2007

Higher Education, the Health Care Industry, and Metropolitan Regional Economic Development: What Can "Eds & Meds" Do for the Economic Fortunes of a Metro Area's Residents?

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Upjohn Institute Working Paper No. 08-140

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February 2007

ABSTRACT

This paper examines the effects of expansions in higher educational institutions and the medical service industry on the economic development of a metropolitan area. This examination pulls together previous research and provides some new empirical evidence. We provide quantitative evidence of the magnitude of economic effects of higher education and medical service industries that occur through the mechanism of providing some export-base demand stimulus to a metropolitan economy. We also provide quantitative evidence on how much higher education institutions can boost a metropolitan economy through increasing the educational attainment of local residence. We estimate that medical service industries pay above average wages, holding worker characteristics constant, whereas the higher education industry pays below average wages; the wage standards of these industries may affect overall metropolitan wages. We also discuss other mechanisms by which these two industries may boost a metropolitan economy, including: increasing local amenities, generating R&D spillovers, increasing the rate of entrepreneurship in local businesses, and helping provide local leadership on development and growth issues. Finally, the paper discusses possible effects of these two industries on disparities between the central city and suburbs in a metropolitan area.

JEL Classification: R58, R11, R23, R53

Paper prepared for the Conference on Urban and Regional Policy Effects, held on March 29–30, 2007, and sponsored by the George Washington University Institute of Public Policy and School of Public Policy and Administration, the Brookings Institution, and the Urban Institute. The authors appreciate the assistance of Wei-Jang Huang, Claire Black, Linda Richer, Babette Schmitt, and Julie Kurtz. We also thank Lara Shore-Sheppard, Diane Pfundstein, and David Jaeger for help in matching metro areas from the various censuses. This paper should not be construed as official views of any of the sponsors of this conference, or of the Upjohn Institute. A substantially shortened version of this paper was published in the book *Urban and Regional Policy and Its Effects* (Margery Austin Turner, Howard Wind, and Hal Wolman, eds.) Brookings Institution Press, 2008.

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1. INTRODUCTION

This paper considers the potential for higher education institutions and the health care industry to be levers for a metropolitan area's economic development. Can state and local public policies that invest in "eds and meds" increase the real economic well-being of a metro area's residents? Are there specific activities of eds and meds that have a stronger regional economic payoff?

These questions are motivated by many longstanding policy debates about the linkage between higher education and health care institutions, and local economies. City neighborhoods and cities, particularly distressed cities, have in recent years looked to higher education and health care institutions as source of jobs and community development investments. The first mention in print media of the economic role of eds and meds is a 1995 article in the Philadelphia Inquirer that discusses Temple University's investments in retail and housing developments in North Philadelphia, Marquette University's involvement in rehabilitating nearby neighborhoods of Milwaukee, Yale University's assistance in redeveloping the nearby downtown of New Haven, and the involvement of University of Pennsylvania students and faculty in social programs in West Philadelphia (Goodman 1995). Eds and meds are relatively immobile compared to many other employers. This immobility gives these institutions a good reason to invest in improving nearby neighborhoods. Of course, relations between education and medical institutions and their surrounding neighborhoods can be combative, especially in situations in which the institution is growing and needs additional property.

Furthermore, many current and new jobs have been provided in many cities by the expanding health care sector, and in some cases by expanding higher education institutions. For example, a 1999 Brookings Institution paper pointed out that in the largest 20 U.S. cities, eds and meds typically are among the largest private employers, with over one-third of those employed by the 10 largest private employers working for higher education or health care institutions, and with an average of 6 percent of total city jobs accounted for by these large eds and meds (Harkavy and Zuckerman 1999).

Even if eds and meds boost the economy of their nearby neighborhoods and cities, eds and meds may not boost the overall metropolitan area economy. The city jobs and investment from eds and meds could merely redistribute economic activity away from suburbs.

However, there are good reasons for policymakers to be interested in eds and meds as a boost to a metro area's economy. With the declining importance of manufacturing as a source of jobs, economic developers have increasingly been looking for other growth levers. As a result, some services have been moved up from being considered unimportant, secondary, "non-export base" activities, which are dependent on other activities to bring new monies into the area, to "export-base industry" status as potential generators of new monies for the area. Education and medical institutions, by attracting students and patients from outside the region, or encouraging students and patients to stay in the region, can thereby attract new monies to an area. In addition, lower transportation and communication costs have caused many businesses to become more footloose. Many footloose businesses are increasingly selecting locations based on the preferences of workers, because one business location factor that remains difficult to move is the local labor force. This confirms the continuing relevance of Adam Smith's contention in *The Wealth of Nations* that "a man is of all sorts of luggage the most difficult to be transported"

(Smith 1776, Book I, Chapter 8). Former students who still enjoy a college environment and older workers who want high-quality local health resources will be difficult to move to an area that has neither. Furthermore, some of the outstanding regional economic success stories of the last 30 years, such as Silicon Valley, Route 128 in Boston, and the Research Triangle in North Carolina, are high-technology developments that are believed to be in part attributable to the quality of the local labor force and the quality of local universities. Furthermore, a widespread perception is that a key future growth area will be biotech, as the health care sector expands and develops. Therefore, there is good reason for policymakers to be interested in exploring whether investments in higher education and health care institutions may boost a metropolitan area's economy.

Furthermore, colleges and universities, particularly public universities, have frequently been interested in dramatizing their contributions to the local economy. Over the last 40 years, hundreds of reports produced by higher education institutions have made claims about these institutions' effects in creating local jobs and income. At the Upjohn Institute, we recently completed a report on Grand Valley State University's economic impact on the Grand Rapids area economy, and also have helped produce a report on Western Michigan University's impact on the Kalamazoo area economy. We also have written a similar report on the economic impact of Bronson and Borgess Hospitals, the two main Kalamazoo hospitals, on the Kalamazoo area economy.

Our hometown of Kalamazoo might not exist today without the economic spinoffs from "eds and meds." Two of Kalamazoo's main private employers, Pfizer (which absorbed the former Upjohn company) and Stryker, were originally developed by two doctors responding to problems in their medical practices. The Upjohn Company was developed in the early twentieth century in part because Dr. W.E. Upjohn was frustrated that many of his patients didn't absorb the pills they were taking but just passed them through their systems. Stryker Medical Instruments was developed in the early twentieth century in part because Dr. Homer Stryker was frustrated with bedsores and other problems for patients from the available hospital beds. Furthermore, another large Kalamazoo employer, Western Michigan University, is located in Kalamazoo in part because the city fathers in 1903 lobbied heavily for the state government to locate a teachers' college in Kalamazoo.

Whatever the historic impact of eds and meds on Kalamazoo, or their historic impact on Silicon Valley, Route 128, and the Research Triangle, the relevant question is whether investments in "eds" and "meds" will pay off economically today and for most metropolitan areas. Some policymakers are clearly hoping that such investments will pay off. In 2003, Florida provided hundreds of millions of dollars in economic development subsidies to lure a new biomedical research facility of the Scripps Research Institute (Lyne 2003). Various institutions and civic leaders in Grand Rapids, Michigan, provided tens of millions of dollars of subsidies to convince Michigan State University to agree in January 2007 to move its medical school to Grand Rapids (Miller 2007).

This paper examines what we know about the impact of higher education and health care institutions on a metropolitan area's economic development. Based on past research, we assume that the most important potential benefit of successful local economic development is the resulting increase in the real earnings of the original local residents (Bartik 1991, 1994, 2005). Past research suggests benefits to in-migrants, local landowners, and the local government's fiscal health are quantitatively smaller than the effects on the real earnings of the original local residents. Therefore, what we ultimately should want to know is how much a public investment of $x in a particular activity of higher education and medical institutions will boost the annual earnings per person of the original residents of the metropolitan area. As our paper shows, we can say a little about this return on investment in eds and meds, but there is a lot we don't know.

The underlying philosophy of this paper's approach is in sympathy with the well-known quotation from the nineteenth and early twentieth century British mathematical physicist William Thomson, Lord Kelvin: "…[W]hen you cannot express it in numbers, your knowledge is of a meager and unsatisfactory kind…"[1] Who would argue against the proposition that eds and meds have some positive effects on a metro area's economy? But the policy relevant question is, what are the magnitude of those effects? And, are there some types of eds and meds activities that have quantitatively larger effects?

This paper only considers the potential economic development benefits of investments in eds and meds for the metropolitan area and its residents. We do not consider the benefits of eds and meds for the nation. These national benefits are important, and might differ quite a bit from metro area benefits due to migration of people and firms. However, the national perspective lies beyond the scope of the current paper.

2. TYPES OF IMPACTS

This section of our paper briefly describes the possible types of impacts that eds and meds might have on a metropolitan area's economic development. In a later section, empirical evidence will be provided on magnitudes of these possible impacts. The possible types of impacts of eds and meds on metro economic development include export-base demand stimulus, human capital development, amenity improvements, R&D spillovers, entrepreneurship increase,

[1]To which economist Frank Knight is reported to have said, "And when you *can* express it in numbers your knowledge is of a meager and unsatisfactory kind" (McCloskey 1983). We can only hope that the numbers we

reduced intra-metro disparities, model employer effects on labor market norms; and economic development leadership.

Export-base demand stimulus. If any industry, including eds and meds, brings in dollars to purchase local goods, and these dollars would otherwise be spent outside the local economy, then this increase in demand will increase local economic output and thereby increase local earnings. An industry can bring in new dollars by selling its goods or services to persons or businesses from outside the local economy ("export-base production"). An industry also can bring in new dollars by selling its goods or services to local persons or businesses who otherwise would have purchased these goods or services from sources outside the local economy ("import substitution").

Intuitively, such demand stimulus seems more plausible for "eds" than for "meds." Without a particular higher education institution in this local economy, many of the students and research dollars at the institution would quite possibly have gone to higher education institutions outside the local economy. For health care institutions, demand for services tends to be more local. If this particular health care institution did not exist, other health care institutions would arise to meet local demand for health services.

Of course, the extent to which a particular higher education or health care institution brings in new dollars will vary quite a bit across different institutions. For example, community colleges, compared to a nationally known selective liberal arts college or research university, will tend to serve local residents and businesses. Although some of a community college's local students may have otherwise left the metro area, other local residents would have stayed, and either not have gone to college, or gone to other local educational institutions that would arise or

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provide improve the quality of our knowledge, even if it is still meager.

expand to meet this local demand.

We must also be careful not to confuse the rapid expansion of an institution or an entire economic sector with whether that sector brings new dollars into the regional economy. For example, even if local hospitals are rapidly expanding and hiring many additional workers, this expansion could simply reflect expanding local demand for hospital services.

The net demand effects of a state or local area investing in eds and meds must include the negative economic effects of any taxes required. These increased taxes might be needed to directly subsidize the expansion of eds or meds, to provide public services to the eds or meds expansion, or to make up for foregone property taxes if the expansion of these tax exempt institutions removes property from the tax rolls. In general, such taxes will be considerably less than the expenditures associated with these industries, because these industries are substantially funded by fees charged students or patients. In addition, even if state or local public spending on a good or service is 100 percent tax financed, a balanced budget expansion in both taxes and spending will still have a net positive effect on the local economy. Only a portion of the increased taxes reduces consumer spending on local goods, whereas the first impact of spending is to increase demand for local goods. (This is the version at the state and local levels of the balanced budget multiplier from any standard macroeconomics course, and has been explored by Orszag and Stiglitiz [2001].)

Human capital development. Increases in the local supply of more productive workers will tend to encourage business development that will use these skills to expand local output and local earnings. Increased local supply of a particular labor skill may increase productivity more if that skill has spillover effects, that is, if an increased supply of workers with that type of labor skill increases the productivity of other types of labor. In addition, long-run productivity effects of an increased local supply of some labor skill increases if that skill allows workers not only to be more productive, but also to more rapidly adapt to new technology that increases productivity.

Development of greater skills and knowledge of graduates is still a primary goal of colleges and universities. The greater skills and knowledge of college graduates from local colleges and universities will stimulate the local economy to the extent that these graduates result in an increase in the average prevailing skills and knowledge in the local economy. Greater availability of local higher education institutions may encourage greater educational attainment by local residents by making higher education more accessible (Card 1995). In addition, graduates of a college and university, both those who originally were residents of the metro area, and those who moved to the metro area to attend the college, may be more likely to locate in that metro area than they would have been if they had attended college elsewhere.

Of course, different types of colleges and universities produce different types of skills. Many liberal arts colleges and universities focus more on increasing their graduates' general skills. Community colleges may focus more on producing occupation-specific or even job-specific skills. For example, many states, most notably North Carolina, provide funding for community colleges to provide free customized job training for new workers or incumbent workers in new or expanding manufacturing companies. Both general skills and occupation-specific skills can increase the productivity of the local workforce, although perhaps different companies will have a different valuation on general vs. occupation-specific skills.

The productivity of the local labor force is potentially also improved by increases in health, such as those brought about by the health care industry. However, it is unclear whether some marginal expansion of local health care institutions will improve local labor force health sufficiently to significantly improve labor productivity.

Amenity improvements. Better amenities in a metropolitan area will attract people to the metropolitan area and thereby attract jobs. Different types of amenities may differentially attract different types of people and therefore different types of jobs. Improvements in local amenities may be encouraged by higher education institutions and health care institutions in several ways. First, a higher quality and variety of local health care or higher education institutions may be considered amenities. Second, higher education or health care institutions may subsidize other amenities. Higher education institutions may have an interest in subsidizing some local cultural activities (music, art) and entertainment activities (college football), both because these activities complement these institutions' educational missions and because these activities may help elicit local support for the institution. (Health care institutions may directly subsidize cultural and entertainment activities to some extent as well, but such activities have less synergy with the core mission of health care institutions than with the core mission of higher education institutions.) Finally, higher education and health care institutions both help generate a local pool of highly educated persons, which may generate sufficient demand to allow for a greater diversity and quality of local amenities, including cultural activities, restaurant offerings, recreational activities, and entertainment options.

R&D Spillovers. Increased research knowledge of local businesses may raise local output through directly raising local productivity. This increased local productivity may lead to further rises in local output by allowing local businesses to gain a greater share of the national market. Increased research knowledge of local businesses or potential local entrepreneurs also may allow production of new products.

Local businesses' research knowledge may be increased by various spillover effects of the R&D knowledge and activities of professors at colleges and universities, and doctors at hospitals, in several ways. The most direct and obvious economic spillover of the research of "eds and meds" is some professor or doctor deciding to use his or her research knowledge to start up her own business in the local area. In addition, the R&D of researchers at universities and hospitals may be licensed to local businesses. University and hospital researchers may convey a wide variety of research knowledge to local businesses, either through formal consulting contracts, or more informally through meetings and casual conversations.

Entrepreneurship increase. Stronger local entrepreneurship will contribute to a stronger local economy. Entrepreneurship depends in part on skills and personality traits. Research suggests that the more highly educated are more likely to be entrepreneurs (Acs and Armington 2006). This suggests the possibility that a local college or university may increase local entrepreneurship by increasing the percentage of college graduates in the local economy. It also may be the case that doctors are more likely to be entrepreneurs in related industries, as many doctors are already running a small business.

Reduced intra-metro disparities. Reduced disparities between city and suburb may increase overall metropolitan growth. For example, Detroit's suburbs might have more vigorous growth and economic development if the city of Detroit was stronger. A stronger city may promote overall metropolitan development by improving the metro area's image, providing more diverse amenities, and providing additional clusters of industries and labor skills that enhance the productivity of other metro industries. There is some empirical evidence that healthier city economies help suburbs, but the evidence is sparse (e.g., Voith 1998).

Intra-metro disparities may be reduced by investment in eds and meds to the extent to which these industries are disproportionately located in central cities. Of course, even if eds and meds happen to be located throughout the metropolitan area, a particular policy may choose to invest in eds and meds in the central city.

Model employer effects on labor market norms. Empirical evidence suggests that wages persistently vary across industries and firms for workers with the same characteristics (e.g., Dickens and Katz 1987; Groshen 1991; Krueger and Summers 1988). Efficiency wage models suggest such wage variations may be due to differences across industries and firms in wage norms, employee turnover costs, business profitability, and the ease of monitoring worker productivity.

Some versions of efficiency wage theory imply that prevailing wages in a local labor market may depend on notions of what wage policy of employers (or other labor market practice by employers) is considered "fair." There is some empirical evidence to support this notion. For example, studies of local living wage laws, which typically regulate the wages paid to government contractors or firms receiving economic development subsidies, suggest far larger effects on local wages and poverty than would be expected by their direct effects on firms whose wages are covered by these laws (Bartik 2004; Neumark and Adams 2003).

The labor market practices of local higher education and health care institutions, as large local employers, may influence local labor market norms about wages and other employer practices. If these large employers choose "high road" labor market practices, with higher wages, more internal promotion, and lower employee turnover, these practices may encourage local norms favoring such employer practices, encouraging other employers to adopt such practices.

Economic development leadership. Effective local leadership can promote local economic development, for example, by identifying key barriers to local economic development and key opportunities for such development, and mobilizing the political and financial resources needed to overcome such barriers and exploit such opportunities. In the economic development arena, historically much leadership has been provided by locally based organizations that heavily benefit from stronger local economic growth, such as locally owned banks and newspapers. As more banks, newspapers, and other local businesses have been bought out by national corporations, the interest of these branch operations in leading local economic development efforts has waned.

Large locally based universities and hospitals are plausible sources of local economic development leadership. Hospitals certainly depend on local demand and therefore have an interest in faster local growth. Universities may depend on the economic health of the local economy in a number of ways: the health of the local economy affects the quality of neighborhoods adjoining the university's properties; the health of the local economy affects the university's ability to attract faculty and do local fund-raising.

3. VARIATION ACROSS METRO AREAS IN EDS AND MEDS

Before discussing the empirical evidence on how a metro area's specialization in eds or meds affects its economy, we first summarize some patterns in variations across metro areas in specialization in eds and meds.

Our definition of "eds" includes colleges and universities, both four-year and community colleges (NAICS codes 6112 and 6113; SIC codes 8221 and 8222). Our definition of "meds" includes doctors' offices and other ambulatory medical facilities, hospitals, and nursing homes and other residential care facilities (NAICS codes 621, 622, and 623; SIC code 80). We strive to include both government-owned and privately owned enterprises. (Note that this is not always possible with many establishment-based databases on industry. Most of our empirical data, however, comes from census-based data collected from households, in which the industry definitions from the employment questions typically do include both government-owned and privately owned enterprises.)

