Estimating the Local Economic Impacts of University Activity Using a Bill of Goods Approach

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Abstract: Economic impact analyses for universities often produce impacts so large that they are viewed with suspicion. Using data collected from universities on actual expenditures as well as the local share of these expenditures to calibrate and regionalize custom economic impact multipliers will produce better results. We compare these economic impacts to those obtained using an "off-the-shelf" multiplier for universities from BEA's Regional Input-Output Modeling System (RIMS II). We find that results are sensitive to initial assumptions about the study region and the scope of university economic activity. Finally, we use these results and our knowledge of the model to provide recommendations to improve the usefulness and reliability of multiplier-based estimates of the economic impact of universities.

I. Introduction

Universities and colleges produce educated people that are more likely to earn higher wages and live longer.[1] Yet the impact of universities and colleges on local communities is broader than these impacts alone. If this were not so, it would be hard to justify the high level of public support that higher education often receives. University impact studies often attempt to quantify as many of these impacts as possible. The most direct of these impacts include the economic activity associated with creation of local jobs and increases in local expenditures. More broadly, these impacts include the value of intangibles like human capital and the value of the local amenities provided by the university.

The measurement of university impacts has been approached through econometric studies, targeted surveys, and input-output analysis.[2] Econometric studies are flexible enough to address how universities create and diffuse knowledge, but the challenges of measuring the scope and value of intangible capital leads to results that can be questionable and are often not

[1] Lemieux (2006) and Sanchez (2010).
[2] For a further discussion of these approaches, see Drucker and Goldstein (2007).

directly comparable across studies. Well-designed surveys can also provide accurate and valuable snapshots, but providing comparable results requires that a survey be administered simultaneously at many institutions. Even though limited to the inter-industry impacts of university expenditures, input-output analysis provides the advantage of allowing observable economic transactions to be used to estimate university impacts with a transparent and consistent methodology.[3]

Our main purpose with this paper is to provide an example of a university impact study that suitably uses the regional input-output modeling system (RIMS II) multipliers produced by the Bureau of Economic Analysis (BEA). We provide an example that shows how practitioners can improve the accuracy of their analysis by collecting and using both project and location specific data to supplement BEA's standard multipliers. We also provides guidance on conducting similar studies that avoid the common pitfalls associated with the use of input-output models.

II. Concerns with university impact studies

Siegfreid, Sanderson, and McHenry (2006) provide a critical review of the pitfalls associated with university impact studies. In their view many university impact studies are conducted with accuracy standards that would be considered "preposterous" in the context of other types of academic research. They note that university impact studies are frequently remiss in specifying the correct counterfactual, which is the true state of regional economy if the university did not exist. For example, many studies fail to recognize that a university located in a cluster of several other universities will have a different counterfactual than a university located several driving hours away from the next closest university. These authors also note that many studies use

[3] Regional input-output models differ from the conventional macroeconomic models that are used to assess the effects of fiscal stimulus on gross domestic product (GDP). Rather than being based on measured inter-industry relationships, macroeconomic models are based on estimates of behavioral changes in GDP expenditure categories.

ambiguously defined study regions and double-count household spending. Finally, these authors note that many studies fail to consider the possible alternative uses of public funds that are spent on universities in a cost-benefit analysis.

With respect to econometric modeling, Siegfreid, Sanderson, and McHenry suggest a cautious approach to applying econometric results to infer the impact of human capital generated by particular universities. They conclude that although positive spillovers that raise the wages of local residents who neither attend nor work at a university may exist, the empirical evidence with respect to magnitude is not yet settled.

Many of the pitfalls noted by Siegfried, Sanderson, and McHenry have been known for over forty years. In particular, a paper by Caffrey and Isaacs (1971) has long offered clear guidance on university impact studies. These authors provide a model that can be applied to evaluate the impact of a college or university as a source of inter-industry transactions, as well as a model for evaluating the impact of local spending by university employees, students, and visitors. These authors also note that part of the economic impact of a university often includes the real estate taxes foregone due to tax-exempt status and the cost of providing public services that would not be needed if the university were not in the community. These costs are also often neglected in more recent university impact studies.

