Outsourcing, Inequality and Cities

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January 2009

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Abstract

The advent of information technology facilitates outsourcing. Although research on offshoring (international outsourcing) has flourished, the literature on domestic outsourcing is new. This paper studies domestic outsourcing on both the empirical and theoretical fronts. The paper empirically shows that office support jobs are increasingly outsourced to small cities for cost savings. Meanwhile, there is a tendency toward increasing spatial segregation of support workers. The paper theoretically analyzes the welfare impact of domestic outsourcing. Contrary to the predictions in the offshoring literature, support workers can be better off because they can benefit from higher productivity without bearing urban congestion.

JEL: R11; R12; R13; R23

Key words: Outsourcing; Welfare inequality; Segregation; System-of-cities
1 Introduction

The advent of information technology, including the Internet, has allowed the 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, typing services can be outsourced to remote locations. Much of the discussion on this process, in both the popular press and academic research, is in an international context (e.g., situations where the lawyer is in the U.S. and the typist is in India). Nevertheless, this process can also take place domestically, so, in this context, the lawyer may be in New York City while the typist may be in North Dakota.

This paper studies, both empirically and theoretically, the domestic outsourcing of business support services like document preparation. There are three main empirical findings. First, the paper provides clear evidence that the business support service industry has been shifting away from large cities and towards small cities and rural areas in recent years. Second, it shows that low wages in small towns and rural areas are the prime force of attraction underlying this shift. Third, the paper shows that there is increasing geographic segregation, as business support workers cluster in some locations while other types of workers, such as managers, cluster in other locations.

In the theoretical analysis, this paper introduces a simple system-of-cities model (see Abdel-Rahman and Anas, 2004, for a thorough review and discussion of this type of models) that delivers the above empirical findings. This model comprises large localities that are called cities and small localities that are called rural areas, and it consists of support workers and managers. As a key element in the model, firms face a trade-off between labor costs and remote-communication friction. On the one hand, support workers in rural areas accept less compensation because they need not commute. On the other hand, these support workers have lower marginal productivity because of the friction caused by remote communication. New technologies that lower this friction increase marginal productivity and lead support jobs and workers to rural areas. The result is increasing segregation — the separation of support workers from managers who remain in cities.

The most surprising theoretical finding concerns welfare effects. The paper shows that the reduction in communication friction that leads to domestic outsourcing necessarily benefits support workers but has an ambiguous welfare impact on managers. Overall, domestic outsourcing unambiguously decreases welfare inequality between these two types of workers. While the details will be explained later, the main reason is that, with outsourcing, support workers are able to benefit from higher productivity without bearing urban costs. The welfare implication of the paper is in sharp contrast to the findings in the
international trade literature about the impact of the geographic separation of tasks, where the process is called offshoring. Antras, Garicano and Rossi-Hansberg (2004) and Kremer and Maskin (2006) both show that support workers are worse off relative to managers in the origin country in which firms adopt offshoring. This distinction is due to the different assumptions about labor mobility.

While a large volume of literature on offshoring has emerged\(^1\), the literature on domestic outsourcing is relatively small. Among empirical studies, Abraham and Taylor (1996) show that domestic outsourcing is significant at the national level, and Ono (2001) shows that firms in big cities are more likely to adopt outsourcing. However, the empirical literature has not examined the destination locations of domestic outsourcing. This paper makes a first attempt to study where outsourced jobs go and why certain localities are popular destinations of domestic outsourcing.

From a theoretical perspective, the paper closest to mine is that of Duranton and Puga (2005) who analyze the separation of production tasks. When communication friction is high, firms integrate managerial and manufacturing functions in the same place, and this leads to sectoral specialization across cities. When communication friction is low, firms separate the two functions in different places, and this leads to functional specialization. My paper is different because I consider heterogeneous workers and analyze welfare effects, whereas Duranton and Puga assume homogenous workers and examine changes in cities’ industrial structure. Additionally, the paper is also related to Liao (2008), but the difference is that the focus here is on empirical evidences and welfare effects of domestic outsourcing, while that paper introduces a richer model to provide interesting implications for how domestic outsourcing affects the production structure of firms and interacts with various local labor and housing markets.

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

2 Empirical Findings

This section presents empirical findings using data from the County Business Patterns (CBP) and the Integrated Public Use Microdata Series (IPUMS). The presentation is organized into four parts. The first part includes a discussion on the data sources and data construction. The second part shows that the industry performing outsourced business support services grows substantially faster in small cities and rural areas than in big cities. The third part examines why small cities are attractive to this industry, and the last part highlights a tendency toward increasing geographic segregation of business support workers.