Our meds definition does not include pharmaceutical companies, biotech companies, or similar enterprises that are primarily concerned with inventing and selling new products and services to be used in health care. Similarly, our eds definition does not include activities in non-higher education industries that might produce the new knowledge that is "sold" in the higher education industry. Our focus is on service industries whose original primary goal is to enhance human capital, either through education or health care. Of course, some of the possible positive economic effects of these service industries may come from positive effects on other industries, for example the health care industry might have positive effects on the biotech industry.

We consider two possible definitions of a metro area's specialization in eds and meds. The first is based on the metro area's employment location quotient in each of these industries, a standard concept in regional economics. The employment location quotient for eds will simply be equal to the percentage that higher education employment comprises the metro area's total employment, divided by the percentage that higher education employment comprises total national employment. A similar definition holds for the meds employment location quotient.

The second definition is the earnings location quotient in each of these industries, that is, the percentage that the metro area's labor earnings in eds (or meds) comprises of total earnings in the metro area, divided by the analogous percentage for the nation. The earnings location quotient should in theory be a better proxy for the share of the area's total economic activity in each industry. If the local eds or meds sector is unusually productive, we might expect its earnings location quotient to be somewhat higher compared to its employment location quotient.

We first look at data from the Public Use Microdata Sample (PUMS) of the 2000 census. These data are derived from household surveys.

Table 1 shows that employment or earnings in higher education is a little over 2 percent of total national employment or earnings. The eds share is slightly lower for earnings than for employment, implying that this is a slightly below-average earnings industry. (We will explore pay standards in these industries later in the paper.) Employment or earnings in health care industries is 9 or 10 percent of total national employment or earnings. The meds share is slightly higher for earnings than for employment, implying that this is a slightly above-average earnings industry.

Both eds and meds are large economic sectors. However, meds is about four times as large as eds. As pointed out above, it is quite plausible that meds is much more locally oriented than the eds industry. Or, to look at the other side, compared to eds, a much lower share of meds is export-base, which is devoted to bringing in dollars to the metro economy that would otherwise go elsewhere. However, because meds is so much larger than eds, even a small share of the meds industry that is export-base may be of economic importance to the metro economy.

Table 2 presents some descriptive statistics for location quotients in eds and meds for the 283 metro areas in our sample. The most important finding from Table 2 is that there is far greater variation in the eds location quotient across metro areas than for the meds location quotient. This finding strongly suggests that a much larger share of eds activity than meds activity is export oriented in the typical metro area. Apparently meds activity is largely determined by total metro area economic activity, whereas eds activity varies much more independently of the size of the metro economy. This is not surprising as the term “college town” is better known and more widely heard than “hospital or medical town.”

Table 3 shows some correlations between the eds and meds location quotients. The employment and earnings location quotients are highly correlated for eds, and similarly for meds. However, there is little correlation in the location quotients between the eds and meds sectors.

However, this does not mean that there are not some considerable differences in some cases between the earnings and employment location quotients in eds and meds. Table 4 reports descriptive statistics for the ratio in each metro area of the earnings location quotient for eds to the employment location quotient for eds, and for a similar ratio for meds. This ratio can be rewritten as relative earnings per worker in the metro area in the eds industry (or meds industry) compared to the metro area's average earnings per worker, divided by a similar relative earnings figure for the nation. As can be seen, there are metro areas that have considerably higher or lower relative earnings per worker in eds or meds than the national average.

Table 5 reports the employment location quotient for eds by metro area, with metro areas ordered from the highest location quotient for eds employment to the lowest location quotient. The table also reports the ratio of the earnings to employment location quotient for eds for each metro area. As one would expect, this eds location quotient is highest in what we generally think of as college towns, with large state universities in a relatively modest-sized community. It is also in some of these smaller metro areas that the relative earnings in eds is particularly high.

Table 6 provides a similar ordering of metro areas by the employment location quotient for meds. Rochester, Minnesota, stands out as a specialized city in medical care.

Table 7 reports how the mean and standard deviation of the ed and med location quotients vary in different size classes of metro areas. As can be seen, the largest metro areas have considerably less variation in location quotients for eds, and to a lesser extent for meds.

Larger metro areas tend to have strengths in a wider variety of industries, which means they are less likely to have unusually high concentrations of one industry.

Table 8 reports how the mean and standard deviation of the eds and meds location quotients vary across the four census regions. The Midwest region appears to have more "college towns" than the other regions. The Midwest also has more variation in industrial specialization patterns in different metro areas.

Finally, we look at how the spatial variation in location quotients for eds and meds changes over time. Table 9 is based on data from the PUMS for 1970, 1980, 1990, and 2000 for 125 metro areas that we can roughly match over those four censuses. As can be seen, the standard deviation across metro areas in the location quotient of eds has declined in each decade. This may reflect an expansion of higher education to more metro areas as a higher percentage of the population decides to get a college education.

4. SUMMARY EVIDENCE ON EDS AND MEDS EFFECTS ON LOCAL ECONOMIC DEVELOPMENT

Before considering evidence for specific types of effects of eds and meds on local economic development, we briefly consider the overall "effects" on metro economic development—or at least correlation with metro economic development—of a metro area's specialization in eds and meds.

Table 10 summarizes the results from a series of regressions of metro area employment growth on a metro area's specialization in eds and meds and other variables. The dependent variable in all cases is the average annual employment growth in the metro area over the time period. The time periods considered are 1969–1979, 1979–1989, 1989–2000, and 2000–2004. These time periods are chosen to make the end years coincide with U.S. business cycle peaks;

the intent is that the employment changes over such a time period should reflect long-run growth trends rather than cyclical fluctuations. (2004 is not a business cycle peak but rather the last year of available data for all variables.) We run separate regressions for each time period and a pooled regression that includes 1969–1979, 1979–1989, and 1989–2000.

Eds and meds specialization of the metro area is measured by four variables. Two of these variables are the employment location quotient for eds and meds in the metro area as of the base year for the growth, which is 1969 when the dependent variable is average employment growth from 1969–1979, etc. Two variables are the ratio of the earnings to employment location quotient for the metro area as of the base year. These variables are meant to reflect whether relative earnings per worker for eds and meds is particularly high as of the base year, which might reflect a relatively high productivity eds and meds sector.

Control variables include a "share effect" prediction of employment growth for the metro area over the time period. This share effect is the predicted annual employment growth over the time period if each industry in the metro area had just grown at the average employment growth nationally for that industry over that time period. It reflects "export-base" shocks to the metro area's employment growth due to national demand for the metro area's specialized industries (Bartik 1991). Other control variables include the natural logarithm of metro area employment as of the base year, to control for any differentials due to metro area size in growth trends.

The time period regressions include dummy variables for four regions of the United States to control for unobserved regional trends affecting employment growth. The pooled regression includes a fixed effect for each metro area, to control for unobservable metro area variables affecting employment growth. The pooled regression also includes dummy variables for each time period, to control for unobserved national variables affecting employment growth.

The individual time period regressions implicitly control for national time period effects with the constant term.

The time period regressions are best interpreted as the correlation of base period eds and meds specialization levels with subsequent metro area growth trends. The pooled regression, by controlling for metro area fixed effects, is best interpreted as showing how differences over time for the same metro area in eds and meds specialization are correlated with differences over time for the same metro area in employment growth trends.

As shown by the results for the separate time period regressions, there is no consistent positive correlation between levels of base period metro location quotients in eds and meds and subsequent growth. In fact, a higher location quotient for meds tends to be associated with significantly lower subsequent employment growth in all time periods. A higher location quotient for eds is negatively correlated with subsequent employment growth for three of the four time periods. On the other hand, higher relative earnings in the metro area for eds and meds tends to be positively associated with subsequent employment growth.

The pooled results suggest that a metro area that increases its location quotient for eds or meds will subsequently tend to experience higher employment growth. Changes in relative earnings for eds have no effect in changing a metro area's employment growth trends, but increases in relative earnings for meds tend to increase subsequent employment growth trends.

The sizes of all these effects are modest. Based on the pooled regression, a one standard deviation increase in the location quotient for eds is associated with an increase in annual employment growth of 0.16 percent, or an increase in employment after 10 years of 1.6 percent. The effects of a one standard deviation increases in the other variables is smaller. Even if we consider a larger increase in eds, say, a change equal to a change in the location quotient of 1, the effect on annual employment growth is only 0.26 percent. The effect of a change in the location quotient of meds of one location quotient would increase annual employment growth by 0.35 percent.

The literature on how local employment growth affects earnings suggests that effects on the earnings of the original workers in the metro area will increase by about 40 percent of these employment growth shocks (Bartik 1991, 2001). Approximately half of these changes in earnings of the original residents in this literature are due to higher employment to population ratios, and about half are due to workers being able to move up to better paying occupations. Therefore, based on the pooled results, annual earnings increases due to a one location quotient increase in eds or meds would be about 0.10 percent for eds and 0.14 percent for meds, or 1 percent and 1.4 percent over a 10-year period.

Table 11 repeats this same estimation exercise, but with a different dependent variable, the metro area's annual average per capita income growth over the time period. In this set of regression estimates, the estimated effects of eds and meds specialization upon per capita income growth tend to be inconsistent and statistically insignificant. The most statistically significant result in the pooled regression is for relative earnings per worker for meds; increases in relative earnings for meds are estimated to increase subsequent per capita income growth.

Taken at face value, these results suggest that a metro area that invests in increasing its specialization in eds or meds will increase its subsequent employment growth modestly, but perhaps by an amount worth considering. An increase in earnings of 1 percent or so after 10 years does amount to quite a bit of money. On the other hand, per capita income in the MSA only seems to increase if relative earnings in meds increases.

However, these results are simply summaries for how overall eds and meds specialization is correlated with metro economic development. The estimated effects could be biased by various changes in unobserved variables that happen to be correlated with the eds and meds specialization variables. In addition, these effects of overall eds and meds specialization may not reflect the effects on local economic development of specific types of activities of eds and meds. Therefore, we will now turn to considering the empirical evidence on all the possible mechanisms for eds and meds to affect economic development, as described in section 2 above.

5. EMPIRICAL EVIDENCE ON DIFFERENT TYPES OF IMPACTS

This section considers the empirical evidence on the different possible types of impacts of eds and meds on metro economic development, which were conceptually described previously in this paper.

Export-Base Demand Stimulus

Eds and meds will stimulate demand for local goods and services in three distinct ways:

1) direct purchases from their regional suppliers,

2) consumption expenditures of their staffs, and

3) consumption expenditures of students for eds and teaching hospitals and visitors.

There is a huge literature on the demand effects of eds and meds. Most of this literature is so-called fugitive literature published in reports or working papers, and not in scholarly journals. In the case of higher education demand effects, a 1992 article by Leslie and Slaughter reviewed 60 reports on demand impacts, and a 2006 paper by Siegfried, Sanderson, and McHenry reviewed 138 studies since 1992. The literature on demand-induced economic impacts of hospitals and other health care facilities has not generated as many literature reviews, but there are easily several dozen studies, mostly of rural hospitals' economic impacts (for example, see McDermott, Cornia, and Parsons [1991]), or numerous local economic studies by the Kentucky Rural Health Works Program at the University of Kentucky (available at www.ca.uky.edu/krhw/impact.html). In addition, there are some comprehensive national summaries of local economic impacts due to demand effects of eds and meds that are generated by advocacy groups, for example, a study by the National Association of State Universities and Land-Grant Colleges of the economic impacts of public universities (NASULGC 2001), and a study by the Association of American Medical Colleges of the economic impacts of medical schools and teaching hospitals (AAMC 2007).

How to estimate demand impacts of eds and meds is conceptually clear, but the details are tricky. Among the issues that must be addressed are what proportion of the induced increase in eds and meds in fact will bring new dollars into the community, that is, will enhance the export-base, including substituting for imports; what are plausible multipliers; how to avoid double-counting; and the economic costs of inducing increased local activity in eds and meds.

<u>The export-base percentage</u>. The issue in estimating the demand effects of some policy to induce eds or meds investment is the extent to which this investment will induce new dollars to enter the local economy, as opposed to substituting for dollars that are already being spent locally. For example, if we add a new local college or university, a key question is to what extent this adds new students to the community. We do not want to count, as additional local demand, any expenditures associated with students in the new college who would have otherwise attended another local college, or who would have not attended college but would have been living and spending money in the local community. As another example, if we add a new local hospital, a relevant issue is the extent to which this adds new patients and health care spending to the

community. We would not want to count, as additional local demand, any patients or health care dollars that would have otherwise taken place at some already existing facility in the community. In the case of meds, this may be more difficult to see due to natural growth of the industry. With growing income and aging, the demand for medical services will continue to grow. In such a growth environment, the displacement impact may be difficult to see as the expansion at one hospital will not impact the current demand for services at the other existing hospitals but instead will curtail their growth plans.

Many studies ignore this issue by implicitly assuming that 100 percent of the activity at any eds and meds facility in the local community is truly new dollars brought to the community that would not have occurred if this institution or this group of institutions disappeared. This assumption can only be rationalized as an answer to a quite different and much less policy-relevant question: what would happen if we closed down a particular ed or med institution, or even all such institutions in a local community, and made it illegal to open up or expand any ed or med facilities to replace the closed institution(s)? This is a less policy-relevant question because it is not a feasible experiment that we can imagine carrying out in anything resembling our society. (In addition, the effect on local demand would not be the main social impact of such insane and infeasible policies as forbidding hospitals or colleges to operate in a particular metro area.) In the real world, even if we somehow imagined that all the colleges and hospitals in a metro area were closed, there would be some alternative institutions that would arise in part to replace the closed institutions.[2]

[2]This discussion oversimplifies things a bit. Actually, the usual approach has to assume that after closing existing eds or meds institutions, not only will there be no substitution of increased spending on newly arising eds or meds institutions, but there will be no increased spending on other local goods or services. Throughout this paper, we focus on the substitution of spending for eds (or meds) institutions for one another, because we think that it is the most important demand-side effect to consider, but there also are other types of expenditure substitution.

In determining the effect of addition to local capacity in eds and meds, we have to look not only at new students or new patients attracted to the metro area, but also at whether any local residents who would have otherwise gone to a college or health care facility outside the metro area are induced to stay in the metro area. In the jargon of regional economics, we need to look not only at the effect of an induced capacity expansion in eds and meds on the metro area's "exports" of services to nonmetro area residents, but also at the extent to which the induced capacity expansion "substitutes for imports" by reducing the consumption by metro area residents of services outside the metro area.

Intuition suggests that investment in expansion in eds is much more likely to increase the metro area's exports or substitute for imports than is investment in expanded meds. College students are far more geographically mobile than health care consumers. This intuition is backed up by the earlier results that there is far more variation in location quotients for eds than there is for meds. Meds activity is very tightly tied to local demand, whereas eds activity is far more independent.

We would also expect the extent to which eds and meds expands exports or substitutes for imports to be greater in smaller metro area. In a smaller metro area, for example, the disappearance of a particular ed or med institution is less likely to result in its replacement by expansion of another institution.

In addition, the extent to which a particular ed or med institution expands exports or substitutes for imports will be greater if that institution is offering a ed or med service that is more specialized. If the ed or med service is more specialized, there are less likely to be good local substitutes for that service if this particular institution goes away. The entry of a more specialized ed or med service into the area is not likely to cause any displacement of existing activities since this specialized service was not offered locally before.

<u>The multiplier</u>. A second tricky issue is the likely multiplier effect of any expansion in metro area exports or substitution for imports induced by expansion in eds and meds capacity. By multiplier effects, we mean the ratio of the total increase in local economic activity to the direct increase in economic activity due to expanded exports/reduced imports in eds and meds. This ratio will be greater than one because of induced effects on local suppliers to eds and meds, and effects on local industries that sell goods or services to the employees of eds and meds.

We would expect these multiplier effects for eds and meds to be relatively modest compared to the metro area multipliers that we see for many manufacturing industries. Eds, and to a lesser extent meds, do not depend on specialized local suppliers who must be located close by in order to communicate about new technologies, unlike many manufacturing firms. For example, there is no equivalent in the eds and meds industry to the networks of various tiers of nearby suppliers that characterizes the auto industry. In addition, as we will review below, in general eds, and to a lesser extent meds, is not a particularly high-paying industry, which reduces the local demand effects due to local spending by employees.

Considering both weaker local supplier links and modest wages of eds and meds, it would be surprising if multiplier effects for eds and meds exceeded 2. Most studies do seem to get multipliers less than 2. For example, Siegfried, Sanderson, and McHenry (2006) found that median multipliers in college impact studies for expenditure were 1.7, and for employment were 1.8; Leslie and Slaughter (1992) found mean multipliers of 1.6 for two-year colleges and 1.8 for four-year colleges. However, some studies seem to get multipliers considerably higher than 2, which is questionable.

Multipliers for eds and meds will generally be higher in larger metro areas. A larger metro area will have more specialized local suppliers, and will have a wider variety of goods and services to capture the spending of the employees of eds and meds.

Double-counting. One subtle problem that occurs in some studies, as pointed out by Siegfried, Sanderson, and McHenry (2006), is double-counting certain expenditures. For example, it would be incorrect to count both a college's total spending and student spending on tuition, or to count both a college's total spending and its employees' spending.

Opportunity cost of inducing eds and meds expansion. A difficult issue is the economic impact of the costs of inducing an eds and meds expansion. In general, expansion of publicly owned colleges and universities would be heavily influenced by state government policy, as state government supplies such a significant share of the revenue of public colleges and universities. The state and local government share of public college and university revenues is about 40 percent, of which about 36 percent is state and 4 percent local (Institute of Education Sciences 2006). However, local political lobbying for an expansion of a publicly owned higher education facility may require local "spending" of considerable political capital and giving up other projects or local benefits. At the extreme, one could imagine that the local area might essentially have to incur political costs equivalent to paying for the entire state and local share of the increased revenue needed for expanding the eds facility.

For public hospitals, state and local subsidies amount to about 15 percent of revenue (NAPH [2004]; this excludes Medicare and Medicaid, which amount to another 19 percent and 37 percent of revenue, respectively). Of the $97 billion in annual state and local government spending on hospitals, 59 percent comes from local governments (U.S. Census Bureau 2003–2004).

For private colleges or universities, or private hospitals or other medical care facilities, the location and expansion decisions are made by the private entity that controls that institution. It is unclear what the typical costs are of inducing such an entity to expand its local capacity.

