	2000	2006	2000	2006	2000	2006
Dissimilarity Index	0.050	0.064	0.064	0.081	0.050	0.065
Correlation Index	0.0034	0.0055	0.0063	0.0100	0.0041	0.0064
95% Confidence Interval	0.0031	0.0049	0.0057	0.0090	0.0037	0.0058
of Correlation Index	0.0038	0.0061	0.0070	0.0111	0.0045	0.0071

Table 7: Summary Statistics of Variables Used in the Regression

Variable	Mean	Standard Deviation	Minimum	Maximum
Log(BSS employment in 2006/ BSS employment in 1998)	0.285	0.636	-1.692	2.760
Log(MSA population in 2000)	13.479	0.897	12.435	16.724
Percentage of MSA employment in the DI in 1998	52.813	5.743	31.061	66.064
Log(DI employment in 2006/ DI employment in 1998)	0.152	0.111	-0.189	0.726
Percentage of MSA employment in the BSS in 1998	0.628	0.498	0.042	3.248
Diversity in 1998	-0.103	0.025	-0.272	-0.074
Competition in 1998	1.437	0.946	0.201	6.330
Average hourly wages in 2000	13.150	1.523	9.434	18.032
Lobor suitability (2000 education)	-29.776	10.036	-59.249	-11.869
Labor suitability (2000 occupation)	-130.463	6.598	-147.099	-118.908

Table 8: Correlation Matrix of Variables Used in the Regression

Variable	Y	X1	X2	X3	X4	X5	X6	X7	X8	X9
Y	1									
X1	-0.19	1								
X2	-0.03	0.16	1							
X3	0.21	0.09	-0.04	1						
X4	-0.28	0.14	0.07	0.06	1					
X5	-0.10	0.44	0.54	0.06	0.28	1				
X6	0.34	-0.29	-0.14	0.18	-0.60	-0.38	1			
X7	-0.43	0.52	0.29	-0.03	-0.01	0.28	-0.11	1		
X8	0.05	-0.19	-0.32	-0.14	0.11	-0.05	-0.06	-0.42	1	
X9	-0.32	0.58	0.39	0.01	0.25	0.56	-0.38	0.55	-0.17	1

Y: Log(BSS employment in 2006/ BSS employment in 1998)
X1: Log(MSA population in 2000)
X2: Percentage of MSA employment in the DI in 1998
X3: Log(DI employment in 2006/ DI employment in 1998)
X4: Percentage of MSA employment in the BSS in 1998
X5: Diversity in 1998
X6: Competition in 1998
X7: Average hourly wages in 2000
X8: Lobor suitability (2000 education)
X9: Labor suitability (2000 occupation)

Table 9: Determinants of BSS Employment Growth: Results from WLS Regressions

	Dependent variable: Logarithmic growth of BSS employment from 1998 to 2006			
	(1)	(2)	(3)	(4)
Constant	3.057**	3.151**	2.628	2.247
	(.798)	(.914)	(1.306)	(2.335)
Log(MSA population in 2000)	-.178**	-.188**	-.134**	-0.006
	(.057)	(.056)	(.057)	(.062)
Percentage of MSA employment in the DI in 1998		-.003	-.004	.004
		(.010)	(.012)	(.012)
Log(DI employment in 2006/ DI employment in 1998)		1.323**	.910*	.620*
		(.538)	(.462)	(.374)
Percentage of MSA employment in the BSS in 1998			-.340**	-.273**
			(.138)	(.128)
Diversity in 1998			1.866	5.731**
			(2.917)	(2.783)
Competition in 1998			.135*	.157**
			(.080)	(.073)
Average hourly wages in 2000				-.163**
				(.050)
Lobor suitability (2000 education)				-.008
				.005
Labor suitability (2000 occupation)				-.007
				.011
State fixed effects	Yes	Yes	Yes	Yes
R square	.41	.43	.51	.57
Number of observation	166	166	166	166

Note: * and ** stand for significance at 10% and 5%, respectively.

Standard errors of parameter estimates are in parentheses beneath these estimates

Table A1: Determinants of BSS Employment Growth: Results from WLS Regressions for Cities with 100k+ people

	Dependent variable: Logarithmic growth of BSS employment from 1998 to 2006			
	(1)	(2)	(3)	(4)
Constant	2.165**	1.564	2.628	2.247
	(1.029)	(.973)	(1.306)	(2.335)
Log(MSA population in 2000)	-.153*	-.186**	-.129**	-0.010
	(.086)	(.079)	(.057)	(.056)
Percentage of MSA employment in the DI in 1998		.015**	.017**	.010
		(.007)	(.008)	(.009)
Log(DI employment in 2006/ DI employment in 1998)		1.431**	1.108**	.954**
		(.499)	(.441)	(.393)
Percentage of MSA employment in the BSS in 1998			-.310**	-.313**
			(.093)	(.091)
Diversity in 1998			.067	2.453
			(2.197)	(2.175)
Competition in 1998			.110**	.105**
			(.047)	(.045)
Average hourly wages in 2000				-.164**
				(.042)
Lobor suitability (2000 education)				-.007
				.005
Labor suitability (2000 occupation)				-.001
				.010
State fixed effects	Yes	Yes	Yes	Yes
R square	.10	.15	.25	.34
Number of observation	331	331	331	329

Note: * and ** stand for significance at 10% and 5%, respectively.

Standard errors of parameter estimates are in parentheses beneath these estimates