DETERMINANTS OF INDUSTRIAL GROWTH IN UKRAINIAN CITIES

by

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Abstract

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Economists agree about presence of knowledge externalities in agglomeration process, that arise due to specialization and diversity, competition and firm size, as well as from the local economy structure. The purpose of the study is to identify which particular measure promotes or inhibits industrial growth within Ukrainian cities. The industry-city level analysis is conducted on the sample of total 179 Ukrainian cities during 2001-2009. The main focus is on two large groups of industries: manufacturing and services. Our results are mostly significant and similar to previous findings by Glaeser et al. (1991). We found that diversity and local competition also foster growth in Ukraine. While diversity brings equal benefits for all sectors, manufacturing industries gain significantly more from competition. Industrial growth negatively affected by specialization and firm size.

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LIST OF ABBREVIATIONS

HHI. Hirschman-Herfindahl index

LQ. Location quotient

NACE. General Name for Economic Activities in the European Union (French: Nomenclature Generale des Activites Economiques dans I`Union Europeenne)

ISIC. International Standard Industry Classification

C h a p t e r 1

INTRODUCTION

The concept of "development" implies change. Economic development implies not simply change, however, but in some sense "change for the better".

Economic Growth refers to producing/consuming "more of the same," increases in measured per-capita GDP for example, while Economic Development, proper, refers to producing/consuming "more different (and better) things."

(Jacobs, 1969; Ikeda, 2011)

Outside the traditional neoclassical theories of growth (e.g., Lucas, 1988, or Solow, 1956), economic theory has provided a rich set of explanations why productivity levels or growth rates are different across countries, and whether those explanations hold through time. Neoclassical growth model proposed by Solow (1956) assumed growth to be driven by a combination of factors including technological change. However, this technological change in the neoclassical growth model was assumed to be exogenously determined. In a sense, it was treated as a public good or a market failure. Endogenous growth theories assume quite the opposite: they treat technological changes as private goods hence allowing for potential divergence in patterns of economic growth across nations or regions. Such theories allow for knowledge spillovers, when innovations generated by a firm make this knowledge available to other firms in the industry or even to other industries.

Almost every self-respected economist working in agglomeration literature has an explanation why do cities exist. Cities bring advantages with proximity. There is potential for interaction between individuals, firms and even industries. This idea lies behind every agglomeration analysis. Cities foster growth promoting positive

externalities through concentration of highly-skilled workers, easy access to new technologies, availability of natural resources and other factors of production. People have moved to cities to live, work, start families and businesses. They find themselves more productive in cities: there is documented evidence of increased output per worker in urban areas (Glaeser, 2010). Hence, urban areas offer unique opportunities for industrial growth.

The old discussion on agglomeration economy concerns industrial scope. The extent to which urbanization happens across industries is still uncertain - whether it is related to the size of the city or industrial concentration. In addition, urbanization process may be associated not only with the city size itself but also with the level of diversity and innovative activities (Jacobs, 1969). The other situation refers to spatial concentration of activities within or between sectors. In each case there is a place for externalities. Almost a hundred years ago Marshall (1920) made a contribution that is still relevant: "When an industry has thus chosen a locality for itself, it is likely to stay there long: so great are the advantages which people following the same skilled trade get from neighborhood to one another … The advantages of variety of employment are combined with those of localized industries in some of our manufacturing towns, is a chief cause of their continued economic growth." In this case it can be suggested that regional growth is in turn driven by industries in cities since they serve as concentration points for capital.

Economists have been quite successful in determining key factors contributing to industrial agglomeration. There is evidence that knowledge spillovers in cities occur precisely because of localization and regional specialization. There is substantial evidence confirming that knowledge spreads faster in cities simply because cities foster growth in the number of firms and thus stimulate competition (Porter, 1990). Competition, in turn, forces companies to generate

innovations. Finally, there is well-documented evidence of the effect of urbanization economy and urban diversity on productivity growth. However, it is yet unclear which particular factors should be held accountable for enhanced business growth in cities. It is possible to determine these factors through analyzing firm-level data on employment, productivity, and annual output. Existing literature on the subject offers numerous accounts of country-specific agglomeration factors that are responsible for urban growth in particular locations.

Ukrainian economy is remarkable for local growth analysis due to the following reasons. First is that national employment followed few directions. While total labor is constantly declining during the total period of independence, relocation from rural to urban areas is also present. Ukraine is considered a transition country; in addition, there are consequences from being part of the Soviet Union that are observed in the structure of the economy. All this makes the predictions of the analysis uncertain and since no two growing countries are alike, it is possible to assume that agglomeration economies affect Ukraine in its own specific way.

Thus, the primary objective of this research is to find way through which agglomeration economies drive regional growth in Ukraine. By understanding sources of urban growth in Ukraine it will be possible to determine specific implications for industrial and regional policy.

Analysis of the Ukrainian economic structure shows that competetitive environment as well as sectoral diversity in the city lead to higher growth of the region. Among negative forces there are specialization of the industry and high initial average size of the firm.

The rest of the paper is organized as follows. Chapter 2 contains literature review, in Chapter 3 estimation model is developed and methodology is explained. Chapter 4 contains description of the data used for the analysis, Chapter 5 reports the results of the estimation and Chapter 6 concludes.

Chapter 2

LITERATURE REVIEW

Even though the debate on the contribution of agglomeration economies and competition within the industry to local growth has started long ago, Almeida (2006) points out that the majority of empirical work on the subject is fairly recent. Empirical studies of regional economic growth focus on dynamic externalities that are related to urbanization. This section provides an overview of existing research aimed at explaining growth within cities. In particular, this section focuses on agglomeration indicators which were found to positively affect growth: concentration within the city and the industry, measures of diversity in the city and in the industry, and outside employment

Glaeser et al. (1991) pointed out that there are three different situations, in which agglomeration economies emerge. The first one refers to geographic concentration of firms within the same industry with an emphasis on the importance of companies that come through different stages of the same production process or within-industry diversity. The second situation refers to geographic concentration of companies that operate in different industries thus focusing on the importance of between-industry diversity. Finally, the third case refers to geographic competition of firms that operate in the same market thus emphasizing within-industry competition (Lasagni, 2011).

