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Economic Development Quarterly 2011 25: 303
DOI: 10.1177/0891242411418494

Economic Development Quarterly
25(4) 303–315

DOI: 10.1177/0891242411418494
http://edq.sagepub.com

Supply or Demand, Make or Buy: Two Simple Frameworks for Thinking About a State-Level Brain Drain Policy

Paul D. Gottlieb[1]

Abstract

This article lays out two broad criteria for crafting a particular brain drain policy at the state level. The first, which we are calling "supply or demand," asks whether a state experiencing brain drain is below average in high-tech labor demand or above average in high-tech labor supply (the latter concept measured by university enrollments). It is argued that the answer to this question matters a great deal to the policy response. The article then proposes a second, related framework for crafting brain drain policies, which is used widely in the world of business. This is whether a state should "make" or "buy" its own high-tech workers. Benchmarking data and a new review of state policy programs are then used to compare what states are doing with what they ought to be doing in light of their particular situations.

Keywords

university role in economic development, state and local economic development policy, labor force issues, jobs

Supply or Demand

Any article on brain drain necessarily begins with a questionable premise, which is that having a large number of educated people in your state is a more important driver of economic prosperity than the hiring and location decisions made by businesses. Brain drain as a problem is associated with the hypothesis that "jobs follow people" at the interregional scale, an assertion still regarded among regional scientists as unproven (Hoogstra, Florax, & Van Dijk, 2005; Partridge & Rickman, 2003; Steinnes, 1982).

The present article does not seek to settle this issue. Instead, it recognizes that both approaches have theoretical merit, and that state policy makers should consider benchmarking their situations to see where remedial action is required—on the supply side of the high-tech labor market or on the demand side. In some cases, the answer may be neither. If you compare the scale of the higher education system and high-tech industries in Boston to those in other metropolitan areas, for example, it becomes very difficult to argue that there is a problem of either supply *or* demand. Perhaps housing costs, infrastructure, and taxes are the things that require remediation in this hotbed of New Economy innovation.[1]

For purposes of this study, the scale of a state's higher education infrastructure will be assumed to proxy the emphasis that political decision makers place on the supply of knowledge workers to the local economy. Research universities have well-known impacts on the demand side of high-tech labor markets as well (Hill & Lendel, 2007; Lendel, 2010; Nagle, 2007; Smilor, O'Donnell, Stein, & Wellborn, 2007), but their most obvious function is to provide a flow of college graduates into a state's labor market, most of them natives. A large scale of higher education activity, such as that found in Massachusetts, can also transform out-of-state residents into permanent members of the local workforce because such students develop location-specific human capital that gives them an incentive to stay put after they graduate (Bound, Groen, Kedzi, & Turner, 2004; Tornatzky, Gray, Tarant, & Zimmer, 2001; Winters, in press).

For present purposes, it is not necessary to argue that a large flow of local university graduates creates an equal number of knowledge jobs, in a modern day version of Say's Law. It is simply necessary to observe that a state with a large flow of talent from its own universities faces less of a labor supply problem, other things equal, than a state with a low per capita flow of talent from its own universities.[2]

To be relevant to economic development policy, any benchmarking exercise of this type should focus on jobs in industries that export out of the state, and not on population-serving

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Table 1. Measures of Relative State Labor Supply From Institutions of Higher Education, 2009

State	Total enrollments per capita	Rank	Science, technology, and business degrees granted per capita	Rank	Science and technology degrees granted per capita	Rank
California	0.109	1	0.0035	15	0.0017	14
Florida	0.080	14	0.0034	18	0.0013	20
Georgia	0.068	19	0.0037	13	0.0015	18
Illinois	0.107	3	0.0051	2	0.0021	3
Indiana	0.087	7	0.0046	5	0.0018	9
Louisiana	0.073	18	0.0035	16	0.0017	16
Maryland	0.082	12	0.0042	9	0.0020	5
Massachusetts	0.096	4	0.0056	1	0.0026	1
Michigan	0.091	6	0.0046	6	0.0021	4
Minnesota	0.108	2	0.0047	4	0.0019	7
Missouri	0.095	5	0.0050	3	0.0018	12
New Jersey	0.065	21	0.0029	20	0.0014	19
New York	0.084	10	0.0045	8	0.0018	10
North Carolina	0.075	17	0.0035	17	0.0017	15
Ohio	0.081	13	0.0039	11	0.0018	13
Pennsylvania	0.078	16	0.0046	7	0.0022	2
Tennessee	0.066	20	0.0028	21	0.0011	21
Texas	0.078	15	0.0033	19	0.0015	17
Virginia	0.087	8	0.0038	12	0.0020	6
Washington	0.082	11	0.0037	14	0.0018	11
Wisconsin	0.084	9	0.0041	10	0.0019	8

Source. National Center for Educational Statistics, Integrated Postsecondary Education Database, institution-level data for 2009.

occupations expected to have a location quotient close to 1.0. Following the conventional wisdom of the past 30 years, it will also be useful to focus on knowledge jobs, such as those in science and technology, that have the potential to contribute to rapid growth. Some of these jobs, like those in IT consulting and other producer services, are not always in export sectors, but contribute to economic growth by improving the productivity of all sectors in the state's economy.

The present study will use state-level data organized by occupation to identify jobs that are typically targeted by economic development policy—omitting, for example, family physicians. Data on science and technology occupations are commonly used to identify high-tech industries in U.S. regions (Markusen, Hall, & Glasmeier, 1986). For purposes of economic development analysis, occupational data are often viewed as interchangeable with—or at least complementary to—NAICS (North American Industry Classification System) industry data (Chapple, 2004; Currid & Stolarick, 2010; Markusen, Wassall, DeNatale, & Cohen, 2008; Thompson & Thompson, 1993).

