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Economic base multipliers: a comparison of ACDS and IMPLAN

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Abstract. Many local and regional practitioners still use the single multiplier version of economic (export) base analysis in project assessments. However, dependable estimates of this multiplier require that the division of total activity into its export (basic) and local (non-basic) components be reasonably accurate across all industries. This paper compares the economic base multiplier that is generated by a shortcut approach, one calibrated by the Arizona Community Data Set (ACDS), with that generated by the popular IMPLAN input-output model. The comparison is made across 577 micropolitan (all non-metropolitan) US counties in the year 2000. Although the two approaches are not at all similar they generate comparable economic base multipliers. Moreover, various regional attributes, like human capital and specialization, affect the two multiplier estimates in much the same way.

JEL classification: R11, R12, R15

Key words: Economic base multiplier, ACDS, IMPLAN, micropolitan, regional features

1 Introduction

Isard's *Methods of regional analysis* (1962) contains many insights that are still very relevant to today's local and regional practitioners of regional science. One important topic discussed at length in the book is the regional multiplier. From his observations it is clear that the practitioners of the day were already dealing with the array of issues that arise when estimating the multiplier, whether that estimation is for the entire economy or for specific industries. Fifty years ago regional scientists like Isard (1960), Tiebout (1962) and Miernyk (1965) were already asking questions like: Where is the region's boundary? Do we use sales, value added, income or employment data? Are cross-sectional or longitudinal data better? And, what levels of industrial disaggregation do we adopt?

Today's practitioners face a very different sort of problem: How to choose the most appropriate multiplier model for their purposes? A few years back, following the Northridge earthquake, An et al. (2004) evaluated 19 different metropolitan impact models on 11 criteria, and this study did not even include all of the choices that were available to analysts or practitioners. Each enjoyed its own particular strengths and weaknesses – concerning such matters as policy relevance, geographic detail, event transferability, accessibility and the like – so real trade-offs in information would occur whenever one model was substituted for another. While the authors called for more research on expensive, data-intensive impact models, which was certainly understandable given their topic, elaborate models of this sort will never be adopted by practitioners working in the many small municipal- and county-level agencies spread across the nation. For the most part, these practitioners prefer multiplier models that are adaptable, inexpensive, and fully transparent.

As any discipline matures a certain amount of applied research is needed to clarify its approaches, methods, and techniques. Such activity generally corresponds to what Kuhn (1970) called normal science and Popper (1970) called descriptive problems. Despite their differences, both of these philosophers would certainly recognize such 'non-extraordinary' inquiry as being fundamental to the discipline's practitioners. So, in regional science, a certain amount of research will always be needed either to widen and update evaluations of the various regional multiplier models – not only those that have been devised in the past but those that will be devised in the future. Clearly, a lot more comparative research is needed in this applied branch of the discipline, where both the strengths and the weaknesses of the competing multiplier methodologies are brought to full light.

This paper examines one of the most contentious issues in economic base analysis, at least where a single or aggregate multiplier is thought to be satisfactory: How is total activity separated into its export and local components? In doing so the paper compares two very different approaches that practitioners in the US have at their disposal to estimate the economic base multiplier. One approach uses a new shortcut (indirect) method that divides the total employment of major industries into basic and non-basic jobs. This approach involves borrowing estimates taken originally from the Arizona Community Data Set (ACDS) and applying them to larger areas, so here the approach is bottom-up. The other approach uses the popular IMPLAN input-output model and industry-level estimates of exports are summed to identify each region's export base. Here the approach makes use of national sales and purchase (input-output) coefficients as the foundation for regional counterparts so the second approach is top-down. Both approaches are widely known to practitioners and neither is excessively expensive to apply for individual regions (Bonn and Harrington 2008). Moreover, when compared to several other methods, especially those that use regional or spatial econometrics, both approaches generate an estimate of the single regional multiplier that is fairly easy to understand.