\(^1\)Researchers, including, but not limited to, Pol Antras, Rechard Baldwin, Luis Garicano, Gene Grossman, Elhanan Helpman and Esteban Rossi-Hansberg have made significant contributions to this literature.
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 the details and quality of this procedure and the CBP data.

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

This study makes use of 1998 and 2006 CBP data, as well as the data from the 2000 Census and the 2006 ACS. To facilitate comparisons, I aggregate the data to the 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 the issues and quality of this mapping strategy.

2.2 Growth of Business Support Services

This subsection discusses the employment growth of the Business Support Services (BSS), NAICS 5614. According to the NAICS definition, the BSS is 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." Thus, this is the industry that emerged during the wave of business services outsourcing. Its sub-industries include document preparation services, telephone call
centers, business service centers, etc. Since many U.S. industries rely on these services, BSS is an important industry, with about 800 thousand employees. BSS is also fast growing. It grew by 21% between 1998 and 2006, while the U.S. total employment only grew by 11% during this period. Because BSS was not identified by the industrial classification system prior to 1997, the longest time period for which CBP data are usable is from 1998 to 2006.

The maps in Figure 1 illustrate the employment growth in BSS between 1998 and 2006 for each metropolitan area, i.e., city. 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 has been highly concentrated in small cities.

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. The LQ is a ratio measuring geographic concentration of activities in the area of interest. 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. As shown in the table, the overall growth of BSS employment was considerably higher for cities in smaller size classes. While growth was only 5% for the ten biggest cities and 9% for other cities with more than one million people, growth was 40% 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 was 53%. Since the overall growth of U.S. total employment was fairly monotonic across the four classes, 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.

2.3 Why BSS Leaves Big Cities

The previous subsection suggests that BSS is increasingly concentrated in small cities and rural areas because BSS employment grows substantially faster there. This subsection attempts to explain why

\footnote{All 360 metropolitan areas identified by the 2003 definition had positive employment in both 1998 and 2006.}

\footnote{The result is not sensitive to the selection of size classes’ threshold values.}
these small localities attract BSS. Specifically, three sets of control variables are included to assess three competing hypotheses. The estimation results suggest that BSS grows faster in small cities mainly because these places have favorable local labor market conditions such as lower wages.

The first set of variables evaluates how BSS growth is related to the locations of the “downstream industries” (DIs) which use BSS more intensively than do other industries. One may naturally suspect whether BSS grows faster in small cities simply because DIs are there. This hypothesis would be particularly sound if outsourcing requires physical proximity of BSS to DIs; if DIs must use local BSS, cities with a higher geographic concentration of DIs or faster DI growth should have faster BSS growth during waves of service outsourcing.

This set of variables includes the percentage of city employment in DIs in 1998 and the DI employment growth between 1998 and 2006. The former is equivalent to the LQ up to a scale and is on the initial concentration of the DIs. The DIs are identified using the 1997 Input-Output Tables. Table 2 presents the use of BSS as intermediate inputs by industry. Industries are classified by their 2-digit NAICS codes with the exception of two, as these two industries used BSS much more intensively than did other industries with their superordinate 2-digit NAICS code. This is shown in column 7 which reports the "intensity ratio." This ratio is the share of BSS services used by the 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 main users of BSS and are considered the DIs.

The second set of variables controls for localization and urbanization economies that may affect BSS employment growth. There are appealing theories that attribute urban industrial growth to these external economies, whereby a firm can benefit from innovations and improvements that occur outside the firm but within the city. As such, cities with these benefits could have faster BSS growth. The first variable included here is about urban 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 urban 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, the percentage of city employment in BSS measures urban specialization\textsuperscript{4}, and the formula below measures urban diversity:

\[ \text{Diversity}_j = - \sum_{i \neq \text{BSS}} x_{ij}^2 \]

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

The third set of variables controls for local labor market conditions, such as wages and labor suitability, and the data for these variables come from the 2000 Census. Documented in various sources, the primary reason for outsourcing jobs to India is to access low-cost labor. Possibly, this is also a key motive behind domestic outsourcing. Thus, the city average wage rate is considered. Specifically, this is the average hourly wages of workers in Office and Administrative Support, a broad Standard-Occupational-Classification category comprising 17\% of U.S. workers, as these workers are the backbone of BSS and constitute 48\% of BSS employment\textsuperscript{5}.