III. Assumptions in regional input-output analysis

The relative simplicity of off-the-shelf regional input-output multipliers is achieved through the use of a linear model of inter-industry relationships and a particular set of assumptions about regional demand. In this section we review several key assumptions that can have a significant impact on the results of economic impact analysis.

The first point to appreciate is that multipliers used in regional input-output analysis are commonly derived from national input-output accounts rather than detailed survey data on the local economy. This means that when using off-the-shelf multipliers there is an implied assumption that there is a common production pattern for all the output related to a particular multiplier. This common production pattern assumption implies that the inputs to university activity are well represented by the input structure in the national input-output accounts for private colleges and universities. A related point that follows from the input-output framework is that the models that produce these multipliers are linear. This means that all inputs, including labor, are used in fixed proportion in the production of output: if an industry doubles its output, then it will double all its inputs.[4] Finally, input-output relationships are fundamentally average relationships, and implicitly assume that there are no binding supply constraints. This means that inputs will be available to supply an increase in output.

An additional point involves household spending. There are two key assumptions that practitioners should understand about household spending: composition and location. When using RIMS II multipliers, for example, the local impact of household spending is based on a national pattern of personal consumption expenditures from BEA's input-output accounts. Second, the RIMS II multipliers implicitly assume that employees spend their money where they live, rather than where they work.[5]

A final point involves the location of production. Compared with national multipliers, regional multipliers must account for the unavailability of many required inputs in a local economy. By regionalizing multipliers, the impact is refined to estimate only the inputs that are likely to be locally supplied and therefore have an impact on the local economy. RIMS II does

[4] Bureau of Economic Analysis (2009)
[5] Journey-to-work data are used to adjust household spending. For more on this topic, see Bureau of Economic Analysis (1997).

this by using detailed wage and salary data to calculate location quotients, which represent the concentration of a particular industry in a local economy relative to that in the Nation. These location quotients are then used to adjust the national data in the creation of regional multipliers. The use of these location quotients implies that the pattern of local purchases of particular inputs matches the pattern of local production.

Through regionalization with location quotients, regional input-output multipliers account for iterative rounds of local spending associated with a change in final demand, such as an increase in export demand or a new construction project. However, because of the assumptions built into input-output models and the method that is used to account for local supply in RIMS II, the results from using these multipliers are likely to represent upper bound estimates.

In section IV we show a simple application of an off-the-shelf multiplier for a university impact application and highlight some of the areas where standard assumptions may be unrealistic.

IV. The off-the-shelf approach

To show how the off-the-shelf approach is used, consider estimating the impact of a new instructional program that is expected to bring in an additional $10 million of tuition to the university. The direct effect is defined as the increase in inputs purchased by the university for the purpose of operating the new instructional program. The indirect effect is defined as the additional rounds of spending in the supply chain of those inputs, and the induced effect is defined as the household spending by employees throughout the supply chain. Type II multipliers account for the direct, indirect, and induced effects, whereas Type I multipliers only account for the direct and indirect effects. Table A shows the Type II final-demand multipliers for the "Junior colleges, colleges, universities, and professional schools" industry in the Austin-Round Rock-San Marcos, TX metropolitan statistical area (MSA).

The off-the-shelf approach to using these multipliers indicates that the $10 million increase in tuition and direct university spending leads to $21.9 million of total spending (output multiplier times $10 million), an increase in local GDP (value added) of $13 million (value added multiplier times $10 million), an increase in local earnings of $7.6 million (earnings multiplier times $10 million), and an additional 240 jobs in the local area (employment multiplier per million times $10 million).

Table A. Type II Total Final-Demand Multipliers for Junior Colleges, Colleges, Universities, and Professional Schools (611A00), Austin-Round Rock-San Marcos, TX MSA

Industry	Output (dollars)	Value Added (dollars)	Earnings (dollars)	Employment (jobs)
Junior colleges, colleges, universities, and professional schools (611A00)	2.1871	1.2982	.7603	24.0

There are several crucial assumptions embedded in the calculation of the effects that relate to the underlying assumptions and structure of the model. First, that the inputs to this university's activity are well represented by the input structure in the national input-output accounts for this industry. Second, that the increase in tuition payments from the new program will result in a proportional increase in the university's purchase of locally supplied inputs. Third, the pattern of household (induced) spending of the new employees will be the same as that observed on average at the national level. Fourth, new students will all come from outside the region and are not currently enrolled in other schools in the area. Fifth, the university will hire new employees on either a full-time or part-time basis instead of extending the hours of employees currently working at the university.