This study's benchmarking analysis is restricted to the 21 most populous U.S. states. These 21 states were profiled in an earlier, unpublished report on which the present work is based (Gottlieb, 2001). That earlier study presented its benchmarking results in graphical form, finding it convenient to focus in on a set of states evenly divisible by three. Studying fewer than half of the states also reduces the workload associated with our state-by-state analysis of policy programs (e.g., see table later in text), while still capturing close to 77% of the country's population and making the tables easier to read and interpret.

Table 1 provides benchmarking data on the supply side of state labor markets, based on measures of the scale of higher education in 2009. Column 1 of this table shows postsecondary enrollments per capita. Column 2 shows degree completions[3] per capita in science, technology, and business fields, which are most likely to funnel graduates into export sector firms. Column 3 is similar to column 2, but it omits business fields because a significant portion of business graduates do not work in export sector firms. Although three different measures are presented in Table 1, the correlation coefficients for each pair of measures all exceed .58 (.63 if Spearman rank coefficients are used). Thus, the three measures tell much the same story. This story reflects the magnitude of higher education infrastructure that has emerged over the years in each state, including both public and private institutions.

Table 2 provides benchmarking data on the demand side of the labor market in each state. Total employment per capita is uninformative, so column 1 of this table shows business

Table 2. Measures of Relative Demand for Export-Related Occupations, 2009

State	Export occupations per capita	Rank	Export occupations per capita in science and technology	Rank
California	0.065	8	0.022	8
Florida	0.049	19	0.016	18
Georgia	0.058	12	0.016	17
Illinois	0.068	7	0.019	14
Indiana	0.046	20	0.015	19
Louisiana	0.045	21	0.013	20
Maryland	0.082	4	0.031	4
Massachusetts	0.089	1	0.034	2
Michigan	0.056	15	0.021	9
Minnesota	0.084	3	0.027	5
Missouri	0.057	13	0.019	13
New Jersey	0.069	6	0.024	6
New York	0.061	9	0.017	16
North Carolina	0.055	17	0.018	15
Ohio	0.055	16	0.020	12
Pennsylvania	0.056	14	0.020	11
Tennessee	0.049	18	0.012	21
Texas	0.059	11	0.022	7
Virginia	0.085	2	0.035	1
Washington	0.071	5	0.032	3
Wisconsin	0.060	10	0.020	10

Note. See Table 4 for definitions of export occupations and science and technology occupations.
Source. U.S. Department of Commerce, Bureau of Labor Statistics, Occupational Employment Statistics for 2009.

and technical employment per capita, while column 2 shows the same figure with business occupations removed. These two columns are designed to be the equivalent of columns 2 and 3 in Table 1. In fact, the federal government's classification of postsecondary degree programs is quite similar to its classification of occupations; the two can be matched to each other at several levels of detail (see table and the discussion later in the text).

Policy makers can use Tables 1 and 2 to benchmark their states in terms of the concentration of export industry workers and related educational programs. Taken together, the tables also help identify broad categories of state supply and demand situations that appear reasonable on their face, but which imply very different policy interventions. Massachusetts, for example, ranks near the top on both university enrollments per capita and on export/high-technology jobs per capita. As argued above, this situation would appear to lead to a policy recommendation of "keep up the good work." At the other end of the spectrum, Louisiana ranks in the bottom third on both measures, leading to a recommendation to work on all fronts simultaneously. States with very different rankings on supply and demand are rarer,[4] perhaps more interesting, and also intuitively reasonable. Many states in the Midwest, for example, are known for having strong systems of higher education—often with multiple state-sponsored universities and campuses, but they are not quite as robust on the employment demand side. One example of such a state is Indiana, with a top-third ranking on enrollments per capita (Table 1) and a bottom-third ranking on export/tech jobs per capita (Table 2).

At the opposite end of this spectrum is New Jersey, which ranks last of the 21 large states in postsecondary enrollment per capita, but sixth in export and high-tech jobs per capita. New Jersey has very high educational attainment in its workforce and an advanced industrial structure focused on pharmaceuticals and financial services. With a small geographic area and many institutions of higher education in nearby cities, the state also has a significant amount of cross-border migration that has, intentionally or not, enabled it to staff its knowledge jobs reasonably well. Whether its university sector is large enough, or is sufficiently engaged with local high-tech industries to generate new start-up firms on the Boston or San Jose model, remains a matter of considerable concern to state economic development officials (New Jersey Higher Education Task Force [NJHETF], 2010; Stoup, 2005).

Does the relative magnitude of college supply and industry demand, as identified here for Indiana and New Jersey, actually lead to higher levels of in- or out-migration for new college graduates? State migration data for the year 2009 by age cohort and educational attainment are available from the Census Bureau's American Community Survey, but they are not cross-tabulated by both of these characteristics. This makes it difficult to isolate the migration behavior of newly minted graduates. Several past studies, however, support the common sense idea that measured brain drain (brain gain) of recent college graduates is driven by the sheer number of local job opportunities relative to the number of students coming onto the local job market.

Using National Science Foundation microdata on science and engineering graduates for the year 1993, Tornatzky, Gray, Tarant, and Howe (1998) found that a measure of net in-migration across states was correlated with a high percentage of service jobs, a measure known to be correlated with the science and technology job measure reported in Table 2. These authors embedded the scale of each state's higher education system inside their net migration variable, making it difficult to isolate the influence of this factor in a regression context. However, they found indirect evidence of the role played by university capacity in their finding that states with a high percentage of high school graduates staying home for college experienced greater out-migration from college to work. As they explain in their interpretation of this finding, a larger state university system will logically produce both greater retention of high school students going to college and greater out-migration of college graduates, other things equal (Tornatzky et al., 1998, p. 19).