If inducing the expansion of eds or meds has local costs, which will require higher local taxes, the costs of such taxes should be considered in the analysis. Higher local taxes, other things equal, will lower local demand and local economic activity. In general, this local economic effect will be less than the same sized local spending, as only a portion of any increase in local taxes will come at the expense of less spending on local goods, as local residents would have spent a considerable amount on out-of-metro area purchases due to Internet sales, tourism, and travel-related sales, or would have saved some of these funds.

Any tax costs of financing an expansion of eds or meds are likely to only be a small fraction of the increased expenditures associated with the eds or meds expansion. As mentioned, total state and local spending on public higher education is only about 40 percent of such institution's revenues. Total state and local spending on health care is only 13 percent of total health care spending (National Center for Health Statistics 2006, Table 120).

Some illustrative calculations. We provide some reference calculations for plausible impacts of eds and meds using the Upjohn Institute's version of the REMI model for the Grand Rapids and Kalamazoo metro areas. (Regional Economic Models Incorporated (REMI) constructed the model for the Grand Rapids and Kalamazoo metro areas at the request of the Upjohn Institute. REMI models combine the standard regional input-output model with a general equilibrium model with a forecast component. REMI is well regarded by regional economists and has been used in hundreds of studies.) For each metro area, we consider the economic effects of inducing an expansion of a higher education institution, or a hospital, that is associated with a

$100 million increase in expenditures of the institution. Such calculations allow us to consider the issues outlined above in a consistent way for both eds and meds.

As shown in Table 12, the REMI model has default estimates for what proportion of such expansions will come from substituting for other local economic activity, and what proportion will come from either expanding local exports or substituting for local imports. As shown in the table, this export-base percentage is much greater for higher education than for health care. In addition, the export-base percentage is higher for Kalamazoo than for Grand Rapids, which reflects the larger size of Grand Rapids and the greater substitution response due to an expansion in ed and med capacity in Grand Rapids.

The multiplier estimates from the REMI model, as expected, are modest in size. Multipliers are lower for higher ed than for health care. The lower multipliers for eds than for meds may be due to fewer local suppliers in higher ed than in health care, and lower wages in higher ed than in health care. As expected, multipliers are also lower in the smaller metro area of Kalamazoo than in Grand Rapids.

The export base percentages and multipliers end up yielding estimates that the gross local economic impact of higher education institutions is about equal to the total expenditure in the higher education institution. This finding is consistent with Blackwell, Cobb, and Weinberg's (2002) statement that in "most of the university impact studies [that] we reviewed … a university's annual impact approximately equals its annual budget." This finding occurs because the export-base percentage for the typical university is modestly less than one, and the multiplier is modestly higher than one, so the resulting impact is close to the university's budget.

In contrast, the economic impact of meds is only one-quarter to one half of the institution's budget. This largely occurs due to a much lower export-base/import substitution role for the typical health care facility, which is only partly offset by a larger multiplier.

As mentioned before, most of the ultimate benefits of local economic development are due to increased earnings of the original local residents. These increased local earnings will be some lesser percentage of the total increase in earnings of the metro area due to expanded capacity in eds and meds. We assume about 70 percent of increased local economic activity goes to labor. Based on previous regional studies, we assume increased earnings of the original local residents due to a demand shock to local earnings is about 40 percent of the total increase in metro area earnings (Bartik 1991, 2001). The result is an increase in local earnings of about one-quarter of the institution's expenditure for eds, and about one-tenth of the institution's expenditure for meds.

We might want to standardize such impacts not in terms of a given dollar increase in induced institutional capacity, but rather in terms of the size of that sector. This would allow us, for example, to consider such issues as the relative impact of inducing an *x* percent expansion in eds versus an *x* percent expansion in meds. We therefore consider the effect on local residents' earnings of a policy that attempts to induce a one location quotient expansion in ed or med capacity. It should be emphasized that we allow for substitution effects that occur because this induced one location expansion will not all be export-base, but will instead displace existing activity in other eds or meds facilities.[3] An attempted one location quotient expansion in eds or meds capacity is also equal in absolute value (but opposite in sign) to the economic impact if all

[3]And of course may also displace spending on other local goods and services.

the existing ed or med facilities in a metro area disappeared, but we allowed the economy to "naturally" determine to what extent these closed institutions would be replaced.

As shown in the table, because meds is a much larger industry than eds, we end up getting similar sized increases in local earnings from a one location expansion. For both industries, an attempt to change eds or meds capacity by one location quotient would affect local earnings by about 1 percent. Even though the meds sector is far less an export base sector than the eds sector, its much larger size means that its demand-side impact on local residents' earnings is equal to or even somewhat greater than the impact of the eds sector.

We also do some speculative calculations in which we adjust for some hypothetical local tax costs of inducing these eds and meds expansions. These assumed costs are based on the assumption that the costs of inducing an expansion will be equal to the state and local share of revenues for the industry, which is 40 percent for public higher education and 13 percent for the overall health care sector. We then run these costs into the REMI model to see the economic impact of these increased local taxes, and the extent to which these tax costs might offset the gross impact of the increased capacity in eds and meds. In general, there is not a complete offset even under what seems like an extreme assumption, that the local government will have to pay the total average share of state and local government in the industry to induce an expansion. The economic impact is not offset due to the local costs for two reasons: 1) it does not cost $1 to induce a $1 increase in local capacity; and 2) in general, a $1 increase in local taxes, even with multiplier effects of those taxes, reduces local demand by less than a dollar.

Human Capital Development

An increase in local eds and meds capacity will in general be likely to increase the quality of local human capital, which will affect local economic development and local earnings. We focus here on empirical evidence that bears on how changes in eds capacity affects human capital and thereafter local economic development and earnings. Empirical evidence of such effects of increases in meds capacity is lacking.

The logical chain of causation between eds capacity expansion and increase in local college grads is as follows. Some induced increase in eds capacity will result in a somewhat lesser increase in the size of the eds sector, after allowing for some substitution for otherwise existing eds capacity. The net increase in eds capacity will increase local production of college grads, Only some proportion of this increase in local production of college grads will result in a net increase in the proportion of college grads in the local labor force, for two reasons. First, some of the locally produced college grads will move out, even if nothing changed in local labor market conditions. Second, with more local college grads, wages and employment rates for college grads are depressed. While this will attract some employers seeking college grad workers, it also will encourage out-migration of college grads and discourage in-migration of college grads.

The ultimate increase in the "local college grads percentage"—the percentage of college grads in the local labor force—has effects on the earnings of the original local residents in two ways. First, some of the increase in local college grads may reflect local residents who were induced by the ed capacity expansion to get a college degree, and ended up both getting higher earnings and staying in the local area. This reflects a private return to more educational attainment of local residents. Second, there is significant evidence that there are spillover effects on the local labor market of educational attainment. The productivity of an individual worker will not only depend on that individual's educational attainment, but also on the average educational attainment in the local labor market. This average educational attainment may allow employers to more readily use more advanced technology or introduce new technologies. The productivity increases due to spillover effects of a greater local college grad percentage will increase local earnings by attracting business growth, and this growth in labor demand will raise local earnings both by increasing local employment to population ratios and increasing local occupational attainment.

From a local economic development perspective, we do not want to count the gains from this area's expansion of eds capacity that will accrue outside the area's original residents who remain in the area. For example, we do not want to count the gain in earnings of original local residents whose educational attainment is increased by the expanded ed capacity, but who end up obtaining higher earnings in some other local economy. Furthermore, we do not count the extra local earnings of outsiders who come in for a college degree and stay, as these outsiders would have otherwise probably been just as well off in some other area. However, we do count the education spillover effects of these outsiders on the original local residents. By inducing persons to come to the area and get a college degree and stay, the productivity of the local economy is enhanced, which will help attract business growth and thereby provide spillover benefits to the original residents.

All of these effects take some time to occur. It takes a while for an increase in local educational capacity to have its full effects upon the college grad percentage in the local labor force. It also takes a while for an increase in the local college grad percentage to have its full effects in attracting additional business activity and increasing local earnings.

We will try in a rough way to assign numbers to the long-run local earnings effects of an ed capacity expansion, and then scale back these effects for shorter-run analyses. We scale these effects for an initially induced increase in eds capacity of one location quotient. This could be seen as considering either the net earnings effect of the local ed sector in the average local economy, or the effect of doubling ed capacity in a typical area. To get long-run numbers, we make various assumptions based on the empirical literature.

<u>Substitution effects</u>. Per our discussion above, we conservatively assume that the net effects on ed capacity are 75 percent of the initially induced effects. (This uses the export-base percentage for higher education in Grand Rapids from the REMI model.) To put it another way, if some college increased its capacity in an amount equal to the entire current local educational sector, we assume that 25 percent of this increase would be offset by reductions in capacity in other local educational institutions. Therefore, the net change in ed capacity from a one LQ induced change is a change of 0.75 LQs.

<u>Long-run effects on stock of college grads allowing for direct and induced migration of college grads</u>. Bound et al. (2004) have a paper that estimates that 15 years after some increase in a state's production flow of college grads, the increase in the stock of college grads is about 30 percent of the flow increase. This presumably reflects some normal out-migration of college grads, plus the effects on migration patterns, due to changes in state labor market conditions caused by a shock to college grad labor supply. As metro labor markets are in general smaller than state labor markets, we assume that the net effects on the local stock of college grads of an increase in the flow are about 15 percent of the flow. Therefore, the college grad stock will go up by about 15 percent of 0.75LQ = 11.25 percent of whatever stock of college grads would occur due to a location quotient of 1.0. About 29 percent of the current labor force (age 25 and older)

has a college degree (Digest of Education Statistics 2005, 2006, Table 8). By definition, the typical area in the United States has a location quotient of 1.0. This amount of higher education activity must be sufficient to result in 29 percent of the labor force having a college degree. Therefore, this implies that an initial induced increase in the local ed location quotient of 1.0 will lead to an increase in the local percentage of college grads of 11.25 percent times 29 percent = 3.26 percent of the local labor force.[4]

Effects of college grads percentage on long-run local labor demand due to productivity effects. A number of studies suggest that an increase in the percentage of college grads in the local labor force will increase local employment growth (Shapiro 2006; Glaeser and Saiz 2004; Gottlieb and Fogarty 2003). The empirical estimates from Shapiro are typical in their magnitude. Shapiro's estimates imply that an increase in the local percentage college graduates of 3.26 percent (from above) will increase a metro area's employment after 10 years by 1.38 percent.[5]

But the 10-year increase in employment will be an underestimate of the long-run increase in employment. We know that the employment level in regions only gradually adjusts to its long-run equilibrium level in response to changes in regional economic conditions. The well-known article by (Helms 1985) estimates that regional employment adjusts annually by 8.9 percent of

[4]Groen (2004) has sometimes been cited (for example, by Siegfried, Sanderson, and McHenry [2006]) as showing a weak relationship between college location and the eventual choice of place to live and work of college-educated workers. Groen concludes that at the state level, attending a college in state *x* increases the proportion of students who eventually choose to work in that state by only 10 percent. However, Groen obtains these estimates by focusing on students who apply to more than one state for college, and these students may be more footloose than the students who only apply to one state for college. In addition, Groen's estimates do not allow for any effect of college expansion in increasing the proportion of the local population that attends college; all of Groen's estimates are conditional on students deciding to attend college. Furthermore, Groen's estimates do not allow for any aggregate effects of more students graduating on the attractiveness of an area to college graduates. Finally, Groen's estimates are contradicted by the aggregate estimates of Bound et al. (2004), that seem more directly pertinent to the issue at hand.

[5]Shapiro's empirical estimate in his Table 3 is that the coefficient on the ln(college grad share) in an equation explaining 10-year growth is 0.0786. But Shapiro's estimates are for the 1940–1990 period, with lower average educational attainment. Using 1980 as a typical year, the average percentage college graduates in that year was 17 percent, according to the 2005 Digest of Education Statistics. $\ln(17 + 3.26) - \ln(17) = 0.1754$. Multiplied by 0.0786, this gives a 10-year increase in ln(employment) of 0.0138.

the difference between current regional employment and the region's long-run equilibrium employment level. This implies that the long-run increase in employment will be 1.6424 times the 10-year increase in employment.[6] Therefore, the implied long-run increase in employment, due to a 3.26 percent increase in the local percentage of college graduates, will be 2.27 percent (= 1.38 percent × 1.6424).[7]

Shapiro's estimates suggests that about 60 percent of the effects on employment growth of the local college grad percentage is due to the college grad percentage's effects on the local labor force's productivity. (The remaining 40 percent of the growth effects of the college grad percentage is estimated to be due to effects of the local college grad percentage on the metro area's amenities; we will consider these amenity effects further below.) This implies that the productivity effects of an increase of 3.26 percentage points in the local college grad percentage will only explain 60 percent of the total long-run increase in employment of 2.27 percent. Therefore, an increase of 3.26 percentage points in the local college grad percentage will increase labor demand, due to higher labor force productivity, by 1.36 percent (= 60 percent of 2.27 percent).

<u>Effects of shocks on local labor demand on local earnings</u>. The regional economics literature suggests that a 1.36 percent shock to local labor demand will increase local earnings by 2/5ths or 40 percent of the shock to labor demand, or 0.54 percent (= 0.4 × 1.36 percent; Bartik [1991]). About half of this increase in local earnings in due to increases in the local employment

[6]Helms' adjustment estimates imply that the long-run effect on regional business activity is equal to the effect after *t* years, divided by [1 − (0.9104 taken to the *T*th power)]. For $T = 10$, this equation means that long-run employment will increase by 1.6424 × the 10-year effects.

[7]Derived from using national average college grad percentage of 17 percent for Shapiro results in Table 3, and then taking 10-year growth and multiplying based on Helms by 1.64.

to population ratio, and the other half is due to local residents moving up to higher-paying occupations.[8]

Private earnings returns to local residents from increased local educational attainment. Card (1995) estimates a quite large effect of the availability of local four-year colleges on educational attainment. The presence of such a college in the local community when a youth is 14 is estimated to raise the average number of years of education by at least 0.32 years. An increase of 0.32 years is roughly equivalent to an increase in the percentage of youths graduating from college of 8 percentage points (8 percentage points = 0.32 divided by 4).[9]

Suppose we assume that the effects of college availability are roughly linear, that is, a change in the college location quotient by one unit always has the same effect on college graduation rates in local youth (from zero to 1.0, or from 1.0 to 2.0), and a change in the college location quotient by 0.50 location quotients will have half of that effect on college attainment, etc. Card's estimates can be interpreted as switching from a location quotient for local colleges

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[8]This is a conservative estimate of the effects on earnings of the local college grad percentage compared to more direct estimates of the effects of the local college grad percentage on wages. However, we believe this conservative estimate is more reliable. For example, Moretti (2004) estimates that a one-percentage-point increase in the local college grad percentage will increase local wages (in addition to the effects on those educated) by 0.6 to 1.2 percentage points. He argues that this increase is an increase in the real wage. These estimates imply that a 3.26 percentage point increase in local college grads will increase local wages and thereby local earnings by 2 to 4 percent. This estimate is 4 to 8 times the earnings effects we use in the text. However, we regard our smaller estimate as more reliable than Moretti's, for several reasons. First, most of his estimates do not control for any local prices. The one estimate that does control for local prices only controls for a local rent index. But we would expect overall local prices, other than local rents, to go up due to the share of local land and labor costs in the production and distribution of many local goods and services. Therefore, it is unclear whether Moretti's estimates really represent real wage and real earnings effects. Second, the local college grad percentage can affect local wages in a number of ways, not just due to effects on productivity. Local wages can also be affected by the amenity effects of the local college grad percentage, and by effects of higher education institutions on local wage norms. Moretti's estimates do not allow us to separate these effects out, unlike Shapiro's estimates.

[9]For example, if the presence of the local college only has one effect, that of causing 8 percent of local youth to increase their education by 4 years and graduate from college, 0.08×4 will equal a 0.32 increase in average years of education. Of course in the real world, a presence of a local college may cause some local youth to increase their education from zero years of college to one year, which will not affect the college graduation rate. But it may also cause some local youth to increase their years of college from 3 years to 4 years, which will increase the college graduation rate. If we assume these effects are roughly offsetting, then a 0.32 increase in average years of education is equivalent to a 8 percentage point increase in college graduation.

of zero to a location quotient of 1.0. The implied effect of this is to increase the college graduation rate for local youth by eight percentage points.

As described above, we assume that if we induce an initial increase in the ed location quotient by 1.0, the resulting net increase in the local ed location quotient will be 0.75, due to displacement of existing ed activity. Under these assumptions, this investment in ed capacity will increase the college graduation rate for local youth by six percentage points.

However, not all these youth will stick around the metro area. Estimates suggest that in the long run, a little over 50 percent of college graduates stay in the same state as their state of birth (Bartik 2006). Suppose we assume that this percentage is half as much for the typical metro area, or about 25 percent of local area residents who get a college education in the area stay in the area. Then the implication is that the local residents who get a college education because of expanded local college options, and then stay in the local area, will comprise about 2 percent of the local labor force. This would be over half of the 3.26 percent increase in the local percentage college grads that we previously calculated.

To be conservative in our calculations, we assume that only one quarter of the 3.26 percent increases in the local college grad percentage is due to local residents who were induced to get a college degree, or 0.81 percent of the total local labor force. Earnings differentials due to a college degree are now over 60 percent; we use a figure of 66.5 percent, taken from the college board. The percentage increase in overall local earnings due to the increase in college graduation of the original residents who stay in the local area will be 0.81 percent times 66.5 percent or 0.54 percent.

Therefore, the total estimated increase in local earnings due to an inducement of a 1.0 increase in ed capacity is 0.54 percent (social spillover effects of education on earnings) + 0.54

percent (effects on local residents induced to increase their college graduation rate) = 1.08 percent. Half is due to extra educational attainment for the area's youth, and the other half is due to the social spillover effects of having more college grads.

But these are long-run effects; we would not expect them to be fully realized until the increase in educational capacity has had a chance to affect the entire age range of the workforce, which will take about 40 years. If the effects take place evenly over that 40-year period, after 10 years local earnings will have increased by about one-fourth of the long-run effects, or 0.27 percent (= $1.08 \times 10 \div 40$).