The first type of external scale economies is known as Marshall-Arrow-Romer (MAR) effect. This type is also referred to as localization externalities and is associated with high concentration of economic activity within a company's own industry (De Vor and De Groot, 2010). Marshall (1890) emphasized that benefits

to growth occur from knowledge spillovers. Other sources of benefits to growth in the case of MAR externalities include labor market pooling since an industry with high concentration of economic activity can potentially attract a large labor force of better quality. Glaeser et al. (1991) suggested that Silicon Valley is a good example of growth initiated by knowledge spillovers that led to industry growth and local development.

Within the second type the industry is said to be subjected to Jacobs' (1969) externalities, case when diverse industrial structure stimulates local growth (Henderson, 1992). Local industrial diversity protects the industry from demand fluctuations by offering a wider clients' base. Furthermore, local industry diversity suggests that producers may switch between substitutable inputs which are essential in case of input scarcity or an increase in prices (De Vor and De Groot, 2010). Jacobs (1969) stated that inter-industrial knowledge spillovers occur in urban agglomerations not only due to diverse economic activity in cities but also due to high density of social networks. Lengyel and Szanyi (2013) pointed out that in case of Jacobs externalities learning in urban agglomerations occurs primary due to the fact that industry borders are no longer distinct in big cities. Hence, innovation roots itself in knowledge spillovers occuring between totally unrelated fields (De Vor and De Groot, 2010). Thus, local growth is stimulated by between-industry diversity.

The third type is known as Porter's agglomeration conditions. The emphasis of this agglomeration effect is heavily put on the competition degree within an industry. Combes (2000) suggested that competition produces a non-linear impact on growth: higher competition stimulates RandD; however, in case when innovations occur too fast due to intense competition, returns from RandD become low which leads to a decline in innovation. This suggests non-linear

impact of competition on innovation-driven growth. Glaeser et al. (1991) referred to Schumpeter (1942) who suggested that in this case a monopoly is better than high competition since it allows internalizing innovations by restricting ideas from flowing outside the innovative company. Contrary to that, Porter (1990) believed that it is competition within specialized and geographically dense industries that stimulates growth.

There is extensive literature that attempted to explain local growth by MAR, Jacobs or Porter externalities (e.g., Glaeser et al., 1991, Henderson et al., 1992, Gerben, 2004, Almeida, 2006; for an overall evaluation: Beaudry and Schiffauerova, 2009, or Puga, 2010). The literature offers sometimes conflicting views regarding the role of each type of externality. Nevertheless, previous research provides useful insights into specific types of industries subjected to each type of externality and the extent to which each type of agglomeration economy affects local growth in different cases. Mixed evidence regarding the nature and effect of externalities is not surprising: as pointed out by Beadry andand Schiffauerova (2009), knowledge spillovers are invisible and thus hard to track or measure. Differences in observed results may also be explained by methodological issues, measurement, and by varying strength of agglomeration forces across industries (Beadry and Schiffauerova, 2009).

Beadry and Schiffauerova (2009) examine the extent to which MAR and Jacobs' externalities are most beneficial to growth and innovation. Carefully reviewing 67 previously conducted studies one of the goals is to identify a threshold at which either of the two theories becomes dominant through. Authors state that approximately 70% of the analyzed studies found some confirmation of MAR externalities existence while a comparable share (75%) found proof of Jacobs' externalities. Solely negative impact is observed for Marshall externalities more

often than for Jacobs externalities. This may suggest that while regional specialization may inhibit local economic growth, diversification is less likely to have this effect (Beadry and Schiffauerova, 2009).

One of the fundamental studies on the role of technological spillovers in growth of cities was Glaeser et al. (1991). Research is focused on examining the role of geographical concentration and competition in industries in 170 United States cities between 1956 and 1987. The study points out that the three approaches are very appealing in a sense that although they do not offer mutually exclusive explanations of growth in cities, they offer diverse opinions about most important factors. In a cross-section of city-industries cells, the author uses employment growth as a proxy for industry growth. The study found that overrepresentation of an industry in a particular area inhibits growth of this industry in the same region. This contradicts to suggestions made by MAR and Porter. Finally, Glaeser et al. (1991) found support for Jacobs-type externality theory by proving that industry growth is catalyzed by city diversity. Hence, substantial labor mobility across industries that results in cross-fertilization of ideas seems to stimulate local growth.

Another study of prime interest is Henderson et al. (1992) that used data on employment in manufacturing industries in the United States cities between 1970 and 1987. The study aimed at examining two sets of questions. First, the study determined characteristics of a city's economic environment that were important in determining employment levels in different industries. Second, the study explored the extent of persistence in employment patterns and the sources of such persistence. Henderson et al. (1992) explored employment in machinery, electrical machinery, primary metals, computer and electronic components industries and focused on the 224 Primary Metropolitan Statistical Areas in the

United States. The study found that future level of employment and productivity in the industry is determined by own present industry's employment As far as newer industries (such as high-tech) are concerned, Henderson et al. (1992) suggested that greater industrial and overall diversity of a city are crucial to attracting new industries since such environment facilitates information exchange. This supports Jacobs-type externality theory. However, city diversity appeared to be unimportant in retaining the new industry and current levels of employment depended mostly on market conditions.

Combes (2000) examines how structure of the local economy as manifested through sectoral specialization and diversity, competition, average plant size, and employment density affected employment growth of 341 local areas in France in 1984-93. Author finds that industry density and diversity inhibit employment growth in industrial sectors of the economy while stimulate it in service sectors. Combes (2000) suggests that this happens primarily due to presence of large clientele and supplier base and due to inter-sectoral knowledge spillovers. Localization economies or effects of specialization on urban or industry growth were found for neither industrial nor service sectors. Competition was shown to inhibit growth in some sectors such as apparel or automobile industry. Industrial sectors grow faster in non-dense areas while services tend to develop faster in denser areas. Some of these results do not confirm those found in the United States thus reflecting different patterns in factor mobility.

Almeida (2006) studies regional growth in Portugal between 1985 and 1994 to find evidence of MAR, Jacobs or Porter externalities in manufacturing sectors of the economy using the approach developed by Combes (2000). Author suggests that employment growth may not be a correct measure of local productivity growth and thus assumed labor biased technological change; hence, Almeida

(2006) uses regional wage growth instead and adjusts it by different types of labor employed. Evidence of MAR externalities are found in some of the manufacturing sectors; however, sector competition or sector diversity produced no effect on local growth. These results contradict those of Combes (2000) and those of Henderson et al. (1992).

