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EMPLOYMENT RESEARCH

STEM and the Local Economy

Do Regions Reap the Benefits of a STEM-Educated Workforce?

Fran Stewart

ARTICLE HIGHLIGHTS

- Occupational competencies add insight to the educational attainment proxy.
- Increasing a region's share of bachelor's degrees may not increase regional economic well-being, broadly defined.
- A higher share of regional employment in jobs requiring above-average STEM does improve regional well-being, but many of these STEM jobs do not require a bachelor's degree.
- Roughly half of regional employment is in jobs requiring below average STEM and below-average soft skills, a category of occupational human capital associated with reduced regional well-being.

The pursuit of science, technology, engineering, and math (STEM) degrees has moved from one of personal interest or professional ambition to a matter of economic imperative and public priority. The policy assumption is clear: Economies benefit when scientists make discoveries, engineers solve problems, and computer experts program solutions. The places that can attract or develop these professionals are deemed the winners in today's technology-driven economy. The certainty of this conventional wisdom has driven countless interventions targeted at growing the local STEM "pipeline." Yet, an important question remains: Does a greater supply of STEM-degreed workers bring about the expected economic gains for regional economies? Largely imitative efforts to expand the ranks of highly educated STEM workers neglect important differences in regional demand for such skills. This approach also neglects the importance of other skill sets to regional competitive advantage. Understanding the best way to invest in regional human capital requires a broader understanding of regional human capital differences.

Shifting the Focus to Occupational Competencies

This article highlights research in *The STEM Dilemma: Skills That Matter to Regions*, which was recently published by the Upjohn Institute (see p. 7). The book looks at the regional workforce through the lens of the knowledge, skills, and abilities (KSAs) associated with regional occupations. This fine-grained approach uses data in the Occupational Information Network (O*NET) database to identify differences in regional human capital concentrations. The O*NET database scores the importance and the required level of 120 individual KSA attributes for each occupation. Matching the occupational KSA attributes to wage and employment data available from the Occupational Employment Statistics (OES) enables examination of the actual human

capital differences present in regional economies and answers some important questions:

1. To what extent do STEM occupations drive modern regional economies?
2. Do STEM occupations provide better wages for regional employees?
3. What other KSAs represent valuable regional human capital?
4. Is there a relationship between the KSAs in demand by regional occupations and the welfare of the region itself?

Guided by the sharp policy focus on STEM study, this research set out to explore the effect of STEM skill concentrations on regional well-being.

Educational attainment is associated with higher wages but does not necessarily have significant effects on other measures of regional well-being.

However, because employers often say they want workers who can communicate effectively, solve problems, think critically, and motivate others, the research also examined the contribution of "soft" skills to the regional economy. Of the 120 KSAs included in the O*NET database, this study sorted 35 into a bundle representing STEM competencies and 50 into a bundle representing soft skills. What is clear among the bundle of STEM KSAs is the importance of math and computer knowledge, as well as more "hidden" STEM competencies (Rothwell 2013), such as mechanical skills and operations monitoring. Within the bundle of soft KSAs, communication skills, specifically oral expression and comprehension, are important, as well as skills associated with listening and understanding.

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STEM Skills, Soft Skills, and Worker Wages

Each O*NET occupation was assessed as to whether its requirement of the bundle of STEM KSAs and the bundle of Soft KSAs was above or below the mean for all occupations. This allowed for the categorization of each occupation as High or Low STEM and High or Low Soft. Although STEM and soft skills are often discussed in policy, research, and the media in isolation, this research follows the premise that occupations require a combination of competencies. For example, high engineering knowledge presumably also often demands high deductive reasoning. Thus, all occupations were ultimately sorted into one of four categories: 1) High STEM/High Soft, 2) High STEM/Low Soft, 3) Low STEM/High Soft, and 4) Low STEM/Low Soft. The categories enable direct comparison of KSA distributions across U.S. regions and allow identification of differences in regional human capital needs.