It could well be argued that similar effects might be produced by improvement in local health care quality, which might be brought about by expansions in the local health care industry. In theory, better local health care quality should reduce absenteeism and worker turnover, and improve workers' mental health and therefore productivity at work. However, there simply is insufficient evidence of what the magnitude might be of some of the links in this causal change. Will improvements in local meds capacity actually improve health care quality and hence the health of local workers? If so, what is the magnitude of these effects? What is the magnitude of the link between local health care quality and local productivity? We simply don't know the answers to these questions.

Amenity Improvements

Increases in eds and meds capacity may also increase the well-being of a metro area's original residents by improving amenities. Amenity effects due to eds and meds may occur directly or indirectly. A direct effect on amenities of eds and meds is when these industries themselves offer services that are perceived by metro area residents as amenities. For example, a university may offer artistic performances that are better quality or lower-priced than would otherwise occur. Local health care quality may be perceived as an amenity.

An indirect effect on amenities is when an increased capacity of these industries increases production of amenities by metro area organizations or persons other than the eds and meds institutions. For example, the demand of professors or grad students from a particular ethnic group, or doctors and health care personnel from a particular ethnic group, may encourage the metro area to have more restaurants that offer that ethnic group's foods. This greater diversity of restaurant offerings may be perceived as an amenity by some residents of the metro area other than eds and meds employees.

We want in this subsection to review evidence that may suggest the existence and likely magnitude of the effects of eds and meds on local amenities. We would like ideally to measure this magnitude by some dollar value of eds' and meds' effects. For example, we might want to translate the dollar value of eds and meds into its equivalent in terms of real earnings for local residents. Of course, if the value of eds and meds as amenities causes local nominal wages to decline and local housing prices and overall prices to increase, some or even all of the amenity benefits of eds and meds might be shifted from local residents in general to local residents who own land.

There are many urban economics studies that document the importance of amenities in metro areas, but unfortunately few examine the importance of eds and meds in influencing amenities. Some studies have shown that urban amenities have important effects on a metro area's real wages, with variables that are amenities causing real wages to decrease, presumably because more people want to live in that area (Blomquist 1988; Gyourko and Tracy 1991; Kahn 1995; Gyourko, Kahn, and Tracy 1999). In theory, in the long run, if people have perfect information about amenities, and everyone has the same amenity valuation, then these real wage differentials should perfectly reflect the underlying valuation people have of the amenity. However, with one exception (see below), none of this literature examining real wage effect of amenities includes variables that are directly related in an obvious way to eds and meds.

There also is literature that has sought to infer a value of amenities from migration behavior. In theory, holding real wages and employment opportunities and other metro area characteristics constant, metro areas with higher amenities should attract more in-migrants, and lose fewer out-migrants. Richard Florida (2002) has written a highly influential book, *The Rise of the Creative Class*, which argues that today's economic development is driven more by where people want to live, and that people want to live in areas that offer more amenities. However, none of the variables he explores as migration drivers is obviously directly related to eds and meds. Some variables might be hypothesized to be indirectly related to eds and meds, for example, some of his variables related to tolerance of gay couples, etc., but it is unclear exactly the quantitative magnitude of how eds and meds capacity would relate to these variables.

In a recent paper, Gottlieb and Joseph (2006) examine the migration behavior of recent college grads with a math or science major and/or who work in a science-related occupation. This paper does include a variable directly related to eds capacity, the proportion of the population that is college educated. They find that this variable is highly significantly attractive to these recent college grad math/science workers. Unfortunately, they do not provide calculations that allow us to assess the magnitude of this variable's effects on migration probabilities, let alone to equate the migration effects of this variable to some dollar equivalent in higher real earnings.

The one paper that does directly allow some dollar calculations of the value of eds is Shapiro's (2006) previously mentioned paper. Among other things, this paper estimates how the college grad percentage affects the 10-year change in real wages. Shapiro interprets this 10-year change in the real wages due to the initial level of the college grad percentage in the metro area as reflecting the value of some change in amenities in a metro area. This interpretation relies on the assumption that the real wage levels in the economy are in long-run equilibrium both at the beginning and end of the decade, or at least any deviations from equilibrium are not systematically related to the college grad variable.

Based on Shapiro's estimates, a one LQ increase in eds capacity will in the long run have a implicit value, in reduced real earnings, of 0.32 percent. Based on the calculations above, in the long run an induced 1 LQ increase in eds capacity will increase the local percentage of the labor force that is college grads by 3.26 percentage points. Shapiro's coefficients imply that an increase in the local college grads by one percentage point will reduce real wages by 0.098 percent.[10] Extrapolating this to a 3.26 percent change gives the effect of a −0.32 percent change in real earnings.

We also explored other possible estimates of how eds and meds are related to amenity effects on real wages. Beeson and Eberts (1989) provide estimates of how much the real wages of 35 different metro areas are affected by amenities. We use this as a dependent variable, and try to explain these amenity differentials by the location quotients of eds and meds, along with controls for metro area size and region. The results are reported in Table 13. We do not find any statistically significant effects of eds and meds upon this amenity measure.

[10]Shapiro's Table 4 has a 0.0172 coefficient for the effect of the natural log of the college share on real wages. Shapiro's estimates cover the 1940–1990 period. The average national college grad percentage in 1980 for those 25 years old and over was 17 percent. An increase in the college grad percentage of 1 percent, from 17 to 18

What are the implications of the point estimates in Table 13 for the effects of attempting to induce a one location quotient increase in eds and meds? As stated before, an induced increase in eds capacity of one location quotient might reasonably be expected to lead to a net increase in local eds capacity of 0.75 location quotients. An induced increase in meds capacity of one location quotient might reasonably be expected to lead to a net increase in local meds capacity of 0.16 location quotients. Both of these figures reflect displacement, as the induced expansion in eds or meds causes some displacement of existing local eds or meds capacity. Both of these estimates are derived from the REMI model's estimates for the Grand Rapids metro area, as given in Table 12. Therefore, the net effect of a one location quotient shock to eds would be to reduce amenities by an amount equivalent to a −0.8 percent reduction in real wages (= 0.75 × −0.011). The net effects of a one location quotient shock to meds would be increased amenities by an amount equivalent to a 1.1 percent increase in real wages (= 0.16 × 0.068). Although these amenity effects are large, they are extremely imprecisely estimated, which is not surprising, given the small sample of only 35 metro areas.

We also tried to look at the amenity effects of eds and meds using our own real wage equation. We first estimated a wage equation using 2000 PUMS data for all metro areas, with the log of the individual's wage rate regressed on variables for education, age, race, gender, marital status, marital status interacted with gender, industry, and metro area. We then combined these metro area dummies with estimates of metro area prices for 28 metro areas with such BLS comparative price data to create an index of real wages for each of these metro areas. The metro area real wage index was then regressed on the metro area's location quotients for eds and meds, with controls for the metro area's size and region. We entered the negative of the real wage, so

percent, increases the natural log of the college share by ln(18) − ln(17), which equals 0.057. Multiplying this by that the coefficients could be interpreted as positive for amenities and negative for disamenities. The results are shown in Table 14.

As shown in the table, these results imply that a one location quotient increase in eds capacity, which will increase net eds capacity by 0.75 location quotient units, would be valued at the equivalent of 8 percent in real wages. This large effect is still only marginally statistically significant, which perhaps reflects the small sample size of only 28 metro areas. In contrast, the effects of meds capacity on metro real wages is clearly statistically insignificant.

If we interpret this effect of eds capacity as only due to amenity effects, this is a very large effect of eds capacity on amenities, in terms of its real earnings valuation. However, there could be other reasons why eds capacity might affect wages. For example, as will be discussed below, if the eds industry tends to pay lower wages, a greater concentration of the eds industry in an area may affect local wage norms and hence local real wages for other industries.

It should also be kept in mind that this interpretation of the real wage effects of eds and meds as due to amenities assumes that real wages are on average in long-run equilibrium in metro areas. But in reality it may take some time for a change in eds or meds capacity to have its long-run equilibrium effects on wages.

Finally, we look at the correlation of one measure of eds and meds with an index that is supposed to directly measure metro area quality of life, the Places Rated Almanac overall index of metro quality of life. This overall index is the average of 9 subindices. Each subindex is a fairly arbitrary combination of various indicators of quality of life that are relevant to that subindex, with the combined subindices arbitrarily scaled so that each has a maximum of 100 and a minimum of 0. One subindex is labeled education, and includes some measures fairly

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Shapiro's coefficient gives a wage effect of 0.098 percent (calculated as 0.00098 = 0.0172 × 0.057).

directly related to eds capacity, such as college enrollment weighted by whether the college is two years or four-years. Another subindex is health, and includes some measures fairly directly related to meds capacity, such as hospital beds, and measures of the numbers of various types of physicians per 100,000 residents.

Table 15 shows some regressions of the overall mean metro quality of life index, and the various subindices, on the ed and med location quotients, and controls for metro area size and region. Both eds and meds have significant positive effects on the overall index. This is in part due to the ed and med location quotients having positive effects on the education and health subindices, as one would expect. (Note that because the overall index is the average of the nine subindices, the overall coefficient on eds or meds is the average of their respective coefficients in the nine subindex regressions.) However, it is also the case that the eds LQ is significantly positively correlated with the arts index. This is not surprising; the arts index depends on a number of items related to arts museum attendance and performances of music, dance, orchestra and professional theater, which no doubt tend to be higher in metro areas with a larger higher ed presence.

Overall, this review of the evidence suggests that eds and meds do have effects on metro amenities that are positive. However, the quantitative magnitudes of these effects are uncertain. There is too much variation across different estimation approaches to be very confident that we have identified how households value eds and meds as amenities. In addition, there are too many other possible ways in which eds and meds may affect metro wages to be confident that we have isolated the amenity effects.

R&D Spillovers

The research activities of higher education institutions, and perhaps some research-oriented hospitals, may have significant spillover effects on local economic development. It has been argued that it is this role of universities that has "the greatest potential to affect economic development" (Paytas et al. 2004, p. 4). The policy community's interest in this role of higher education institutions is probably largely inspired by the success of Silicon Valley, Route 128 around Boston, and the Research Triangle, all of which are usually believed to be in part attributable to the research strengths of nearby universities.

What is the research evidence on the magnitude of these economic development effects of universities via research spillovers? To summarize at the outset, the case study evidence, from case studies of particular universities in particular local economies, suggests that the local economic development impact of higher education research activities is not a mechanical function of the size of the research or the size of the university, but rather depends upon many idiosyncratic features of the university and the local economy. Local economic development impacts of eds' research activities do not occur solely or in many cases primarily due to technology transfer to local new business start-ups, but rather occurs due to a wide variety of ways in which the research knowledge and expertise at the university can help local businesses address productivity problems and other business problems. Empirical estimation of effects of university research activities on local economic development tend to be fragile—that is, estimated effects are quite different in different studies. A study's estimates of these effects differ quite a bit due to the measures used in that study for university research activities and local economic development. Estimated effects of university research on economic development also differ greatly in different metro areas and for different time periods. The fragility of results may reflect the difficulty of measuring which university activities matter most to different types of local economic development, and how these effects vary with the local economy, as well as our inability in most cases to find natural experiments in which government policy or some other exogenous change has caused large changes in university research activities.

Some major recent projects that coordinate multiple case studies of university research/local economic development interaction are the Local Innovation Systems Project based at the MIT Industrial Performance Center (Lester 2005) and a recent report for EDA of the Center for Economic Development at Carnegie Mellon (Paytas, Gradeck, and Andrews, 2004). As these case studies point out, the typical U.S. university cannot be expected to have the same economic influence on the local economy as MIT or Stanford. For example, the University of Akron sought to focus on helping the local economy transition from tire production to innovation in polymer production. But, according to the case study evidence, Akron-area polymer firms "didn't see much of value emerging from the university's laboratories, and some had already developed sophisticated strategies for interacting with universities nationally" (Lester 2005, p. 19, based on research by Safford [2004]).

In fact, the evidence suggests that the overall university influence of local economic development through technology transfer is quite limited. As pointed out by Lester, "… new business formation around university science and technology is a very small fraction—probably no more than 2–3 percent—of the total rate of new business starts in the United States" (Lester 2005, p. 10). Furthermore, patenting by universities in the United States "is only a minor contributor to the overall stock of patented knowledge. About 3,700 patents were granted to U.S. universities in 2001, out of a total of about 150,000 U.S. patents issuing in that year" (Lester 2005, p. 10). A 2003 review paper by Feldman and Desrochers makes the judgment that "[S]ince the 1980s, despite the establishment of university technology transfer offices, incentives from federal and state governments, and new industrial outreach efforts, most research universities have not been particularly successful at technology transfer and have not yet generated significant local economic development" (p. 5).

However, for the typical university, research activities can have a much broader impact on local economic development than is captured by just looking at technology transfer through new business startups. This broader impact is through a wide variety of formal and informal interactions in which professors, researchers, and students at the university interact with nearby businesses, either through formal contracts, or more informal interaction, to help local businesses solve a wide variety of problems. Paytas et al. (2004) conclude from their various case studies that "the structure of the [university's] technology transfer office does not determine a university's performance in generating economic impact" (p. 7). According to Paytas et al., one factor that really distinguishes a university that is effective in local economic development is the "breadth of involvement" of the university: "Universities need to address business and legal issues, workforce education, infrastructure, and industry relationships, as well as technology and R&D capacity, in order to yield regional benefits. The most engaged universities demonstrate these kinds of diverse, integrated commitments across administrative and academic units, including the schools of business, engineering, law, medicine, and public policy" (p. 9). Impact is also argued to depend on the alignment of the university's research activities with the characteristics of local industries.

Given the diversity of interactions between university research activities and local economic development, it is perhaps not surprising that quantitative research on these interactions has yielded diverse results. For example, Anselin, Varga, and Acs (1997) find that more university research in a metro area is positively associated with private research in the metro area and the number of business innovations in the metro area. Varga (2000) goes on to find that the impact of university research on business innovations is greater in metro areas that are larger and have more existing high technology activity. Hill and Lendel (2007) find that higher-rated science and technology doctoral research programs at a metro area's universities are associated with significantly higher metro employment and per capita income growth. They report that this result is fragile to including a control for metro area size. Bania, Eberts, and Fogarty (1993) find that university research in a metro area only positively affected business start-ups in the metro area in one industry, electrical and electronic equipment, out of the six industries they studied. They also point out that even if university research leads to innovation, "any resulting new products or processes will frequently be developed in other locations" (p. 765).

An important recent empirical paper on the connection between university research and local economic development is a working paper by Andersson, Quigley, and Wilhelmsson (2006). The main strength of this paper is that it focuses on the results of an explicit policy decision by the Swedish government to establish new universities with a strong research component in a number of regions from the late 1970s on. Their data are pooled cross-section and time-series data on output per worker and number of researchers in different Swedish communities and years. Controlling for fixed community effects and year effects, they find that an increase in university researchers is associated with higher output per worker. That is, a community's relative productivity, compared to its past relative productivity, is positively influenced by its relative share of university researchers, compared to its past share. These effects are particularly strong for the newer universities set up by the Swedish government.

Because of these stronger effects for the newer universities, they simulate that the decentralization of university research in Sweden raised the average productivity of the Swedish economy, compared to what would have happened if the research had been kept in the old universities. This finding is in obvious contrast with the empirical estimates of Varga (2000). Andersson et al.'s results support decentralization of higher education research activities as the best way to promote overall national economic development, whereas Varga's results support more spatial concentration of higher education research activities as the best way to promote overall national economic development.

Based on these case studies and quantitative research studies, it seems likely that spillover effects of university research activities on local economic development are important. However, it seems impossible, and also misleading, to come up with some summary estimate of how much a given expansion in a local university will affect local employment growth and hence local earnings. The research findings are too diverse to come up with a believable summary, and the literature suggests that the impact will depend upon many features of the local university and local economy. Finally, there does not appear to be much evidence on the potential role of teaching hospitals or other health care institutions in creating research spillovers.

Entrepreneurship

Another possible transmission mechanism by which eds and meds might affect local economic development is through encouraging entrepreneurship. Higher entrepreneurship will in turn increase local employment growth and hence local earnings.

The recent book by Acs and Armington (2006) provides an extensive review on the determinants and effects of entrepreneurship in the U.S. They find that local entrepreneurship rates are significantly increased by the college graduate share in the local labor force, and that local entrepreneurship rates in turn have a significant positive effect on local employment growth.

We can apply their estimated coefficients to simulate the long-run effects of attempting to induce a 1.0 location quotient increase in higher ed, which as stated above, is estimated to increase the local labor force share of college grads in the long run by 3.26 percent. Based on Acs and Armington's coefficients, a 3.26 percent increase in the local labor force share of college graduates will increase the number of new small firms created per year, per thousand persons in the local labor force, by 0.177.[11] Other equations estimated by Acs and Armington imply that an increase of the firm formation rate by 0.177 per thousand persons in the labor force will increase the annual employment growth rate over a three year period by 0.156 percent.[12] Based on regional economics research by Helms (1985) on how fast regional economies adjust to their long-run equilibrium, the long-run adjustment of local employment to some location determinant will be about 4.07 times the three-year adjustment.[13] As the three-year adjustment is 0.468 percent (= 3 × 0.156 percent), the long-run employment adjustment would be about 1.905 percent. Based on Bartik (1991), the increase in local real earnings will be about 40 percent of the shock to employment, or 0.76 percent (= 40 percent of 1.905 percent). Therefore, the long-run predicted increase in local real earnings will be about 40 percent of that, or 0.76 percent. This full effect would not be realized until the increase in local eds capacity has reached its full

[11]Acs and Armington (2006) report beta coefficients, or effects when all variables are standardized so that one unit is one standard deviation. The beta coefficient for the effect of the college graduate share on the all sector firm formation rate is 0.29 (p. 69, Table 3.5). As the standard deviation of the college graduate share is five percentage points (p. 63, Table 3.4), and the standard deviation of the annual firm formation rate per thousand persons in the labor force is 0.938 (p. 63), the results stated in the text follow by some simple algebraic calculations.

[12]Acs and Armington (2006, p. 131, Table 5.6) estimate that a one standard deviation increase in the firm formation rate increases the annual employment growth rate by 0.56 standard deviations (averaging over the three three-year time periods). The average standard deviation of the three-year growth rate is 0.0165 (p. 128, Table 5.4). The results given in the text then follow.

[13]The Helms model implies that employment adjusts to its long-run level by 8.96 percent per year.

effect upon the college grad percentage in the local labor force; as discussed above, this will probably take around 40 years, until all cohorts in the labor force have reached higher education levels.