Attempts to overcome potential biases of using employment growth regressions are not limited to Almeida (2006). Cingano and Schivardi (2012) point out that such regression assume that productivity gains result in employment gains through shifts in labor demand; thus, there is an implicit assumption that labor supply changes are independent of local conditions. However, such factors as high rent or pollution may adversely impact labor mobility and thus lead to incorrect measures of the causal link between employment growth and agglomeration economies. To correct for this, Cingano and Schivardi (2012) constructed a sectoral TFP measure to account for productivity growth in Italy. The authors found that Marshallian externalities produce a significant positive impact on productivity. Initial employment in the sector (or the size of the city) also raises TFP. Urban diversity, local competition or firm sizes are irrelevant to TFP changes.

Studies attempting to evaluate the role of agglomeration economies in local growth in transition economies are scarce. Lengyel and Szanyi (2013) focus on testing MAR hypothesis to explain regional growth in Hungary for 1998 and 2005. The study is extended by firm-ownership structure to evaluate how foreign-owned capital and domestically-owned capital affected productivity and employment growth. The work is of particular interest since it is focused on the role of MAR externalities in context of a dual economy formed by the gap between foreign-owned MNEs that heavily invested in skilled labor or RandD

and stagnating domestically-owned companies. Authors find that in Hungarian context, regional specialization, high industry concentration with big firms, and levels of initial employment positively affected TFP growth thus supporting local knowledge externalities hypothesis. Furthermore, Lengyel and Szanyi (2013) state that the presence of foreign-owned businesses stimulated employment and productivity growth while the prevalence of domestically-owned firms only inhibited growth.

A study by Vakhitov and Bollinger (2010) is the only one investigating agglomeration benefits in Ukraine. Using firm-level data, authors estimate agglomeration economies for Ukrainian machine manufacturing and high-tech industries. The study focuses on firms with different ownership types and finds that foreign-owned firms in the investigated sectors gain highest returns to agglomeration while state-owned firms gain the lowest. Private-owned firms in the analyzed sectors also have higher returns to agglomeration than state-owned companies. The study confirms the hypothesis established by other studies, namely, that agglomeration primarily occurs at the management level. These results are similar to those of Lengyel and Szanyi (2013) for Hungary.

Analysis of existing studies suggests that the effect of agglomeration externalities on regional growth is indeed location-specific. Furthermore, research results do depend on the growth phase of the economy. Ukrainian case is particularly remarkable and interesting. Government policies aimed at supporting specific underproductive sectors (such as coal mining) further distort employment growth. High concentration in some industries (such as heavy industry) combined with low outside-industry diversity in regions where those industries are prevalent is also expected to affect potential analysis of the effect of agglomeration economies on local growth. While it is possibly to assume that those results

would be similar to the Hungarian case based on previously discussed literature, it can be inferred that in the case of Hungary, the impact of the political factors was not so significant.

To summarize previous findings, the following should be stated. The majority of empirical work on returns to agglomeration is fairly recent. Multiple existing studies that focus on the effects of agglomeration on regional or industrial growth produce contradictory findings concerning the effects of particular agglomeration types that affect growth the most. Among the fundamental works investigating returns to agglomeration are studies that confirm that economic growth in cities is affected by city diversity. There are studies that suggest that competition may inhibit industry growth for some sectors. While studies that investigate returns to agglomeration in transition economies are scarce, findings for Hungary and for Ukraine both confirm that agglomeration occurs at the management level. In the case of Ukraine, returns to agglomeration are higher for foreign-owned and privately-owned companies.

Chapter 3

METHODOLOGY

In general, during the total period of Ukrainian independence demographic statistics displays a decrease of total population[1]. At the same time people tend to move from smaller towns to urban areas. Consequently, both these effects lead to a situation when population as well as employment in smaller cities decreases and employment in the metropolitan areas remains the same or even increases in few major cities like Kyiv, Donetsk or Kharkiv. On the other hand, it is possible to notice that due to the more distinguishable borders between cities and countries, employment mobility in Ukraine is significantly smaller in comparison to the USA or European countries. In such a manner we can neglect employment movements within the country and state that local determinants of agglomeration play a crucial part in urban growth.

The primary purpose is to identify which particular agglomeration determinants affect industrial growth in Ukraine. In line with a considerable body of agglomeration literature, the parameters of specialization, diversity and local competition are chosen. Current methodology is mainly based on those proposed in Glaeser et al. (1991) and Combes (2000). We start with the following basic model:

[1] State Statistics Service of Ukraine - Demographics:
http://www.ukrstat.gov.ua/operativ/operativ2007/ds/nas_rik/nas_u/nas_rik_u.html

$$(Y)_{s,c} = \alpha + \beta_1(CONC_{s,c}) + \beta_2(COMP_{s,c}) + \beta_3(DIV_{s,c}) + \beta_4(SIZE)_{s,c} + \beta_5(IND\_EMPL)_{s,c} + \beta_6(OTHER\_EMPL)_{s,c} + \text{error}, \quad (1)$$

where Y is local growth of the sector *s* and in the city *c,* CONC is a measure of industrial concentration in the industry *s* in the city *c* that corresponds to the MAR externalities; COMP measures competition in the industry *s* in the city *c* that represents Porter's externalities; DIV is a measure of diversity of other presented industries in the city *c* except observable sector *s* that corresponds to Jacobs' externalities. SIZE is the index capturing the average size of the firm in the industry *s* in the city *c,* and finally IND_EMPL and OTHER_EMPL measure employment in the examined sector and outside the sector *s* in the city *c* correspondingly. In the next subsection each index is described in detail.

3.1 MAR externalities

Location quotient is chosen as the most appropriate measure of sector concentration due to its simplicity and popularity in the literature (Beaudry and Schiffauerova, 2009).

$$LQ_{s,c} = \frac{EMPL_{s,c}/\ EMPL_c}{EMPL_s/EMPL_{UA}} \quad (2)$$

where $EMPL_{s,c}/EMPL_c$is local employment in the sector relative to the total employment in the city, and $EMPL_s/EMPL_{UA}$ is industrial employment in the whole country relative to the total employment in Ukraine. This way the variable is corrected for the situation when the industry in the city is greater only due to the larger city size. When the value of this index equals one, this means that the

percentage of employed people in the industry in the city is equal to the national average. If the value of the location quotient is less (more) than one then the sector is under-represented (over-represented) in the region.

