

## DEALING WITH "INDUCED MIGRATION" IN UNIVERSITY IMPACT STUDIES

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The migration-inducing effect of an institution of higher education is often overlooked in university impact studies. This paper deals with estimating the local economic impacts of a university accounting for the fact that students and staff induced to the area by the presence of the university are unlikely to remain in its absence. It is argued that this is an important aspect of the correct identification of the counterfactual position and a vital component in accurate impact analysis. A case study is presented relating to the short-term impacts of the Northwestern University campus in the city of Evanston, Illinois. The tendency to overstate this impact through the incorrect treatment of induced migration is illustrated. It is also shown that the estimated income and output impacts attributed to the university are very sensitive to changes in the local consumption patterns of migrants.

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Most studies of the urban and regional impacts of institutions of higher education do not take their migration-inducing role into account. Yet a much-vaunted contribution attributed to institutions of higher education is said to be their role in attracting highly skilled staff and students to a given area. In the short term, the income generation and spending power of the migrants are said to provide considerable injection into the local economy, creating a ripple-like effect through consecutive rounds of spending and respending. This boost finds expression in its effects on local business, the local tax base, and local household incomes (Kott, 1987–1988). Over the long term, this role in attracting staff and students is said to be reflected in a "seeding" effect on the local economy by creating a pool of highly skilled labor that can serve the local economy and by generating know-how, technology, and services that diffuse locally. Particularly in small towns and more rural locations, this longer-term effect of human capital and knowledge formation can increase local attractiveness and reverse negative migration trends through affecting location decisions of households and firms (Hudson, 1974).

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Although not all colleges and universities have an equal role in inducing migrants into their area, and much depends on their sources of funding (public versus private) and organization (single campus versus statewide system), much of the local economic impact attributed to universities is based on their role as an attractor of mobile human resources. This immediately begs the question, Without the university, would the same effects still have occurred? This question touches on one of the key issues in estimating the urban and regional impacts of institutions of higher education: the ability to assess what would have happened in their absence. In order to be able to attribute the observed effects to the university, we need to have some accurate alternative state-of-the-world picture. Estimating this counterfactual position is a particularly critical methodological issue in impact analysis and evaluation studies (Rossi and Freeman, 1992; Mohr, 1992).

This paper presents an attempt at dealing with estimating the impacts of an institution of higher education in the presence of "induced migration." This term refers to those staff and students attracted to the area as a result of the presence of the university and who would likely leave the area in the university's absence. An assessment of the impact of the university on the local area has to take this counterfactual position into account. A case study is presented relating to the short-term impacts of the Northwestern University campus on the city of Evanston, Illinois. The tendency to overstate this impact through the incorrect treatment of induced migration is illustrated. On this basis, the paper offers some broader conclusions relating to the question of mobile resources attracted by institutions of higher education and their evaluation in university impact studies.

## UNIVERSITY IMPACT STUDIES AND THE TREATMENT OF MIGRATION

As noted above, while the issue of the institution of higher education as a positive migration factor has been generally recognized, it has rarely received specific attention. Different migration streams are generated by the university and their economic impacts vary accordingly. For example, university construction and expansion attracts short-term migrants such as building crews. Their impact is likely to be short term and with a high level of "leakout" as much of their income flows back to their place of residence. Similarly, commuters attracted to employment/study at a university are another form of short-term migrant with very marginal impact on local incomes and employment. The migrants with the largest expected impact are the faculty, staff, and students attracted to live in the area due to the university presence. Their impact can be both long and short term.

Very little attention has been directed toward estimating the long-term im-

pacts of a university in general and of university-induced migrants in particular. This is probably because the long-term impacts of a university, such as human capital and knowledge formation, are less tangible than the short-term income and employment effects. Identifying, operationalizing, and isolating these impacts over the long term is particularly difficult and most of this work has been of an aggregate and indirect nature. The general approach has been to take a specific growth process as the focus and look at the relative growth induced by the institution of higher education. Thus, Beeson and Montgomery (1990) look at the way universities affect local labor markets while Florax and Folmer (1992) look at the effect of the human capital base on local industry investment patterns.