This "ed capacity" effect via entrepreneurship effects of local college grads might be an additional effect beyond the general effects of enhanced human capital. Alternatively, this effect of enhanced human capital might be an alternative to the social spillover effects of enhanced human capital estimated above. Acs and Armington also find that after adding firm formation rates as an explanatory variable, the estimated positive effects of college grad share on local employment growth disappear. That is, they conclude that all the statistically significant effects of the college grad share on local employment growth can be explained by its effects on local entrepreneurship.

It is possible that meds capacity might also have some effect on entrepreneurship, for example, if doctors are more likely to be entrepreneurs. However, we know of no empirical evidence for or against this hypothesis.

Intra-Metro Disparities

In the absence of any previous research literature, we did our own examination of whether eds or meds tends to be disproportionately located in central cities. If so, an overall increase in capacity of eds and meds, without any attempt to follow some special pattern of geographic expansion, would tend to reduce intra-metro disparities in jobs and income.

To do this examination, we once again used data from the 2000 PUMS. We focused on 65 metro areas for which we were able to get micro data on the central city vs. suburban location of the respondent for more than 70 percent of the PUMS sample for that metro area, and for which central city and suburban identified respondents were each more than 10 percent of that metro area’s PUMS sample. (The city vs. suburban location of a PUMS respondent may not be identified in smaller metro areas because of confidentiality restrictions.)

For each of these 65 metro areas, we calculated both the central city and suburban employment location quotients for both eds and meds. We also calculated the ratio of the central city to the suburban location quotient for both eds and meds for each metro area.

These location quotients tell us whether central city or suburban residents in each of the 65 metro areas tend to be more likely than the average national PUMS respondent to be working in the eds or med industries, and whether central city or suburban residents are more likely to be working in eds (or meds) in a particular metro area. This focus on where the industry’s workers live is only part of the intra-metro effects of eds or meds. Presumably it also matters where the universities and hospitals are located. However, the residential location of the industry’s workers will have an important influence on the effects of eds or meds expansion on central city vs. suburban incomes and tax base.

The statistical summary of results is in Table 16. As the table shows, central city ed location quotients tend to be considerably higher than suburban ed location quotients. Central city med location quotients on average are slightly higher than suburban med LQs. Therefore, although investment in either eds or meds would tend to favor workers with a central city residence, the concentration in benefits for central city workers is greater for eds than meds.

Tables 17 and 18 show the results for the 65 metro areas, sorted by the ratios of central city to suburban location quotients for eds and meds. There obviously are some metro areas that not only have a high specialization in higher education, but also have a relatively high proportion of higher education workers residing in the central city, including “college towns” such as Ann

Arbor and Madison, but also some large cities such as Minneapolis, Pittsburgh, New Orleans, and Seattle. For meds, the central city specialization is not as pronounced.

Although these results are interesting, it does not seem feasible to extend this analysis to simulate how much this reduction of intra-metro disparity will increase overall metro economic development. We do not have available consensus estimates on the effects of reduced intra-metro disparities on metro growth. Furthermore, it would be a daunting task to connect these estimates of location quotients of cities vs. suburbs to a specific measure of intra-metro disparity.

Model Employer Effects on Labor Market Norms

Increases in eds or meds capacity may also affect local labor market earnings due to these industries' wage practices. As discussed above, we know that different industries tend to persistently pay different wages for workers, holding constant worker characteristics. These "efficiency wage" differentials may reflect a wide variety of industry characteristics, including unionization, wage norms, the costs of worker turnover, and the ease of monitoring worker productivity.

Obviously a redistribution of a metro area's workers towards industries with positive efficiency wage differentials, and away from industries with negative efficiency wage differentials, will directly increase wages for the workers who move to higher-paying industries. In addition, however, there is evidence that a metro area that moves towards higher-paying industries will find its overall earnings per capita increasing by more than one would predict based on national industry wage differentials (Bartik 1993). If a metro area's industry mix changes so that, based on national industry wage norms, we would expect wages to be higher by 1 percent, average real earnings per working age adult is estimated to increase by 2.2 percent. These overall wage effects of the "efficiency wage mix" of the metro area appear to reflect in part an influence of average metro wage practices on the wages paid in each industry. In addition, higher metro area wages will tend to increase labor force participation, and will also increase local demand and job creation.

To our knowledge, no prior efficiency wage analysis has included all workers, both public and private, in these two industries. We also wanted to explore how these industry wage differentials differed by education level. Therefore, we decided to do our own efficiency wage analysis that would include estimation of efficiency wage differentials for both eds and meds.

We analyzed wages using a sample from the 2000 PUMS. The wage regressions controlled for gender, marital status, race, age, 283 metro areas, education (in the overall regression), and 254 industries.

Table 19 reports the results. Overall, eds pays about 14.5 percent less than the average industry for a given set of worker characteristics. Meds pays about 4.8 percent more than the average industry. The separate regressions for different education groups make it clear that these results are not simply being driven by high wages for doctors and low wages for professors, relative to their education. On the other hand, for some of the lowest education groups, the wage differentials are quite different.

We can apply these results to estimate the effects on local earnings of a policy that tries to induce an expansion in each industry of one location quotient. As previously discussed, because of displacement effects, the proportion of metro area employment in the industries will on net expand by less than one location quotient. For eds, we assume, as was done previously, that a policy that adds one location quotient to eds activity will lead to a net expansion of 0.75 location quotients in industry activity. For meds, displacement is higher. We assume, as was done previously, that a policy that adds one location quotient to meds activity will lead to a net expansion of 0.16 location quotients in metro area activity in meds.

For eds, the mean percentage of national employment in this industry is 2.32 percent as of 2000. Therefore, an expansion in a metro area of this industry by 0.75 location quotients is an increase in the percentage of local employment in this industry of 1.74 percent (= 0.75 × 2.32 percent). We assume that we are switching employment to eds from industries of average pay. Therefore, a switch of employment of 1.74 percent from an average-paying industry to an eds industry that pays 14.5 percent below average, will directly lower average wages in the metro area by −0.25 percent (= 1.74 percent × −14.5 percent). But, as mentioned above, estimates suggest that a 1 percent change in the average predicted wage in a metro area based on the metro area's industry mix will change overall metro area earnings per capita by 2.2 percent, due to both changes in other industries' wage norms and changes in employment rates. Therefore, we predict that this investment in attempting to expand local eds capacity by one location quotient will, through its effect on local efficiency wages, lower average local earnings per capita by −0.55 percent (= −0.25 percent × 2.2).

For meds, the mean percentage of national employment in this industry is 8.90 percent as of 2000. Therefore, an expansion in a metro area of this industry by 0.16 location quotients is an increase in the percentage of local employment in this industry of 1.42 percent (= 0.16 × 8.90 percent). A switch of employment of 1.42 percent from an average-paying industry, to a meds industry that pays 4.8 percent above average, will directly increase average wages in the metro area by 0.07 percent (= 1.42 percent × 4.8 percent). With the "wage norm" multiplier of 2.2, the estimated effect on metro area earnings per capita is an increase of 0.15 percent (= 0.07 percent × 2.2).

The above analysis simply considers the labor market effects of expanding eds or meds, conditional on current labor market practices in these industries. There also is the policy option of altering employer practices in these industries in terms of pay, worker training, and promotion practices. Sectoral employment programs are one option for the public sector to seek to intervene to alter training and upgrading opportunities in a given industry. Many such programs involve public sector training organizations working with different firms and organizations in a particular industry to set up training programs that are suited to the industry's needs, while also improving worker advancement options. Sectoral employment programs frequently target health care, because it is a major industry that employs many low-income persons, is expanding, and frequently has concerns about worker shortages. An evaluation of one group of initiatives in sectoral programs is provided by Pindus et al. (2004). While such programs are promising, as of now there is still considerable uncertainty about sectoral programs' effects on worker outcomes.

Economic Development Leadership

There is a widespread impression among persons familiar with economic development that traditional business sources of leadership in local economic development policy are less available today than they once were, particularly in smaller metro areas, and that local leadership for economic development often has an increasing role for eds and meds. However, hard statistical evidence for this subjective judgment is difficult to find.

A 2001 report by Beth Siegel and Andy Waxman for EDA looked at the economic development challenges facing "Third Tier Cities," which they defined as cities with populations of 15,000 to 110,000 and that were primary to their regional economic base. This report is based in part on case studies of 10 smaller urban areas, as well as the authors' prior consulting work in over 25 small cities. According to Siegel and Waxman,

> Thirty years ago, in most small cities in the United States, if you needed something done…, you could get together the 'captains of industry,' and they would not only provide the funding, but get personally involved … These 'captains' were usually the owners of the large, locally owned manufacturing companies and the executives of the locally owned banks, department stores, and nonprofit institutions. Today, this core of corporate leadership has largely evaporated in the third-tier cities … Smaller cities are finding that the remaining leadership is primarily composed of the key staff of the community's nonprofit employers—most notably, the regional healthcare institutions, United Way, and community colleges (2001, p. 21).

A 2004 survey by the International City/County Management Association looked at economic development activities in cities of 10,000 and greater population, and counties of 50,000 and greater population. Based on this survey, 34 percent of all local governments responding said that colleges or universities participated in creating local economic development strategies. However, college and university participation in the creation of local economic development strategies was reported by 62 percent of local governments of 100,000 and greater population, and by 56 percent of central city governments (ICMA 2006). In previous, similar ICMA surveys of local governments in 1994 and 1999, "college or university" was not listed as one of the options for participating in the creation of local economic development strategies. Therefore, it is impossible to tell whether college or university participation has increased over time, although perhaps their lack of inclusion in prior surveys reflects a perception that they were not involved.

The participation of eds and meds in local economic development leadership is arguably an important potential impact of eds and meds. However, based on current research, it is impossible to quantify this impact.

6. CONCLUSION

To sum up: "eds" and "meds" probably have a variety of positive effects on a metro area's economic development. These effects are large enough to be important for public policy. However, there is considerable uncertainty about the magnitude of many of these effects. The magnitude of effects likely depends a great deal on the nature of the metro area economy, and the specific characteristics of the induced expansion of eds or meds.

We emphasize again that all these estimates are for effects of eds and meds expansion on a local metropolitan economy. The economic development effects of eds and meds expansion at the national level might be quite different.

Table 20 summarizes the results from this paper. The table includes both results we can quantify, and results for which we just know whether they are positive or not. Most of the effects in the table are for a policy that attempts to induce a one location quotient increase in the metro area's eds or meds. We consider effects in terms of their average percentage effect on the annual local earnings of the original local residents. We consider both effects after 10 years, and long-run effects.

As shown in this table, local demand effects of eds or meds expansion are quite important. Furthermore, even though "meds" is much less of an export-base industry than eds, it is such a large industry that a one location quotient expansion has considerable demand effects.

Human capital effects of eds expansion are modest in the short run but loom larger in the long run. There is some question about the exact mechanism by which these human capital effects occur, that is, whether they take place through encouraging entrepreneurship or through making workers more productive.

Eds and meds probably have some positive effects on amenities, the reduction of intra-metro disparities, and local leadership, but the magnitude of the local economic payoffs involved are quite uncertain. Particular activities of eds in research probably have important spillover effects on the local economy, not just through technology transfer to new firm start-ups, but also through more informal positive effects of the research knowledge at universities on productivity in existing businesses.

Meds probably has some positive effects on local wage standards. On the other hand, eds may have some negative effects on local wage standards.

Overall, it seems quite plausible that a one location quotient expansion in either of these industries will increase local earnings on the order of magnitude of 1 percent. However, for an expansion equal to 1 percent of the local workforce, the effects of eds expansion probably exceed the effects of meds expansion by at least 2 to 1 in the short run and 4 to 1 in the long run.

As for research gaps, clearly we know much less about the local economic development effects of meds than of eds. In addition, we know less than we should about the research spillover and amenity effects of eds. The research activities and amenity influences of higher education institutions are likely to have large long-run effects on a metro area's economic development.

Table 1. The Share of Eds and Meds in the U.S. Economy

	Eds share (as percentage of all industries) 2000 PUMS	Meds share (as percentage of all industries) 2000 PUMS
Employment	2.32	8.90
Earnings	2.20	9.87

NOTES: Data come from authors' analyses of Public Use Microdata Sample, U.S. Census, and are based on data on 7,432,576 persons. Eds industries are defined as colleges and universities, both public and private, and both four-year and community colleges (NAICS codes 6112 and 6113). Our definition of "meds" includes doctors' offices and other ambulatory medical facilities, hospitals, and nursing homes and other residential care facilities (NAICS codes 621, 622, and 623).

Table 2. Descriptive Statistics for Location Quotients for Eds and Meds, 283 Metro Areas, Based on 2000 Census

	Employment location quotient		Earnings location quotient	
	Eds	Meds	Eds	Meds
Mean location quotient	1.263	1.051	1.355	1.124
Standard deviation of location quotient	1.243	0.237	1.592	0.302
5th percentile	0.351	0.744	0.348	0.729
10th percentile	0.444	0.793	0.441	0.808
25th percentile	0.594	0.900	0.594	0.923
Median	0.873	1.033	0.892	1.090
75th percentile	1.347	1.166	1.312	1.278
90th percentile	2.530	1.319	2.532	1.458
95th percentile	3.568	1.382	3.744	1.564

NOTES: The observations analyzed in this table are for 283 metro areas. For each metro area, the variable is a location quotient, which is the ratio of the share of employment or earnings in that industry in that metro area to that industry's share in the nation. The underlying data used to generate these location quotients are PUMS data from the 2000 census.

Table 3. Correlation Between Eds and Meds Location Quotients for Employment and Earnings, 283 Metro Areas

Correlation of variable in row with variable with column is reported in each cell	LQ employ, eds	LQ employ, meds	LQ earn, eds	LQ earn, meds
LQ employ, eds				
LQ employ, meds	−0.039			
LQ earn, eds	0.984	−0.047		
LQ earn, meds	0.092	0.901	0.099	

NOTES: The underlying observations are on four location quotient variables for each of 283 metro areas in the United States.

Table 4. Descriptive Statistics for Ratio of Earnings to Employment Location Quotients for Eds and Meds, 283 Metro Areas, Based on 2000 Census

	Ratio of earnings to employment location quotients	
	Eds	Meds
Mean ratio of location quotients	1.030	1.067
Standard deviation of ratio of location quotients	0.168	0.126
5th percentile	0.797	0.881
10th percentile	0.829	0.911
25th percentile	0.910	0.978
Median	1.021	1.055
75th percentile	1.122	1.133
90th percentile	1.278	1.241
95th percentile	1.339	1.285

NOTES: The observations analyzed in this table are for 283 metro areas. For each metro area, the variable is the ratio of the location quotient for earnings for eds (or meds) to the location quotient for employment for eds (or meds).

Table 5 Metro Areas Ranked by Location Quotient for Higher Education

Ranking	Metro area	Employment location quotient for eds	Ratio of earnings to employment location quotient for eds
1	State College, PA	8.173	1.344
2	Champaign-Urbana-Rantoul, IL	7.734	1.224
3	Bryan-College Station, TX	7.160	1.492
4	Bloomington, IN	7.072	1.430
5	Iowa City, IA	6.664	1.220
6	Gainesville, FL	5.936	1.220
7	Lafayette-W. Lafayette, IN	5.391	1.111
8	Columbia, MO	5.385	1.194
9	Athens, GA	4.934	1.294
10	Yolo, CA	4.724	1.297
11	Charlottesville, VA	4.444	1.323
12	Auburn-Opekika, AL	4.439	1.397
13	Ann Arbor, MI	3.789	0.955
14	Muncie, IN	3.615	1.047
15	Flagstaff, AZ-UT	3.568	1.063
16	Madison, WI	3.559	1.044
17	Tuscaloosa, AL	3.472	0.993
18	Provo-Orem, UT	3.317	0.867
19	Lansing-E. Lansing, MI	3.280	1.141
20	Tallahassee, FL	3.043	1.176
21	Las Cruces, NM	2.973	1.091
22	Greenville, NC	2.941	1.267
23	Lincoln, NE	2.865	1.038
24	Lexington-Fayette, KY	2.837	1.193
25	Lubbock, TX	2.801	1.141
26	Fort Collins-Loveland, CO	2.788	1.046
27	Bloomington-Normal, IL	2.770	0.803
28	Springfield-Holyoke-Chicopee, MA	2.689	0.989
29	Hattiesburg, MS	2.530	1.016
30	Santa Barbara-Santa Maria-Lompoc, CA	2.496	1.004
31	South Bend-Mishawaka, IN	2.436	0.960
32	Waterloo-Cedar Falls, IA	2.403	1.021
33	Raleigh-Durham, NC	2.274	1.022
34	New Haven-Meriden, CT	2.249	1.105
35	Terre Haute, IN	2.178	1.038
36	Eugene-Springfield, OR	2.116	0.935
37	Bellingham, WA	2.048	0.865
38	Santa Cruz, CA	2.000	0.875
39	Waco, TX	1.997	1.128
40	Fargo-Morehead, ND/MN	1.978	0.976
41	Tucson, AZ	1.937	1.120
42	Trenton, NJ	1.932	1.075
43	Chico, CA	1.926	1.315

Table 5 (Continued)

Ranking	Metro area	Employment location quotient for eds	Ratio of earnings to employment location quotient for eds
44	LaCrosse, WI	1.876	1.042
45	Worcester, MA	1.822	0.892
46	Austin, TX	1.813	0.901
47	Syracuse, NY	1.796	0.967
48	Knoxville, TN	1.796	1.021
49	St. Cloud, MN	1.782	0.811
50	Binghamton, NY	1.741	0.957
51	Boston, MA-NH	1.733	0.923
52	Kalamazoo-Portage, MI	1.710	0.904
53	San Luis Obispo-Atascad-P Robles, CA	1.647	1.093
54	Abilene, TX	1.641	0.868
55	Baton Rouge, LA	1.620	0.934
56	Fayetteville-Springdale, AR	1.593	1.173
57	Columbia, SC	1.560	1.053
58	Albany-Schenectady-Troy, NY	1.497	1.026
59	Dutchess Co., NY	1.483	0.696
60	Eau Claire, WI	1.464	1.080
61	Duluth-Superior, MN/WI	1.458	1.159
62	Springfield, MO	1.458	0.925
63	Jackson, TN	1.442	1.072
64	Columbus, OH	1.379	0.889
65	Hamilton-Middleton, OH	1.370	0.797
66	Greeley, CO	1.360	1.003
67	Galveston-Texas City, TX	1.360	1.357
68	Toledo, OH/MI	1.355	0.966
69	Rochester, NY	1.350	1.025
70	Erie, PA	1.348	0.895
71	Benton Harbor, MI	1.347	0.864
72	Williamsport, PA	1.340	1.216
73	Oklahoma City, OK	1.325	1.054
74	Wilmington, DE/NJ/MD	1.321	0.879
75	Providence-Fall River-Pawtucket, MA/RI	1.286	0.912
76	Baltimore, MD	1.275	1.004
77	Monroe, LA	1.273	1.261
78	Albuquerque, NM	1.256	0.993
79	Pittsburgh, PA	1.255	1.035
80	Santa Fe, NM	1.250	1.000
81	Dayton-Springfield, OH	1.239	0.829
82	Olympia, WA	1.226	0.789
83	Honolulu, HI	1.206	1.088
84	Akron, OH	1.202	0.805
85	Lynchburg, VA	1.201	0.795
86	Spokane, WA	1.200	1.048