The first assumption is that the new spending is similar in content to that reflected on average in the national input-output tables as the output of Junior colleges, colleges, universities, and professional schools. This may be an unrealistic assumption for large universities that operate like multi-unit enterprises and provide a wide variety of services, such as instruction, research and development, technology licensing, hospital care, cultural events, retail sales, museum operation, child care, and sports activities. Each of these services requires a different mix of intermediate inputs and labor; hence, estimating the impacts of these different services requires the use of different multipliers. In these cases, a separate assessment for each specialized service is best. Table B shows the difference in industry multipliers that might be considered in a university impact study in Austin-Round Rock-San Marcos MSA. The employment multiplier is particularly sensitive to hours worked in each industry. Industries with a larger number of part time workers will necessarily have a larger jobs multiplier.

Table B. Comparison of Type II Total Final-Demand Multipliers for Selected Industries

Industry	Output (dollars)	Value Added (dollars)	Earnings (dollars)	Employment (jobs)
Construction (230000)	2.0763	1.1449	0.6740	18.0
Analytical laboratory instrument manufacturing (334516)	2.1248	1.0255	0.6042	11.7
Optical instrument and lens manufacturing (333314)	1.9939	0.9959	0.6113	13.9
Electronic computer manufacturing (334111)	1.8544	0.7838	0.3559	6.2
Retail trade (4A0000)	1.8736	1.2031	0.5872	21.2
Scientific research and development services (541700)	2.1503	1.2863	0.7682	16.5
Hospitals (622000)	2.0738	1.2442	0.7165	18.0
Child day care services (624400)	1.9123	1.1689	0.5840	40.1
Performing arts companies (711100)	2.0563	1.2349	0.6834	49.4
Spectator sports (711200)	2.0222	1.2653	0.7990	24.1
Museums, historical sites, zoos, and parks (712000)	2.2184	1.3776	0.8119	24.0

When evaluating the appropriateness of off-the-shelf multipliers for a particular project, it is particularly important for practitioners to understand that the multipliers for Junior colleges, colleges, universities, and professional schools are not the correct choice for investment in buildings, structures, or software that might be undertaken by the university. In each of these cases, the impacts of investment activities must be estimated separately with a separate set of multipliers related to these purchases.

The size of the multiplier effect can also vary dramatically depending on the size of the study region. Table C compares multipliers for three progressively larger regions, which include first a county, next a set of counties, and finally a state. The $10 million tuition increase for the new program has an estimated impact of 185 jobs in Travis County compared with the estimated 240 jobs for the multi-county region. The difference lies in the embedded assumptions about where inputs are produced and employees spend their income. If the purpose of the analysis is to isolate the economic impact on Travis County without respect to neighboring communities, then the multiplier for the county would be more appropriate.

The state-level multiplier provides the economic impact of a change in final demand for all counties in Texas. The use of this multiplier assumes that the $10 million in additional tuition revenue for the new program came entirely from outside of Texas and that none of this out-of-state tuition would have gone to another Texas institution. The use of this multiplier may be appropriate for a state-wide university system of many campuses, but its use for an isolated campus in a rural area will imply the use of inputs from the entire state, overestimating the impact of a change in final demand.

Table C. Comparison by Region of Type II Total Final-Demand Multipliers for Junior Colleges, Colleges, Universities, and Professional Schools (611A00)

Region	Output (dollars)	Value Added (dollars)	Earnings (dollars)	Employ-ment (jobs)
Travis County, TX..	2.0045	1.1853	.5768	18.5
Austin-Round Rock-San Marcos, TX MSA[1]....	2.1871	1.2982	.7603	24.0
Texas...	2.5082	1.4426	.8514	26.4

1. Composed of the following counties in Texas: Bastrop, Caldwell, Hays, Travis, and Williamson.

Our next section provides an approach that can mitigate the effects of these standard assumptions in cases where practitioners conclude that they are not realistic. In particular, a bill-of-goods approach, rather than an "off-the-shelf" approach that uses a single set of multipliers, can be used to relax these assumptions and produce results that are likely to be more accurate.