This index displays knowledge about representation of industries over the country and their evolution. It is possible to recognize key industries that are unique and crucial for the development of regional or export-oriented economy. Also it allows identifying industries that catalyze economic development of the city[2]. While in the economic literature MAR externalities often find negative confirmation, we also expect to have a negative effect of specialization on the industrial growth (Beaudry and Schiffauerova, 2009).

There are some drawbacks in using location quotient. First, it does not capture the absolute size of an industry. High values of location quotient may be also present for industries with small labor force relative to the total national value. Second, there are no clear cutoff points of the index for defining the presence of agglomeration economy. For instance, there are some examples where the value 1.25 is taken for analyzing the UK and US industries[3] (O'Donoghue and Gleave, 2002). We propose to determine the average value of industrial specialization over the country as a cutoff point for considering development of the sector.

[2] EMSI: ECONOMIC MODELING SPECIALISTS INTL.,Understanding Location Quotient http://www.economicmodeling.com/2011/10/14/understanding-location-quotient-2/

[3] INCONTEXT, Location Quotients: A Tool for Comparing Regional Industry Compositions http://www.incontext.indiana.edu/2006/march/1.asp

3.2 Jacobs' externalities

The next measure of agglomeration to be considered is diversity of industries. The basic form of diversity is calculated with Hirschman-Herfindahl index[4]:

$$HHI_{s,c} = \sum_{i \in s,c}\left(\frac{OUTPUT_{i,s,c}}{OUTPUT_{s,c}}\right)^2 \quad (3)$$

where $OUTPUT_{i,s,c}/OUTPUT_{s,c}$ is the share of individual firm's output *i* relative to the output of the sector *s* in the city *c*. As it is usually counted in percentages, the maximum value of index is equal to 100,000 ($100\%^2$) indicating the presence of monopoly. The lower limit of the HHI is zero, which indicates the presence of a large number of small firms. The classical form of the Herfindahl index is used in the USA by the Department of Justice and Federal Reserve to control for market competitiveness in the case of a merger. (Cardell et. al, 1997; Fed. Res. Bull. 188, 1993).

This work employs the inverse Hirschman-Herfindhal employment-based index, following the methodology by Combes (2010).

$$DIV_{s,c} = \frac{1/\sum_{s' \neq s}^{c}\left(\frac{EMPL_{s',c}}{EMPL_c - EMPL_{s,c}}\right)^2}{1/\sum_{s' \neq s}\left(\frac{EMPL_{s'}}{EMPL_{UA} - EMPL_s}\right)^2} \quad (4)$$

where $EMPL_{s',c}$ is employment in all other industries *s'* except observable within city *c*, $EMPL_c - EMPL_{s,c}$ is total city employment reduced by the local industrial employment. The variable is normalized with the same index calculated for the national industrial employment in Ukraine. In particular, $EMPL_{s'}$ is employment in other industries on the country level and $EMPL_{UA} - EMPL_s$ is total Ukrainian labor force reduced by employment in the observable industry. In this work

[4] Investopedia web-site: http://www.investopedia.com/terms/h/hhi.asp

shares are used in the relative terms. For more simplified interpretation, the index is standardized and the variable takes the value of around one. The index takes its maximum values in the case when local output produced by the other than own sectors is evenly distributed. In the following theories of Porter and Jacobs, diversity generates knowledge externalities arising from cross-interactions, thus higher values are supposed to be connected with industrial growth.

3.3 Porter's externalities

The last agglomeration measure counts local competition. As it was previously discussed, the effect of competition on industrial growth is non-linear. In particular, the influence of competition on knowledge spillovers is definitely present, but its impact on industrial growth is unclear. The Ukrainian market is not developed enough to have formidable competition; thus, we expect to have a positive correlation between competition and growth in this analysis.

Glaeser et al. (1991) uses the measure of local industrial competition. Due to the absence of individual firms' output and employment, he measures competition as the number of firms per worker in the industry in the city relative to the total number of firms in the industry in the US. In this case, the discussion is caused by the question whether keen competition is driven by a high number of competitive firms or is due to the relatively smaller firms compared to the average in the country. Combes (2000) proposes to use the inverse of this index to test for the economies of scale. He states that it captures the average size of a firm.

$$\mathrm{SIZE}_{s,c} = \frac{\mathrm{EMPL}_{s,c} / \mathrm{NUM\_FIRMS}_{s,c}}{\mathrm{EMPL}_{s} / \mathrm{NUM\_FIRMS}_{s}} \qquad (5)$$

where $NUM\_FIRMS_{s,\ c}$ is total number of firms that consist of employees $EMPL_{s,\ c}$ in the sector *s* in the city *c*. This index is also normalized by the same variable calculated for the national industrial level.

Fortunately, availability of data allows constructing concentration ratios for each firm. Following Combes (2010), competition is calculated as the inverse of the Hirschman-Herfindhal index of employment concentration based on employment firm relative to the total industrial labor force. As previously, the variable is normalized with the index on the Ukrainian industrial level.

$$\mathrm{COMP}_{s,c} = \frac{1/\sum_{i \in sc}\left(\frac{\mathrm{EMPL}_{i\,s\,c}}{\mathrm{EMPL}_{s\,c}}\right)^2}{1/\sum_{i \in s}\left(\frac{\mathrm{EMPL}_{i\,s}}{\mathrm{EMPL}_{s}}\right)^2} \quad (6)$$

where $EMPL_{i\,s\,c}$ is employment of the individual firm **i** operating in the sector **s** in the city **c**, and $EMPL_{s\,c}$ is the total employment of the industry **s** in the city **c**. As before, the index is normalized by its industrial value on the country level. The value of index decreases with higher share of some firm in the industry. In this case firm dominance may be treated as the presence of monopoly and the industry is locally less competitive. Higher values of competition index imply greater competition in the industry.