Table 5 (Continued)

Ranking	Metro area	Employment location quotient for eds	Ratio of earnings to employment location quotient for eds
87	Buffalo-Niagara Falls, NY	1.174	1.103
88	Davenport, IA-Rock Island -Moline, IL	1.161	0.778
89	Allentown-Bethlehem-Easton, PA/NJ	1.154	0.970
90	Seattle-Everett, WA	1.152	0.834
91	Philadelphia, PA/NJ	1.126	1.027
92	Dover, DE	1.125	1.077
93	San Francisco-Oakland-Vallejo, CA	1.116	0.960
94	Jackson, MS	1.110	0.974
95	Springfield, IL	1.093	1.380
96	Anniston, AL	1.089	1.361
97	Utica-Rome, NY	1.089	1.015
98	Medford, OR	1.088	0.914
99	Charleston-N.Charleston,SC	1.071	1.174
100	Jamestown-Dunkirk, NY	1.063	1.029
101	Reno, NV	1.061	1.088
102	Nashville, TN	1.059	1.060
103	Peoria, IL	1.059	0.842
104	Cedar Rapids, IA	1.056	0.918
105	Omaha, NE/IA	1.045	1.127
106	New Orleans, LA	1.044	1.150
107	Scranton-Wilkes-Barre, PA	1.027	1.020
108	Wilmington, NC	1.026	1.074
109	San Jose, CA	1.025	0.808
110	Kankakee, IL	1.018	0.727
111	Birmingham, AL	1.011	1.121
112	Harrisburg-Lebanon--Carlisle, PA	1.006	0.928
113	Daytona Beach, FL	1.006	1.122
114	San Diego, CA	0.999	1.118
115	Milwaukee, WI	0.992	0.961
116	Savannah, GA	0.985	1.021
117	Johnson City-Kingsport--Bristol, TN/VA	0.984	0.983
118	Portland, ME	0.983	0.863
119	Sharon, PA	0.982	1.017
120	Fitchburg-Leominster, MA	0.981	1.063
121	Salinas-Sea Side-Monterey, CA	0.980	1.200
122	Greensboro-Winston Salem-High Point, NC	0.978	1.081
123	Washington, DC/MD/VA	0.974	0.874
124	Lafayette, LA	0.973	0.918
125	Pensacola, FL	0.970	1.085
126	Evansville, IN/KY	0.969	0.841
127	Huntsville, AL	0.967	1.078
128	Brockton, MA	0.961	0.803
129	Minneapolis-St. Paul, MN	0.958	0.893

Table 5 (Continued)

Ranking	Metro area	Employment location quotient for eds	Ratio of earnings to employment location quotient for eds
130	Richmond-Petersburg, VA	0.953	1.060
131	Salt Lake City-Ogden, UT	0.951	1.071
132	St. Louis, MO-IL	0.930	1.058
133	Appleton-Oskosh-Neenah, WI	0.929	0.874
134	Amarillo, TX	0.924	1.094
135	Little Rock--North Little Rock, AR	0.922	1.302
136	Greenville-Spartanburg-Anderson SC	0.919	0.850
137	Montgomery, AL	0.913	1.289
138	Decatur, IL	0.893	0.784
139	Memphis, TN/AR/MS	0.886	1.097
140	Los Angeles-Long Beach, CA	0.882	1.034
141	New York-Northeastern NJ	0.881	0.937
142	Newburgh-Middletown, NY	0.873	1.036
143	Fresno, CA	0.858	1.293
144	Chattanooga, TN/GA	0.858	0.921
145	Cincinnati-Hamilton, OH/KY/IN	0.857	1.006
146	Chicago, IL	0.851	0.944
147	Asheville, NC	0.850	0.905
148	El Paso, TX	0.849	1.141
149	St. Joseph, MO	0.844	0.861
150	Green Bay, WI	0.843	0.827
151	Sioux City, IA/NE	0.842	0.640
152	Altoona, PA	0.832	1.129
153	Portland, OR-WA	0.830	0.915
154	Kenosha, WI	0.829	0.694
155	Denver-Boulder, CO	0.828	0.938
156	Boise City, ID	0.823	0.867
157	Laredo, TX	0.820	1.278
158	Des Moines, IA	0.812	0.957
159	Pueblo, CO	0.809	0.814
160	Miami-Hialeah, FL	0.806	1.061
161	Mobile, AL	0.805	1.205
162	Billings, MT	0.792	0.927
163	Augusta-Aiken, GA-SC	0.789	1.231
164	Hartford-Bristol-Middleton- New Britain, CT	0.784	1.103
165	San Antonio, TX	0.781	1.206
166	Wichita, KS	0.781	0.936
167	Louisville, KY/IN	0.765	1.050
168	Salem, OR	0.760	1.017
169	Lancaster, PA	0.760	1.037
170	Clarksville- Hopkinsville, TN/KY	0.758	0.991
171	Redding, CA	0.748	0.836
172	Norfolk-VA Beach--Newport News, VA	0.745	1.129

Table 5 (Continued)

Ranking	Metro area	Employment location quotient for eds	Ratio of earnings to employment location quotient for eds
173	Atlanta, GA	0.744	1.011
174	Grand Junction, CO	0.743	1.072
175	Jackson, MI	0.741	0.883
176	Bridgeport, CT	0.741	0.747
177	Longview-Marshall, TX	0.739	0.870
178	Cleveland, OH	0.737	0.969
179	Grand Rapids, MI	0.735	0.882
180	Tulsa, OK	0.733	1.080
181	Nashua, NH	0.731	0.818
182	Colorado Springs, CO	0.722	1.011
183	New Bedford, MA	0.716	1.098
184	Joplin, MO	0.704	1.116
185	Macon-Warner Robins, GA	0.698	1.361
186	Corpus Christi, TX	0.697	0.922
187	Florence, AL	0.691	1.382
188	Albany, GA	0.691	1.315
189	Waterbury, CT	0.690	1.246
190	Phoenix, AZ	0.689	0.966
191	Riverside-San Bernadino, CA	0.688	1.110
192	Houston-Brazoria, TX	0.684	1.016
193	Tacoma, WA	0.677	0.880
194	Reading, PA	0.676	0.799
195	McAllen-Edinburg-Pharr-Mission, TX	0.665	1.563
196	Saginaw-Bay City-Midland, MI	0.662	0.904
197	Brownsville-Harlingen-San Benito, TX	0.658	1.179
198	Kansas City, MO-KS	0.656	0.965
199	Sumter, SC	0.655	0.853
200	Fayetteville, NC	0.639	1.187
201	Lake Charles, LA	0.637	0.862
202	Yuma, AZ	0.634	0.904
203	Topeka, KS	0.629	0.893
204	Stockton, CA	0.622	0.995
205	Shreveport, LA	0.621	1.069
206	Johnstown, PA	0.617	0.840
207	Flint, MI	0.614	1.223
208	Racine, WI	0.614	1.329
209	Santa Rosa-Petaluma, CA	0.611	1.014
210	Sacramento, CA	0.605	1.105
211	Ventura-Oxnard-Simi Valley, CA	0.602	0.979
212	Merced, CA	0.601	1.022
213	Dallas-Fort Worth, TX	0.594	0.882
214	Goldsboro, NC	0.592	0.974
215	Indianapolis, IN	0.585	0.896

Table 5 (Continued)

Ranking	Metro area	Employment location quotient for eds	Ratio of earnings to employment location quotient for eds
216	Lima, OH	0.584	0.814
217	Charlotte-Gastonia-Rock Hill, NC-SC	0.583	0.905
218	Fort Wayne, IN	0.580	0.973
219	Roanoke, VA	0.577	0.798
220	Yuba City, CA	0.572	1.337
221	Tampa-St. Petersburg-Clearwater, FL	0.572	1.025
222	Canton, OH	0.563	0.983
223	Bakersfield, CA	0.562	1.112
224	Janesville-Beloit, WI	0.562	1.194
225	Kileen-Temple, TX	0.561	1.082
226	Myrtle Beach, SC	0.560	1.339
227	Melbourne-Titusville-Cocoa-Palm Bay, FL	0.556	0.930
228	Rockford, IL	0.553	0.807
229	Columbus, GA/AL	0.543	1.178
230	Wichita Falls, TX	0.536	1.074
231	Sioux Falls, SD	0.533	1.133
232	Alexandria, LA	0.531	1.118
233	Manchester, NH	0.530	0.953
234	Gadsden, AL	0.528	1.376
235	Orlando, FL	0.524	1.024
236	Rocky Mount, NC	0.521	0.965
237	Beaumont-Port Arthur-Orange,TX	0.512	0.974
238	Kokomo, IN	0.511	0.810
239	Richland-Kennewick-Pasco, WA	0.510	1.034
240	Tyler, TX	0.507	0.959
241	Anchorage, AK	0.507	0.790
242	Bremerton, WA	0.506	1.013
243	Modesto, CA	0.496	1.299
244	Youngstown-Warren, OH-PA	0.483	1.052
245	Barnstable-Yarmouth, MA	0.477	1.405
246	Lakeland-Winterhaven, FL	0.477	0.984
247	Fort Lauderdale-Hollywood-Pompano Beach, FL	0.476	1.196
248	Ocala, FL	0.472	1.047
249	Atlantic City, NJ	0.472	0.958
250	Yakima, WA	0.463	0.833
251	Danbury, CT	0.463	0.655
252	Jacksonville, FL	0.455	1.047
253	Monmouth-Ocean, NJ	0.453	0.870
254	York, PA	0.444	0.850
255	Detroit, MI	0.444	0.912
256	Wausau, WI	0.442	1.129
257	Danville, VA	0.430	1.261
258	Fort Walton Beach, FL	0.428	0.934

Table 5 (Continued)

Ranking	Metro area	Employment location quotient for eds	Ratio of earnings to employment location quotient for eds
259	Odessa, TX	0.420	1.024
260	Fort Pierce, FL	0.419	1.257
261	Stamford, CT	0.407	0.558
262	Sheboygan, WI	0.399	0.874
263	West Palm Beach-Boca Raton-Delray Beach, FL	0.393	0.927
264	Panama City, FL	0.373	1.126
265	Hickory-Morgantown, NC	0.373	1.185
266	Biloxi-Gulfport, MS	0.370	1.040
267	Elkhart-Goshen, IN	0.362	0.852
268	Hagerstown, MD	0.357	1.266
269	Mansfield, OH	0.351	0.910
270	Las Vegas, NV	0.350	1.263
271	Visalia-Tulare-Porterville, CA	0.340	1.385
272	Sarasota, FL	0.328	1.016
273	Fort Smith, AR/OK	0.325	1.249
274	Rochester, MN	0.322	0.659
275	Jacksonville, NC	0.321	1.059
276	Dothan, AL	0.282	1.280
277	Glens Falls, NY	0.277	1.047
278	Fort Myers-Cape Coral, FL	0.277	1.076
279	Punta Gorda, FL	0.257	1.203
280	Vineland-Milville-Bridgetown, NJ	0.231	0.780
281	Houma-Thibodoux, LA	0.220	1.002
282	Decatur, AL	0.208	1.357
283	Naples, FL	0.206	1.293

NOTES: This table lists each metro area's location quotient for higher education employment, and the ratio of the location quotient for higher education earnings to higher education employment, with metro areas ranked by the location quotient for higher education employment.

Table 6. Metro Areas Ranked by Location Quotient for Medical Care

Ranking	Metro area	Employment location quotient for meds	Ratio of earnings to employment location quotient for meds
1	Rochester, MN	3.081	1.138
2	Alexandria, LA	1.905	1.116
3	Iowa City, IA	1.782	1.223
4	Columbia, MO	1.561	1.307
5	Waterbury, CT	1.507	0.881
6	Duluth-Superior, MN/WI	1.491	1.125
7	Punta Gorda, FL	1.485	1.118
8	Gainesville, FL	1.469	1.368
9	Sharon, PA	1.405	0.978
10	Asheville, NC	1.402	1.317
11	Redding, CA	1.399	1.095
12	Shreveport, LA	1.390	1.249
13	Johnstown, PA	1.387	1.079
14	New Haven-Meriden, CT	1.384	0.994
15	New Bedford, MA	1.382	0.962
16	Worcester, MA	1.377	0.884
17	Augusta-Aiken, GA-SC	1.364	1.078
18	Lexington-Fayette, KY	1.356	1.133
19	Tyler, TX	1.355	1.142
20	LaCrosse, WI	1.344	1.047
21	Galveston-Texas City, TX	1.344	0.913
22	Barnstable-Yarmouth, MA	1.344	1.084
23	Dutchess Co., NY	1.344	0.822
24	Pueblo, CO	1.342	1.127
25	Greenville, NC	1.337	1.304
26	Pittsburgh, PA	1.335	1.030
27	Utica-Rome, NY	1.334	1.000
28	Scranton-Wilkes-Barre, PA	1.326	1.030
29	Hartford-Bristol-Middleton- New Britain, CT	1.319	1.018
30	Vineland-Milville-Bridgetown, NJ	1.314	1.121
31	Brockton, MA	1.301	0.911
32	Lubbock, TX	1.299	1.240
33	Altoona, PA	1.298	1.026
34	Spokane, WA	1.297	1.055
35	Jackson, TN	1.296	1.265
36	Topeka, KS	1.296	1.055
37	Buffalo-Niagara Falls, NY	1.290	1.010
38	Birmingham, AL	1.288	1.032
39	Charlottesville, VA	1.287	1.129
40	Jackson, MI	1.281	0.919
41	Grand Junction, CO	1.279	1.263

Table 6. (Continued)

Ranking	Metro area	Employment location quotient for meds	Ratio of earnings to employment location quotient for meds
42	Little Rock--North Little Rock, AR	1.278	1.060
43	Hattiesburg, MS	1.272	1.229
44	Goldsboro, NC	1.272	1.102
45	Allentown-Bethlehem-Easton, PA/NJ	1.270	0.953
46	Jackson, MS	1.266	1.053
47	Monroe, LA	1.260	1.149
48	Kankakee, IL	1.242	0.959
49	Sioux Falls, SD	1.240	1.207
50	Philadelphia, PA/NJ	1.238	0.947
51	Tuscaloosa, AL	1.238	1.109
52	Sarasota, FL	1.232	1.124
53	Abilene, TX	1.224	1.162
54	Roanoke, VA	1.220	1.245
55	Springfield, IL	1.218	1.033
56	Gadsden, AL	1.215	1.285
57	Brownsville-Harlingen-San Benito, TX	1.203	1.160
58	Boston, MA-NH	1.200	0.910
59	Providence-Fall River-Pawtucket, MA/RI	1.200	1.044
60	New York-Northeastern NJ	1.199	0.909
61	Ocala, FL	1.193	1.174
62	Billings, MT	1.187	1.229
63	Cleveland, OH	1.178	0.977
64	Toledo, OH/MI	1.177	1.009
65	Albany-Schenectady-Troy, NY	1.177	0.953
66	Savannah, GA	1.176	1.107
67	Saginaw-Bay City-Midland, MI	1.173	0.883
68	Portland, ME	1.171	1.048
69	Canton, OH	1.171	0.979
70	Flint, MI	1.168	0.891
71	Houma-Thibodoux, LA	1.166	1.200
72	St. Joseph, MO	1.165	1.122
73	Louisville, KY/IN	1.163	1.039
74	Binghamton, NY	1.161	1.125
75	Joplin, MO	1.158	1.365
76	Ann Arbor, MI	1.158	1.000
77	Dothan, AL	1.156	1.199
78	Fort Pierce, FL	1.156	1.123
79	Baltimore, MD	1.154	0.986
80	Amarillo, TX	1.154	1.140
81	Youngstown-Warren, OH-PA	1.154	0.940
82	Corpus Christi, TX	1.147	1.188
83	Johnson City-Kingsport--Bristol, TN/VA	1.142	1.177

Table 6. (Continued)

Ranking	Metro area	Employment location quotient for meds	Ratio of earnings to employment location quotient for meds
84	Springfield-Holyoke-Chicopee, MA	1.142	1.005
85	Erie, PA	1.140	1.046
86	Dayton-Springfield, OH	1.140	0.957
87	Peoria, IL	1.137	0.959
88	Rochester, NY	1.137	0.929
89	Newburgh-Middletown, NY	1.136	0.930
90	Eau Claire, WI	1.133	1.321
91	Springfield, MO	1.133	1.311
92	Syracuse, NY	1.133	1.057
93	Beaumont-Port Arthur-Orange,TX	1.132	0.861
94	Tampa-St. Petersburg-Clearwater, FL	1.132	1.073
95	Milwaukee, WI	1.131	0.966
96	New Orleans, LA	1.130	1.111
97	St. Louis, MO-IL	1.123	0.961
98	Chico, CA	1.123	1.194
99	Charleston-N.Charleston,SC	1.122	1.256
100	Evansville, IN/KY	1.122	1.050
101	Bridgeport, CT	1.122	0.883
102	Knoxville, TN	1.118	1.113
103	West Palm Beach-Boca Raton-Delray Beach, FL	1.112	1.039
104	Fort Smith, AR/OK	1.112	1.339
105	Albany, GA	1.110	1.241
106	Harrisburg-Lebanon--Carlisle, PA	1.109	1.046
107	Medford, OR	1.107	1.124
108	Lima, OH	1.107	1.040
109	Fort Lauderdale-Hollywood-Pompano Beach, FL	1.102	1.072
110	Jamestown-Dunkirk, NY	1.102	1.054
111	Fort Myers-Cape Coral, FL	1.098	1.096
112	Racine, WI	1.097	0.861
113	Wichita Falls, TX	1.092	1.109
114	Wichita, KS	1.092	1.027
115	Monmouth-Ocean, NJ	1.089	0.845
116	Cincinnati-Hamilton, OH/KY/IN	1.089	0.950
117	Decatur, IL	1.088	0.865
118	Indianapolis, IN	1.088	0.980
119	Lafayette, LA	1.086	1.032
120	Daytona Beach, FL	1.083	1.114
121	Mobile, AL	1.083	1.053
122	Wausau, WI	1.079	1.177
123	Columbia, SC	1.079	1.144
124	Glens Falls, NY	1.078	0.889
125	Williamsport, PA	1.076	1.197

