Effects of Industry Agglomeration on Indicators of Growth and Development in Maine

Todd M. Gabe *
Department of Resource Economics and Policy; 5782 Winslow Hall, University of Maine; Orono, ME 04469-5782. E-mail: todd.gabe@umit.maine.edu

Abstract

Regional and local policymakers often use targeting-based economic development strategies to obtain and enhance the benefits of industry agglomeration. Although many policymakers and researchers believe they exist, the benefits of industry agglomeration are difficult to capture and measure directly. Thus, past studies have used a variety of indirect indicators to measure the effects of industry agglomeration.

Using results from several recent studies, this paper examines and compares the effects of industry agglomeration on firm location, employment growth and earnings in Maine. A key objective of the paper it to identify the industries in which agglomeration seems to matter. Our work is guided by the idea that the variables measuring business location, employment growth and earnings may capture different benefits of industry agglomeration.

Empirical findings suggest that firm location, employment growth and earnings are all, to some degree, positively associated with industry agglomeration. We find that agglomeration appears to matter, according to at least one of these indicators, in 35 of the 58 2-digit SIC industries considered in the paper. Focusing on each indicator individually, we find that industry agglomeration encourages business location in 17 of 54 industries, it promotes establishment growth in 17 of 58 sectors, and agglomeration increases establishment wages in 9 of 58 industries

Our results suggest that the selected indicators of growth and development do, in fact, capture different aspects of industry agglomeration. Furthermore, the way in which agglomeration impacts growth and development may vary systematically by industry. This implies that there is no one-size-fits-all approach to promoting industry agglomeration, and researchers and policymakers should use multiple indicators to evaluate the impacts of agglomeration-based strategies.

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Regional and local policymakers often use targeting-based strategies to promote and encourage a high agglomeration of activity in a selected industrial sector. Such policies are motivated, no doubt, by the recognition that industry agglomeration provides benefits that are external to individual businesses but are shared by establishments operating in the local industry. These localization externalities include the availability of a skilled workforce and specialized machinery, and information spillovers concerning product markets and production technologies (Barkley and Henry; Krugman; Marshall). Although many economic development researchers and practitioners believe in them, localization externalities are difficult to capture and measure directly. Past studies have used a variety of indirect indicators related to region-industry and business performance (e.g., firm location, employment growth, wages) to measure the effects of industry agglomeration (Glaeser et al.; Head, Ries, and Swenson; Gibbs and Bernat).

This paper examines the effects of industry agglomeration on indicators of growth and development in Maine. Using results from several recent studies, we discuss the extent to which firm location, employment growth and earnings are positively associated with industry agglomeration, and identify the industries in which agglomeration seems to matter. Our work is guided by the notion that the indicators of growth and development used in the paper may capture different aspects of localization externalities. For example, businesses may locate in an area with a high agglomeration of industry to tap into a skilled labor force or key natural resource. On the other hand, an existing business may grow more rapidly in an area with a high agglomeration of industry than elsewhere because of knowledge spillovers received through repeated dealings with similar firms.

The rest of the paper is organized as follows. Section two discusses previous studies that have examined the effects of industry agglomeration on regional economic growth. Section three presents the methods and data we used to analyze the effects of industry agglomeration in Maine. Section four summarizes the results from our research, and we discuss some implications for policy in section five.

Effects of Industry Agglomeration on Regional Growth

Previous studies have examined the effects of industry agglomeration on firm location, employment growth and wages (Glaeser et al.; Head, Ries, and Swenson; Gibbs and Bernat). Some of these studies make a distinction between "static" and "dynamic" localization externalities (Glaeser et al.; Henderson, Kuncoro, and Turner; Sveikauskas). Static localization externalities are the immediate benefits an establishment receives from its close proximity to other businesses in the same industry. These benefits, such as the availability of industry-specific inputs, explain the high geographical concentration of many U.S. industries and the

prime importance of industry agglomeration in the location decision process (Guimaraes, Figueiredo, and Woodward, 2000; Head, Ries, and Swenson; Krugman).

Dynamic localization externalities are the benefits an establishment accrues over time from repeated dealings with other local businesses in the same industry. These knowledge spillovers explain the high levels of employment growth, productivity and wages associated with industry agglomeration (Gibbs and Bernat; Henderson). O'hUallachain and Satterthwaite found a positive relationship between employment growth and industry size, and Henderson, Kuncoro, and Turner uncovered a positive relationship between employment growth and an industry's share of total local employment. Although the effects of industry agglomeration on rural employment change reported by Barkley, Henry, and Kim are somewhat mixed, Henry and Drabenstott found that industry clusters are a "major source" of manufacturing employment growth in U.S. rural areas.