In addition, BSS providers could be attracted to cities with more suitable labor-force composition. Following Glaeser and Kerr (2008), I construct two measures of labor suitability. Classifying educational attainment into 14 categories according to the groupings of the 2000 Census, the first measure is defined as

\[ \text{Suitability}_j = - \sum_k |L_k - L_{k,j}| \quad (1) \]

where the subscript \( k \) indicates the category of educational attainment and the subscript \( j \) indicates the city. \( L_k \) is the percentage of BSS national employment in category \( k \), and \( L_{k,j} \) is the percentage of city \( j \)'s total employment in category \( k \). Multiplying the summation by negative one, a higher value indicates that, in terms of educational attainment, the city’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 \( (1) \) except that the subscript \( k \) instead indicates occupation.

The rest of this subsection discusses estimation. The summary statistics for variables are provided in Table 3, the correlation matrix in Table 4, and the regression results in Table 5. The method of estimation is weighted least squares (WLS) as the Breusch-Pagan test constantly rejects the homoscedasticity

\textsuperscript{4}Using BSS LQ yields the same estimation result.

\textsuperscript{5}Using the average hourly wages of all BSS employees or all wage and salary earners yields a similar result.
assumption of OLS. The regressions include state fixed effects⁶ that control for unobservable characteristics like state policies, union power, the regional environment, and other factors. The regressions only consider metropolitan areas with more than 250,000 people because, due to nondisclosure, the information from the CBP is of limited value when one is interested in a narrowly defined industry in a small geographic area (Holmes and Stevens, 2004). Specifically, the 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 those small metropolitan areas with fewer than 250,000 people.

The first column of Table 5 shows that city size has a significant negative impact on BSS employment growth. We suspect this is due to omitted variable bias. BSS may be attracted to small cities because these cities are where DIs are, have advantageous localization and urbanization economies, or have favorable local labor market conditions. Including various control variables introduced earlier into the regressions allows us to identify which hypothesis is most plausible in explaining the negative relationship between BSS growth and city size.

Favorable local labor market conditions, lower wages in particular, may be the primary reason for small cities’ success in attracting BSS. As columns 2 and 3 suggest, including DI concentration and growth makes little difference for the coefficient of log city size, and including sources of localization and urbanization economies only modestly reduces the coefficient. Nevertheless, 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.

As suggested by column 4, the impact of DI growth on BSS growth is significant (but only at the 10% level), and the impact of the initial concentration of DIs is insignificant. These results are not surprising. The advent of communication technology facilitates service outsourcing, but distance could still matter to certain business support functions. Thus, the BSS performing these functions could be attracted to those cities with high DI growth. (The newly settled DIs, in this case, need these BSS in the same city.) On the other hand, a city initially concentrated with DIs may not necessarily have higher BSS growth

⁶Among 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.
because new technologies have made a large number of business support functions "virtual." (DIs, in this second case, may outsource work to a BSS provider in a different city.)

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 impact on the growth of the industry, while urban diversity and local competition have a significant positive impact on growth. The estimates in column 4 are consistent with their findings. Additionally, column 4 indicates that not all labor market conditions have a significant impact on BSS growth. While the impact of initial average hourly wages of support workers is significant and negative, the impact of each of the two labor suitability measures is insignificant.

In summary, the results in Table 5 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 outsourcing is to reduce costs.\footnote{According to the 2006 Data Center Outsourcing Survey, 44% of respondents acknowledged cost reduction as their reason for outsourcing. The second and the third most popular reasons were to access IT resources unavailable internally (34%) and to free up internal resources (31%).}

2.4 Increasing Segregation of Support Workers

Theoretically, outsourcing of business support work to small cities and rural areas could lead to the geographic segregation of support workers and non-support workers like managers and professionals. Although one could study the segregation of BSS workers, the results may not be empirically important since the size of BSS employment is small compared to the size of U.S. total employment. Therefore, I examine, within the DIs, the degree of segregation of Office and Administrative Support workers from other types of workers. My take is that, in the sense of vertical disintegration, outsourcing really has taken place at the plant level within companies given that U.S. companies have changed from sectoral to functional urban specialization (see Duranton and Puga, 2005).

The LQ of DI support workers is assessed first. This is the location’s share of DI support workers relative to the location’s share of DI total employment. Table 6 presents this LQ by city-size class by census year and shows a shift in the geographic concentration of DI support workers. In 2000, these workers were almost evenly distributed across the four city-size classes, but, in 2006, they were more concentrated in small cities. Also presented in the table are the percentage changes in the LQ from 2000 to 2006. Cities in a bigger size class had a smaller percentage change in the value of the LQ.