3.4 Empirical model

The following discussion concerns the choice of a dependent variable that measures industrial growth. Most of the researches including seminal papers of Glaeser et al. (1991) and Combes (2000) use employment growth as a proxy variable for measuring economic growth. However, the choice of this measure is often disputed (Beaudry and Schiffauerova, 2009). The basic assumption behind

choosing employment as a proxy for growth is that homogeneous labor can move freely across cities within a country. Almeida (2006) denies this assumption and accentuates on costs of migration. Migration costs are highly dependent on the season and geographical location, which is important if taking into account the large territory of Ukraine. Numerous manufacturing firms in Ukraine often require highly skilled workers such as miners, farmers or seamen who cannot be easily replaced. Other factors that may affect local employment are various unemployment risks that arise due to heterogeneity of represented firms. Declining industries may dismiss low-productive workers resulting in unemployment and further migration or firm creation (Cingano and Schivardi, 2004). However, in spite of the discussed difficulties and because of other variables such as wages or a number of firms associated with even greater number of problems, employment growth is still the most used proxy for measuring industrial development. Thus, we decided to use it as well to compare the results with the benchmark models.

Output growth is suggested as a better indicator of the sector development; however, it is rarely used due to the data availability concerns. Nevertheless, the data on revenue and employment of individual firms also indicating the industry of operation are available, which provides a possibility for using output as a dependent variable. Hence, we conclude that both employment and output growth should be considered as a dependent variable. It also allows to check for robustness of the obtained results. Consequently, two dependent variables are used in this analysis:

$$\mathrm{GR\_EMPL}_{s,c} = \log\left(\frac{\mathrm{EMPL}_{2009}}{\mathrm{EMPL}_{2001}}\right) \quad (7)$$

$$\mathrm{GR\_OUTPUT}_{s,c} = \log\left(\frac{\mathrm{OUTPUT}_{2009}}{\mathrm{OUTPUT}_{2001}}\right) \quad (8)$$

We also include the log of employment outside the industry *s* in the city *c* - ($OTHER\_EMPL_{s,c}$) and log of employment of particular sector *s* in the city *c* - ($IND\_EMPL_{s,c}$) as control variables. While all the agglomeration externalities are employment-based, for the second set of analysis using output growth the controls are revenue-based and in logarithmic terms as well: ($IND\_OUTPUT_{s,c}$) and ($OTHER\_OUTPUT_{s,c}$). As a result, the preferred specifications are the following:

$$(GR\_EMPL_{s,c}) = \alpha + \beta_1(LQ_{s,c}) + \beta_2(DIV_{s,c}) + \beta_3(COMP_{s,c}) + \beta_4(SIZE_{s,c}) + \beta_5(IND\_EMPL_{s,c}) + \beta_6(OTHER\_EMPL_{s,c}) + \epsilon, \quad (9)$$

$$(GR\_OUTPUT_{s,c}) = \alpha + \beta_1(LQ_{s,c}) + \beta_2(DIV_{s,c}) + \beta_3(COMP_{s,c}) + \beta_4(SIZE_{s,c}) + \beta_5(IND\_OUTPUT_{s,c}) + \beta_6(OTHER\_OUTPUT_{s,c}) + \epsilon, \quad (10)$$

Following previous agglomeration literature all explanatory variables are calculated for the base year 2001 reflecting the influence of initial characteristics of industries on growth. Dependent variables of interest measure growth of industry between 2001 and 2009 years. This lag enables to capture changes in the maximum available period: it is nine years in our case. Indexes of diversity, competition, specialization and average firm size are taken in real terms, while unit variables such as industrial employment, other employment and dependent variables are taken in logarithmic terms in order to capture growth rate.

3.5 Industries and geographical scope

Previous studies on the effects of agglomeration are diverse in terms of analyzed industries. Glaeser et al. (1991) pooled all sectors in the regression analysis; Combes (2000) also provided a general analysis and a separate analysis for the group of service industries. In addition, he analyzed each sector separately. While the results appeared to be partially significant, Combes (2000) studied only significant coefficients, calculating the number of industries with significant coefficients relative to the total amount of sectors. In other agglomeration studies the list of analyzed sectors is mostly constrained, for example, Henderson et al. (1992) restricted the analysis to few manufacturing and high-tech industries.

In the given study we decided to focus on two large groups of interest: manufacturing and services. We provide the analysis separately for two groups for comparison and, in addition, pool them together to capture the general situation. The main argument is that groups are very diverse with respect to their resources and products. First, manufacturing production is highly dependent on natural resources and other geographical characteristics, thus it is more localized, while service industries are not necessarily so restricted in their choice of location . Second, final products of service industries are often non-tradable, while manufacturing goods can be marketed outside the origin or even exported. Hence, it is reasonable to differentiate the results of growth patterns between the two groups.

The next issue considers geographical scope. In the analysis of American industries the focus has always been on Metropolitan Areas. European studies consider different types of employment zones, such as local labor systems in Italy, zones d'emploi in France or local labor market in Sweden (Beaudry and Schiffauerova, 2009). In case of Ukraine, we take into consideration 669

administrative areas. The areas include 179 cities of oblast or republican subordination (with average population above 50,000 residents), and 490 rural areas. In the work all important coefficients are calculated based on the national sample, while the regression analysis is restricted to 177 cities.

It is also important to mention the endogeneity problem. While we are interested in the influence of initial characteristics on growth of industries, we should emphasize the absence of the reverse relationship. All the independent variables are calculated on the base year 2001 and the dependent variables are counted as the growth rate 2009/2001. Therefore, it is unlikely to observe an impact of growth on initial values, thus endogeneity concern is not relevant.

Summing up, the analysis starts with the computation of variables. Based on the firm level data firstly the competition index is calculated. Collapsing the data to the industry city level the remaining agglomeration externalities are counted. Adding the control variables we have all explanatory variables from 2001. In the next step dependent variables calculated for 2001/2009 period are added to the dataset. Restricting the sample to the cities regression analysis is conducted on the pooled sample, and separately for manufacturing and services.

Chapter 4

DATA DESCRIPTION

In Ukraine every commercial firm has to submit annual statements on financial performance to the National Statistics Office (Derzkomstat). The database of these statements is restricted and not available for public use. However, for the purpose of this research, access to the data was provided through KSE data collection service.

All variables for the project were generated based on the records on total employment and total revenue of each firm over 2001-2009. In addition, industry and territorial classification were also available which helped place each firm into exact industry-city cell. Large firms may have several branches. However, the number of firms with branches in multiple cities is negligible and should not significantly affect the general results of the study.

Territory of Ukraine is split into 24 oblasts. Further, every oblast is split into a number of administrative rural areas, rayons. There are 490 of such rayons. Separately from rayons, there are 177 cities of oblast subordination. Two more cities (Kyiv and Sevastopol) have a special status of Republican subordination. The analysis of industrial growth is performed at the level of 177 cities, whereas all variables were calculated at the national level.