The findings of the paper reflect the diverse socio-economic and demographic conditions in the nation's micropolitan counties during the US Census year of 2000. Micropolitan counties, whose core areas employ fewer than 50,000 people, have suddenly become a subject of great interest (Davidsson and Rickman 2011; Vias 2012; Wilson et al. 2012). These areas were specifically targeted because they are the largest regional statistical units where it makes sense to compute a single multiplier, which is so widely used by many practitioners. On the other hand, many micropolitan areas are simply too small to warrant the detailed study of individual industries, even in manufacturing or services; in fact, econometric estimates of multipliers for such industries will have uncomfortably large errors in these small economies (Connaughton and McKillop 1979). The ACDS multiplier estimates are developed from employment bifurcations that were made across eight major industries while the IMPLAN multiplier estimates are developed from current-dollar income bifurcations made across the same industries. The IMPLAN estimates were not converted into employment figures so the model's usual output would remain as transparent as possible (Charney and Leones 1997). The specific intentions of the paper are twofold: first, to compare the size and the size-distribution of the alternative multiplier estimates; and second, to establish how the alternative estimates are affected by other attributes of the micropolitan economies. In other words, do attributes like human capital or relative location affect the two multiplier estimates in a similar or dissimilar way? Given that the two approaches are so very different, it would be very encouraging to find that their multipliers are not only comparable in size but that other regional factors influence those multipliers in a similar manner. The paper does not deal with time-series data and does not address regional forecasting, so its findings will be of greatest interest to practitioners who assess the short-run impacts of new private or public investments (Kilkenny and Partridge 2009).

2 The two approaches

The Arizona Community Data Set was generated by administering nearly 50 in-depth surveys in the US Southwest between the mid-1970s and early 1990s, and uses estimates of basic (export) and non-basic (local) employment that were established for individual businesses. Aggregation of the part- and full-time employment data to major industries followed the guidelines of the then existing SIC code. Results from the earliest surveys are discussed in some detail in Gibson and Worden (1981) and the entire data set is summarized in Vias (1996). A shortcut multiplier has been recently developed that is calibrated by the relationships existing between local jobs and total jobs across the ACDS. This calibration was subsequently tested for goodness-of-fit using two entirely different groups of small-area economies and the results were remarkably encouraging. Estimation details of the single or aggregate economic base multiplier are shown in Mulligan (2008) and estimation details of the (lesser known) disaggregate economic base multiplier are shown in Mulligan (2009). The main advantage of this method over other shortcut methods, like the assignment method, is that non-zero basic and non-basic job allocations can be made in nearly every industry of the target economy, thereby making the base multiplier estimates realistic in both their size and their composition. As a result, the multiplier effect actually can be unpacked to provide reasonably accurate industry-by-industry estimates of the local job shifts expected to follow a new private or public investment.

However, questions have been raised at professional meetings about the usefulness of the ACDS in making generalizations about other parts of the nation. Other concerns have been voiced about the nature of the small-area economies that were used to make the original calibrations: specifically, were these places too small, too specialized, or too far removed from metropolitan effects? Still other questions have been raised about using data that do not recognize that the employees of different industries have different levels of productivity and thus earn different average wages. Admittedly, too, the original information that was collected and then used to make the calibrations is becoming dated. However, the regression-based results given in Mulligan (2009) provide overwhelmingly strong evidence that the ACDS can be used to estimate economic base multipliers of micropolitan counties found across the entire US, at least up to the year 2000. Here the goodness-of-fit statistics are very much superior to those of a handful of comparable studies that have simply assigned the entire employment of major industries to either the basic or non-basic sector (Braschler 1972).

IMPLAN, on the other hand, is exclusively a regional input-output model (see http://implan.com/V4/Index.php). However, its estimates are not based on any direct surveys and its general structure typifies that of all non-survey input-output models found in the regional science literature (Rickman and Schwer 1995a, 1995b; Lynch 2000). In particular, IMPLAN assumes a uniform national production technology and uses the regional purchase coefficients (or location quotients) to regionalize the national model, which can then be used to generate impacts and a variety of regional data and summary measures, including output, income (Type I and Type II), and employment multipliers. However, the particular application in this paper does not address the household consumption effect. Similar to other commercially available approaches, such as REMI, IMPLAN builds its data set from top to bottom. National data serve as control totals for state data, which in turn serve as control totals for county data. The primary sources of employment and earnings data are County Business Patterns and the Bureau of Economic Analysis, although other data are borrowed from the Bureau of Labor Statistics and the Census of Governments. IMPLAN's state-level output data are drawn from the BEA's output series and the Annual Survey of Manufacturers. County-level output by industry is estimated using BLS earnings-to-output ratios as proxies. The implicit assumption of uniform earnings-to-output ratios across counties within a given state is adopted in other black-box models as well. Moreover, no account is taken of possible spatial dependency in the various estimates, where the economies of nearby counties tend to be more alike than county economies that are widely separated. For the purposes of this paper, year 2000 estimates were made for various activities, including exports, final demand, and total output in each of the eight industries. The small amount of activity that was not assigned to major industries, but to a sector called other, was proportionally assigned to those eight industries. Just to be clear, those estimates were made for a high level of industrial aggregation (see below) and this would bring error into the input-output calculations; on the other hand, many micropolitan counties simply did not exhibit a dense matrix of interindustry transactions, so using excessive disaggregation would constitute methodological overkill (Lahr and Stevens 2002). In any case, the various industry-level estimates were simply combined to arrive at the required economy-wide estimates, all of which were stated as current income. In a straightforward manner, the overall level of local income was estimated as the difference between overall total income and overall export income.