Using an updated version of the same microdata set, Gottlieb (2001) confirmed the expected impact on college-to-work migration of both high-tech university supply and high-tech job demand, measured as in Tables 1 and 2 above. The results in Gottlieb and Joseph (2006) also suggest that, other things equal, there will be net out-migration of new graduates from metropolitan areas that have a large university presence, as indicated by the level of federal R&D spending at local universities. Kodrzycki (2001) confirmed the importance of aggregate job availability as a pull factor for new college graduates.

Getting back to specific cases, it should be noted that in 1993, Indiana ranked in the bottom quartile on Tornatzky et al.'s (1998) measure of in-migration from college to work (this is equivalent to being in the top quartile with respect to out-migration), whereas New Jersey ranked in the top quartile on graduate in-migration. The data shown in Tables 1 and 2 would presumably produce similar rankings for these two states today, if more recent migration data were available for college degree holders in their early 20s. Also reflecting Indiana's high measured rate of graduate out-migration is the aggressive attention this state has paid to the problem of brain drain for many years (Ambrose, 1998; Indiana Fiscal Policy Institute [IFPI], 2000). In contrast, at least one official New Jersey study dismissed brain drain as a problem precisely because the state appeared to be successful at drawing knowledge workers from other states (New Jersey Commission on Higher Education [NJCHE], 1998; Schmidt, 1998).

Policy Implications of the State Supply and Demand Rankings

We may ask two questions about the data presented above: (a) What do they imply about what each state ought to be doing? and (b) How do the rankings correlate with what each state is actually doing?

The first of these questions is easier to answer than the second. One obvious conclusion is that policy makers could easily be misled by the data they collect—from exit interviews, for example—on the magnitude of out-migration from college to work. A state ranking high on such a measure might be "over-universitied," rather than being undersupplied with knowledge economy jobs. For example, in Gottlieb (2001), the states of Massachusetts and Ohio were found to have nearly identical measures of science and engineering out-migration from college to work. Yet the former is an economic powerhouse that just happens to have enormous higher education capacity, while the latter represents the more common scenario of strong land grant university infrastructure combined with below-average high-tech employment. Low per capita export industry employment is, along with such measures as income and population decline, a far more direct indicator of an economic development problem than is college-to-work brain drain.

A state that ranks low on Table 2, then, has its work cut out for it. A state that ranks low on Table 1 has a choice to make. If it decides to ignore the role played by local universities in technology commercialization (see below), then perhaps nothing needs to be done: Less spending on higher education could even fund new tax breaks for businesses (see e.g., Deskins, Hill, & Ullrich, 2010). The more modern view, of course, is that unless you have New Jersey's peculiar geographic advantages (and perhaps even if you do), you must increase the quantity and quality of your higher education system if you want to become a "knowledge economy" state (Lendel, 2010; Tornatzky, Waugaman, & Gray, 2002). In this view, Table 1 tells certain states that they have remedial work to do on the higher education side of the ledger.

For this study, data on state spending by expenditure category were collected from the National Association of State Budget Officers (NASBO) for the 21 large states shown in Tables 1 and 2. The remediation hypothesis predicts that states ranking low on university capacity will spend more money trying to expand this capacity than states ranking high on university capacity. Unfortunately, this argument requires data on marginal expenditures, which are not easy to interpret.[5] Total state higher education budgets frequently include the operating budgets of the universities themselves; thus, states ranking high on Table 1 necessarily have larger higher education budgets than those ranking low. Attempts to close this gap are not reflected in the annual budget data.

Economic development budgets, on the other hand, are not necessarily correlated with existing economic success as it is defined in Table 2. The main problem with characterizing economic development activities using the NASBO data is that many states combine economic development (demand side) and workforce development (supply side) activities in the same departments, and it is difficult to separate the two types of activities. This mixing is so common that we were forced to use a measure of state economic development spending that includes workforce development but excludes community development and housing activities. Using this measure, and omitting two outliers—one that cannot be included under any circumstances and another that emerges as a statistical outlier—there is a significant negative relationship between state economic development spending as a percentage of gross state product and the export job figures reported in Table 2 (see Figure 1). This negative relationship continues to hold if economic development spending is measured as a percentage of the total state budget. It follows that states spend a higher percentage of available funds on economic development when they are deficient in technically oriented export jobs, as one would expect. States appear to be well aware of, and acting on, their demand-side deficiencies. The chief caution with respect to this conclusion is that the budget figures behind Figure 1 include a considerable amount of vocational workforce expenditures, which are demand side only to the