Industrial classification follows European NACE (General Name for Economic Activities in the European Union) code, which, in turn, is based on ISIC (International Standard Industry Classification). ISIC is the internationally accepted United Nations system for classifying economic activities. Analysis is

performed at the two-digit level of the industrial code aggregation and includes 48 industries. Based on Eurostat division[5] of economic activities industries are also aggregated into two groups: manufacturing (22) and services (26). Total list of industries by groups is presented in Table 4 in the end of the work. On the initial firm level data we calculated the competition employment-based index of each firm. The detailed sample composition is found at Table 8 in the appendix.

The next step is undertaken to collapse data based at the industry and city level. Following the methodology, diversity and location quotient indexes are calculated as well as variables of the industry's average size, controls and dependent variables. As it was previously mentioned, exogenous variables are taken for one base year 2001, while dependent variables are calculated as a ratio of 2009/2001 indicators. Descriptive statistics of the final dataset that is used in the regression analysis is provided in Table 1.

[5] Statistical classification of economic activities:

http://epp.eurostat.ec.europa.eu/portal/page/portal/product_details/publication?p_product_code=KS-RA-07-015

Table 1: Descriptive statistics of all variables used in the regression analysis (2001)

Variable	Number of obs.	Mean	Std. Dev.	Min	Max
Log (employment growth) $_{s,c}$	5 408	-0.055	1.625	-6.811	7.773
Log (output growth) $_{s,c}$	5 408	0.580	2.148	-10.547	13.223
Competition $_{s,c}$	5 408	0.066	0.235	0.000	7.180
Diversity $_{s,c}$	5 408	0.774	1.057	-0.977	3.523
Location Quotient $_{s,c}$	5 408	1.798	5.062	0.001	159.654
Log (other industrial revenue in the city) $_{s,c}$	5 408	-0.027	0.067	-1.372	0.000
Log (other industrial employment in the city) $_{s,c}$	5 408	-0.034	0.129	-3.303	0.000
Average Firm Size $_{s,c}$	5 408	1.087	2.145	0.001	101.273
Log (industry employment) $_{s,c}$	5 408	4.908	2.079	0.000	12.438
Log (industry revenue) $_{s,c}$	5 408	7.540	2.817	-1.609	18.114

Average value of location quotient is 1.8 which exceeds the proposed value of 1.25 in economic literature (O'Donoghue and Gleave, 2002; 2). It is explained by the presence of extreme outliers in 95% percentile (maximum value of 160 cannot be logically explained). Outliers appear because of data limitations.

The mean of average firm size variable before normalization equals 92 employees per firm in the industry in the city and 105 in the industry in Ukraine. This way the mean value of normalized coefficient is 1.05.

In addition, it is useful to compare explanatory variables within industries. Table 2 presents the average variable for the two groups, while detailed statistics is provided in Table 5 and Table 6.

Table 2: Comparative statistics of exogenous variables for manufacturing and service industries

Industry	Competition	Location Quotient	Standardized Diversity	Normalized average firm size
Average for manufacturing industries	0.050	2.664	0.866	1.164
Average for service industries	0.111	1.718	0.780	0.969

Competition and diversity are higher in service industries than in manufacturing. This means that service market, in contrast to manufacturing, has more competitive environment. Also higher value of location quotient index supports the statement that manufacturing sectors are more localized. The average size for manufacturing is also higher. It corresponds with the issue that primarily more labor intense factories are present in the manufacturing sectors.

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Chapter 5

RESULTS AND DISCUSSION

It is important to keep in mind that during the period of analysis (2001 – 2009) Ukrainian employment has significantly decreased[6]. This happened due to several reasons. First, as it was previously mentioned, the population of Ukraine started reducing from 1994 approximately at a rate of 0.5% each year. The second problem is population aging.[7] Finally, the country sustained significant outflow of working age population. This way the value of the employment growth variable in 2009 relative to 2001 often takes the value less than 1. Further, half of manufacturing industries have suffered from employment reduction. The greatest reduction is observed in furniture, apparel, machinery and media sectors. From service industries where 30% suffer from labor reduction the largest effect has occurred in retail and education. The fact is explained with the flow from state-owned to private-owned sectors. Therefore when interpreting the results it would be more correct to describe the influence of particular exogenous variable not only on employment growth but also on the lower speed of employment reduction.

Controlling for heterogeneity between industries, fixed effects are present in each regression. As mentioned in methodology part, analysis in the work is provided on the pooled industries (1) and separately for manufacturing (2) and services (3). Such approach allows for robustness check. The fact that signs are

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[6] State Statistics Service of Ukraine - Main Statistical Indicators of Labor Statistics
http://www.ukrstat.gov.ua/operativ/operativ2005/gdn/prc_rik/prc_u/osp_u.html

[7] State Statistics Service of Ukraine - Demographics:
http://www.ukrstat.gov.ua/operativ/operativ2007/ds/nas_rik/nas_u/nas_rik_u.html

not changed within three groups of interest enables us to state that results are actually robust.

In this research we are considering growth rates of the same industries in different cities as a function of measures of knowledge externalities. This way the unit of observation is a sector in a city. Only 177 cities are left in the final sample. Comprehensive results from the regression analysis of the equation (9) are shown below in the Table 3.

It should be pointed out that exogenous variables are calculated for the base year 2001 and the endogenous variable (employment growth) is estimated as a ratio of employment between 2009 and 2001 years. Thus, interpretation of estimates follows the formulation: "how do initial industrial characteristics affect the coefficient of interest".

Table 3: Employment growth 2009/2001 of the industry in the city

	(1) All industries	(2) Manufacturing	(3) Services
Competition	0.472***	1.224*	0.375***
	[0.108]	[0.550]	[0.102]
Diversity	0.221***	0.236***	0.201***
	[0.020]	[0.034]	[0.024]
Specialization	-0.019***	-0.012	-0.032***
	[0.005]	[0.008]	[0.008]
Average firm size	-0.047***	-0.010	-0.061***
	[0.010]	[0.022]	[0.011]
Other employment	-1.504***	-1.073*	-2.975***
	[0.422]	[0.543]	[0.808]
Industry employment in the city	-0.371***	-0.459***	-0.304***
	[0.012]	[0.021]	[0.016]
Constant	1.609***	1.839***	1.407***
	[0.055]	[0.090]	[0.068]
Fixed effects	yes	yes	yes
Number of observations	5 423	2 280	3 143
R-squared overall	0.2192	0.2505	0.1905

Standard errors in brackets
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Coefficients appeared to be mostly significant with the exception of specialization and normalized average firm size in manufacturing industries. All variables for all industries and service sectors are highly significant: at 1% level. Signs of the variables and differences between two groups of interest follow predictions that are described in methodology part. We focus only on significant estimates.