3 Descriptive results

This section of the paper summarizes the underlying data that were used to develop the alternative multiplier estimates. All of the results, based on the nation's $n = 577$ micropolitan counties, pertain to eight major industries in the year 2000: primary, PRIMA; construction, CONST; manufacturing MANUF; transportation, communications, and public utilities, TCPUT; all trade, TRADE; finance, insurance, and real estate, FIRES; other services, SERVS; and all levels of government, PADMN. Columns 1 and 2 of Table 1 reveal descriptive statistics for the absolute levels of total and export employment, respectively, where the export employment was estimated by ACDS. This table also shows descriptive statistics for the absolute levels of total output (column 3) and exports (column 4), as estimated by IMPLAN. Note that the representative (or statistically average) county had nearly 22,600 total employees who in turn generated approximately \$2,422 million in overall output. It is noteworthy that both approaches found services and manufacturing to be the dominant export industries but their ranks were reversed, as manufacturing (services) proved to be much more important to the typical county economy when using the income-driven IMPLAN (employment-driven ACDS) methodology. Moreover, the coefficients of variation (not shown) indicated that some IMPLAN industry levels tended to exhibit considerably more dispersion than ACDS, a property that was especially evident in primary activities and in finance, insurance, and real estate.

In any case, as column 5 of Table 1 shows, the product-moment (Pearson) correlations between the two measures of total activity are all high. The weakest correlations are seen in TCPUT ($r = 0.553$), PRIMA ($r = 0.693$), and PADMN ($r = 0.703$), while the highest correlation ($r = 0.886$) of all is seen in the economy-wide figures for total employment and total output. But the coefficients given in column 6, which address export employment and export income, are more revealing. As was expected, these alternative measures of export activity usually exhibited

Table 1. Industry levels: descriptive statistics and correlations (n = 577)

Industry	ACDS Total Mean (SD)	ACDS Export Mean (SD)	IMPLAN Total Mean (SD)	IMPLAN Export Mean (SD)	ACDS IMPLAN Total correlation	ACDS IMPLAN Export correlation
PRIMA	877.4	650.9	130.5	80.2	0.693**	0.737**
	(764.2)	(720.3)	(234.9)	(135.7)		
CONST	1616.9	544.6	188.6	14.8	0.895**	0.635**
	(1294.1)	(414.0)	(180.8)	(27.8)		
MANUF	4199.9	3688.9	1083.6	527.8	0.803**	0.731**
	(3732.7)	(3351.3)	(1094.2)	(585.4)		
TCPUT	1529.6	443.2	133.8	27.6	0.553**	0.265**
	(1122.7)	(277.5)	(163.3)	(73.2)		
TRAD	3481.6	1181.6	185.6	25.1	0.852**	0.394**
	(2580.5)	(826.4)	(164.1)	(48.9)		
FIRES	984.0	286.4	89.5	11.1	0.755**	0.509**
	(839.4)	(314.1)	(114.2)	(42.1)		
SERVS	8812.0	4351.1	381.1	53.8	0.849**	0.399**
	(6378.9)	(3236.7)	(364.6)	(129.5)		
PADMN	1097.0	258.2	231.6	48.8	0.703**	0.372**
	(986.4)	(602.9)	(235.9)	(128.7)		
TOTAL	22598.4	11405.1	2424.2	789.2	0.886**	0.681**
	(15534.8)	(7538.4)	(1762.4)	(664.7)		