The assumed payoff for individuals who invest in higher skills is higher wages. As human capital theory would suggest, occupations requiring both

above-average STEM and above-average soft skills paid the highest wages, and occupations requiring below-average STEM and below-average soft skills paid the least (see Figure 1). But in the High/Low combinations of skills, occupations requiring High Soft skills but Low STEM skills returned higher median wages than those requiring above-average STEM skills paired with below-average soft skills. This suggests the importance of High Soft skills to individual returns on human capital. Interestingly, High Soft occupations were more highly correlated with occupations requiring at least a bachelor’s degree than were High STEM occupations, bespeaking higher education’s role in developing or signaling hard-to-assess soft skills. The data in Figure 1 argue for greater policy interest in the development of valuable soft skills, which often cut across a large variety of occupations.

Wide Differences in Regional Human Capital Concentrations

Table 1 shows how human capital concentrations differ across metropolitan statistical areas (MSAs). On average, scientists, engineers, software developers, and other High STEM/High Soft workers make up 13.1 percent of regional employment. However, the region with the largest concentration of High STEM/High Soft employment has five times the share of the MSA with the least. Computer programmers, electromechanical technicians, computer numerically controlled machine programmers, and other High STEM/Low Soft workers account for about 10 percent of regional employment on average but 25 percent of employment in the region with the largest concentration of such workers. The Low STEM/High Soft category include such occupations as chief executives, managers, lawyers, teachers, and mental health counselors. The average regional employment in Low STEM/High Soft occupations

is 16 percent, but the MSA with the largest concentration has more than three times that of the region with the smallest share. The category consisting of occupations with Low STEM/Low Soft requirements, such as home health aides, customer service representatives, and retail salespeople, accounts for nearly half of all employment across the regions. Some regions have as many as 6 of 10 jobs in occupations requiring below-average STEM and below-average soft skills. Given the overriding policy focus on college-going, Table 1 also shows the average share of the MSAs’ population age 25 and over with a bachelor’s degree or higher. The difference between regions with the smallest share of highly educated residents and those with the largest is pronounced.

The wide variation in occupational human capital requirements evident in Table 1 calls into question the wisdom of largely imitative policies aimed at growing the STEM pipeline. Not all places have the same STEM demand or capacity to absorb STEM supply. This difference also raises doubt as to whether the individual benefits from human capital development (higher wages) “roll up” to improve regional economic well-being overall, as so many policies that promote college-going and STEM study assume.

A Complex Relationship: Human Capital and Regional Economic Well-Being

To examine the relationship between regional human capital concentrations and regional economic well-being, a region’s distribution of employment across the four categories was regressed against data from the American Community Survey and Moody’s Analytics. Guided by Andreason (2015), this study adopts a broader view of regional economic well-being beyond the common focus on wages. In addition to wages, gross regional product (GRP), GRP per capita, per capita income, and poverty

Figure 1 Occupational Median Wage by STEM/Soft Category

	Low STEM	High STEM
High Soft	\$57,360 (N = 155)	\$72,220 (N = 182)
Low Soft	\$29,500 (N = 259)	\$41,300 (N = 168)

SOURCE: O*NET and OES (2014); author’s calculations.

rate were used as dependent variables in the study. Each MSA's labor force participation rate, share of employment in manufacturing, population change from 2010–2013, and ratio of median house value relative to the U.S. median house value were entered as control variables. A common measure of human capital—the share of the adult population with a bachelor's degree or higher—was also regressed on the data for comparison, revealing that the models with the occupational competency measures had greater explanatory power. Moreover, the education variable was only positively associated with two well-being indicators: median wage and per capita income.

All the occupational human capital categories affected regional median wage in the way human capital theory suggests. A higher concentration of employment in occupations requiring any kind of above-average KSAs was associated with higher regional wages. The practical implication of this finding is that a region may see improved economic well-being from promoting STEM skill development, but the region may also benefit from focusing on soft skill development. Another important finding is that having a high proportion of Low STEM/Low Soft employment was a substantial drag on the regional economy. Such regions tend to have lower (or negative) growth in GRP, lower productivity, and lower per capita incomes. This indicates a need for greater policy focus on addressing issues surrounding jobs that are important to the economy but that come with low pay and limited benefits for workers and present significant challenges to regional well-being.