Positive signs of *initial competition* coefficients reflect that tighter competition positively affects local industrial growth. While an average index for services is twice as large, this group gains less from competition. Taking into account that competition has non-linear effect on growth, this reflects that manufacturing

benefits a lot from competition while for services the positive effect is decreasing. Hence existences of positive effect of Porter's externalities that refer to the degree of competition are corroborated.

The *initial diversity* of other represented industries in a given city promotes industrial growth in a given industry. Observed effect is slightly higher for services and manufacturing. Firms receive higher benefits from facing higher variety in other sectors. In such a way externalities arising from interaction between industries are found to have an empirical confirmation.

Negative signs of *initial industrial concentration* reveal that initial specialization of the industry negatively affects growth of the sectors that reflects Porter's and Jacobs' theories. The fact that concentration of the industry may represent its monopoly power estimations reflects its negative influence. Presence of the monopolistic firm indeed reduces economic development of the total sector. At the same time the effect is more significant for services than for the pooled average. However, we cannot argue that it is greater than for manufacturing taking into account statistical insignificance of the last coefficient.

Initial average firm size of the industry also impedes industrial growth. Logically, it may be explained by noting that initially bigger size at the same time means older industry. Thus, its speed of growth becomes slower over time. Glaeser et al. (1991) supports this idea claiming that smaller firms grow faster. The effect for service sectors is greater than the total industrial average.

Furthermore, it does not come as a surprise to observe negative and statistically significant effect of control variables: other employment in the city and local industrial employment. High initial employment leads to slower growth of the sector. The same evidence is found by Glaeser et al. (1991).

As the next step of the analysis regression analysis of the equation (9) is provided and the results are present in Table 7. As Glaeser et al. (1991) mentions that revenues rather than employment provide more reliable results, it is also crucial to confirm or supplement preceding estimates. Testing out hypothesis with the revenue growth the results appeared to be similar to the previous. Hence we can state robustness of the results.

Summing up two models, we can confirm presence of agglomeration externalities in economic development of Ukrainian cities. Information spillovers from interaction of diverse industries bring benefits for all industries equally. Competition brings high benefits for manufacturing group of sectors, while for services this effect is also positive but someone smaller. As a result mainly Porters' and Jacobs' externalities within industries are observed. Specialization of particular industry assuming presence of monopoly power prevents its growth. This actually denies the theory of MAR externalities.

Chapter 6

CONCLUSIONS

While agglomeration processes have been deeply investigated, the way economies agglomerate and particular reasons that lead to urbanization are still poorly explained. However, the point on which researchers uniformly agree is that knowledge externalities take place in the urbanization process.

There are few situations when knowledge spillovers appear. First, so-called MAR externalities may arise due to high concentration of economic activity in the industry. Second, Jacobs' externalities appear in diverse economies. Precisely, interactions between different sectors bring new knowledge that stimulates local growth. Finally, Porter's externalities arise in highly competitive markets. While these knowledge externalities contradict each other to some extent, they work more as complements and are also very difficult to measure and the results in economic literature are quite diverse.

Thus, the main objective of the current work is to find out which agglomerations externality takes place in Ukraine and which ones promote or inhibit industrial growth within cities. Following previous fundamental works of Glaeser et al. (1991) and Combes (2000), we developed our methodology with several extensions. The availability of data on firms revenues allow us to provide the analysis not only based on the employment, as the most of researchers did, but also based on revenues as a proxy for industrial growth. This also allows to make a robustness check.

We provided analysis on industry-city level with a sample of 177 cities during the period between 2001 and 2009. In our study we focused on two groups of

industries: manufacturing and services. First, we pooled together two groups of interest to detect the Ukrainian situation in general and in addition we analyzed each group separately to compare the results. Manufacturing and services are different groups with respect to their resources and products. While the first group is highly dependent on natural resources, thus manufacturing production is more localized, products of the second group of industries are often non-tradable, thus more evenly distributed among the country.

Estimations are mostly significant and results follow the expectations. Diversity as well as competition fosters industrial growth and this effect is almost equal between two groups of interest. Thus, all the sectors equally benefit from presence of other industries in the city. Competition also has a positive effect on growth and the impact is much higher for manufacturing. Specialization and average firm size hamper industrial development. Service sectors suffer more on national average. And finally, industries with high initial employment and high employment outside the industry tend to grow slowly.

Our results closely follow previous findings in agglomeration literature. Specifically, they are similar to Glaeser et al. (1991) results that analyzed US cities between 1956 and 1987 years.

Summing up, current work fills the existent gap in the agglomeration research in Ukraine. We may conclude that pursuing the aim of economic development of cities in Ukraine is important to create diverse environment with high level of competition restricting the power of monopolies. As Glaeser et al. (1991) mentioned, large number of small firms pushes the economic development of cities. This statement is also applicable to Ukraine.

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Table 4: List of two-digit industries

Manufacturing industries	**Service industries**
Mfg. food (15)	Electricity, gas, steam (40)
Mfg. textiles (17)	Water collect, purification (41)
Mfg. apparel, fur (18)	Auto sale, repair; fuel sale (50)
Mfg. leather, luggage (19)	Wholesale trade (51)
Mfg. wood, cork, straw pdct. (20)	Retail trade, HH goods repair (52)
Mfg. paper, pulp (21)	Hotels and restaurants (55)
Publishing, printing (22)	Land transport; pipelines (60)
Mfg.coke, ref. petrol, nuclear (23)	Water transport (61)
Mfg. chemicals (24)	Air transport (62)
Mfg. rubber (25)	Travel agency, transp. support (63)
Mfg. non-metal mineral (26)	Post, telecom (64)
Mfg. basic metal (27)	Financial intermediation (65)
Mfg. fabricated metal (28)	Insurance and pension funding (66)
Mfg. machinery, eqip. nec (29)	Auxil. fin. intermediation (67)
Mfg. office machinery (30)	Real estate (70)
Mfg. electrical machinery (31)	Renting machinery, equip., HH (71)
Mfg. radio, tv, commuic. equip. (32)	Computer and related (72)
Mfg. medical, precision, watch (33)	Research and development (73)
Mfg. motor vehicles (34)	Other business activities (74)
Mfg. other transport (35)	Public admin, defense (75)
Mfg. furniture (36)	Education (80)
Recycling (37)	Health and social work (85)
	Sewage and refuse disposal (90)
	Membership organizations, NGO (91)
	Recreational, cultural, sports (92)
	Other individual services (93)