Notes: ACDS is measured in employment and IMPLAN is measured in current income ($m); correlation is Pearson coefficient, ** indicates 0.01 significance.

lower correlations than did the counterpart measures for total activity. This occurred because basic activity tends to be distributed more sporadically than non-basic employment; for the same reason county economies show more specialization in export activity than in total activity. In fact, for basic activity, four values of r can be seen to be lower than 0.50: in TCPUT, TRAD, SERVS, and PADMN. Further examination of the results (not shown) actually indicated that the ACDS estimates for exports correlated somewhat better with the IMPLAN estimates for final demand than with the IMPLAN estimates for exports. Because exports always constitute a portion of final demand, this second finding indicates that the IMPLAN income-driven estimates for exports were often somewhat lower, relatively speaking, than the ACDS employment-driven estimates for exports.

More insights are provided by Table 2, which repeats the earlier comparisons but now focuses on industry percentages instead of industry levels. Columns 1 and 2 show employment results using the ACDS approach. Note that manufacturing constitutes on average 18.2 per cent of total jobs in the 577 micropolitan counties but is responsible for an even higher amount, 30.4 per cent, of overall export jobs, thereby confirming that this particular industry is heavily export-oriented. But, as seen in columns 3 and 4, IMPLAN estimates that on average manufacturing constitutes an even more significant amount, 40.5 per cent, of the average county's overall output, and a truly astounding proportion, 58.6 per cent, of its overall export income. Clearly IMPLAN rates the importance of manufacturing much higher than does ACDS. Some of this difference is doubtless attributable to the different metrics, where IMPLAN recognizes that employees in some industries, especially manufacturing, are more productive than the employees in others. In contrast, services and trade are seen to be very important sources of employment in ACDS but their importance to regional output is somewhat diminished in IMPLAN. It is also

Table 2. Industry percentages: descriptive statistics and correlations (n = 577)

Industry	ACDS Total Mean (SD)	ACDS Export Mean (SD)	IMPLAN Total Mean (SD)	IMPLAN Export Mean (SD)	ACDS IMPLAN Total correlation	ACDS IMPLAN Export correlation
PRIMA	5.15 (4.6)	7.63 (7.6)	8.47 (12.6)	18.01 (22.9)	0.847**	0.740**
CONST	7.10 (1.8)	4.92 (1.6)	8.19 (4.6)	2.38 (4.2)	0.567**	0.403**
MANUF	18.17 (9.1)	30.41 (14.9)	40.51 (21.9)	58.64 (30.1)	0.732**	0.706**
TCPUT	6.81 (1.7)	4.32 (1.6)	5.66 (4.9)	3.41 (6.9)	0.404**	0.211**
TRAD	15.07 (2.3)	10.42 (1.8)	7.75 (3.5)	3.57 (5.15)	0.386**	0.278**
FIRES	4.17 (1.1)	2.38 (1.3)	3.61 (2.6)	1.41 (3.9)	0.506**	0.428**
SERVS	38.41 (6.7)	37.15 (10.16)	15.29 (7.6)	6.22 (11.3)	0.545**	0.488**
PADMN	5.20 (3.4)	2.74 (5.3)	10.52 (8.3)	6.36 (12.3)	0.508**	0.333**
TOTAL	100.00	100.00	100.00	100.00		

Notes: ACDS is measured in employment and IMPLAN is measured in current income; correlation is Pearson coefficient, ** indicates 0.01 significance.

noteworthy that IMPLAN places somewhat more weight on government activities, both overall and in exports. In any case, the various Pearson correlation coefficients shown in columns 5 and 6 of Table 2 indicate that the two approaches generate their most similar industry proportions in PRIMA and MANUF and their least similar industry proportions in TCPUT and TRAD. So the most similar estimates of industry proportions occur in precisely those same industries that are known to be highly export-oriented.