Only one skill category—High STEM/Low Soft—was shown to have a statistically significant impact on all five indicators of regional economic well-being, controlling for the other variables. Table 2 details the magnitude of the effects of variations in human capital concentrations on regional

Table 1 Human Capital Concentrations across 395 MSAs

Occupational human capital category	Mean share across regions	Share in region with least highly educated residents	Share in region with most highly educated residents
High STEM/High Soft	13.1	5.0	25.4
High STEM/Low Soft	9.5	4.1	25.1
Low STEM/High Soft	15.9	8.1	26.2
Low STEM/Low Soft	48.4	34.9	62.3
Population aged 25+ with BA+	26.9	11.9	58.3

SOURCE: Author's calculations.

economic well being. In broad terms, human capital development accrues benefit to regions, but the effect is not as straightforward or as broad-based as typically assumed. Some human capital categories are statistically associated with some aspects of regional well-being while others are not.

Conclusion

This research clarifies how human capital development functions in the larger economy and how differences in human capital deployment impact

regional well-being. These insights should help policymakers shape more targeted and effective place-based policies. Regional human capital development should increase the supply of valuable talent, provide employers with access to appropriately skilled workers, and connect workers to opportunities that best align with their talents. Key insights from the research include the following:

- Educational attainment is associated with higher wages but does not necessarily have

Table 2 Summary of the Impact of a One Standard Deviation Increase in the Share of Employment in a Specific Occupational Group on Five Measures of Regional Economic Performance

Occupational group	Five dependent or outcome variables						
	Mean share of regional employment (%) ^a	SD (% point)	Median wage (\$)	Gross regional product (% pt.)	GRP per capita (\$)	Per capita income (\$)	Poverty rate (%)
High STEM/High Soft	13.1	3.1	6,131	-1.5	3,138		
High STEM/Low Soft	9.5	2.6	5,250	3.3	9,779	1,507	-0.8
Low STEM/High Soft	15.9	3.1	5,443		4,914	1,056	
Low STEM/Low Soft	48.4	4.3	-3,548	-1.9	-4,281	-690	

NOTE: A blank cell indicates that the impact was not statistically significant from having no impact. ^aThe percentages do not add up to 100% because not all occupations have been mapped by O*NET; the OES survey does not include self-employed workers; certain government occupations are not included in this analysis; and the OES suppresses data at the detailed occupational level if inclusion of the data may reveal specific establishments in an MSA.

SOURCE: Author's calculations.

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significant or desirable effects on other measures of regional well-being.

- Above-average STEM KSAs are associated with increased regional well-being, but “high” may not be as high as is typically assumed. Not all value comes from college-degreed STEM occupations. These results show the importance of many technician and mechanical jobs that often are overlooked or ignored in articles, research, and policy on the economic importance of STEM jobs.
- Efforts to help dislocated workers may be more effective if they explore the skills associated with previous occupations and try to match workers to occupations with similar skill needs. Helping workers make the case for cross-cutting skills to regional employers could be a more effective economic development strategy than investment in big leaps of unrelated retraining.

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Fran Stewart is the author of The STEM Dilemma: Skills That Matter to Regions (Upjohn Press, 2018). She has written extensively on economic development, manufacturing, economic driver industries, and education.

Race to the Bottom?

Local Tax Break Competition and Business Location

Evan Mast

State and local governments in the United States spend \$45–\$80 billion each year on programs that encourage economic development in a particular geographic area (Bartik 2017; Kline and Moretti 2014). These programs, often called place-based policies, typically offer tax breaks in an effort to attract businesses or encourage the growth of existing businesses. These range from huge subsidies like the \$3 billion that Foxconn recently received from the state of Wisconsin to small programs that target local small businesses. A crucial feature of place-based policies is that they are very decentralized—state and local governments account for 80 percent of total spending.

This article highlights findings from a recent paper that focuses on two potential effects of decentralization in business tax breaks (Mast 2017). First, competition between subnational governments could increase total tax exemptions. Second, local control of tax breaks could cause firms to choose locations where they produce more value for the community. The latter may occur because jurisdictions with more to gain from landing a firm offer larger exemptions, sending a signal that could improve the match quality between towns and firms.