V. The bill-of-goods approach

A university impact analysis can be substantially improved through a bill-of-goods approach. This approach uses detailed data on the purchases of the locally produced inputs (including local labor). The impacts of these purchases are then added to the initial change in final demand to arrive at the total impact. The information needed to use this approach includes the specific categories of budget expenditures, the share of each that is sourced within the local region, and the earnings and residence of the university's employees.

Information that is specific to our university's new program might look something like that presented in Table D. The new program brings in $10 million of revenue and also requires an additional $10 million of purchases, including salaries, of which $6 million is purchased locally. In this example, the sum of intermediate purchases and labor earnings is used as a proxy for a final-demand change. This information can also be summarized as follows:

- **Final-demand change—**$10 million increase in university expenditures as a result of a new program attracting students from outside of the region.
- **Local purchases—**$6 million of local purchases, as shown in Table D. In addition, the university will hire 140 new employees, also shown in Table D.
- **Affected industries—**The university and local industries that produce and distribute the goods and services purchased by the university.
- **Affected region—**The Austin-Round Rock-San Marcos, TX Metropolitan Statistical Area, since most of the university employees reside in this area and most of the goods and services purchased by the university are produced by industries in this area.

Table D illustrates the multiplier derived from the change in regional purchases of the university. The $10 million dollar increase in regional purchases is broken into components with a regional multiplier for each type of expenditure. The implied multiplier is 20.4 and leads to an estimated increase of 204 part-time and full-time jobs using the bill-of-goods approach. Practitioners may reasonably be concerned about the source data requirements of this approach. However, the largest component of the multiplier's impact comes from employee earnings. Even in cases where it may be difficult to collect data on the location of each the university's vendors, it still may be possible to identify where the university's employees reside.

This example shows that getting the regional component of earnings estimated accurately will go a long way toward improving an impact analysis. The impacts calculated using the bill-of-goods approach are more accurate than those produced with the direct method, which estimates an increase of 240 part-time and full-time jobs for the same university.

Table D. Estimating the Employment Impacts of a University Using a Bill-of-goods Method

Expenditures	Increase in Regional purchases in producers' prices	Final-demand employment multiplier (jobs)	Employment impact (jobs)
Employee earnings	$5,000,000	10.6365	53.2
Electricity	$200,000	6.6949	1.3
Gas	$110,000	6.3108	0.7
Water	$65,000	11.9699	0.8
Maintenance and repair	$180,000	18.0354	3.2
Books for sale at bookstore	$300,000	10.2733	3.1
Laboratory supplies	$80,000	9.4066	0.8
Truck transportation	$15,000	17.9329	0.3
Wholesale margin	$50,000	11.6000	0.6
Subtotal	$6,000,000	n.a.	63.9
Plus: Initial change	**n.a.**	**n.a.**	**140.0**
Total	n.a.	n.a.	203.9
Implied final-demand employment multiplier*	**n.a.**	**20.4**	**n.a.**

* Calculation of implied multiplier: 203.9 ÷ $10 million = 20.4

VI. Student and visitor spending

Student and visitor spending are often included in university impact studies. For these types of analyses, it is important to identify only the additional spending that occurs within the study region as a result of the presence of the university. This is an even more important consideration now that many purchases that were once made within the region, such as textbooks and clothing, are now made online. However, even local purchases often are made for goods that are produced elsewhere. In this case the impact on the local economy is limited to the share of those expenditures that is earned by the retail, wholesale, and transportation sectors in the local region. In order to attribute all of local spending to a particular region, every part of its supply chain, from manufacture to delivery to the customer, would need to take place within the study region.

In practice, once the local purchases are identified, it is necessary to determine whether the manufacturers of these products and the industries responsible for bringing these products to market are located in the study region. Expenditures valued in consumer, or purchaser, prices must also be separated into the production costs, transportation costs, and wholesale trade and retail trade margins before using the multipliers. As an example, take a local purchase of $200,000 in men's clothing.

Table E shows the producer and purchaser values in the $200,000 of men's clothing sales, based on national input-output relationships. This table shows us that the manufacturer captures $96,000 of this value, with the remainder going to the wholesale, retail, and transportation activities.