4 The average multiplier

Interest now turns to the division of total activity into its export (basic) and local (non-basic) components. In Table 3, columns 1 and 2 refer to results from the ACDS while columns 3 and 4 refer to IMPLAN results for the so-called representative economy. Here the main focus is on the composition of the average multiplier, which is the simple ratio that is formed between the numerator of total activity *TOTAL* and the denominator of export activity *EXPRT*. The average or ratio multiplier is more useful as a descriptive device than as a predictive tool; nevertheless this version of the multiplier continues to be widely used by practitioners for assessing project impacts and for clarifying the nature of local or regional specialization (Klosterman 1990; Bendavid-Val 1991; Blair and Carroll 2009). The difference between total activity and export activity constitutes local activity, so $LOCAL = TOTAL - EXPRT$. But this division necessarily holds over each industry of the economy, so that $LOCAL_i = TOTAL_i - EXPRT_i$ in the ith industry, where $\Sigma\, LOCAL_i = LOCAL$. The composition of the average multiplier M is determined by first calculating the various industry-specific ratios $LOCAL_i/TOTAL$ and then summing those ratios across all i industries. This aggregation leads to the estimate of the coefficient R =

Table 3. Composition of the average multiplier

Industry	ACDS $100 \times LA_i/TA$ Mean (SD)	ACDS $100 \times LA_i/TA$ Percent	IMPLAN $100 \times LA_i/TA$ Mean (SD)	IMPLAN $100 \times LA_i/TA$ (%)	ACDS IMPLAN Correlation
PRIMA	0.96 (0.15)	1.99	3.04 (5.13)	4.49	0.475**
CONST	4.56 (1.18)	9.46	7.57 (4.10)	11.19	0.463**
MANUF	2.21 (0.68)	4.59	20.44 (11.91)	30.26	0.596**
TCPUT	4.57 (1.32)	9.48	4.58 (2.92)	6.77	0.336**
TRAD	9.71 (1.88)	20.15	6.74 (2.72)	9.97	0.340**
FIRES	2.95 (0.52)	6.12	3.25 (1.91)	4.80	0.388**
SERVS	19.47 (2.40)	40.40	13.47 (5.56)	19.92	0.509**
PADMN	3.76 (0.74)	7.80	8.51 (5.63)	12.58	0.411**
TOTAL	48.19 (4.60)	100.00	67.63 (12.50)	100.00	0.295**

Notes: LA_i is local activity in the *i*th industry and *TA* is total activity; ** indicates 0.01 significance.

LOCAL/TOTAL, where *R* is the average propensity of total jobs to induce local jobs. The estimate of the average multiplier *M* in the representative economy follows directly, where $M = 1/(1 - R)$. So when the ratio *R* of local activity to total activity is high, the export base multiplier *M* is also necessarily high. Note that both *R* and *M* are calculated for each and every micropolitan economy.

In Table 3, the ACDS results shown in column 1 correspond to an average multiplier of $M = 1.930$ in the representative economy. This means that every 51.81 export jobs are responsible for an additional 48.19 local jobs, which sum to 100 jobs in all. Of these 48.19 'extra' local jobs, 0.96 are in PRIMA, 4.56 in CONST, 2.21 in MANUF, and so on. Column 2 indicates the percentage composition of these local jobs where, most notably, 20.15 per cent are in trade and 40.40 per cent are in services. The alternative array of local jobs that is estimated by IMPLAN is shown in column 3. Here 32.37 export jobs are responsible for an additional 67.63 local jobs, which creates 100 jobs in all. So now the average multiplier in the representative economy is estimated to be $M = 3.089$, a figure that is much higher than the alternative. Contrary to the ACDS approach, a very large number (20.44) of local jobs is created in MANUF for every 100 total jobs found in the economy. As column 4 indicates, the local-industry composition of the second multiplier is somewhat different as well. IMPLAN allocates somewhat more local jobs, relatively speaking, to PRIMA, CONST, and PADMN in addition to the higher amount already noted for manufacturing. On the other hand, ACDS allocates more local jobs, relatively speaking, to the service and trade industries. Nevertheless, as column 5 indicates, the two estimates of local activity are significantly correlated across all eight industries. So while the two approaches might generate somewhat different estimates of local activity, those differences appear to be remarkably consistent across the various observations. In other words, any differences in the economic base multiplier estimates of the two approaches do not appear to be random but instead reflect the systematically different features of ACDS and IMPLAN.