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|}
\hline
City Size Class & 2000 LQ & 2006 LQ \\
\hline
Large Cities & 0.25 & 0.20 \\
\hline
Medium Cities & 0.30 & 0.35 \\
\hline
Small Cities & 0.45 & 0.50 \\
\hline
Rural Areas & 0.10 & 0.15 \\
\hline
\end{tabular}
\caption{LQ by City Size Class}
\end{table}
To assess the overall degree to which support workers in DIs are segregated, two measures are used. The first measure is the dissimilarity index:

\[ \text{Dissimilarity} = \frac{1}{2} \sum_j \left| \frac{S_j}{S} - \frac{O_j}{O} \right| \]

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

The second measure of the overall level of segregation is a correlation index as proposed by Kremer and Maskin (1996). Denoted by \( \lambda \), the index is defined as:

\[ \lambda = \frac{\sum_j N_j (\Pi_j - \Pi)^2}{N \Pi (1 - \Pi)} \]

where \( N_j \) and \( N \) refer to DI total employment at location \( j \) and in the country, respectively, and \( \Pi_j \) and \( \Pi \) refer to support workers’ share of DI total employment at location \( j \) and in the country, respectively. In addition, the 95% confidence interval for this index is

\[ \frac{F(N - J, J - 1)_{0.025}}{F(N - J, J - 1)_{0.025} + \frac{1-\lambda}{\lambda}} \leq \lambda \leq \frac{F(N - J, J - 1)_{0.975}}{F(N - J, J - 1)_{0.975} + \frac{1-\lambda}{\lambda}} \]

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 segregation.

Table 7 shows the time path for the dissimilarity index and correlation index. I additionally examine the isolation index and find that values are similar to the correlation index. Overall, the indices suggest that Office and Administrative Support workers are still distributed rather evenly across cities and rural areas. However, the numbers in the table do indicate a tendency toward increasing segregation of support workers between 2000 and 2006. The dissimilarity index increased from 0.049 to 0.064, and the correlation index increased from 0.0033 [0.0030, 0.0036] to 0.0053 [0.0048, 0.0058]. If this trend continues, the segregation of support workers would become more significant in the future, and the consequent impact on welfare would need attention. This motivates the next section.
3 Theoretical Analysis

This section examines the impact of domestic outsourcing using a simple system-of-cities model in which large institutions called the 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 an implication for welfare inequality that domestic outsourcing benefits support workers relative to managers. Nevertheless, this implication can be generated by other modeling approaches as well. 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; \( \phi \) 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 the 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, we assign each city a representative producer with the production function:

\[
Y = AH^a (L + \tau L_r)^{1-\alpha}
\]

where \( H \) and \( L \) denote the number of managers and clerks in the city, respectively, and \( L_r \) denotes the number of clerks who are outside the city and perform the outsourced clerical work for the producer. Outsourcing is subject to an iceberg cost due to communication friction: Only a \( \tau \) 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 $\gamma$ is a parameter on the curvature of this function. It is assumed that only managers (the high-skilled workers) can contribute to the level of spillovers. The empirical literature supports this assumption (see Rosenthal and Strange, 2004). It is also assumed that the externality only exists 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 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 the worker’s location. Thus, $cz$ is the commuting cost for the worker who lives $z$ units away from the CBD. The total commuting cost (i.e., the city’s congestion) 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 developer owns city’s land and earns rent. The developer has to decide the number 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 $\kappa$ to attract managers who contribute to the city’s knowledge spillovers, due to competition with other developers for managers. 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 detail.

One limitation of system-of-cities models is that they work only over a limited range of parameter

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8 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 positive externalities to the city. Thus, I abstract this option from the model.
values, and virtually all researchers focus on symmetric equilibria. To focus on the interesting case, three assumptions about parameter values are made: (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 $\mu$ 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 $(H, L, L_r, N, \mu)$, a price vector $(w_h, w_l, w_{lr})$ and a transfer $\kappa$ 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$^9$

$$
N = H + L \tag{2}
$$

$$
\phi = H\mu
$$

$$
1 - \phi = L\mu + L_r\mu
$$

**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 the aggregate output minus aggregate commuting costs. The equilibrium is optimal because city developers internalize externality through transfer payments. This is a standard feature of this type of model.