The human capital formation effect over the long term is heavily contingent on the stability of faculty and students in the region. It can be argued that by raising the average level of human capital in the area, the institution of higher education increases productivity of all labor in the area (Hudson 1974). This is because the skill composition of the labor force will affect the technology used, thereby indirectly upgrading all labor. However, this regional effect will only be felt if some of the students stay on in the area after completion of studies. If the migration function of the university is no more that of a stepping stone or entrepôt with local and nonlocal students flowing in and out of the area, then an opportunity cost occurs that is equal to the income foregone over the period in which local students were studying. Conversely, by attracting migrants from outside the area (students who later stay on in the area) or by stabilizing the rate of out-migration of skilled labor previously attracted, the university is instrumental in increasing local value added in terms of the prior education that these migrants bring with them.

Faculty and high-level administration attracted to the area also have a long-term seeding effect. This effect is measured in terms of human capital and knowledge formation and should not be counted separately. However, most of the attention to the impacts of faculty and staff has been focused on their short-term income and employment effects. These short-term effects have received considerably more attention than the long-term impacts and the main attention in these studies is to the impact of the university on local household income, local business, and the local tax base. In some studies other impacts, such as the effects of visitor spending and the impact on the local credit base, are also addressed.

Three broad methodological approaches can be recognized. The first—the *accounting approach*—is based on the judicious articulation of the various forms of direct impacts (on employment, income, and sales) that the university generates. This work has roots in the the American Council on Education (ACE) report (Caffrey and Isaacs, 1971) that set out a standardized research framework for studies of this kind. University-generated data for expenditure

and payroll and survey evidence of staff and student expenditure patterns form the basic input data; generally an income multiplier is calculated to illustrate the local university impact. Examples of studies of this kind include Moore (1979), Rosen, Strang, and Kramer (1985), and Elliot and Meisel (1987).

A second approach can be termed the *regional economic analysis approach*. In this type of analysis local change is often the primary focus of study while the university is viewed as a change-inducing factor (which could equally be a new port, convention center, or some other large-scale project). Work of this kind is also concerned with both short- and medium-term effects via the simulation of all kinds of "disturbances" to final demand connected to the university, for example, increased or decreased enrollment, employment, or purchasing. These studies generally use input-output analysis as their primary analytic tool (Dorsett and Weiler, 1982; Beck et al., 1993) or have imported input-output-generated coefficients in order to supplement an accounting-type analysis (Rosen, Strang, and Kramer, 1985; Elliot and Meisel, 1987; Zelder and Sichel, 1992).

Finally, the calculation of Keynesian-type income-expenditure multipliers in illustrates the *demand side approach* to university impacts. Like the input-output approach, the impact of a disturbance likely to affect changes in demand is estimated. However, the scale of analysis is generally micro and this approach attaches much weight to the neat and concise specification of the main relationships between the university and the local economy. The microeconomic analysis of projects such as new firms, power plants, and urban renewal projects has also been applied to institutions of higher education (Brownrigg, 1973; Bleaney et al., 1992; Armstrong, 1993).

Although these studies generally attempt to construct some baseline, counterfactual position against which to measure the observed impacts of the university, very few of them pay specific attention to the migration-inducing role of the university in this assessment. This is a particularly important issue with respect to income effects associated with an institution of higher education. For example, in estimating this income impact we may not be able to attribute all extra earnings to the presence of the university as many university faculty and staff may well have attained a similar level of earnings elsewhere in the absence of the university. There is therefore a high opportunity cost (shadow price) associated with the income generated via induced migration. This cost has to be discounted from total net benefits attributable to the university; otherwise the university effects will be overstated.

## THE SETTING

We now consider the economic effects generated by Northwestern University's campus on Evanston, Illinois, accounting for migration to the area in-

duced by the presence of the university. This is not a full analysis of the impacts associated with Northwestern University, which also has a campus located in downtown Chicago. It relates only to those employed or studying at Evanston. Evanston residents employed or studying at the Chicago site are excluded and expenditure figures generated by the Chicago campus (even those to Evanston vendors) are also excluded.