The above results demonstrate how the various industry-specific estimates are first unpacked and then repacked to arrive at the economy-wide estimates for the export base multipliers. However, these estimates refer to a county economy that is really only a statistical artifact and we must now return to the actual distribution of the average multipliers to gain further insights. Across the array of 577 micropolitan counties the ACDS estimates of the average multiplier range from a low of 1.13 to a high of 2.37, where the mean is 1.94, the median is 1.95, the standard deviation is 0.151, and the coefficient of variation is 0.078. In comparison, the IMPLAN estimates of the average multiplier range from a low of 1.26 to a high of 26.81, where the mean is 3.73, the median is 3.20, the standard deviation is 2.127, and the coefficient of variation is 0.571. So not only are the IMPLAN multiplier estimates much higher on average but their distribution is much more dispersed than the ACDS estimates. The discrepancy between these mean figures and the ones mentioned above simply reflects the varying shapes of the two size-distributions of average multipliers. With the exception of a few cases, the distribution of multiplier estimates by the ACDS approach is approximately normal while that for the IMPLAN approach is highly skewed to the right. In short, IMPLAN generates a fair number of very high estimates that are simply not generated by the alternative approach. Nevertheless, the two arrays of estimates remain significantly correlated, although the coefficient is now only $r = 0.164$.

Further light is shed on this issue by examining those particular counties where the IMPLAN estimates are very high; in fact, 91 (or 15.8%) of the IMPLAN multipliers exceed 5.00, an absurdly high figure – even for income-based multipliers – when dealing with fairly small non-metropolitan areas. This is an issue with IMPLAN that has been noted before for small counties and one that certainly deserves more study (Rickman and Schwer 1993). In any case, those counties with exceptionally high multipliers are somewhat larger and exhibit slightly more (less) total employment in services (manufacturing), but on the surface there are no real striking differences that distinguish these counties from those with much lower multipliers. But when a simple classification of the economic types is introduced, much clearer results fall out. Using the functional typology devised by Mulligan (2009), the means for the average multipliers in four very different types of economies are as follows: diversified, $n = 170$, $M = 3.82$; industrial, $n = 139$, $M = 3.06$; service, $n = 151$, $M = 3.62$; and trade, $n = 117$, $M = 4.31$. Clearly IMPLAN generates low average multipliers for those counties that exhibit industrial (primary or manufacturing) specialization but generates high average multipliers for those other counties that exhibit specialization in trade. Further scrutiny shows that IMPLAN regularly assigns most of the output in trade to households as opposed to exports and this appears to be largely responsible for the large multiplier estimates that characterize counties that specialize in trade. As a result, IMPLAN can generate very large industry-specific multipliers for trade when induced effects are introduced (Price et al. 2008).

5 The marginal multiplier

More informative is a sequence of ordinary least squares regressions that provide estimates of the marginal multiplier, a form preferred by many local and regional practitioners because it reflects how a change in a region's export activity induces a change in that region's total activity. Here the estimation of the marginal multiplier allows control for the various demographic, economic, and geographic factors that might affect the size of the region's multiplier effect. This paper considers two families of models. The first family has the following form:

$$LOCAL = a + b * EXPRT + \boldsymbol{c} * \boldsymbol{FACTO}$$

and the second family has the alternative form:

$$LOCAL = a + d * TOTAL + \boldsymbol{c} * \boldsymbol{FACTO}$$

where *LOCAL, EXPRT,* and *TOTAL* again represent local, export, and total activity. ***FACTO*** is a vector of other regional attributes. The first family is the most commonplace depiction of the economic base logic while the second family, which recognizes that local industries significantly trade with one another, shares a similarity with the consumption model of Keynes. In the first case the multiplier estimate is $M_1 = 1 + b$ while in the second case the multiplier estimate is $M_2 = 1/(1 - d)$.

In the simplest version of these models no contextual factors are included in the estimation. Then, using ACDS, the local-job creation propensity of export employment is $b = 1.048$ where the 95 per cent confidence interval ranges between 1.029 and 1.067; on the other hand, using IMPLAN, the local-income creation propensity of export income is $b = 1.291$ where the 95 per cent confidence interval ranges between 1.182 and 1.401. Here the ACDS estimation has much superior goodness-of-fit statistics; consider, for example, that the adjusted R-squared is 0.955 for the former but only 0.482 for the latter. So while the IMPLAN multiplier estimate, $M_1 = 2.291$, is significantly higher than the ACDS multiplier estimate, $M_1 = 2.048$, the gap between the two estimates is now much lower than was the case of the average multiplier (see above). For purposes of comparison, it is highly instructive to look at the degree of correlation between the various outputs of the alternative models. Not surprisingly the predicted values enjoy a high degree of correlation, where $r = 0.681$, but more interesting is the finding that the residuals also enjoy a significant degree of correlation, where $r = 0.280$. Clearly, then, the alternative methodologies not only generate similar patterns of predicted values but they also generate similar patterns of over- and under-prediction across the array of 577 micropolitan counties. By itself this result comprises strong evidence that the two models, although very different in methodology, are nevertheless capturing the same underlying economic structures of those counties.