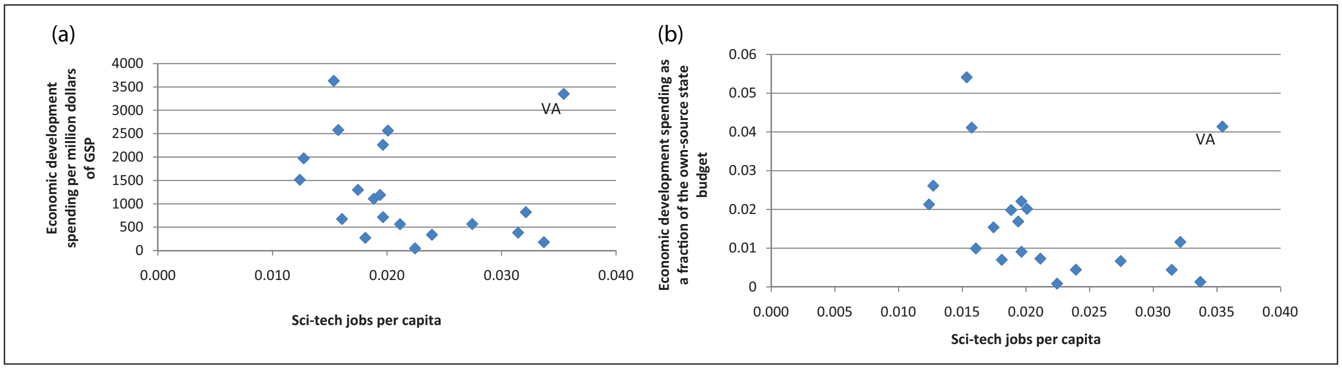

Figure 1. Economic development spending (A) per million dollars of gross state product as a function of science and technology workers per capita ($\rho = -.55, p = .0152$) and (B) as a proportion of own-source state budget, by science and technology workers per capita ($\rho = -.59, p = .0079$): 21 large states (2009)

Note. Of the 21 largest states, California is omitted because its development expenditures are an order of magnitude higher than in most states, likely reflecting the administration of programs that in other states would be strictly federal. Virginia, a statistical outlier, is omitted from the calculation of the correlation coefficients. It seems likely that the number of technology workers in Virginia is heavily influenced by the D.C. metro area, but the state government spends a significant amount of money to redress economic deficiencies downstate.

Source. National Association of State Budget Officers; GSP from Bureau of Economic Analysis, 2009 year data in 2005 dollars.

extent they are industry targeted or involve direct aid to businesses. These state workforce expenditures are, of course, unrelated to higher education supply-side policies as defined for purposes of this study.

Make or Buy

An unstated premise of both higher education and K-12 policies in most U.S. states is that the primary job of state educational institutions is to prepare a labor force for the state's own economy. The empirical reality is, of course, at odds with this assumption. As shown in Groen (2004) and Waldorf (in press), there is significant migration from state to state within the United States. Each state educational system necessarily trains the labor force of its immediate neighbors, of more distant neighbors, and to a lesser extent, the world. In fact, for discussion purposes, we may state a devil's advocate position on human capital migration that very few state officials would endorse. This is the idea that training your own labor force might actually put your state at a disadvantage in the fast-moving global economy.

In contrast to elected officials, the private sector takes a more even-handed approach to the question of whether an entity should provide an essential service itself, or contract it out to somebody else. Since the middle of the last century, a large management literature has arisen on this so-called "make or buy" decision (Culliton, 1942; Higgins, 1955; Hubler, 1970; Levy & Sarnat, 1976). This literature lists decision criteria that could conceivably be relevant to a state's decision on how much money to spend educating its own labor force. Even more important, it might help inform decisions on whether a state's educational programs must be perfectly matched to its existing industry structure, as one would expect to happen in a state as a result of industry lobbying and hometown corporate philanthropy.

Any modern management textbook will have a page or two summarizing the main make or buy decision criteria (see e.g., Daft, 2005). There are two main reasons you might want to "buy" a service or a component: (a) *Quality:* You can pick from the best in the world. Learning-by-doing among highly specialized entities, as well as economies of scale, could mean that your highest quality source of supply lies elsewhere; You simply cannot do the job as well. (b) *Flexibility:* If conditions change, you can just change suppliers. This is harder to do if you "make," because you will have set up internal capacity that must be reengineered with each fundamental change in your needs. The major downside of a "buy" strategy, on the other hand, is lack of hands-on control and the need for multiple contracts and accountability enforced by external audits (Daft, 2005).

At first glance—and thinking only of the supply side of the labor market for now—these decision criteria would appear to provide at least some support for a buy strategy when a state seeks to develop its professional workforce. Admittedly, the argument on the quality of labor supply is a difficult one. If every state in the United States sought to hire[6] the limited number of MIT graduates produced each year, their salaries would be bid up to the point where some of the cost savings of the strategy would disappear. Expanding centralized sources of professional labor supply in the United States would be a difficult and controversial undertaking (although it is not unheard of; consider the role of government-sponsored super academies, such as those in France).

The flexibility argument, on the other hand, appears legitimate. Is any institution *less* flexible than a university employing tenured faculty members? If anything, the premium that the global economy places on workforce flexibility is greater than ever while local institutions of higher education are indeed fixed investments. The matter of hands-on control is a nonissue, since the relationship to other states' university systems is not contractual and the purchased input (professional labor) does some of its own quality control. The real critique of this line of thought is that it could lead to a "race to the bottom" in higher education spending, as each state seeks to free ride on its neighbors.

This discussion has intentionally been provocative, seeking to lay out an extreme form of the argument before moving back toward the middle. A more modest statement of the potential benefits of a state buying at least some of its professional talent is that it does not want to have a business and innovation culture that is provincial and inward looking. Especially in less populated states that are geographically isolated, it is possible that a significant percentage of the engineers in a particular technology firm, for example, will all hold the same degree from the same university, having all studied with the same professors. Entrepreneurial innovation benefits from the vitality of different perspectives. This is in essence what Richard Florida has argued in various works that highlight the beneficial impact of diversity and cosmopolitanism in metropolitan regions (Florida, 2002a, 2002b; Florida, Knudsen, & Stolarick, 2010; Florida, Mellander, & Stolarick, 2008).