### 3.2 Equilibrium Analysis

This section discusses the equilibrium and includes an analysis on how decreased communication costs increase segregation of managers and clerks and affect welfare. A quick comparison between the two

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$^9$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 outsourced work all live in rural areas because they want to save on commuting costs and rent.
limiting cases, \( \tau = 1 \) and \( \tau = 0 \), facilitates the discussion on the intuition of the 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 workers living at the city edge pay 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, outsourcing 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

\[
\begin{align*}
\max_{\{H, L, \kappa\}} & \quad \frac{cH^2}{4} - \kappa H \\
\text{s.t.} & \quad V_h = w_h + \kappa - \frac{cH}{2} \\
& \quad w_h = \alpha H^{\gamma+\alpha-1} L_1^{1-\alpha} \\
& \quad w_{lr} = (1 - \alpha) H^{\gamma+\alpha} L_1^{-\alpha}
\end{align*}
\]

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 workers’ and firms’ optimization problems. The intuition of these constraints is as follows: The developers 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 producers are willing to locate themselves in the city and have to be high enough so that workers are willing to work for the city’s producers. Through competition, the guaranteed levels are equal among developers, and the developers simply take these levels as given.
Solving the first order conditions and using $L = 0$ as well as (2), we have

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

(3)

This 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. Together with (3), this condition implies that

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

(4)

Then, (2), (4) and $L = 0$ determine the equilibrium allocation which, in turn, determines the equilibrium wages and transfer.

$\tau = 0$ Outsourcing clerical work is impossible in this case. All clerks must live in cities, and $L_r = 0$.

The developer’s profit maximization problem is

$$\max_{(H, L, \kappa)} \frac{c(H + L)^2}{4} - \kappa H$$

s.t.

$$V_h = w_h + \kappa - \frac{c(H + L)}{2}$$

$$V_l = w_l - \frac{c(H + L)}{2}$$

$$w_h = \alpha H^{\gamma + \alpha - 1} L^{1 - \alpha}$$

$$w_l = (1 - \alpha) H^{\gamma + \alpha} L^{-\alpha}$$

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

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

(5)

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 elements from the $\tau = 0$ case. A new technology that increases the proportion of deliverable outsourced services from 0 to 1 has effects on segregation, city size, average rent, output and welfare.

Increasing $\tau$ 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 $\tau$ increases from 0 to 1, because

$$N_1 = H_1 > \frac{1}{\phi} H_1 = \frac{1}{\phi} H_0 = N_0$$

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 $\tau$ increases from 0 to 1, clerks are strictly better off because

$$V_{11} = H_1^\gamma (1 - \alpha) \left(1 - \frac{\phi}{\phi}\right)^{-\alpha} > H_0^\gamma (1 - \alpha) \left(1 - \frac{\phi}{\phi}\right)^{-\alpha} - \frac{cN_0}{2} = V_{10}$$

In the new equilibrium, clerks not only save on commuting costs and rent by living in rural areas, but also earn higher wages since 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 $\tau$ from 0 to 1 unambiguously decreases welfare inequality, defined as the ratio of managers’ welfare to clerks’ welfare, because

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

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 $\frac{\alpha + \gamma - 2\gamma - \frac{\phi}{1 - \alpha}}{1 - \alpha - 2\gamma (1 - \phi)}$ to $\frac{\alpha + \gamma - 2\gamma}{1 - \alpha}$ reflects the impact on welfare inequality when $\tau$ increases from 0 to 1.

To see this, let us consider the following facts. First, both types of workers earn a constant share of the economy’s aggregate output. This is $\alpha$ for managers and $1 - \alpha$ for clerks. Second, the aggregate urban cost of living is a constant proportion, $2\gamma$, of 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 \( \phi \) proportion of this cost is paid by managers, and the other \( 1 - \phi \) 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 domestic outsourcing benefits support workers because it allows them to access higher productivity without paying the urban cost of living. Eliminating communication friction makes the marginal productivity of rural support workers as high as their urban counterparts, and living in rural areas saves on urban living costs. This generates the sorting of support workers into rural areas and leads to complete segregation. Because accommodating support workers, 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 outsourcing, rural support workers can additionally benefit from this higher productivity. On the other hand, managers may not necessarily benefit from the sorting. Although they 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 transfer payments; support workers do not pay these costs 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 \( \tau \) 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 the atomistic decisions of workers and firms, but not the actions of large institutions such as 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 \( \epsilon \) 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 managers’ indirect utility is \( x \) in both \( \tau = 0 \) and \( \tau = 1 \) cases, but the equilibrium number of managers in established cities increases when \( \tau \) increases from 0 to 1. Then, it is readily seen that clerks’ indirect utility is increased and welfare inequality is mitigated when \( \tau \) 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 outsourcing.