During 1991–1992, 3,519 faculty and staff (full- and part-time) were employed at Evanston and 11,684 students were enrolled in full-time courses. Total expenditure attributable to this campus (gross payroll and payments) is estimated as \$365 million out of a total university gross expenditure of \$547 million. This makes Northwestern the single largest income and employment generator in Evanston. The city of Evanston has a population of 73,000 and a labor force of 36,000 (Bureau of the Census, 1990). When considering the economic effects of the university on Evanston it is necessary to appreciate that at this scale, the university is more than just a local educational institution. It can be considered a large business operation engaged in running an education and research institution, a housing complex, a sports and cultural organization, and affiliated with other important local institutions such as the local hospital and science park.

The city of Evanston has an “open” economy, functionally linked to that of the Chicago metropolitan area. As such, we can expect some “leakage” of economic impacts with effects generated in Evanston having impact elsewhere. Demand generated by the Evanston campus is not necessarily met in the city as payments flow out to the city of Chicago and its metropolitan area. Incomes generated in Evanston are not always spent there as commuters to Evanston campus will tend to spend much of their disposable income at their place of residence.

However, the university also serves to counterbalance this “leaky bucket” character of the Evanston economy. Student expenditures (especially those of undergraduates) are likely to be oriented to the local economy. The university also attracts visitor spending, which by nature is directed toward local goods and services. Furthermore, the Evanston economy is heavily oriented toward the service sector. The largest employment sectors are Educational Services (8,123 employees), Other Professional and Related Services (6,140), Finance, Insurance and Real Estate (4,555), Retail Trade (4,289), and Health Services (3,740) (Bureau of the Census, 1990). The propensity of these sectors to generate local value added is generally quite high.

## ASSUMPTIONS

A critical assumption underlying this analysis relates to the role of the university in inducing migrants to the area that would not have been attracted

otherwise. Empirically, this effect can be measured by assessing the institution of higher education's effect on local incomes. This effect can be estimated for two segments in the local population: those who would be living in the area irrespective of the university presence (nonmigrants) and those whose presence is attributable to the university (induced migrants). The assumption is that university faculty and academic-related staff (executive, administrative, management, and professional) are part of a national labor market. In the absence of the university it is assumed that they would hold identical employment at different (non-Evanston) locations. Their incomes would remain the same while their geographic distribution would differ. In contrast, other staff (secretarial, clerical, technical, skilled crafts, service, and maintenance) are all assumed to be nonmigrants. In the absence of the university they would be unemployed. Those that are Evanston residents would continue to reside in the city while those that commute from outside (mainly Chicago) would be considered unemployed at their place of residence.

This distinction is important when examining the impact of the university on local disposable income. Disposable income is taken to represent a measure of welfare. The welfare of induced migrants is assumed to be indifferent to the presence of the university in Evanston. They could probably attain a similar level of welfare at another location if there was no university in Evanston. Due to the presence of the university, part of their income is now spent in Evanston, thereby generating additional local incomes. Induced migrants' spending therefore contributes to the local economy, raising the level of the disposable income of nonmigrants, i.e., Evanston residents and others who would not move out in the absence of Northwestern. However, the personal welfare of the induced migrants is not enhanced by the university presence and their incomes should not be counted when estimating the university impact on local disposable income.

In the analysis that follows this distinction is operationalized through making distinctions between *exempt* and *nonexempt* staff. These classifications are payroll/accounting categories relating to the Fair Labor Standards Act and broadly correspond to faculty, executive, administrative, and professional (exempt) staff on the one hand, and secretarial, technical, skilled, service, and maintenance (nonexempt) staff on the other. We assume that all exempt staff (and faculty) are induced migrants that work in a national labor market. Nonexempt staff are assumed to be local in orientation; they would not move out in the absence of the university.

From Table 1 it becomes apparent that this distinction is a rather crude one. Only 35 percent of nonexempt employees are in fact Evanston residents. Another 36 percent commute daily from Chicago and the rest come from elsewhere in the metropolitan area. By counting all nonexempt staff as nonmigrants, we are in effect erring on the conservative side. Ostensibly, we are

**TABLE 1. Evanston Faculty and Staff by Place of Residence,\* 1992**

	Place of Residence				Total
	Evanston	Chicago	Metrop Chicago	Else	
Exempt Staff <sup>†</sup>	365	252	295	9	921
Faculty	586	181	351	17	1135
Nonexempt Staff <sup>‡</sup>	511	537	410	5	1463
Total	1462	970	1056	31	3519

*Source:* Human Resource Administration, Northwestern University.