I do not propose that higher education spending be cut back in any state. Higher education generates positive externalities, so the incentives to provide too little of it are already troubling. The argument above also ignores the role that proximity plays in the commercialization of university research (Abramovsky & Simpson, 2009; Bishop, Reichstein, & Salter, 2008; Lindelof & Lofsten, 2004). In Gottlieb (2001), I lay out the make and buy arguments for professional workers in greater detail, without taking a firm position on one versus the other. This much, however, seems clear: A purely inward-looking strategy on professional talent is not likely to be as beneficial as one that adds at least some buy strategies to the make instincts so often exhibited by public officials and industry leaders.

Evidence for a bias among policy makers against "buying" professional talent from out of state is not difficult to find. Table 3 reports the results of two surveys of state and metropolitan brain drain/brain gain policies, one conducted in 2000 and the other in 2010. Several differences between the two surveys should be noted. First, the economic context of each study was quite different. The year 2000 witnessed high-tech labor shortages driven by the dot-com frenzy while the current recession has made the recruitment of educated professionals appear to be a luxury when compared, for example, with helping displaced blue-collar workers.

Second, the 2000 survey relied entirely on media reports and on one secondary source, a survey of the 50 states by the IFPI. The Indiana report was restricted to the subject of "postsecondary graduate retention"—itself an interesting choice on the part of those who commissioned it. Because Table 3's enumeration of talent attraction programs in the year 2000 effectively relies on the thoroughness of a handful of journalists, it is likely that some attraction programs were missed. In contrast, the year 2010 survey consisted of a comprehensive review of 21 state government websites and telephone calls to key informants in state departments of education and economic development, with the goal of identifying any labor supply program that might target out-of-state talent. Even with this more systematic approach, we do not claim to have proven the absence of any particular type of program in a given state. For example, talent attraction programs not appearing in Table 3 could be run by private or nonprofit entities and, therefore, not have shown up on a state government's web portal.

These caveats notwithstanding, Table 3 is notable for the lack of programs—in either year—that are explicitly designed to attract out-of-state professional talent in the 18 to 25 year age range. This is in spite of Richard Florida's influential book about this group, *The Rise of Creative Class*, which was published in 2002 and emphasized the benefits of cosmopolitanism.

The exceptions to this rule are instructive. By 2000, several programs designed to attract outside professional talent were implemented at the metropolitan scale (Table 3). Yet metropolitan areas cannot rely exclusively on home-grown talent, while many of their recruitment targets will come from the same state (e.g., Chapel Hill to Charlotte). Cities were also more receptive to creative class recruitment ideas in this period because they encouraged investments in such things as the arts and attractive urban spaces.

Many states have tuition forgiveness programs for graduates in medicine, nursing, or K-12 teaching that are insensitive to the recipient's state of origin. One can easily make the case, however, that these are not economic development programs. They seek to redress labor shortages in industries that are population serving and cannot easily be reduced in size.

This brings us to the interesting cases of Oklahoma in 2000 and Michigan in 2010. Oklahoma, with its smaller economy, was one of the few states at the height of the dot-com boom that (a) announced that its ultimate objective was to increase the educational attainment of its workforce, not merely to retain its own graduates; and (b) listed as one strategy to achieve this objective, "attract college degree holders from outside the state" (Oklahoma State Regents for higher Education [OSRHE], 1999). In part because this initiative was designed by the Oklahoma Board of Regents, specific tools mentioned in the initial report included recruiting professors and easing residency requirements for new students so that they can pay in-state tuition. It is not clear how these ideas were greeted by state officials working outside of higher education, but they remain official state policy (OSRHE, 2008). In my opinion, the state of Oklahoma has

Table 3. Brain Drain Policy Survey Results, 2000 and 2010

	Year 2000 survey of media reports plus 1999 Indiana survey			Year 2010 web and telephone survey		
	Retention initiatives	Talent attraction initiatives[a]	"Come back home" initiatives	Merit scholarship/ loan program	Eligibility for merit scholarships	Talent attraction initiatives[a]
21 large states						
California				Yes	Residents	None found
Florida	Yes[b]			Yes	Residents	None found
Georgia	Yes[b]			Yes	Residents	None found
Illinois	Yes[b]			No		None found
Indiana	Yes[c, b]			Suspended in 2010	Residents	None found
Louisiana	Yes[d, b]			Yes	Residents	None found
Maryland	Yes[b]			Yes	Residents	None found
Massachusetts				Yes	Residents	None found
Michigan	Yes[b]		Yes[d]	Yes	Natives or students	Michigan Engineering Incentive
Minnesota				no		None found
Missouri	Yes[b]			yes	Residents	None found
New Jersey				yes	Residents	None found
New York	Yes[b]			yes	Residents	None found
North Carolina	Yes[b]			no		None found
Ohio	Yes[e]		Yes[f]	yes	Residents	None found
Pennsylvania	Yes[d]		Yes[g]	No		None found
Tennessee	Yes[b]			Yes	Residents	None found
Texas				No		None found
Virginia	Yes[b]			No		None found
Washington				Yes[h]		None found
Wisconsin	Yes[b]			Yes	Residents	None found
Additional states						
Connecticut	Yes[e]		Yes[e]			
Oklahoma	Yes[e]	Yes[e]	Yes[d]			
Iowa	Yes[d]					
Nebraska	Yes[i]					
New Hampshire	Yes[j]					
Metropolitan areas						
Atlanta	Yes[k]	Maybe[k]				
Buffalo	Yes[l]					
Charlotte	Yes[k]	Yes[k]				
Louisville		Yes				
Toledo		Yes[j]				
Philadelphia	Yes[m]	Yes[m]				

a. Excludes generic tourism programs and programs targeted at star professors or proven entrepreneurs.
b. International Fiscal Policy Institute (2000).
c. Ambrose (1998).
d. Associated Press State and Local Newswire (2000, April 15).
e. Associated Press State and Local Newswire (2000, February 27).
f. Ad campaign observed firsthand by author.
g. McLaughlin (1999).
h. Program is limited to 150 students a year, statewide.
i. Schmidt (1998).
j. CNN (2000, February 27).
k. WSJ (1999, June 23).
l. Bonfatti (1999).
m. Brin (1999).

taken a suitably wide, research-driven view of the problem of brain drain and its possible remedies (see e.g., Gottlieb & Fogarty, 2003 on the importance of educational attainment).