These two effects are important for evaluating policies that restrict which governments can offer tax breaks, such as proposals to ban state exemptions or the recent moratorium on some

local exemptions in the Phoenix area. Such proposals have attracted attention recently, as Amazon and Foxconn have conducted well-publicized searches for locations for new expansions.

The Importance of Local Taxes For Businesses

This article focuses on local, rather than state, government tax breaks. State and local taxes are a large component of the total business tax burden—a 2014 estimate pegged total state and local businesses taxes at \$688 billion versus total federal corporate income tax revenues of \$320 billion (Phillips et al. 2015).¹

While state incentive packages for national searches are more heavily publicized, local tax breaks are important in many cases. First, most firms do not search nationally when considering an expansion or relocation. Second, even for firms conducting national searches, there is often a second, local stage to their search. For example, Foxconn considered several sites in Racine and Kenosha Counties after announcing their intention to build in Wisconsin. Local tax breaks also amount to large sums—approximately \$700 million in New York State in 2013.

The Effect of Competition on Local Tax Breaks

To begin, I study spatial competition between local governments in New York State. Do governments offer

ARTICLE HIGHLIGHTS

- Competition from nearby local governments increases business tax breaks.
- Simulations suggest that businesses typically locate in the same towns that they would have chosen if local tax breaks were not allowed.

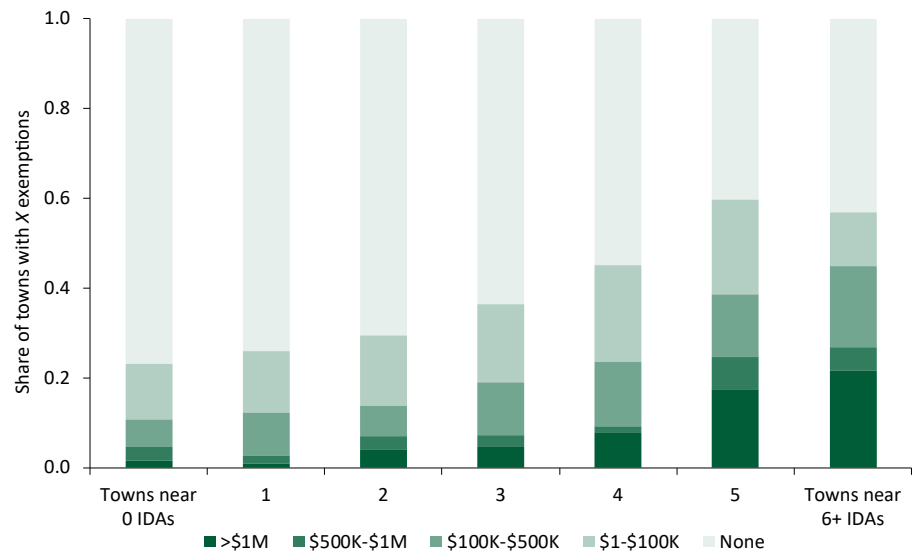
more tax breaks when there are more competitors nearby? In New York, competitors are industrial development agencies (IDAs), local economic development agencies that represent either a county or a town and offer tax breaks in an effort to improve economic conditions in their jurisdictions. While every county has an IDA, only about 50 of 1,000 towns have their own agencies. A town that does not have its own IDA is represented by its county's IDA.

The correlation between the number of IDAs within 25 kilometers and the dollars of tax breaks in a town, shown in Figure 1, suggests that competition increases tax breaks. However, this association may reflect other characteristics that are correlated with high levels of competition—for example, heavily populated areas have both more competition and more economic activity. To circumvent this problem, I use geography to construct a natural experiment.

Figure 2 shows the towns in Ulster County labeled according to the number of counties within 25 kilometers of the town. Within the county, variation in this measure appears to be idiosyncratic—it depends mostly on whether a town is at the edge or on the corner of its county. Noting this, I compare towns within the same county that have different numbers of counties within 25 kilometers in order to estimate the causal effect of increased competition.