\*Residence identified by 3-digit zip code: Evanston (602); Chicago (606,607), Metropolitan Chicago (600,601,603,604,605).

<sup>†</sup>Exempt Staff: Executive, Administrative, Management, Professional, and Technical staff.

<sup>‡</sup>Nonexempt Staff: Secretarial, Clerical, Technical Paraprofessional, Skilled Crafts, Service and Maintenance staff.

causing a small reduction in the size of the impact on the local population generated through induced migrant's spending. Strictly speaking, therefore, the disposable income multiplier is measuring the effect attributable to the university not just on nonmigrant Evanston residents but on all those Evanston employees who are nonmigrants (even if they do not live in the city).

A second and similar assumption refers to students. Again, it is assumed that in the absence of Northwestern, they would be "costlessly" distributed across other similar universities at different locations. Some empirical evidence in fact exists supporting this induced migrant thesis with respect to Northwestern students. An examination of some 90 private colleges and universities in the U.S. has ranked Northwestern in fourth place in terms of the national orientation of the market that it serves (Lowe and Viterito, 1989). While there is some evidence pointing to a distance decay effect in university enrollment decisions (Leppel, 1993), this generally relates to smaller, private colleges. In the case of a large, private institution such as Northwestern University, the student constituency to which it appeals and the market that it serves have a national rather than a regional base.

Further support from this contention comes from an analysis of freshmen applications over the last four years. Data supplied by the Office of the Director of Admissions shows that following Illinois (18.3 percent), the largest concentrations of applications by state come from California (9.8 percent) and New York (8.3 percent). Even the major midwestern states of Illinois, Wisconsin, Michigan, and Ohio together do not account for more than 32 percent. The discrepancy between local (term and permanent (home) addresses for students also serves to underscore this point (Table 2). While the vast majority of undergraduate students are Evanston-based during term time (95 percent), the perma-

**TABLE 2. Students at Evanston Campus by Local and Permanent (Home) Address,\* 1992**

	Address				Total
	Evanston	Chicago	Metrop Chicago	Else	
Graduate Students					
Local Address	2779	840	411	253	4283
Permanent Address	1419	676	400	1788	4283
Undergraduate Students					
Local Address	7006	149	139	107	7401
Permanent Address	186	376	897	5942	7401

*Source:* Office of the Registrar, Northwestern University (Full-time students, Fall Quarter).

\*Addresses identified by 3-digit zip code: Evanston (602), Chicago (606,607), Metropolitan Chicago (600,601,603,604,605).

ment address for some 80 percent is outside Illinois. For graduate students, the Evanston orientation during term time is less pronounced (65 percent), but the discrepancy between local and permanent address is also smaller.

## METHODOLOGY

The estimation procedure is based on the premise that Northwestern's contribution to the local economy is represented by the additional income, output, and employment induced by the university, over and above what would have happened in its absence. This proposition imposes limitations on attributing impacts to the university and as such could understate the effects of Northwestern. It follows Bleaney et al. (1992) in estimating income and output effects on the basis of Keynesian-type multipliers. These measure the ratio of initial (first-round) to total (final-round) impacts for both disposable income and output. On the basis of these income measures an employment multiplier associated with Northwestern is also calculated.

The procedure is detailed in the Appendix. In broad terms it consists of the following steps. The first step consists of deriving the gross output effect generated by the university. This comprises two parts: (1) university payroll expenditure and any additional income of university employees and (2) expenditure to local external vendors for purchases and services. On this basis the disposable income effect initially generated is simply gross output minus social insurances and taxes, plus transfers, dividends, and interest. In addition, we have to subtract the income attributable to induced migrants and the value of local purchases and services. This represents the first-round income and output effects of the university in the local area. In principle, the rest of the procedure involves



tracing the diminishing round-by-round effects of this initial injection as it ripples through the local economy.

However, the initial injection has not yet been fully specified. This is done in the second step where the second-round output effect is specified as comprising the following three additional components: (1) the proportion of student expenditure that is local, (2) the change in local expenditure induced by the university for nonmigrants (i.e., those whose disposable incomes are expected to change as a result of the university presence), and (3) the change in local expenditure attributable to the university for induced migrants (whose spending in the area increases local incomes). Thus, at this stage we are including the effect of two sets of migrants in the calculation. First, student expenditure is included as an output effect. Second, the additional local spending by induced migrants (faculty and staff) is also included due to its contribution to the local economy raising the level of the disposable income of the nonmigrants. As in the first step, this second-round income effect is simply the output effect taxed at the appropriate rate.