In a possible harbinger of decisions to come in other states (Severson, 2011), Michigan recently discontinued its merit-based scholarship programs aimed at high school students, because of lack of funds. However, it has launched a more targeted zero-percent loan program for engineering students who work in Michigan after graduation, called the Michigan Engineering Incentive (MEI). Because Stafford loan eligibility is required, this latter program is not strictly merit based, but it clearly has an economic development rationale. Of particular interest for present purposes is the following statement on program eligibility: "You are either a Michigan resident attending school anywhere in the United States or a non-Michigan resident attending a Michigan school."[7] With this statement, Michigan has broadened the eligibility for state financial aid beyond the usual categories of in-state resident or local high school student.

The State of Ohio has a similar technology-oriented program, "Choose Ohio First," but eligibility is restricted to Ohio residents, and the program is administered through state universities. Nevertheless, it could be that both of these hard-hit rustbelt states are inching away from traditional merit-based scholarships—where the only criteria are attending high school in the state and getting good grades—to science and engineering scholarships that are available after matriculation, implying a somewhat more flexible interpretation of the notion of residency. If so, this would appear to be a step in the direction of buying at least some outside talent while targeting technology as a field of study and economizing on fiscal resources that are increasingly scarce in the nation's state capitals.[8]

The Issue of Program–Industry Match

Having rejected the idea that states should free ride on the higher education systems of their neighbors, it is appropriate to move the discussion away from the relative magnitude of state supply and demand to the character of that supply and demand. More specifically, does the mix of educational programs within states match the mix of occupations demanded by employers within those states? If the answer to this question is yes, is this good or bad for the state economy? If it appears to be bad, reflecting the potential costs of a higher education system that is not sufficiently cosmopolitan, then the arguments for a buy strategy and for significant graduate cross-migration are enhanced.

To investigate this question, we developed a measure of the match between the distribution of degrees granted in each state's system of higher education and the distribution of occupations in its workforce. For purposes of this analysis, population-serving fields such as law, clinical health care, and social work were included. A total of 146 degree programs and 317 detailed occupations were assigned to 28 common fields that could be used to match the two. These common fields, including detailed breakdowns within science and technology, are shown in Table 4 (the matching algorithms are available on request). Data on degree completions by state and by field of study were compiled from the Integrated Postsecondary Education Data System of the National Center on Education Statistics. These data were reported directly by 5,374 institutions of postsecondary education in the United States for the year 2009. State data on employment by occupation for the same year come from the Occupational Employment Series of the U.S. Bureau of Labor Statistics.

Table 4. Common Fields Used for Matching Educational Programs and Occupations Across States

		Classification for economic development		
		Sci-tech	Business	Other
1	Aeronautical engineering	×		
2	Agricultural science and forestry	×		
3	Architecture and related	×		
4	Biomedical engineering	×		
5	Biology	×		
6	Business		×	
7	Chemical engineering	×		
8	Chemistry	×		
9	Civil engineering	×		
10	Communications, media, art, and sports			×
11	Computer engineering	×		
12	Computer science and mathematics	×		
13	Drafting and technical design	×		
14	Earth and atmospheric sciences	×		
15	Electrical engineering	×		
16	Environmental engineering	×		
17	Clinical health care professions			×
18	Industrial engineering	×		
19	Law			×
20	Materials science and engineering	×		
21	Mechanical engineering	×		
22	Nuclear engineering	×		
23	Other sciences	×		
24	Other engineering	×		
25	Physics and astronomy	×		
26	Psychology			×
27	Social sciences			×
28	Social work and related helping professions			×

Given a common set of fields and a body count of occupations and degrees by field in each state, it is possible to calculate a standardized measure of degree program–occupational match, as follows:

$$\sum_{f=1}^{28} | pe_f - pg_f |,$$

where f indexes the number of common fields, pe_f is the proportion of all state employees in field f, and pg_f is the proportion of all 2009 graduates trained in field f.

Table 5 shows this match index value for each of the 21 large states. The column to the right of this index value shows the ratio of total degree completions to total employment in each state, using the same 28 fields that comprise the mismatch

Table 5. Data Used to Analyze Program–Occupation Mismatch, 21 Largest States

State	Measure of mismatch	Rank	Ratio of enrollments to jobs (×100)	Rank	New Economy Index 2008	Rank
California	0.50803	3	7.51954	12	75.02	6
Florida	0.34063	19	8.49461	3	58.26	14
Georgia	0.37749	15	7.53787	11	59.96	12
Illinois	0.40165	10	8.3439	6	62.61	9
Indiana	0.39162	11	8.9394	1	47.43	18
Louisiana	0.31775	20	8.43218	4	44.72	21
Maryland	0.44046	7	5.98173	20	79.99	3
Massachusetts	0.57596	2	7.42797	13	97.03	1
Michigan	0.35294	17	8.66266	2	62.21	10
Minnesota	0.38607	12	6.69122	15	66.05	8
Missouri	0.30257	21	8.37619	5	46.89	19
New Jersey	0.47411	6	5.18001	21	77.04	4
New York	0.48709	5	7.70056	10	74.42	7
North Carolina	0.50013	4	6.47883	17	57.39	15
Ohio	0.34983	18	7.96686	9	52.98	16
Pennsylvania	0.43761	8	8.3288	7	59.16	13
Tennessee	0.38503	13	6.8171	14	46.71	20
Texas	0.3772	16	6.66586	16	62.13	11
Virginia	0.59884	1	6.20354	19	75.58	5
Washington	0.41881	9	6.44076	18	81.91	2
Wisconsin	0.38299	14	8.28169	8	50.6	17