### 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 \( \tau \) 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:

\[
\begin{align*}
\text{MAX} & \quad \frac{c(H + L)^2}{4} - \kappa H \\
\text{s.t.} & \quad V_h = w_h + \kappa - \frac{c(H + L)}{2} \\
& \quad V_l = w_l - \frac{c(H + L)}{2} \\
& \quad w_h = \alpha H^{\gamma + \alpha - 1} (L + \tau L_r)^{1-\alpha} \\
& \quad w_l = (1 - \alpha) H^{\gamma + \alpha} (L + \tau L_r)^{-\alpha} \\
& \quad w_{lr} = \tau (1 - \alpha) H^{\gamma + \alpha} (L + \tau L_r)^{-\alpha} \\
& \quad H \geq 0; \ L \geq 0; \ L_r \geq 0
\end{align*}
\]

The non-negative constraints are not binding when the value of \( \tau \) 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

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

(6)

and

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

(7)

where \(\rho\) denotes the ratio of clerks to managers in the city. The equilibrium value of this ratio is a decreasing function in \(\tau\):

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

(8)

Together with (2) and the first order conditions of the producer’s profit maximization problem, the above three equations determine the equilibrium allocation, wages and transfer. The next two propositions are regarding the impact of a marginal increase in \(\tau\) when \(\tau \in (\tau, \bar{\tau})\).

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

**Proof.** Let \(\theta\) 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 \(\forall \tau \in (\tau, \bar{\tau}), \frac{\partial N}{\partial \tau} > 0\). Since the city population increases in \(\tau\), so will the average rent. \(\blacksquare\)

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

**Proof.** For the aggregate urban cost of living, the \(\frac{\phi}{1-\phi}\) proportion is paid by managers and the other \(\frac{1-\phi}{1-\phi}\) proportion is paid by the city’s clerks. Welfare inequality thus can be written as

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

Clearly, \(\frac{\partial V_h}{\partial \tau} < 0\), since \(\frac{\partial \rho}{\partial \tau} > 0\). \(\blacksquare\)
4 Conclusion

This paper examines the issue of domestic outsourcing. Empirically, the paper shows that the industry performing outsourced business support services grows substantially faster in small cities than it does in big cities. An examination of growth determinants suggests that the primary reason for small cities’ success may be the less expensive support workers who are more available in these cities. Additionally, this paper presents evidence of increasing segregation of support workers from other types of workers during the wave of service outsourcing.

This paper constructs a simple model that delivers the empirical findings. More importantly, the model suggests that domestic outsourcing benefits support workers relative to managers and thus mitigates welfare inequality. This is contrary to the offshoring literature, which predicts that international outsourcing may hurt domestic support workers. Although the model is stylized, it does shed light on how domestic outsourcing could affect where people live and how well they live, and both these results are obtainable under an alternative modeling approach such as self-organization. The possibility for support workers to work for city firms without paying commuting costs, i.e., the congestion, is the key.

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

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 the segregation may have a long-term impact on the economy’s productivity. Future research could consider this possibility.

References


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

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

Logarithmic growth of BSS employment
- less than 1.5 s.d below the mean
- 0.5 ~ 1.5 s.d. below the mean
- 0 ~ 0.5 s.d. below the mean
- 0 ~ 0.5 s.d. above the mean
- 0.5 ~ 1.5 s.d. above the mean
- more than 1.5 s.d above the mean

Mean = 0.303
S.D. = 0.88

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

Logarithmic growth of BSS employment
- less than 1.5 s.d below the mean
- 0.5 ~ 1.5 s.d. below the mean
- 0 ~ 0.5 s.d. below the mean
- 0 ~ 0.5 s.d. above the mean
- 0.5 ~ 1.5 s.d. above the mean
- more than 1.5 s.d above the mean