I find that an additional IDA within 25 kilometers increases the probability that at least one business in a town receives tax exemptions from 25 to 30 percent and increases the dollars of exemptions by over 50 percent. These estimates show that tax break competition is not entirely driven by competing states and suggest that tax breaks are not exclusively a tool to help firms on the margin of profitability. I also show that the effect rapidly fades out as the radius of competition extends beyond 25 kilometers, suggesting that competition is quite local.

Figure 1 Tax Breaks in Towns with Different Levels of Local Competition



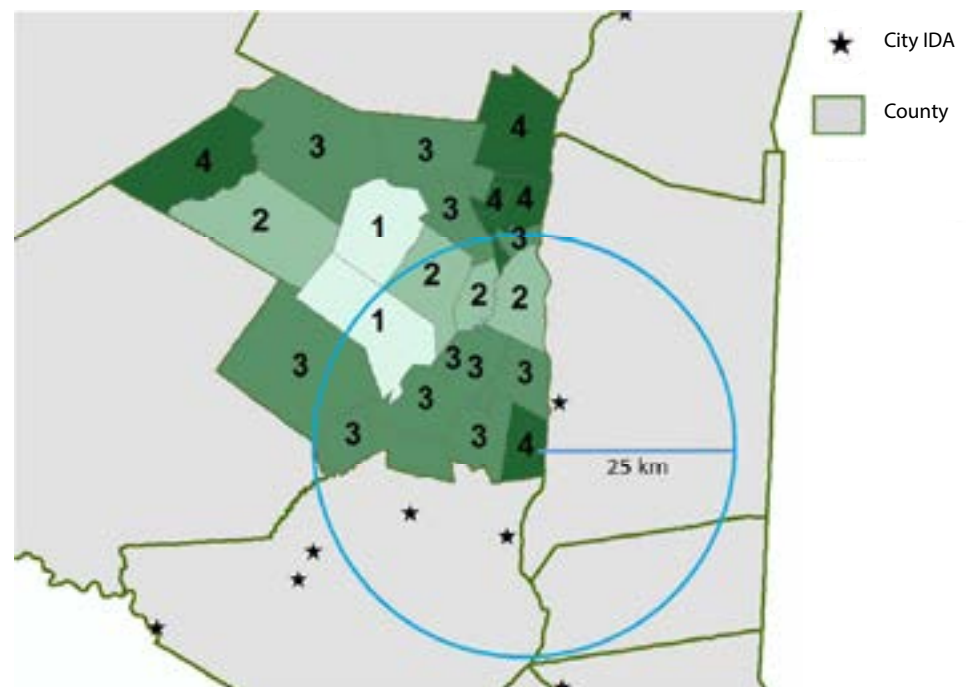
SOURCE: Author's calculations using New York State data.

The Effect of Tax Breaks on Business Location

The previous exercise sheds light on the effect of competition but says little about how tax breaks affect firm

location. To address this question—in particular, how business locations would change if towns were not allowed to offer tax breaks—I perform a simulation exercise.

Figure 2 Example Variation in the Number of Counties within 25 km of a Town



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I develop a simple model of towns offering tax breaks to attract firms. Towns compete in a setting similar to an auction, but with the twist that firms also have preferences over towns, so

An additional IDA within 25 km increases the probability that at least one business in a town receives tax exemptions from 25 to 30 percent and increases the dollars of exemptions by over 50 percent.

they do not just select the town that offers the largest tax break. I choose the parameters of the model to match the effect of competition estimated in the previous section.

I use the estimated model to simulate two counterfactual policies—eliminating town IDAs (leaving just county IDAs) and eliminating all IDAs. I find that firms typically choose the same location across the two counterfactuals and a status quo simulation, indicating that tax breaks do little to improve the town/firm match. The town most likely to land a particular firm is the same in every policy regime for about 85 percent of firms.

This result occurs not because firms do not care about tax breaks, but because of the way that IDAs interact with one another. For example, suppose that Syracuse is attractive to Firm A and has a very high probability of winning when no tax breaks are allowed. When local tax breaks are allowed, competing towns will offer tax breaks in an attempt to cut into Syracuse's lead, but Syracuse will respond with an exemption large enough to stay ahead of the competition. This strategic behavior reduces changes in firm location across policy regimes.