Source. See text.

index. This is a broad measure of the extent to which each state is overuniversitied, including both population-serving and export-serving fields (compare with the second and third columns of Table 1, where the focus is on economic development). The next column of Table 5 introduces a new measure, which is the value of the State New Economy Index compiled by the Information Technology and Innovation Foundation (ITIF) and Kauffman Foundation in 2008. This is a widely used aggregate measure of technology, knowledge workers, innovation, venture capital, and related infrastructure in the 50 states.

For all 50 states, the University-Occupation Mismatch Index was regressed on state land area, state population, and on the second and third columns of Table 5. The goal of this analysis was to see if small states are more "provincial" in their higher education programming (land area was added to distinguish different geographic cases such as Rhode Island and Montana); if states with excess university capacity[9] pay less attention than other states to local education–industry match; and finally, if states generally regarded as successful in innovation and entrepreneurship pay less or more attention than other states to education–industry match.

The regression results in Table 6 suggest that states scoring high on the New Economy Index are less likely than other states to have a rigid match of university degree programs to the state's current mix of occupations. This result does not prove that university programs that are poorly matched to existing industries cause economic success as defined by the authors of the New Economy Index. The cause of that success could lie elsewhere, and the mix of occupations in the economy could simply have raced away from the university system, which is slower to change. Nevertheless, the results in Table 6 cast doubt on the idea that institutions of higher education must always serve local industry needs if a state is to prosper (see also Florida, 1999). A secondary result in Table 6 is that university capacity that is high relative to job demand is associated with a greater degree of program-occupation match, possibly reflecting the experience in Midwestern and Great Plains states having large public university systems. (This relationship is stronger when Vermont, a clear outlier with respect to the dependent variable, is removed from the sample.)

Many university presidents in states such as California and Massachusetts would agree with Table 6's results. They believe that their institutions contribute to their state's economy precisely because they push forward the boundaries of knowledge for all humanity. These world-class universities, many of them public, do not feel themselves restricted to the local demand for skilled labor or ideas. This is a perspective that state legislators and local industry leaders do not always embrace.

Table 6. Factors Correlated With Relatively Low Match of State Educational Programs to Occupations Within 50 U.S. States (Using 28 Professional Fields)

Variable	Parameter estimate	Standard error	*t* value	*Pr* > |*t*|
Intercept	0.36892	0.09252	3.99	.0002
Land area	3.50×10^{-8}	1.64×10^{-7}	0.21	.8315
Population in 2009	-3.34×10^{-9}	2.08×10^{-9}	−1.61	.1148
New Economy Index in 2008	0.00293	0.001	2.91	.0056
Ratio of enrollments to jobs	−0.01125	0.00746	−1.51	.1387
$N = 50$				
F value	3.58	$p > F$	.0128	
R^2	.2416			
Adjusted R^2	.1742			

Same as above but with Vermont removed

Variable	Parameter Estimate	Standard Error	*t* value	*Pr* > |*t*|
Intercept	0.40007	0.0734	5.45	<.0001
Land area	6.11×10^{-8}	1.29×10^{-7}	0.47	.6393
Population in 2009	-2.14×10^{-9}	1.66×10^{-9}	−1.29	.2035
New Economy Index in 2008	0.00256	0.000798	3.2	.0025
Ratio of enrollments to jobs	−0.01478	0.00594	−2.49	.0167
$N = 48$				
F value	5.65	$p > F$	.0009	
R^2	0.3392			
Adjusted R^2	0.2791			

Note. The dependent variable is logically restricted to values between 0 and 2. The very tight range of actual values that are far from these endpoints, however, justifies the use of ordinary least squares.

Conclusion

This study has benchmarked 21 large states on the raw magnitude of the local supply and demand of new college graduates, which it argues is a primary determinant of measured brain drain from college to work. It argues further that measured out-migration for this population is caused by a shortage of knowledge-oriented jobs (a genuine problem) *or* by especially large university enrollments (not a problem). Obviously, it is important for state policy makers to distinguish between these two causes, and Tables 1 and 2 provide some of the relevant information to do so.

The study then borrows some ideas from the business literature on make or buy decisions, leading to an argument that at least some out-of-state recruitment is desirable. Information on state government spending and programmatic initiatives was used to argue that states in this sample recognize and act on their demand-side deficiencies, seeking to correct a relative lack of high-technology and export jobs. Where labor supply is concerned, however, these 21 states focus overwhelmingly on graduate retention, and tend to ignore the "buy" side of the make or buy dichotomy.

If a state's real goal is to increase its level of human capital, then why the overwhelming preference for retaining—rather than attracting—educated workers? One possible answer is that it is simply easier. Retention targets are currently onsite, they know (and presumably like) the state, they are able to interact more easily with local employers, and many of them have hometown loyalty. This is one reason why several attraction initiatives listed in Table 3 asked state natives to "come home," rather than trying to entice complete newcomers.