This process continues through successive rounds of spending and responding with ever-decreasing multiples of the initial injection until the stage of final convergence is reached. At this stage there is no further local impact attributable to the university. The multiplier effect of the university is simply calculated as the ratio of this final round to first-round effects. Finally, the employment impacts are calculated on the basis of the income impacts. In this estimation, units of income are converted to units of employment on the basis of the ratio of local average wages in the colleges and universities sector to local average wages in the service sector.

## DATA

This study has relied as much as possible on internal university-generated data. Some of the figures are readily available in sources such as the *Northwestern Data Book, 1991-1992*, prepared by the Office of Administration and Planning and the Northwestern Financial Report. Other data were generated for the study or provided on request: staff and faculty residences, payroll data, and tax rates and geographic distribution of payroll by direct deposit were provided by the Human Resource Administration; students by local and permanent place of residence was provided by the Office of the Registrar; freshman enrollment by state by the Office of Admissions; student expenditure patterns by the University Enrollment Office and Graduate School Administration; and geographic distribution of payments to vendors by the Office of the Controller and Purchasing Department.

Resource and time limitations did not allow for conducting surveys of staff and student expenditure patterns. Instead, estimates were made on the basis of

national surveys such as the Consumer Expenditure Survey 1988–1989 for the Chicago SMA (BLS, 1991) or on the basis of other research findings (Bleaney et al., 1992; Lewis, 1988; Yale University, 1990).

## RESULTS

The summary results of the above estimation are presented in Table 3. In order to emphasize the importance of accounting for the influence of induced migrants, the results are calculated twice: once excluding induced migrants from the income impact and once including them. As expected, including induced migrant incomes results in consistent overstatement of the multiplier effects associated with the university. The bias is particularly pronounced with respect to the income and employment impacts. The absolute magnitude of the multipliers, although not particularly large when excluding the disposable income of induced migrants, would nevertheless seem to be realistic for a relatively open economy such as that of Evanston. We would expect a rather large leakout effect to the large and diversified Chicago economy and, as a result, smaller local multipliers in Evanston itself.

A further issue concerns the relative volatility of the multipliers to changes in the parameters relating to the expenditure of induced migrants. Prior work suggests that the multipliers are particularly sensitive to changes in the values of those parameters relating to the local propensity to spend of students and staff/

**TABLE 3. Northwestern University Campus Impacts on Evanston:  
Summary Results**

	Impact (\$ M)	
	Including Induced Migrants' Income Effect	Excluding Induced Migrants' Income Effect
First-Round Gross Output	207.7	207.7
First-Round Disposable Income	55.5	37.9
Second-Round Gross Output	68.6	42.2
Second-Round Disposable Income	51.9	31.9
Third-Round Gross Output	7.8	4.8
Third-Round Disposable Income	5.9	3.6
Final Convergence—Output	285.1	255.3
Final Convergence—Income	98.4	73.9
Output Multiplier ( $k_O$ )	1.38	1.22
Income Multiplier ( $k_I$ )	2.48	1.94
Employment Multiplier ( $k_E$ )	2.55	1.69

TABLE 4. Sensitivity Tests for Values of University Impact Coefficients

	Including Induced Migrants' Income Effect				Excluding Induced Migrants' Income Effect			
	Gross Output (\$ M)	Total Disp. Inc (\$ M)	$k_O$	$k_I$	Gross Output (\$ M)	Total Disp. Inc (\$ M)	$k_O$	$k_I$
Estimated Effects	285.3	98.4	1.38	2.48	255.3	73.9	1.22	1.94
Expanded Effects <sup>1</sup>	334.5	135.7	1.61	3.40	282.3	94.3	1.35	2.48
Contracted Effects <sup>2</sup>	242.9	66.4	1.16	1.66	232.3	56.5	1.11	1.48

<sup>1</sup>Proportion of staff/faculty expenditure that is local = .2629; proportion of student expenditure that is local = .60.