Table E. Final-demand Changes Valued in Producer and Purchaser Prices*

Commodity	Purchaser Value	Producer Value
Men's and boys' clothing	$200,000	$96,000

Few practitioners, if any, will have local data on these various components. An alternative is to use national averages to infer the likely shares for each component. Table F shows the producer value, transportation costs, trade margins, and the purchaser value for Apparel, leather, and allied product manufacturing at the national level for 2002. This information can be used to create ratios of the producer value, transportation costs, and trade margins to the total purchaser value at the national level. These ratios are shown in Table G.

The national ratios can be multiplied by the $200,000 purchase of men's clothing in purchaser prices. This will provide estimates of the final-demand change for the Apparel, leather, and allied product manufacturer, the transportation provider, the wholesaler, and the retailer. These estimates are shown in Table H. The local economic impact includes only the share of each type of cost that is incurred within the study region.

Table F. National Input-Output Commodity Composition of PCE of Men's and boys' clothing
[Millions of dollars]

Commodity	Producer Value	Railroad Costs	Truck Costs	Water Costs	Air Costs	Oil Pipeline Costs	Gas Pipeline Costs	Wholesale Margin	Retail Margin	Purchaser Value
Apparel, leather, and allied product manufacturing	39,568	5	923	0	70	0	0	10,012	31,820	82,398

Source: 2002 national benchmark Distribution Costs Table D.

Table G. National Ratios for purchases of Men's and boys' clothing
[Shares]

Commodity	Producer Value	Railroad Costs	Truck Costs	Water Costs	Air Costs	Oil Pipeline Costs	Gas Pipeline Costs	Wholesale Margin	Retail Margin	Purchaser Value
Apparel, leather, and allied product manufacturing	0.48	0.00	0.01	0.00	0.00	0.00	0.00	0.12	0.39	1.00

For example, the apparel manufacturing national ratio for retail trade is $31820 million ÷ $82398 million = 0.39.

Table H. Final-demand Changes Valued in Producer Prices
[Dollars]

Commodity	Producer Value	Railroad Costs	Truck Costs	Water Costs	Air Costs	Oil Pipeline Costs	Gas Pipeline Costs	Wholesale Margin	Retail Margin	Purchaser Value
Apparel, leather, and allied product manufacturing	96,000	0	2,000	0	0	0	0	24,000	78,000	200,000

For example, the final-demand change for retail trade is $200,000 x 0.39 = $78,000.

VII. Broader assessments

Important components of the economic impact of universities include not only the transactions that we highlight in our paper, but they also include more difficult to measure impacts like the creation of human and knowledge capital and the role of amenities. Much of this work involves the measurement of intangibles and public goods and can be expected to have a large range of possible estimates. While these estimates are crucial to understanding the value of universities, separating intangible-related impacts from transaction-related impacts can help readers compare results.

Early literature on university economic impacts called for an assessment of the costs associated with universities—public services provided and taxes forgone. These fiscal impacts appear infrequently in more recent university impact studies and this makes it difficult for the reader (the tax-paying public) to assess the opportunity cost of universities. If we are persuaded that higher education has positive returns for the community as well as the individual, assessing the opportunity costs will strengthen rather than weaken the case for public investment.

VIII. Conclusions

The economic and social benefits that universities provide to the communities where they are located are likely to be large, but many of these benefits do not fit readily into an analysis based on the economic transactions of local residents. Harder to quantify benefits are likely to have a wide dispersion of estimates, making the results of any particular analysis overly sensitive to the model used. Two areas where this is particularly true are the benefits to the community of more educated individuals and the local value of knowledge created through university activity.

The usefulness of input-output based impact studies of university activities can be suitably interpreted when analysts understand the assumptions of the linear model and how much final demand spending will really be new to the area. In addition, results can be improved by using a bill-of-goods approach and local information to understand how much intermediate spending will remain in the local area.

Next steps for our work include the development of additional examples for the various economic activities that universities perform, such as construction, research, and spectator sports. Working with a consortium of universities, we plan to compare the actual results from projects with the estimates produced by RIMS II to test the accuracy of the model.

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