A variety of factors may lead to regional industry agglomeration. Rosenthal and Strange found a positive link between industry agglomeration, measured at the zip code, county and state levels, and various aspects of labor market pooling. They also found that knowledge spillovers and an industry's reliance on natural resources affect agglomeration at the zip code and state levels, respectively. Kim, Barkley, and Henry found that the average employment size of industry establishments, the percentage of inputs purchased from extractive industries and the ratio of industry payroll to value added have a positive effect on the geographic concentration of industry in non-metropolitan areas. Ellison and Glaeser (1997, 1999) suggest that, in addition to industry-specific spillovers, natural cost advantages present in certain areas are a key determinant of industry agglomeration.

Maine provides a good case study for an analysis of industry agglomeration in rural areas. Thirteen of sixteen Maine counties are classified as "nonmetropolitan" according to Beale's rural-urban continuum, and five of the nonmetropolitan counties are "not adjacent" to a metropolitan area. Some of the most agglomerated industries in Maine are logging, ship and boat building and repairing, miscellaneous wood products, water transportation services, sawmills and planing mills, fuel dealers, hotels and motels, and camps and recreational vehicle parks (Gabe, 2003). Maine's wood products industries, which rely heavily on the state's natural resources, are typical of the types of sectors that are concentrated in nonmetropolitan areas of the United States (Kim, Barkley, and Henry). Gibbs and Bernat found lumber and wood products clusters in 183 rural areas, which cover 848 nonmetropolitan U.S. counties.

Methods and Data

In this section, we provide a general overview of the firm location and establishment growth models that underlie our empirical analysis. Detailed descriptions of these models are presented elsewhere (Gabe and Bell; Gabe, 2003, 2004).

Business Location Model

A standard business location model relates the expected profits ($\pi_{i,j}$) earned by establishment i in municipality j to a set of location-specific attributes,

[1] $\pi_{i,j} = \beta' X_{i,j} + e_{i,j}$

where, β is a vector of parameters, $X_{i,j}$ is a vector of location-specific attributes, and $e_{i,j}$ is a random error term (Carlton; Friedman, Gerlowski, and Silberman; Guimaraes, Figueiredo, and Woodward, 2000). Profit-maximizing behavior implies that establishment i will locate in municipality k if the expected profits in municipality k exceed the expected profits the business could earn elsewhere (e.g., $\pi_{i,k} > \pi_{i,j}, \ \forall j \in J$).

McFadden's conditional logit model has been frequently applied to examine this type of discrete-choice location problem (Carlton; Coughlin, Terza, and Arromdee; Head, Ries, and Swenson). However, Guimaraes Figueiredo, and Woodward (2003) propose the use of a Poisson regression model, instead of the conditional logit model, to analyze business location decisions of this sort. The number of businesses that began operations per municipality is estimated using a Poisson regression model in which the likelihood of observing n_j new businesses is:

[2] $f(n_j) = (e^{-\lambda j} \lambda_j^{nj})/n_j!$ and $\ln \lambda_j = \beta' X_j$,

where, β is a vector of parameters and $X_{i,j}$ is a vector of location-specific attributes (Coughlin and Segev; Greene).

Along with the industry agglomeration variable (i.e., location quotient) described below, the vector $X_{i,j}$ includes the municipality's distance to the nearest interstate highway, population size, local labor costs, and several local government spending variables. Gabe and Bell discuss these control variables in more detail.

Business Growth and Wages Model

The business growth model that underlies our empirical analysis is,

[3] $S_{t'} = [G(S_t, A_t)]^d (S_t) e_t$

[4] $(\ln S_{t'} - \ln S_t) / d = \ln G(S_t, A_t) + u_t$

where S and A are establishment size and age, G(.) is a firm growth function, t indicates time where $t' > t$ and $d = t' - t$, e is a lognormally distributed error term, and u is normally distributed with mean zero and independent of S and A. This type of framework has been used to examine the relationship between firm (employment) growth rates and internal conditions such as business size and age (Simon and Bonini; Hymer and Pashigian; Singh and Whittington; Evans;

Hall). Previous studies have investigated Gibrat's law, which suggests that firm growth is independent of firm size (Hart and Prais). Jovanovic's passive firm learning hypothesis, which implies a negative relationship between growth and firm age, has also been tested in many empirical studies (Evans; Dunne, Roberts, and Samuelson; Variyam and Kraybill, 1992, 1994).