<sup>2</sup>Proportion of staff/faculty expenditure that is local = .0629; proportion of student expenditure that is local = .40.

faculty (Bleaney at al., 1992; Armstrong, 1993). Here we test for this sensitivity by scaling up these two parameters by 10 percent and then by reducing them by that same percentage. Table 4 shows the effects of increasing and decreasing the proportion of gross student expenditure that is local (IS) from its original value of .50 and doing likewise for the original value of staff/faculty expenditure that is local ( $e = .1629$ ). This is done for the calculations both including and excluding the income effects of induced migrants.

As can be seen, in both cases the income multipliers are volatile to changes in parameter magnitudes while the output multipliers are more robust. Including the income of induced migrants in the calculation only serves to increase this volatility. However, the results when induced migrant incomes are excluded indicate a consistent pattern. For each 0.1 percent change (increase or decrease) in migrant consumption, we can expect a roughly similar change (increase or decrease) in the output multiplier. In the case of the income multiplier, a 0.1 percent change in migrant consumption generates a response five times that magnitude. In contrast, the results including the incomes of induced migrants are much less stable and no general pattern of change in multiplier value in response to change in migrant consumption pattern can be detected. These results serve to further stress the potential distortion that is likely to arise with inadequate treatment of the effects of induced migrants. The impacts of the university on the local economy are likely to be overstated on the basis of volatile and inconsistent multiplier effects.

## CONCLUSION

The issue highlighted here—the treatment of induced migrants in university impact studies—is just part of the wider methodological debate over the treat-

ment of mobile resources in impact analyses and project evaluations (Hamilton et al., 1991). In the present discussion, this issue has been couched in terms of induced migrants. However, with respect to institutions of higher education, human capital is not the only mobile resource employed. A similar case could be made with respect to capital. Research funds and contracts attracted from outside the university area cannot be assumed to be a total benefit with zero cost. For a start, the importing of these funds does not necessarily change their ownership. The know-how and technology resulting from the research may flow back outside the area to the original client. Second, even if research contracts come from federal sources, an opportunity cost representing competing and unsuccessful projects outside the area may have to be discounted from the net benefits attributable to this inflow of funds.

A further conclusion relates to the time frame used when incorporating the induced-migration effects into impact analysis. The emphasis in this paper and in most of the literature reviewed has been on short-term impacts attributable to the university. As noted above, the effect of induced migrants differs greatly over the short and long terms. Over the short term this effect lies in the local income and employment injections that they promote and the induced household expenditure that results. Over the long term their effect is very different. If the migrant stays in the area, the impact is much wider-ranging. The local labor pool is enhanced, local knowledge is generated, and local attractiveness (however measured) is advanced. However, there is another side to the coin. The migrant attracted to the local area (or trained locally) can also be attracted away. In such an instance, the individual migrant bears no loss as he takes his skills and knowledge with him. However, the local area suffers a variety of opportunity costs in this instance (e.g., income foregone over the time period spent studying by locals, the lost skills of nonlocals, and so on).

These long-term effects of migrants are much harder to assess. However, with universities increasingly taking a proactive role in the area of local economic development (Steinnes, 1987), the study of the long-term effects of university-induced migration would seem to be more necessary than ever before.

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## APPENDIX

### PROCEDURE FOR CALCULATING IMPACT MULTIPLIERS DISCOUNTING FOR THE EFFECTS OF INDUCED MIGRANTS

Following Bleaney et al. (1992), the output and income multipliers are estimated concurrently. While the former is a measure of economic activity and the latter is a

welfare measure, their derivation is interconnected. University expenditure activity ( $E$ ) is comprised of two components as follows:

$$E = P + V \quad (1)$$

where  $P$  represents payroll expenditure and  $V$  is expenditure to external vendors for purchases and services. Expenditure on auxiliary enterprises (i.e., dorms and food services) is included here in the  $V$  term but is excluded later on from student expenditures so as to avoid double-counting. On the basis of (1), the additional local gross output attributable to the university will be the above equation modified to account for other additional income earned by university employees (e.g., external consultancy and property income) and discounting purchases and services that are imported from outside. This will yield first-round gross output ( $O_1$ ) as follows:

$$O_1 = P + A + bV \quad (2)$$

where  $A$  is additional income and  $b$  is the proportion of purchases and services ( $V$ ) that are supplied locally.