Table 5: Exogenous variables for manufacturing industry

Industry	Competition	Location Quotient	Diversity	Normalized average firm size
Manufacturing industries				
Mfg. food (15)	0.004	1.373	0.739	1.054
Mfg. textiles (17)	0.028	2.611	0.804	1.105
Mfg. apparel, fur (18)	0.011	2.434	0.610	1.476
Mfg. leather, luggage (19)	0.028	4.243	1.027	1.410
Mfg. wood, cork, straw pdct. (20)	0.017	1.878	0.714	0.660
Mfg. paper, pulp (21)	0.068	4.012	1.073	1.203
Publishing, printing (22)	0.023	0.880	0.648	0.877
Mfg.coke, ref. petrol, nuclear (23)	0.085	8.903	1.013	1.810
Mfg. chemicals (24)	0.039	3.405	0.853	1.628
Mfg. rubber (25)	0.124	1.840	0.852	0.922
Mfg. non-metal mineral (26)	0.012	1.834	0.731	1.021
Mfg. basic metal (27)	0.100	2.424	1.273	1.238
Mfg. fabricated metal (28)	0.013	1.809	0.758	1.198
Mfg. machinery, eqip. nec (29)	0.019	1.701	0.785	1.352
Mfg. office machinery (30)	0.118	2.003	0.962	0.491
Mfg. electrical machinery (31)	0.026	1.783	0.719	1.231
Mfg. radio, tv, commuic.equip. (32)	0.052	2.757	0.896	1.283
Mfg. medical, precision, watch (33)	0.045	2.391	0.870	0.937
Mfg. motor vehicles (34)	0.158	2.774	1.054	0.978
Mfg. other transport (35)	0.074	3.205	1.070	1.391
Mfg. furniture (36)	0.016	1.937	0.760	1.302
Recycling (37)	0.032	2.416	0.834	1.046
Average for manufacturing industries	**0.050**	**2.664**	**0.866**	**1.164**

Table 6: Exogenous variables for services industries

Industry	Competition	Location Quotient	Diversity	Normalized average firm size
Service industries				
Electricity, gas, steam (40)	0.031	0.983	0.782	0.730
Water collect, purification (41)	0.016	2.171	0.711	2.402
Auto sale, rapair; fuel sale (50)	0.013	1.058	0.609	0.874
Wholesale trade (51)	0.007	0.883	0.631	0.972
Retail trade, HH goods repair (52)	0.007	1.235	0.578	0.896
Hotels and restaurants (55)	0.010	1.360	0.542	0.982
Land transport; pipelines (60)	0.176	0.731	0.678	0.630
Water transport (61)	0.214	9.377	1.216	1.368
Air transport (62)	0.080	3.297	1.527	0.896
Travel agency, transp. support (63)	0.363	1.155	0.783	0.644
Post, telecom (64)	1.026	0.174	0.839	0.123
Financial intermediation (65)	0.128	1.195	0.882	0.783
Insurance and pension funding (66)	0.474	1.302	1.165	0.562
Auxil. fin. intermediation (67)	0.017	0.942	0.843	0.762
Real estate (70)	0.010	1.702	0.528	1.717
Renting machinery, equip., HH (71)	0.015	1.877	0.668	1.070
Computer and related (72)	0.012	0.901	0.709	0.991
Research and development (73)	0.030	0.758	0.844	0.780
Other business activities (74)	0.028	0.881	0.604	1.641
Public admin, defense (75)	0.063	2.074	0.984	0.679
Education (80)	0.011	1.148	0.655	0.812
Health and social work (85)	0.039	2.843	0.734	0.873
Sewage and refuse disposal (90)	0.011	2.005	0.659	1.186
Membership organizations, NGO (91)	0.065	2.338	0.959	1.189
Recreational, cultural, sports (92)	0.028	0.764	0.604	0.572
Other individual services (93)	0.008	1.513	0.548	1.047
Average for service industries	**0.111**	**1.718**	**0.780**	**0.969**

Table 7: Output growth 2009/2001 of the industry in the city

	(1) All industries	(2) Manufacturing	(3) Services
Competition	0.665***	2.342**	0.539***
	[0.147]	[0.749]	[0.138]
Diversity	0.310***	0.305***	0.311***
	[0.026]	[0.045]	[0.031]
Specialization	-0.009	-0.009	-0.015
	[0.006]	[0.010]	[0.008]
Average firm size	-0.034*	0.020	-0.051***
	[0.014]	[0.029]	[0.014]
Other revenue	-0.429	-0.453	-0.267
	[0.270]	[0.434]	[0.350]
Industry revenue in the city	-0.390***	-0.441***	-0.360***
	[0.012]	[0.021]	[0.015]
Constant	3.276***	3.426***	3.172***
	[0.085]	[0.140]	[0.105]
Fixed effects	yes	yes	yes
Number of observations	5 408	2 271	3 137
R-squared overall	0.2016	0.1923	0.2130

Standard errors in brackets
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

APPENDIX A

Table 8: Sample composition

Steps	**Unit of observation**	**Year**	**Number of observations**				
			industries	**cities/ areas**	**output**	**employment**	**number of firms**
	firm in the city-industry	2001-2009	55	671	2 960 916	2 969 924	673 254
Keep only alive firms (75%)					2 260 442	2 266 570	542 211
keep only 2001 year	firm in the city-industry	2001			221 927	223 470	238 906
calculate COMP							
Collapse by industry	industry in the city	2001-2009			151 118	151 118	
calculate GR_EMPL, GR_OUPUT							
Collapse by industry	industry in the city	2001			16 731	16 731	
calculate DIV, LQ, AV_FIRM_SIZE, controls							
Leave only cities (37%)				177			
Drop other industries			48				
FINAL regression sample	**City-industry**	**2001**	**48**	**177**	**5 408**	**5 408**	**5408**