Table 6. (Continued)

Ranking	Metro area	Employment location quotient for meds	Ratio of earnings to employment location quotient for meds
126	Fitchburg-Leominster, MA	1.075	0.877
127	Longview-Marshall, TX	1.072	1.266
128	Muncie, IN	1.072	1.078
129	Waco, TX	1.066	1.087
130	Lake Charles, LA	1.065	1.099
131	Chattanooga, TN/GA	1.064	1.131
132	Terre Haute, IN	1.062	0.965
133	Fargo-Morehead, ND/MN	1.057	1.249
134	Memphis, TN/AR/MS	1.055	1.055
135	Fort Wayne, IN	1.053	1.013
136	Odessa, TX	1.047	1.157
137	Tacoma, WA	1.043	1.024
138	Nashville, TN	1.041	1.156
139	Pensacola, FL	1.038	1.210
140	Detroit, MI	1.037	0.881
141	Sheboygan, WI	1.036	0.948
142	Davenport, IA-Rock Island -Moline, IL	1.033	1.074
143	Rockford, IL	1.030	1.001
144	San Antonio, TX	1.030	1.106
145	Madison, WI	1.029	1.111
146	Omaha, NE/IA	1.029	1.037
147	Lynchburg, VA	1.024	1.158
148	South Bend-Mishawaka, IN	1.024	1.145
149	Waterloo-Cedar Falls, IA	1.022	1.207
150	Florence, AL	1.015	1.134
151	Tucson, AZ	1.012	1.063
152	Kansas City, MO-KS	1.010	0.974
153	Richmond-Petersburg, VA	1.009	0.978
154	Greensboro-Winston Salem-High Point, NC	1.007	1.075
155	Kileen-Temple, TX	1.005	1.243
156	Santa Rosa-Petaluma, CA	1.004	0.916
157	Olympia, WA	1.003	1.027
158	Macon-Warner Robins, GA	1.000	1.092
159	Melbourne-Titusville-Cocoa-Palm Bay, FL	0.999	1.039
160	Manchester, NH	0.997	0.967
161	Lancaster, PA	0.996	1.021
162	Wilmington, NC	0.995	1.074
163	Eugene-Springfield, OR	0.993	1.096
164	Benton Harbor, MI	0.991	0.900
165	Albuquerque, NM	0.990	1.124
166	Danville, VA	0.989	1.172
167	Fresno, CA	0.986	1.185

Table 6. (Continued)

Ranking	Metro area	Employment location quotient for meds	Ratio of earnings to employment location quotient for meds
168	Sioux City, IA/NE	0.986	1.106
169	Montgomery, AL	0.981	1.069
170	Columbus, GA/AL	0.981	1.303
171	Lincoln, NE	0.979	1.081
172	Tulsa, OK	0.979	1.048
173	Oklahoma City, OK	0.979	1.083
174	Miami-Hialeah, FL	0.977	1.184
175	Kalamazoo-Portage, MI	0.975	1.045
176	Minneapolis-St. Paul, MN	0.974	0.951
177	Akron, OH	0.974	1.018
178	Yakima, WA	0.972	1.181
179	Baton Rouge, LA	0.971	1.122
180	McAllen-Edinburg-Pharr-Mission, TX	0.971	1.318
181	Atlantic City, NJ	0.968	1.101
182	Raleigh-Durham, NC	0.965	1.021
183	Hamilton-Middleton, OH	0.963	0.930
184	Reading, PA	0.962	0.926
185	Janesville-Beloit, WI	0.953	1.028
186	Danbury, CT	0.951	0.849
187	St. Cloud, MN	0.951	1.087
188	Stockton, CA	0.949	1.017
189	Lakeland-Winterhaven, FL	0.948	1.037
190	Biloxi-Gulfport, MS	0.946	1.181
191	York, PA	0.945	0.950
192	Grand Rapids, MI	0.944	0.907
193	Chicago, IL	0.936	0.942
194	Columbus, OH	0.930	0.977
195	Appleton-Oskosh-Neenah, WI	0.928	0.878
196	Kokomo, IN	0.927	0.753
197	Wilmington, DE/NJ/MD	0.926	1.004
198	Riverside-San Bernadino, CA	0.923	1.071
199	Hagerstown, MD	0.921	0.901
200	Sacramento, CA	0.921	1.051
201	Naples, FL	0.920	1.038
202	Anchorage, AK	0.919	1.047
203	Panama City, FL	0.917	1.269
204	Bellingham, WA	0.916	1.078
205	San Luis Obispo-Atascad-P Robles, CA	0.915	1.235
206	Portland, OR-WA	0.914	0.992
207	Modesto, CA	0.912	1.053
208	Jacksonville, FL	0.911	1.074
209	Rocky Mount, NC	0.910	1.071

Table 6. (Continued)

Ranking	Metro area	Employment location quotient for meds	Ratio of earnings to employment location quotient for meds
210	Honolulu, HI	0.905	1.188
211	Kenosha, WI	0.904	0.900
212	Des Moines, IA	0.901	0.951
213	Visalia-Tulare-Porterville, CA	0.900	1.156
214	Boise City, ID	0.899	0.962
215	Trenton, NJ	0.897	0.940
216	Yuba City, CA	0.893	1.194
217	San Francisco-Oakland-Vallejo, CA	0.882	0.916
218	Champaign-Urbana-Rantoul, IL	0.882	1.136
219	Dover, DE	0.879	0.984
220	Seattle-Everett, WA	0.875	0.976
221	Hickory-Morgantown, NC	0.873	1.091
222	Norfolk-VA Beach--Newport News, VA	0.866	1.082
223	Tallahassee, FL	0.865	1.204
224	San Diego, CA	0.865	1.012
225	Salem, OR	0.858	1.058
226	Provo-Orem, UT	0.858	0.977
227	Decatur, AL	0.852	0.925
228	Huntsville, AL	0.852	0.967
229	Fayetteville, NC	0.846	1.227
230	El Paso, TX	0.844	1.085
231	Los Angeles-Long Beach, CA	0.841	1.048
232	Greenville-Spartanburg-Anderson SC	0.841	1.097
233	Las Cruces, NM	0.840	1.207
234	Santa Fe, NM	0.838	0.912
235	Lansing-E. Lansing, MI	0.836	1.071
236	Bremerton, WA	0.833	0.849
237	Houston-Brazoria, TX	0.833	0.996
238	Flagstaff, AZ-UT	0.826	1.469
239	Stamford, CT	0.822	0.752
240	Anniston, AL	0.822	1.252
241	Salt Lake City-Ogden, UT	0.822	1.045
242	Colorado Springs, CO	0.819	0.989
243	Yolo, CA	0.815	1.117
244	Charlotte-Gastonia-Rock Hill, NC-SC	0.812	1.007
245	Phoenix, AZ	0.812	1.036
246	Nashua, NH	0.809	0.871
247	Athens, GA	0.806	1.415
248	Santa Barbara-Santa Maria-Lompoc, CA	0.805	1.115
249	Orlando, FL	0.805	1.102
250	Santa Cruz, CA	0.801	0.991
251	Clarksville- Hopkinsville, TN/KY	0.801	1.027

Table 6. (Continued)

Ranking	Metro area	Employment location quotient for meds	Ratio of earnings to employment location quotient for meds
252	Cedar Rapids, IA	0.798	1.011
253	Fayetteville-Springdale, AR	0.796	1.045
254	Bloomington-Normal, IL	0.795	0.972
255	Richland-Kennewick-Pasco, WA	0.793	1.012
256	Ventura-Oxnard-Simi Valley, CA	0.791	0.912
257	Green Bay, WI	0.787	1.035
258	Merced, CA	0.777	1.057
259	Washington, DC/MD/VA	0.777	0.895
260	Reno, NV	0.774	1.205
261	Fort Collins-Loveland, CO	0.770	0.994
262	Salinas-Sea Side-Monterey, CA	0.765	1.300
263	Bloomington, IN	0.763	1.060
264	Lafayette-W. Lafayette, IN	0.762	1.061
265	Denver-Boulder, CO	0.762	0.953
266	Greeley, CO	0.760	1.038
267	Mansfield, OH	0.757	0.856
268	Bakersfield, CA	0.748	1.061
269	Fort Walton Beach, FL	0.744	0.956
270	Laredo, TX	0.743	1.111
271	Auburn-Opekika, AL	0.741	1.270
272	Dallas-Fort Worth, TX	0.741	0.985
273	Bryan-College Station, TX	0.741	1.267
274	Yuma, AZ	0.737	1.279
275	Atlanta, GA	0.726	1.004
276	Sumter, SC	0.718	1.088
277	Elkhart-Goshen, IN	0.696	0.946
278	Myrtle Beach, SC	0.691	1.017
279	San Jose, CA	0.673	0.833
280	Austin, TX	0.660	1.035
281	Jacksonville, NC	0.660	1.116
282	Las Vegas, NV	0.604	1.124
283	State College, PA	0.586	1.579

NOTES: This table lists each metro area's location quotient for medical care employment, and the ratio of the location quotient for medical care earnings to medical care employment, with metro areas ranked by the location quotient for medical care employment.

Table 7 Variation in Mean and Standard Deviation of Location Quotients for Eds and Meds, By Employment Size Class of Metro Areas

Quintile	Employment size range of quintile	Eds: Mean LQ	Eds: Standard deviations of LQs in quintile	Meds: Mean LQ	Meds: Standard deviations of LQs in quintile
1	Le 78250	1.086	1.164	1.159	0.356
2	78250 lt Q2 le 124801	1.850	2.053	1.006	0.221
3	124801 lt Q3 le 204257	1.320	1.004	1.056	0.198
4	204257 lt Q4 le 448514	1.130	0.754	1.051	0.149
5	448514 lt Q5	0.922	0.364	0.983	0.167

NOTES: This table divides the 283 metro areas into five employment size classes, each with 56 or 57 metro areas in that size class. The mean employment location quotient, and standard deviation of the employment location quotient, is calculated separately for each size class of metro area.

Table 8 Variation in Mean and Standard Deviation of Location Quotients for Eds and Meds, By U.S. Region

Region	Number of metro areas in region	Eds		Meds	
		Mean LQ	Standard deviations of LQs in quintile	Mean LQ	Standard deviations of LQs in quintile
Northeast	46	1.202	1.176	1.164	0.186
Midwest	71	1.562	1.596	1.090	0.300
South	111	1.126	1.141	1.050	0.208
West	55	1.204	0.892	0.909	0.161

NOTES: This table divides the 283 metro areas among the four census regions. The mean employment location quotient and standard deviation of the employment location quotient, is calculated separately for each region.

Table 9 Standard Deviation of Ed and Med Location Quotients Across Metro Areas, Compared for Four Years: 1970, 1980, 1990, 2000

Year	Standard deviation of ed location quotient	Standard deviation of med location quotient
1970	0.762	0.236
1980	0.660	0.179
1990	0.563	0.181
2000	0.537	0.182

NOTES: This table only includes 125 metro areas that can be matched over time for all four years.

Table 10. Estimated Effects on a Metro Area's Annual Employment Growth Rate of a Metro Area's Initial Specialization in Eds and Meds

	1969-79 results	1979-89 results	1989-2000 results	2000-2004 results	Results pooling data from 1969-79, 1979-89, 1989-2000	Based on pooled regression, effects of one standard deviation increase in location quotient variables
Eds employment location quotient	0.00268 (6.30)	−0.00060 (−1.57)	−0.00091 (−2.57)	−0.00322 (−2.17)	0.00255 (3.84)	0.00161
Ratio of eds earnings to employment location quotient	0.00555 (3.83)	0.00699 (3.36)	0.00579 (3.29)	0.01223 (1.54)	0.00038 (0.34)	0.00006
Meds employment location quotient	−0.00380 (−2.73)	−0.00590 (−3.95)	−0.00460 (−3.69)	−0.01182 (−2.29)	0.00347 (2.38)	0.00067
Ratio of meds earnings to employment location quotient	0.00697 (2.71)	0.00175 (0.52)	0.00614 (1.93)	0.01984 (1.76)	0.00771 (4.38)	0.00081
Share effect prediction of annual employment growth	0.750 (31.13)	0.813 (40.12)	0.830 (35.71)	1.383 (5.28)	0.768 (39.84)	
Ln(employment in metro area in initial year)	−0.00261 (−6.92)	−0.00158 (−5.15)	−0.00172 (−7.21)	0.00029 (0.31)	−0.00673 (−5.00)	
Region dummies?	Yes	Yes	Yes	Yes	No	
Metro area fixed effects?	No	No	No	No	Yes	
National fixed effects for time period?	Yes	Yes	Yes	Yes	Yes	

NOTES: The underlying observations are mean values for each of 125 metro areas that can be matched reasonably well over the entire time period from 1969 to the present using PUMS data. The dependent variable is the logarithmic annual employment growth rate over the time period or periods considered in the regression. The employment growth rate comes from the Regional Economic Information System of the U.S. BEA, and is defined using metro area boundaries as of 2004 for all 125 metro areas. The location quotients are measured using PUMS data from the decennial censuses of 1970, 1980, 1990, and 2000. The location quotients used to explain growth rates over some time period are the location quotients as of the initial year of that time period. The share effect is the prediction of the annual employment growth rate in the metro area over that time period if each industry in the metro area had grown at that industry's national average growth rate over that time period. As shown elsewhere (Bartik 1991), this variable proxies for national demand shocks for the area's export-base industries. Industry mix in each metro area is measured at the 3-digit NAICS level of detail. These data are derived by the Upjohn Institute through working with REIS, BLS, and REMI data on industry employment by county to overcome suppressions, and using overlap years to convert SIC industry numbers to NAICS numbers. Except for the pooled regressions, all estimation is based on 125 observations. The pooled regression is based on observations on 125 metro areas time three time periods, or 375 observations. The nonpooled regressions include dummy variables to control for the four census regions, and implicitly control for national time period effects on growth via the constant term. The pooled regression includes dummy variables for all 125 metro areas to allow for fixed metro area effects on growth, as well as dummy variables for each time period to control for national time period effects on growth.

Table 11. Estimated Effects on a Metro Area's Per Capita Real Income Growth Rate of a Metro Area's Initial Specialization in Eds and Meds

	1969-79 results	1979-89 results	1989-2000 results	2000-2004 results	Results pooling data from 1969-79, 1979-89, 1989-2000	Based on pooled regression, effects of one standard deviation increase in location quotient variables
Eds employment location quotient	−0.00103 (−1.64)	0.00033 (0.42)	0.00202 (2.13)	0.00033 (0.21)	0.00215 (1.19)	0.00135
Ratio of eds earnings to employment location quotient	0.00029 (0.14)	0.00544 (1.26)	−0.00528 (−1.12)	0.01274 (1.50)	0.00096 (0.32)	0.00015
Meds employment location quotient	0.00394 (1.93)	0.00308 (0.99)	0.00536 (1.60)	0.00557 (1.01)	−0.00222 (−0.56)	−0.00043
Ratio of meds earnings to employment location quotient	0.00045 (0.12)	0.00488 (0.70)	−0.02154 (−2.53)	0.02280 (1.89)	0.01334 (2.80)	0.00140
Share effect prediction of annual employment growth	0.099 (2.80)	0.351 (8.33)	0.249 (4.00)	0.968 (3.46)	0.602 (11.53)	
Ln(employment in metro area in initial year)	−0.00162 (−2.92)	0.00146 (2.28)	0.00136 (2.12)	−0.00103 (−1.03)	0.00878 (2.41)	
Region dummies?	Yes	Yes	Yes	Yes	No	
Metro area fixed effects?	No	No	No	No	Yes	
National fixed effects for time period?	Yes	Yes	Yes	Yes	Yes	

NOTES: Sources of data and definitions of data are same as in Table 10, but with different dependent variable. Here, the dependent variable is the annual rate of growth over the time period for the metro area in real per capita income, measured as the annual rate of change in the natural log of metro area per capita income. Per capita income data comes from the Regional Economic Information System of the Bureau of Economic Analysis. Metro areas are defined using 2004 metro area definitions.

Table 12. Estimated Local Economic Development Impacts of Eds and Meds Expansion in Two Typical Metro Areas

Category of effect	Source of calculation	Grand Rapids		Kalamazoo	
		Higher ed	Health care	Higher ed	Health care
Export base %	From REMI model	75	16	87	31
Multiplier	From REMI model	1.33	1.69	1.16	1.47
Gross economic impact (in millions of dollars)	= 100 million expenditure expansion of eds and meds × export base % × multiplier	100	27	101	45
Gross effects on local resident earnings	= gross impact × 70% labor share × 0.4 local earnings effect	28	8	28	13
Rescaled effects: Gross effects as percentage of local earnings for initially induced change of one location quotient	= national earnings share of industry × ratio of gross impact to initial expenditure × 0.4 local earnings share	0.88	1.07	0.89	1.78
Potential local tax cost (in millions of dollars)	Based on state and local share of industry revenues	40	13	40	13
Multiplier effect of local tax cost	From REMI model	0.91	0.91	0.74	0.74
Potential economic impact of tax cost	= local tax cost × multiplier	36	12	29	10
Net economic impact	= gross impact − tax cost	64	15	72	35
Net effects on local resident earnings	= net impact × 70% labor share × 40% local earnings share	18	4	20	10
Rescaled effects: Net % effects on local earnings for a 1.0 LQ change	= national earnings share of industry × ratio of expenditure impact to $100 million × 40% local earnings share	0.56	0.59	0.63	1.39

NOTES: These figures are largely derived from simulating the effects of inducing a $100 million expansion in expenditure on higher ed or health care institutions in Grand Rapids, Michigan, or Kalamazoo, Michigan, using the Upjohn Institute's simulations using the REMI model. All effects are in millions of dollars except for the export base percent, the multiplier effects and the rescaled effects. The multiplier effects are unit free and represent the ratio of the impact on total local economic activity to the increase in export-base expenditure. The rescaled effects are percentage effects on local earnings due to an attempt to induce a one location quotient expansion in eds or meds in each metro area. These rescaled numbers are derived from these simulations by rescaling the size of the expansion, and rescaling the impact to a percentage of local earnings.