We expand equation 4 to include industry agglomeration and other regional characteristics that may affect establishment growth,

$$[5] \quad (\ln S_{t'} - \ln S_t) = \beta_0 + \beta_1 \ln S_t + \beta_2 \ln A_t + \beta_3 (\ln S_t)^2 + \beta_4 (\ln A_t)^2 + \beta_5 (\ln S_t) \times (\ln A_t) + \beta_6 \ln LQ + \beta_7 \ln COMP + \beta_8 \ln POP + \beta_9 \ln DIVER + \beta_{10} INDGRO + \beta_{11} \ln CITY\ WAGE + e$$

where, LQ is a measure of industry agglomeration, COMP represents the competitiveness of the local industry, POP is municipality population size, DIVER is a measure of local economic diversification, INDGRO is a logarithmic growth rate of national industry employment, and CITY WAGE is the local wage rate. Gabe (2004) provides a more detailed description of these variables.

The dependent variable used in the establishment wages model is the natural logarithm of quarterly wages paid per establishment employee divided by the average quarterly wages earned per worker in the U.S. industry. This translates into a rate by which establishments "over" or "under" pay their workers relative to the national industry average. The employee earnings model uses the same set of explanatory variables as the employment growth model shown in equation 5, although the rationale behind the inclusion of some of the control variables is slightly different. For instance, employment size is included in the wage model to test the hypothesis that large companies pay higher wages than small businesses (Brown and Medoff; Doms, Dunne, and Troske).

Data

The firm location, business growth and wages models are estimated using data on large samples of Maine establishments. The firm location analysis focuses on 3,763 establishments that began operations in one of Maine's 129 largest municipalities, in terms of population size, between 1993 and 1995. We identified businesses that began operations in Maine using Covered Employment and Wages (ES-202) data. To be counted as a new investment, the establishment must have an "initial liability date" between the first quarters of 1993 and 1995, and it must have remained in operation with one or more workers until at least 1996. Our empirical analysis of employment growth and wages uses ES-202 data on a sample of 21,775 establishments that employed one or more workers during the first quarter of 1996. We examine the three-year logarithmic growth rate of employment between 1996 and 1999, and wages paid during the first quarter of 1996.

Industry agglomeration is represented in all three of the empirical models by location quotients that are measured at the municipality-industry level. Location quotients are calculated

as the percentage of a municipality's businesses in a 2-digit SIC industry category divided by the percentage of U.S. businesses in the same category. Location quotients greater than one imply that the industry is over-represented (i.e., concentrated) in the municipality relative to the U.S. economy.

Results

Table 1 summarizes our empirical results on the effects of industry agglomeration on business location, establishment growth and wages. We estimated separate business location models for 54 2-digit SIC industries, and establishment growth and wages models for 58 2-digit sectors. As discussed above, we used a Poisson estimator to analyze business location. Because a large number of the businesses in operation in 1996 closed between 1996 and 1999, we used a Tobit estimator in the analysis of establishment growth. Finally, the analysis of establishment wages used an OLS estimator.

In the table, a "+" sign means that the municipality-industry location quotient has a positive and statistically significant effect on the selected indicator, while a "-" sign means that the industry agglomeration variable has a negative and significant effect on the indicator. Cells are left blank in cases where the location quotient does not have a statistically significant effect on the indicator of growth or development. Empirical results related to the control variables, listed in the previous section, are presented elsewhere (Gabe and Bell; Gabe 2003, 2004).

The empirical results suggest that all three indicators are, to some degree, positively associated with industry agglomeration. We find that agglomeration appears to matter, according to at least one indicator of growth or development, in 35 of the 58 2-digit SIC industries. Focusing on each indicator individually, we find that industry agglomeration encourages business location in 17 of 54 industries, it promotes establishment growth in 17 of 58 sectors, and agglomeration increases establishment wages in 9 of 58 industries. On the other hand, industry agglomeration has a negative effect on employment growth in one sector, and it decreases wages in two industries.

The municipality-industry location quotient has a positive effect on all three indicators of growth and development in just one industry, the "real estate" sector. Industry agglomeration has a positive effect on two of the three indicators in the "printing and publishing," "trucking and warehousing," "communication," "wholesale trade – nondurable goods," "apparel and accessory stores," "hotels and other lodging places," "personal services," and "business services" industries. Finally, the location quotient has a positive effect on one of the three indicators in 24 of the 58 2-digit SIC sectors.