On the basis of the first-round output expression we can estimate the first-round impacts on the disposable income of the nonmigrants ( $I_1$ ). This is simply first-round gross output ( $O_1$ ) minus the income attributable to the induced migrants ( $M$ ) and value of local purchases and services ( $bV$ ) taxed at the rate of indirect taxation ( $n$ ). This is all taxed at an appropriate tax rate for the nonmigrants ( $t$ ) and can be expressed as:

$$I_1 = (1 - t)(O_1 - M - bnV) \quad (3)$$

In order to assess the university impact we need to formulate the multiplicand (that expression of initial injection into the local economy which is then multiplied by the multiplier to give the impact estimate) in terms of three major components: (1) the proportion of student expenditure that is local, (2) the change in local expenditure induced by the university for nonmigrants (i.e., those whose disposable incomes are expected to change as a result of the university presence), and (3) the change in local expenditure attributable to the university for induced migrants (whose spending in the area increases local incomes). This latter component is taxed at a rate  $t'$ . This is expressed as:

$$O_2 = lS + ecO_1 + ec(1 - t')M \quad (4)$$

where  $S$  is student expenditure and  $l$  that proportion spent locally,  $e$  is the proportion of university staff and faculty expenditure that is local, and  $c$  is the marginal propensity to consume. This multiplicand also represents the second-round gross output ( $O_2$ ) generated by the university. Applying a tax rate,  $t$ , and indirect tax rate,  $n$ , yields the second-round change in the disposable income of nonmigrants ( $I_2$ ). This also assumes that no further induced migration occurs with no new injections of income. All injections into the local economy have taken place and we are now just tracing the diminishing round-by-round effects of the initial injection:

$$I_2 = (1 - t)(1 - n)O_2 \quad (5)$$

The third-round output effect of a further round of local spending ( $O_3$ ) is simply that amount of the multiplicand ( $O_2$ ) spent locally and taxed at the appropriate rate:

$$O_3 = ec(1 - t)(1 - n)O_2 \quad (6)$$

Similarly, the third-round impact on the disposable income of nonmigrants ( $I_3$ ) is a decreasing multiple of the second-round impact ( $I_2$ ):

$$I_3 = ec(1 - t)(1 - n)I_2 \quad (7)$$

This process continues in ever-decreasing multiples of the initial injection as a smaller and smaller local impact is registered with each successive round of spending. At final convergence ( $O_2$  and  $I_2$ ), the output and income multipliers are defined as the ratio of final-round to first-round effects. The output multiplier,  $k_O$  is defined as:

$$k_O = (O_1 + O_2 + O_3 + \dots + O_2)/O_1 \quad (8)$$

while the income multiplier,  $k_I$ , is defined as:

$$k_I = (I_1 + I_2 + I_3 + \dots + I_2)/I_1 \quad (9)$$

The employment multiplier ( $k_E$ ) associated with the university can be calculated from the income multiplier. This is based on estimating the increase in income needed to generate an additional unit of employment. The main assumption underlying this approach is that the expenditure patterns of employees in the sector where the injection takes place and those of employees in other sectors of the local economy are broadly similar. Total employment created locally as a result of each direct university job is calculated as follows:

$$k_E = (k_I - 1)[(w_e)/(w_s)] + 1 \quad (10)$$

where  $k_I$  is the income multiplier and  $w_e$  and  $w_s$  are the local average wages in the education and service sectors, respectively.

#### *Parameter Values*

Expenditure activity generated by Evanston campus ( $E$ )	\$365 million
Payroll of Evanston campus ( $P$ )	\$185 million
Expenditure to external vendors and services ( $V$ )	\$180 million
Proportion of $V$ that is local ( $bV$ )	.0457
Additional income of faculty and staff ( $A$ )	.10
Direct tax rate for induced migrants ( $t'$ )	.20
Direct tax rate for nonmigrants ( $t$ )	.16

Indirect tax rate ( $n$ )	.10
Proportion of faculty/staff expenditure that is local ( $e$ )	.1629
Marginal propensity to consume ( $c$ )	.922
Total gross student expenditure ( $S$ )	\$34.6 million
Proportion of gross student expenditure that is local ( $lS$ )	.50

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