Mean = 0.303
S.D. = 0.88
Table 1: Growth of BSS Employment and LQ

<table>
<thead>
<tr>
<th>Size class \ Year</th>
<th>1998</th>
<th>2006</th>
<th>% growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 biggest cities</td>
<td>187</td>
<td>197</td>
<td>5.3%</td>
</tr>
<tr>
<td>1,000k ~ 4,390k</td>
<td>223</td>
<td>243</td>
<td>9.0%</td>
</tr>
<tr>
<td>250k ~ 1,000k</td>
<td>136</td>
<td>190</td>
<td>39.7%</td>
</tr>
<tr>
<td>rural areas ~ 250k.</td>
<td>96</td>
<td>147</td>
<td>53.1%</td>
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<table>
<thead>
<tr>
<th>BSS LQ</th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>10 biggest cities</td>
<td>1.07</td>
<td>0.92</td>
<td>-13.3%</td>
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<tr>
<td>1,000k ~ 4,390k</td>
<td>1.18</td>
<td>1.06</td>
<td>-10.6%</td>
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<td>250k ~ 1,000k</td>
<td>1.10</td>
<td>1.28</td>
<td>16.6%</td>
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<td>rural areas ~ 250k.</td>
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<tr>
<td>NAICS</td>
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<td>Column 2</td>
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<td>-------</td>
<td>----------------------------------------------</td>
<td>---------------</td>
<td>------------</td>
</tr>
<tr>
<td></td>
<td>Intermediate use of BSS (millions)</td>
<td>Percentage of the total intermediate use of BSS</td>
<td>Cumulative percentage of the total intermediate use of BSS</td>
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<tr>
<td>52</td>
<td>Finance and Insurance</td>
<td>5358</td>
<td>14.2</td>
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<td>42</td>
<td>Wholesale Trade</td>
<td>4715</td>
<td>12.5</td>
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<td>62</td>
<td>Health Care and Social Assistance</td>
<td>4156</td>
<td>11.0</td>
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<td>54</td>
<td>Professional, Scientific, and Technical Services</td>
<td>4035</td>
<td>10.7</td>
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<tr>
<td>44</td>
<td>Retail Trade</td>
<td>3773</td>
<td>10.0</td>
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<tr>
<td>334</td>
<td>Computer and Electronic Product Manufacturing</td>
<td>2397</td>
<td>6.3</td>
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<tr>
<td>51</td>
<td>Information</td>
<td>1970</td>
<td>5.2</td>
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<td>813</td>
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<td>Educational Services</td>
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<td>Construction</td>
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<td>Manufacturing 32</td>
<td>704</td>
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<td>81A</td>
<td>Other Services Except Public Administration and 813</td>
<td>477</td>
<td>1.3</td>
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<td>Administrative and Support and Waste Management…</td>
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<td>1.7</td>
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<td>72</td>
<td>Accommodation and Food Services</td>
<td>518</td>
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<td>Manufacturing 31</td>
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<td>22</td>
<td>Utilities</td>
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<td>Transportation and Warehousing 49</td>
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<td>Owner-occupied Dwellings</td>
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<td>21</td>
<td>Mining</td>
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<td>11</td>
<td>Agriculture, Forestry, Fishing, and Hunting</td>
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<td></td>
<td>Total intermediate use of BSS</td>
<td>37799</td>
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<td></td>
<td>Total value added</td>
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### Table 3: Summary Statistics of Variables Used in the Regression

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<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
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<tbody>
<tr>
<td>Log(BSS employment in 2006/ BSS employment in 1998)</td>
<td>0.285</td>
<td>0.636</td>
<td>-1.692</td>
<td>2.760</td>
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<tr>
<td>Log(MSA population in 2000)</td>
<td>13.479</td>
<td>0.897</td>
<td>12.435</td>
<td>16.724</td>
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<td>Percentage of MSA employment in the DI in 1998</td>
<td>52.813</td>
<td>5.743</td>
<td>31.061</td>
<td>66.064</td>
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<tr>
<td>Log(DI employment in 2006/ DI employment in 1998)</td>
<td>0.152</td>
<td>0.111</td>
<td>-0.189</td>
<td>0.726</td>
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<tr>
<td>Percentage of MSA employment in the BSS in 1998</td>
<td>0.628</td>
<td>0.498</td>
<td>0.042</td>
<td>3.248</td>
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<td>Diversity in 1998</td>
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<td>0.025</td>
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<td>Competition in 1998</td>
<td>1.437</td>
<td>0.946</td>
<td>0.201</td>
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<td>Average hourly wages in 2000</td>
<td>13.150</td>
<td>1.523</td>
<td>9.434</td>
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<td>Labor suitability (2000 occupation)</td>
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<td>6.598</td>
<td>-147.099</td>
<td>-118.908</td>
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Table 4: Correlation Matrix of Variables Used in the Regression