Recent research, however, suggests that the kinds of tools states have available to them for building up local human capital, especially merit scholarships, might be just as effective at making permanent residents out of newcomers as out of natives (Groen, 2004). This is an update to the earlier conventional wisdom, which argued that "stayers stay" (Tornatzky et al., 2001).

Given the state of the policy literature circa 2000, a focus on graduate retention was understandable. Yet it seems just as likely that state policy makers focusing on retention programs have been guided by politics and not by their reading of the literature on human capital migration. A state's high school students are the sons and daughters of its legislature's constituents. In states that were bypassed by the 1990s tech boom, the most ambitious of these sons and daughters were forced to migrate away from mom and dad

(McLaughlin, 1999). Thus, any state program that sought to build up its high-tech economy by incentivizing this particular group of knowledge workers to stay home was enthusiastically embraced.

It is not clear to what extent these inward-looking strategies led to a penalty in terms of poor economic performance, as compared with more outward-looking strategies. What is clear is that the debate between a state system of higher education that is primarily local-serving and one that pursues global excellence is a real one. It shows up in debates between university presidents and legislators over in-state admission preferences (Groen & White, 2004 argue that this common preference of legislators conflicts with the university's objective function, which is to maximize donations from successful alumni). It shows up also in legislators' and universities' frequently divergent attitudes toward foreign students (Wilson, 2004), who are probably better attraction targets for many states than high school students coming from the "other 49." (See also Waldorf, in press)

This essay has covered so many subjects that its six tables cannot possibly provide scholarly proof of all of the assertions made. Still, they provide basic benchmarking information and they point the way toward more extensive, confirmatory research. It may be too much to hope that the "jobs follow people/people follow jobs" debate can be resolved with any finality. Determining whether universities drive regional growth through their human capital effects or through technology commercialization might be more manageable, unless one takes the view that the inevitable collinearity in the data is fatal (Lendel, 2010). The idea that degree–industry match is irrelevant, or possibly even detrimental, to long-term economic success is a subject that can be explored further using both theory and new data. More generally, make versus buy arguments for professional labor supply in a geographic area the size of a U.S. state should be analyzed in detail to see if alternatives to the conventional wisdom are workable. Some of this research would need to explore the importance of spatial proximity to universities for talent recruitment, noting that at present, the arguments for such proximity are almost all research related. Finally, the fundamental mismatch between states, as the unit of policy decision making, and metropolitan areas, as the proper scale of labor markets (and industry clusters), must be addressed head-on in empirical work and much more creatively in policy development than has been the case to date.

Declaration of Conflicting Interests

The author(s) declared no conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: Part of the research reported here was made possible by grants from the Ohio Board of Regents and the Jobs and Workforce Initiative of the Greater Cleveland Growth Association.

Notes

1 This argument noting Boston's high rankings, on both the supply and demand of knowledge workers (see Atkinson & Gottlieb, 2000), has not prevented that city from wringing its hands about brain drain (see Greater Boston Chamber & Boston Foundation, 2003).

2 One of the things that should presumably be held equal when making this assertion is the state's ability to attract educated workers from elsewhere. The section "Make or Buy" implicitly argues that graduates from outside the state are good substitutes for in-state graduates: They can be recruited almost as easily. We return to this empirical question in the article's conclusion.

This paragraph references the idea, often attributed to Jean-Baptiste Say (1767-1832), that "supply creates its own demand."

3 In the National Center for Educational Statistics database used for this study, annual degree completions are broken down by field of study but total enrollments are not. Therefore, when it is necessary to narrow postsecondary data by field of study, degrees granted are used in place of enrollment. Because a relatively constant percentage of enrolled students graduate each year, these two measures will be highly correlated.

4 The correlation coefficient between the final column of Table 1 and the final column of Table 2 is .54, corroborating the finding of a long-run—although relatively weak—synergy between the supply and demand of university-trained labor in U.S. states identified in Bound et al. (2004). Although Bound et al. advance a labor supply explanation for this observed correlation, the demand- and supply-side effects of having above-average university capacity cannot easily be separated (Hill & Lendel, 2007; Lendel, 2010); nor can the direction of causation be proven to run from higher education to the state's economy instead of the other way around.

5 Many states for which we would predict an increase in spending on university capacity to catch up with other states have been in this position for a long time. Over what period of time should we look for an increase in higher education budgets? Year to year changes in higher education budgets will also be driven by available tax revenues, business cycles, and changes in party control of the state legislature or governor's office.

6 Obviously, states do not choose whether or not to hire nonresidents; private businesses do. Most day-to-day decisions on whether to buy talent from afar are outside of public sector control. Still, state governments can influence the geographic origin of their workforce through a number of higher education, scholarship, tax incentive, and direct recruitment policies. Scaling back higher education capacity, for example, would automatically tilt the source of a state's labor supply in the "buy" direction. Broadly speaking, a state can make decisions that tilt the

balance in the direction of make or buy: It should therefore understand the pros and cons of such decisions, using the standard management analogy to the extent it fits.

7 http://www.michigan.gov/mistudentaid/0,1607,7-128--111860--,00.html, accessed on February 2, 2011.

8 For more on the pros and cons of state-sponsored merit scholarships, see Selingo (2001), Dynarski (2000, 2004), Rogers and Heller (2003), Groen (2004), and Severson (2011).

9 Or, for that matter, deficient university capacity. Both hypotheses can be tested in the same regression by adding a squared version of the ratio of enrollment to employment. This approach did not generate significant results and is not reported in Table 6, which suggests instead that the relationship of program mismatch to the ratio variable is monotonic.

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