Caveats

There are several important caveats to these results, particularly for those on firm location. As with any simulation exercise, it is necessary to make several simplifying assumptions. The most important is that firms are only choosing among towns in New York State. This implies that my model is best suited to firms conducting a local search—such as retail and services establishments, distribution centers, or small manufacturing ventures—or firms in the second stage of a national search. Businesses in my sample tend to be relatively small and in retail or services, and I also present survey evidence in the paper

suggesting that many firms search within a local area.

NOTE

1. Office of Management and Budget, Historical Tables: <https://www.whitehouse.gov/omb/historical-tables/> (accessed January 3, 2018).

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- **Promise Database:** Interactive database of place-based scholarship (aka "Promise") programs. Use this database to generate profiles of individual programs or to sort programs by a variety of characteristics, including location, year established, source of scholarship funding, type of community served, and other key characteristics. Available for free at <http://www.upjohn.org/promise/database/>.

Recent Books from the Upjohn Press

The STEM Dilemma Skills that Matter to Regions

Fran Stewart

Fran Stewart dives into the murky waters where education and economic goals meet to confront several key issues facing policymakers and educators, including the role of public investment



in human capital, the types of human capital investment that provide the greatest public return, and whether those investments should vary by region. Her detailed findings provide evidence that not

all high-paying jobs require STEM skills; that not all good-paying, highly skilled STEM jobs require college degrees; and that “soft skills” (e.g., critical thinking and communication) are important for STEM as well as other high-paying jobs.

Stewart notes that STEM graduates are important for the overall economy, yet not all regions are home to the types of industries that rely on workers with STEM skills. For example, there is a fivefold difference between regions with the largest share of high-STEM employment and those with the smallest. Policy preoccupation with promoting STEM degrees may be overlooking other types of training that may yield greater economic benefit. This suggests that by adopting one-size-fits-all strategies for human capital development, regions may be failing to reap the greatest possible returns on their public investments.

Stewart’s analysis and findings will be of interest to anyone involved in workforce development and regional economic development.

222 pp. 2017

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Confronting Policy Challenges of the Great Recession Lessons for Macroeconomic Policy

Eskander Alvi, Editor

This book brings together a notable group of authors who describe the unprecedented events and the often-extraordinary policies put in place to limit the damage suffered during the



Great Recession and then to put the economy back on a growth track. Not surprisingly, some policies succeeded while others barely made a dent. The analysis of the many lessons and encounters, and

successes and failures, offers fresh perspectives on how to manage the economy in a future crisis of comparable proportion.

In the years following the Great Recession, research has been conducted on the lessons learned from the event, but an appreciation of the accompanying challenges, such as that presented here, adds value and enriches policy content. The hindsight afforded by the Great Recession is invaluable, and the chapters in this book underscore the dire issues policymakers faced.

Contributors include Barry Eichengreen, Gary Burtless, Donald Kohn, Laurence Ball, J. Bradford DeLong, Lawrence H. Summers, and Kathryn M.E. Dominguez.

146 pp. 2017

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Lessons Learned from Public Workforce Program Experiments

Stephen A. Wandner, Editor

This book presents an analysis of the lessons learned from public workforce experiments that



have been conducted and evaluated in the United States. The U.S. Department of Labor (USDOL) has sponsored a number of these experiments over many decades, and some of them have resulted in significant public workforce

program and policy improvements. The USDOL has been a leader in making use of rigorous evaluations of existing workforce programs and in the development of new public program options.

These experimental evaluations of public workforce programs have included training programs—the Job Training Partnership Act (JTPA) and the Workforce Investment Act (WIA)—and the Job Corps. Another effort was a series of unemployment insurance (UI) experiments that were conducted in the 1980s and 1990s to test new or improved reemployment approaches. More recently, experimental evaluations of a UI work-search eligibility review and reemployment services program (Reemployment and Eligibility Assessment).

The contributors to this book show that public workforce program experiments have provided solid evidence on which policymakers have been able to make informed and helpful decisions that have benefitted America’s workers.

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