Table 13. Effects of Local Eds and Meds Location Quotients on the Amenity Component of Real Wages, 1980 Estimates, from Beeson and Eberts

	Coefficient	t-statistic
Ed location quotient	−0.011	(−0.66)
Med location quotient	0.068	(1.61)
Ln(metro area employment)	−0.005	(−0.90)
Northeast dummy	−0.005	(−0.37)
Midwest dummy	−0.035	(−3.08)
West dummy	0.022	(2.03)
R squared = 0.4669, observations = 35 metro areas		

NOTES: The dependent variable is derived from Beeson and Eberts's (1989) measure of the amenity component of wage differentials across 35 metro areas in 1980, except that we reverse the sign so that a higher value implies a higher amenity value for the metro area. The omitted region dummy is obviously the southern region. The dependent variable is implicitly a willingness to reduce the natural log of real wages by that amount due to the amenity.

Table 14. Effects of Ed and Med Location Quotients, as Inferred from Variations in Real Wages in 28 Metro Areas in 2000

	Coefficient	t-statistic
Ed location quotient	0.112	1.81
Med location quotient	0.033	0.21
Ln(metro area employment)	0.017	0.81
Northeast dummy	−0.002	−0.03
Midwest dummy	−0.041	−0.94
West dummy	0.075	1.88
R squared = 0.4566, observations = 28 metro areas		

NOTES: The dependent variable is derived from a regression of the individual's ln wage on individual demographic characteristics, a set of dummies for the individual's industry, and dummy variables for the individual's metro area. The metro area dummies are then combined with an index for overall local prices in 28 metro areas, from Aten (2006), to create an index for real wages in each metro area. National price trends were used to translate Aten's price variable back to 1999, to be consistent with the date of the wage data. We calculated the additive inverse of the real wage, or ln(price) minus ln(metro wage effect), so that effects would be interpretable as "positive" for amenities and negative for disamenities.

Table 15. Effect on Places Rated Almanac Indices of Metro Quality of Life of Ed and Med Location Quotients

	Index									Overall metro quality of life index
	Cost of living	Transportation	Jobs	Education	Climate	Crime	Arts	Health care	Recreation	
Ed location quotient	−1.38 (−1.50)	1.11 (0.94)	2.22 (2.39)	5.57 (5.04)	−0.27 (−0.35)	1.14 (0.96)	2.85 (2.83)	5.57 (5.14)	−0.25 (−0.23)	1.84 (3.67)
Med location quotient	3.47 (0.69)	6.58 (1.02)	−8.86 (−1.74)	8.13 (1.34)	0.50 (0.12)	−10.01 (−1.54)	6.67 (1.21)	58.10 (9.79)	−0.71 (−0.12)	7.09 (2.59)
ln(metro employment)	−8.47 (−8.89)	14.60 (11.97)	13.32 (13.91)	15.26 (13.41)	2.96 (3.71)	−7.98 (−6.53)	16.95 (16.35)	13.18 (11.80)	15.78 (14.20)	8.40 (16.27)
Northeast	−43.96 (−13.57)	−11.18 (−2.70)	−34.65 (−10.64)	0.52 (0.13)	−26.97 (−9.94)	39.09 (9.41)	5.30 (1.50)	−14.32 (−3.77)	−3.81 (−1.01)	−10.00 (−5.70)
Midwest	−15.93 (−5.56)	5.17 (1.41)	−10.57 (−3.67)	11.78 (3.44)	−48.79 (−20.33)	21.77 (5.92)	15.05 (4.83)	−3.35 (−1.00)	0.08 (0.02)	−2.75 (−1.77)
West	−37.27 (−12.02)	−2.43 (−0.61)	3.53 (1.13)	−6.57 (−1.77)	14.33 (5.52)	13.48 (3.39)	5.89 (1.75)	−3.35 (−0.92)	−12.89 (−3.56)	−2.81 (−1.67)

NOTES: Each column represents a separate regression. Each regression has the same right-hand side variables, which are separated into rows. The numbers in each box are the coefficient on the row variable in the regression with the dependent variable given by the column heading, and (in parentheses), the t-statistic associated with that estimated coefficient. The dependent variables in these 10 regressions are metro area values of 9 subindices in the 2000 edition of *Places Rated Almanac*, plus the overall metro quality of life index. These 9 subindices and the overall index are defined for 295 metro areas. The individual subindices are scaled so that the "best" metro area has a rating of 100, and the worst a rating of 0; the mean value of the subindices are typically around 50. Higher being better even applies to the subindices that are named for a disamenity, such as cost of living and crime. The overall quality of life index is the simple average of the nine subindices. The ed and med location quotient data come from the 2000 PUMS data from the U.S. Census. The 283 metro areas in PUMS combine a few of the 295 metro areas in Places Rated. We simply assigned the same location quotient to each of the Places Rated metro areas that is combined into a PUMS metro area. The metro employment data is as of 1999, and comes from the Regional Economic Information System of the U.S. Bureau of Economic Analysis. The omitted regional dummy is for the South. Because the overall index is an average of the nine subindices, the regression coefficients in the overall index regression are averages of the corresponding coefficients in the individual subindice regressions.

Table 16. Central City vs. Suburban Location Quotients for Eds and Meds, Based on Residential Location of Workers, 65 Metro Areas, 2000 Census

	Eds			Meds		
	Median	Mean	Standard deviation	Median	Mean	Standard deviation
Central city employment location quotient	1.133	1.529	1.269	1.110	1.112	0.209
Suburban employment location quotient	0.773	0.850	0.391	1.008	1.006	0.155
Ratio of central city to suburban employment location quotient	1.584	1.777	0.825	1.081	1.110	0.167
Number of metro areas in which central city location quotient exceeds suburban location quotient (out of 65 metro areas)	58			48		

NOTES: Empirical estimates based on individual observations from Public Use Microdata Samples, 2000 census. Results come from 65 metro areas for which central city vs. suburban location was identified for over 70 percent of the residents of the metro area, and for which identified central city and suburban respondents were each over 10 percent of total metro area respondents. The central city and suburban identification is based on place of residence, not place of work. Location quotient for a given industry is proportion of workers in that industry out of total workforce, divided by the same proportion for U.S. as a whole.

Table 17. List of Central City and Suburban Location Quotients for Higher Education, Sorted by Ratio of Central City to Suburban Location Quotient

Metro area	Central city ed location quotient	Suburban ed location quotient	Ratio of central city to suburban location quotient
Ann Arbor, MI	8.752	2.066	4.237
Minneapolis-St. Paul, MN	2.206	0.585	3.773
Pittsburgh, PA	3.331	0.889	3.749
Lafayette, LA	1.591	0.426	3.736
New Orleans, LA	1.856	0.602	3.084
Seattle-Everett, WA	2.209	0.719	3.071
Madison, WI	5.300	1.728	3.067
Baton Rouge, LA	2.746	0.938	2.928
Columbia, SC	3.152	1.100	2.867
Cincinnati-Hamilton, OH/KY/IN	1.807	0.634	2.850
Boston, MA-NH	3.255	1.296	2.511
Austin, TX	2.221	0.933	2.381
Syracuse, NY	3.423	1.466	2.335
Mobile, AL	1.239	0.555	2.234
Riverside-San Bernadino, CA	1.373	0.633	2.169
Memphis, TN/AR/MS	1.109	0.522	2.123
Bakersfield, CA	0.815	0.396	2.056
Washington, DC/MD/VA	1.720	0.837	2.056
Montgomery, AL	1.133	0.556	2.040
Reno, NV	1.389	0.691	2.009
Corpus Christi, TX	0.856	0.427	2.005
Knoxville, TN	2.881	1.472	1.957
Fayetteville, NC	0.904	0.473	1.911
Kansas City, MO-KS	0.902	0.480	1.881
Fort Wayne, IN	0.783	0.421	1.858
Philadelphia, PA/NJ	1.719	0.931	1.847
Richmond-Petersburg, VA	1.568	0.853	1.838
Chicago, IL	1.191	0.663	1.796
Denver-Boulder, CO	0.879	0.499	1.762
Baltimore, MD	1.904	1.099	1.733
Tulsa, OK	0.887	0.533	1.665
Sacramento, CA	0.867	0.523	1.658
Boise City, ID	0.882	0.557	1.584
St. Louis, MO-IL	1.402	0.893	1.570
Tacoma, WA	0.918	0.586	1.567
Ventura-Oxnard-Simi Valley, CA	0.827	0.566	1.463
Akron, OH	1.031	0.719	1.434

Table 17. (Continued)

Metro area	Central city ed location quotient	Suburban ed location quotient	Ratio of central city to suburban location quotient
Hartford-Bristol-Middleton- New Britain, CT	1.055	0.739	1.427
Savannah, GA	1.139	0.806	1.413
San Francisco-Oakland-Vallejo, CA	1.174	0.833	1.409
Detroit, MI	0.580	0.415	1.399
Milwaukee, WI	1.240	0.892	1.391
Rockford, IL	0.643	0.479	1.342
New York-Northeastern NJ	0.996	0.773	1.288
Los Angeles-Long Beach, CA	0.923	0.718	1.286
Erie, PA	1.501	1.265	1.186
Chattanooga, TN/GA	0.956	0.807	1.185
Rochester, NY	1.523	1.308	1.164
San Antonio, TX	0.768	0.661	1.162
Buffalo-Niagara Falls, NY	1.358	1.186	1.145
Worcester, MA	1.920	1.682	1.141
South Bend-Mishawaka, IN	2.582	2.350	1.099
Toledo, OH/MI	1.080	0.997	1.083
Evansville, IN/KY	1.009	0.933	1.082
Spokane, WA	1.248	1.157	1.079
Flint, MI	0.633	0.595	1.063
Fresno, CA	0.945	0.892	1.059
Des Moines, IA	0.820	0.804	1.019
Jacksonville, FL	0.451	0.495	0.912
Green Bay, WI	0.798	0.880	0.907
Bridgeport, CT	0.689	0.773	0.891
Norfolk-VA Beach--Newport News, VA	0.720	0.943	0.764
Oklahoma City, OK	0.715	1.092	0.654
Cleveland, OH	0.426	0.741	0.575
Wichita, KS	0.441	0.775	0.569

NOTES: Derived from same source as Table 16.

Table 18. List of Central City and Suburban Location Quotients for Health Care Industry Education, Sorted by Ratio of Central City to Suburban Location Quotient

Metro area	Central city med location quotient	Suburban med location quotient	Ratio of central city to suburban location quotient
Bakersfield, CA	0.995	0.585	1.700
Fayetteville, NC	1.041	0.725	1.435
Mobile, AL	1.337	0.937	1.428
Rochester, NY	1.462	1.060	1.379
Fresno, CA	1.161	0.856	1.356
Syracuse, NY	1.433	1.062	1.350
Corpus Christi, TX	1.268	0.941	1.347
Baltimore, MD	1.446	1.086	1.332
Worcester, MA	1.525	1.166	1.308
St. Louis, MO-IL	1.391	1.073	1.296
Fort Wayne, IN	1.199	0.938	1.277
Cincinnati-Hamilton, OH/KY/IN	1.317	1.049	1.256
Philadelphia, PA/NJ	1.444	1.165	1.239
Buffalo-Niagara Falls, NY	1.518	1.239	1.225
Detroit, MI	1.226	1.002	1.223
Ventura-Oxnard-Simi Valley, CA	0.938	0.767	1.223
Montgomery, AL	1.054	0.864	1.220
Richmond-Petersburg, VA	1.138	0.960	1.185
Flint, MI	1.264	1.071	1.181
New York-Northeastern NJ	1.299	1.110	1.170
New Orleans, LA	1.222	1.053	1.160
Lafayette, LA	1.168	1.013	1.153
Seattle-Everett, WA	0.964	0.837	1.151
Erie, PA	1.241	1.085	1.144
Boston, MA-NH	1.335	1.168	1.143
Chattanooga, TN/GA	1.159	1.015	1.142
South Bend-Mishawaka, IN	1.110	0.973	1.140
Rockford, IL	1.099	0.975	1.127
Akron, OH	1.136	1.038	1.094
Minneapolis-St. Paul, MN	1.038	0.955	1.087
Bridgeport, CT	1.179	1.085	1.086
Madison, WI	1.071	0.986	1.086
Hartford-Bristol-Middleton- New Britain, CT	1.410	1.304	1.081
Boise City, ID	0.948	0.877	1.081
Memphis, TN/AR/MS	1.084	1.008	1.076
Denver-Boulder, CO	0.790	0.735	1.075

Table 18. (Continued)

Metro area	Central city med location quotient	Suburban med location quotient	Ratio of central city to suburban location quotient
Des Moines, IA	0.931	0.870	1.070
Riverside-San Bernadino, CA	0.980	0.917	1.069
Cleveland, OH	1.241	1.164	1.066
Evansville, IN/KY	1.159	1.088	1.065
Pittsburgh, PA	1.407	1.322	1.064
Tulsa, OK	0.997	0.957	1.042
Kansas City, MO-KS	1.033	0.992	1.042
Spokane, WA	1.304	1.292	1.009
Los Angeles-Long Beach, CA	0.842	0.834	1.009
Baton Rouge, LA	0.976	0.968	1.009
Chicago, IL	0.973	0.968	1.005
Sacramento, CA	0.921	0.921	1.000
San Antonio, TX	1.073	1.079	0.995
Tacoma, WA	1.033	1.046	0.988
Jacksonville, FL	0.939	0.952	0.986
Milwaukee, WI	1.136	1.158	0.980
Columbia, SC	1.055	1.086	0.971
San Francisco-Oakland-Vallejo, CA	0.827	0.852	0.970
Ann Arbor, MI	1.131	1.167	0.969
Austin, TX	0.642	0.678	0.947
Reno, NV	0.752	0.798	0.942
Knoxville, TN	1.091	1.177	0.927
Savannah, GA	1.124	1.235	0.910
Toledo, OH/MI	1.182	1.315	0.899
Washington, DC/MD/VA	0.707	0.789	0.896
Norfolk-VA Beach--Newport News, VA	0.822	0.927	0.886
Wichita, KS	0.965	1.092	0.883
Oklahoma City, OK	0.964	1.095	0.881
Green Bay, WI	0.654	0.894	0.732

NOTES: Derived from same source as Table 16.

Table 19. Effects of Eds or Meds Industry on Log Wages, Controlling for Worker Characteristics

Regression sample	Eds		Meds		Number of observations
	Coefficient	t-statistic	Coefficient	t-statistics	
All workers	−0.145	−89.60	0.048	57.59	4,410,914
High school dropout	0.008	0.70	−0.024	−7.20	583,070
High school graduate	−0.038	−7.22	−0.059	−33.25	1,147,998
Some college	−0.141	−46.35	−0.014	−8.76	1,124,519
Associates degree	−0.166	−28.08	0.155	84.64	345,489
College degree	−0.200	−55.24	0.050	25.36	787,622
Postgraduate degree	−0.129	−46.21	0.132	58.44	422,216

NOTES: The underlying data come from the Public Use Microdata Sample, 2000 census. The observations are on the natural logarithm of wages. Wages are calculated as annual earnings for the person divided by the product of annual weeks worked and usual weekly hours. Observations are excluded if earnings, weeks worked, or usual weekly hours were imputed rather than actually observed. Observations were excluded if calculated wages were outliers, which means that wages were less than \$2 or more than \$200. The sample is all workers 16 years old to 64 years old in metro areas. The regressions controlled for: gender; marital status; marital status interacted with gender; mutually exclusive race categories of Hispanic, white non-Hispanic, black non-Hispanic, and other non-Hispanic; a quartic in age; 283 metro area dummies, and dummy variables for 254 industries. The industry dummies were all included; the weighted sum of the industry variables, where the weights are the estimated proportion of each regression sample in each industry, was constrained to equal zero. This means that the industry wage coefficient measures the wage paid in that industry versus the all industry average wage for that education group. Each row corresponds to a different regression. The education groups are defined so that they are mutually exclusive. For example, “some college” means some years of college attendance without any degree.

Table 20. Summary of Local Economic Development Effects of Eds or Meds Expansion

	Eds	Meds
Category of effect (All scaled, except where noted, to policy that initially tries to expand eds or meds capacity by one location quotient)	Effects on local earnings stated in percentage terms, after 10 years, with long-run effects if different in parentheses	Effects on local earnings stated in percentage terms, after 10 years, with long-run effects if different in parentheses
Export-base demand stimulus	0.88	1.07
Human capital development	0.28 (1.12)	?
Amenities	Positive	Positive
R&D spillovers	Positive	?
Entrepreneurship	0.19 (.76) (double-counting?)	?
Reducing intra-metro disparities	Yes, significantly	Yes, marginally
Efficiency wage effects	−0.55	0.15
Local leadership effects	Positive	Positive
Sum of types of effects	0.80 + (2.21) ignoring double-counting 0.61 + (1.45) assuming full double-counting	1.22 +
Sum rescaled to attempted 1% of labor force expansion	0.34 + (0.95) ignoring double-counting 0.26 + (0.63) assuming full double-counting	0.14 +
Directly estimated aggregate effect (section 4 of paper)	0.75	0.22

NOTES: All estimates are derived from earlier tables and text discussion in the paper. Most of the numbers come from section 5 of the paper. The directly estimated aggregate effect is derived from section 4, although the section 4 figures are adjusted to reflect displacement effects of a one location quotient expansion of eds or meds. The estimated effects are all percentage effects on average local earnings of the original residents who stayed in the metro area. Therefore, 0.88 is the first column's (88/100)ths of one percent. Note that these estimates are for policy initiatives that directly induce a one location expansion in eds or meds, or, in some cases, a 1 percent of labor force expansion. The net effect on the location quotient will be less because of displacement of existing activity in the industry, with the table assuming that net activity only increases by 0.75 location quotients for eds and 0.16 location quotients for meds, based on REMI estimates. The 1 percent of labor force numbers are derived by dividing the sum numbers by the average percentage in the industry nationally, which is 2.32 percent for eds and 8.90 percent for meds.

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