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<th>Variable</th>
<th>Y</th>
<th>X1</th>
<th>X2</th>
<th>X3</th>
<th>X4</th>
<th>X5</th>
<th>X6</th>
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<td>X1</td>
<td>-0.19</td>
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<td>X2</td>
<td>-0.03</td>
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<td>X3</td>
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<td>X4</td>
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<td>X6</td>
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<td>X8</td>
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<td>1</td>
</tr>
</tbody>
</table>

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: Labor suitability (2000 education)  
X9: Labor suitability (2000 occupation)
Table 5: Determinants of BSS Employment Growth: Results from WLS Regressions

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>3.057**</td>
<td>3.151**</td>
<td>2.628</td>
<td>2.247</td>
</tr>
<tr>
<td></td>
<td>(.797)</td>
<td>(.914)</td>
<td>(1.306)</td>
<td>(2.335)</td>
</tr>
<tr>
<td>Log(MSA population in 2000)</td>
<td>-.178**</td>
<td>-.188**</td>
<td>-.134**</td>
<td>-.006</td>
</tr>
<tr>
<td></td>
<td>(.057)</td>
<td>(.056)</td>
<td>(.057)</td>
<td>(.062)</td>
</tr>
<tr>
<td>Percentage of MSA employment</td>
<td>-.003</td>
<td>-.004</td>
<td>.004</td>
<td></td>
</tr>
<tr>
<td>in the DI in 1998</td>
<td>(.010)</td>
<td>(.012)</td>
<td>(.012)</td>
<td></td>
</tr>
<tr>
<td>Log(DI employment in 2006/ DI</td>
<td>1.323**</td>
<td>.910**</td>
<td>.620*</td>
<td></td>
</tr>
<tr>
<td>employment in 1998)</td>
<td>(.538)</td>
<td>(.461)</td>
<td>(.374)</td>
<td></td>
</tr>
<tr>
<td>Percentage of MSA employment</td>
<td>-.340**</td>
<td>-.273**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>in the BSS in 1998</td>
<td>(.138)</td>
<td>(.128)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diversity in 1998</td>
<td>1.866</td>
<td>5.731**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.917)</td>
<td>(2.783)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Competition in 1998</td>
<td>.135*</td>
<td>.157**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.080)</td>
<td>(.073)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average hourly wages in 2000</td>
<td></td>
<td></td>
<td>-.163**</td>
<td>(.050)</td>
</tr>
<tr>
<td>Lobor suitability (2000 education)</td>
<td></td>
<td></td>
<td>-.008</td>
<td>.005</td>
</tr>
<tr>
<td>Labor suitability (2000 occupation)</td>
<td></td>
<td></td>
<td>-.007</td>
<td>.011</td>
</tr>
<tr>
<td>State fixed effects</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Adjusted R square</td>
<td>.20</td>
<td>.22</td>
<td>.32</td>
<td>.39</td>
</tr>
<tr>
<td>Number of observation</td>
<td>166</td>
<td>166</td>
<td>166</td>
<td>166</td>
</tr>
</tbody>
</table>

Note: * and ** stand for significance at 10% and 5% respectively. Standard errors of parameter estimates are in parentheses beneath these estimates.
Table 6: Downstream Industry’s LQ Growth

<table>
<thead>
<tr>
<th>Size class \ Year</th>
<th>2000 LQ</th>
<th>2006 LQ</th>
<th>LQ growth, 2000 - 2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 biggest cities</td>
<td>1.00</td>
<td>0.97</td>
<td>-2.80%</td>
</tr>
<tr>
<td>1,000k ~ 4,390k</td>
<td>1.00</td>
<td>0.99</td>
<td>-0.59%</td>
</tr>
<tr>
<td>250k ~ 1,000k</td>
<td>1.01</td>
<td>1.03</td>
<td>2.52%</td>
</tr>
<tr>
<td>rural areas ~ 250k</td>
<td>1.01</td>
<td>1.03</td>
<td>2.70%</td>
</tr>
</tbody>
</table>
Table 7: Segregation of Office and Administrative Support Workers in the DI

<table>
<thead>
<tr>
<th>Year</th>
<th>Dissimilarity Index</th>
<th>Correlation Index</th>
<th>95% Confidence Interval of Correlation Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>0.0489</td>
<td>0.0033</td>
<td>0.0030 - 0.0036</td>
</tr>
<tr>
<td>2006</td>
<td>0.0641</td>
<td>0.0053</td>
<td>0.0048 - 0.0058</td>
</tr>
</tbody>
</table>