Discussion and Implications

This paper examined the effects of industry agglomeration on business location, establishment growth and earnings. We estimated firm location models for 54 2-digit SIC sectors, and establishment growth and earnings models for 58 2-digit sectors to identify the industries in which agglomeration seems to matter. Focusing on each of the indicators individually, we find that industry agglomeration encourages location in 31.5 percent of the sectors, while agglomeration enhances employment growth and earnings in 29.3 percent and 15.5 percent of the industries, respectively. When we take all three indicators into account, however, we find that industry agglomeration has a positive effect on growth or development in well over one-half of the 2-digit SIC industries.

These results suggest that the indicators of growth and development used in the paper may capture different aspects of localization externalities. As suggested above, businesses may flock to an area with a high agglomeration of industry to locate close to a key natural resource, as the case may be in the "lumber and wood products" industry. On the other hand, the growth of existing establishments in agglomerated industries may be due to inter-firm information spillovers or shared marketing efforts.

Our results also imply that the way in which agglomeration impacts growth and development may vary systematically by industry. Although a full comparison based on multiple industry characteristics is beyond the scope of this paper, we use the average size of U.S. industry establishments to illustrate this point. In the 17 sectors in which industry agglomeration affects location, the average U.S. establishment employed 31.1 workers. This is compared to an average of 23.7 workers per establishment in the 37 sectors in which agglomeration does not a significant effect on location. On the other hand, the average U.S. establishment employed 23.5 workers in the industries in which agglomeration enhances growth, compared to 30.4 workers in the sectors in which agglomeration does not have a significant effect on growth. Whereas Kim, Barkley, and Henry found that average establishment size increases an industry's tendency to agglomerate, our results provide some evidence that average establishment size may also influence the ways in which agglomeration impacts location and employment growth.

These findings provide yet another challenge to policymakers when developing and evaluating agglomeration-based economic development strategies. Along with the difficulties of picking which industry to target, creating supportive institutions, and catching up with established clusters (Barkley and Henry), policymakers need to consider the fact that there is no one-size-fits-all approach to promoting industry agglomeration. Agglomeration-based strategies may be effective at attracting new establishments in some industries, while they may encourage the growth of existing businesses in other sectors. Our results also suggest that policymakers should use multiple indicators to evaluate the success of agglomeration-based strategies. As our analysis shows, an evaluation based on one indicator alone may fail to detect the effects of industry agglomeration.

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TABLE 1. EFFECTS OF INDUSTRY AGGLOMERATION ON LOCATION, GROWTH AND WAGES

Industry	Location	Growth	Wages
General contractors and operative builders			+
Heavy construction, except building			
Special trade contractors		+	
Food and kindred products			
Textile mill products	+		
Apparel and other textile products			
Lumber and wood products	+		
Furniture and fixtures		+	-
Paper and allied products	NA		
Printing and publishing		+	+
Chemicals and allied products	+		
Rubber and miscellaneous plastics products			
Leather and leather products		-	
Stone, clay, and glass products			+
Fabricated metal products			
Industrial machinery and equipment	+		
Electronic and other electronic equipment			
Transportation equipment	+		
Instruments and related products	NA	+	
Miscellaneous manufacturing industries	+		
Local and interurban passenger transit			
Trucking and warehousing	+	+	
Water transportation			
Transportation by air	NA		
Transportation services			
Communication	+	+	
Electric, gas, and sanitary services		+	
Wholesale trade - durable goods			
Wholesale trade - nondurable goods	+		+
Building materials and garden supplies			
General merchandise stores		+	
Food stores		+	
Automotive dealers and service stations		+	

Table is continued on the following page.

TABLE 1. CONTINUED

Industry	Location	Growth	Wages
Apparel and accessory stores	+	+	
Furniture and homefurnishings stores	+		
Eating and drinking places		+	
Miscellaneous retail	+		
Depository institutions			
Nondepository institutions			+
Security and commodity brokers			
Insurance carriers			-
Insurance agents, brokers, and service		+	
Real estate	+	+	+
Holding and other investment offices			
Hotels and other lodging places	+		+
Personal services	+	+	
Business services		+	+
Auto repair, services, and parking			
Miscellaneous repair services			
Motion pictures			
Amusement and recreation services			
Health services	+		
Legal services			
Educational services			
Social services		+	
Museums, botanical, zoological gardens	NA		
Membership organizations			+
Engineering and management services	+		

Notes: A "+" means that the municipality-industry location quotient has a positive and significant effect on the indicator. A "-" means that the municipality-industry location quotient has a negative and significant effect on the indicator. Cells are left blank in cases where the location quotient does not have a statistically significant effect on the indicator of growth or development. NA indicates that results are not available for the sector.