The second family of models generates fairly similar results. Here $d = 0.518$ (95% confidence interval: 0.513–0.522) for ACDS while $d = 0.674$ (95% confidence interval: 0.659–0.690) for IMPLAN, where the goodness-of-fit statistics (now both R-squared values exceed 0.925) are better for the second family because local activity is being regressed on itself. Here the ACDS multiplier estimate is $M_2 = 2.074$ while the IMPLAN multiplier estimate is $M_2 = 3.067$, so introducing local demand on the right-hand side of the regressions generates even a wider spread in the alternative estimates of the marginal multiplier. In fact, now the estimates of the marginal multiplier closely resemble those for the means of the average multiplier stated earlier. Also, the correlations between the alternative predictive values ($r = 0.886$) and the alternative residuals ($r = 0.303$) are even higher than in the earlier case – both of these being results that could be anticipated.

6 Regional effects

The final piece of comparative analysis examines how the sizes of the multipliers vary with the incidence of important regional features. This has become a prominent approach in the local and regional development literature as seen in the numerous attempts to model recent business growth in different parts of the US (Goetz et al. 2009). The estimates for the slope variables b and d now include the effects of 11 (largely uncorrelated) regional factors that were thought to likely influence either industry-specific or overall levels of local activity in the micropolitan counties. In fact, a prior multivariate analysis assisted in distilling this group from a much larger array of nearly 30 factors. The 11 chosen factors can be grouped as follows: two household attributes; three demographic characteristics; three economic features;

and three location properties. A detailed discussion of the 11 factors is given in Mulligan and Vias (2011) but, for present purposes, sufficient rationale is given for the adoption of each in the multiplier estimation.

Some micropolitan areas, like declining mining centres, have a much higher incidence of poverty than other areas. Sometimes, though, the nature of this poverty is due as much to the age or gender composition of households as to short- or long-run economic circumstances. In any case, when the percentage of the total population in poverty, *POVER*, is higher, households tend to demand fewer local goods and services. As a result, the expected effect of higher household poverty on local jobs is negative. Human capital has especially important implications for the nation's geography of employment (Storper and Scott 2009). Better educated and more skilled workers not only make existing industry more productive but also serve to attract new, competitive industries. Some non-metropolitan areas enjoy advantages in high-tech manufacturing or in producer services, either because they offer lower wages than metropolitan areas or because of the lifestyle choices of entrepreneurs. The percentage of persons aged 25 and over with a university degree, *DEGRE*, is often used to measure the presence of human capital. Those micropolitan counties with abundant human capital are expected to have greater propensities to create local jobs. So the expected effect of each household attribute on the size of the multiplier is: *POVER*, –; and *DEGRE*, +.

Demographic characteristics will certainly affect economic growth but precisely how these characteristics will impact the sizes of micropolitan multipliers is less certain. It is widely known that dependency ratios vary considerably across the nation and, as a consequence, many eco-demographic models include ratios of population to employment (or the inverse) in their calculations (Taylor 1986). Furthermore, in many parts of the US, population change now precedes employment change and the dependency ratio will significantly shift in those situations. Also, ratios shift locally with the incidence of heavy in- or out-commuting in labour markets. *Ceteris paribus*, those counties with higher dependency ratios, *POPDE*, should experience relatively more local demand for goods and services. Moreover, counties that have recently experienced substantial population growth will often exhibit a lag in the appearance of major export industries because these sorts of businesses require longer planning horizons. Rapid population growth, as seen in many boom towns, can significantly increase the demand for locally provided goods and services. The variable *POPGR*, which represents growth in the previous decade, also serves as a good remedy for endogeneity in the estimation procedure (Partridge et al., 2008). Finally, population density is likely to play a bigger role in the success of local industries as opposed to export industries in micropolitan counties (Mushinski and Weiler 2002). A local market with high population density, *PDEN*S, will generally be welcomed by firms engaged in retailing and services, but having this high local density is probably not so critical for the success of firms in export industries. So the expected effect of each demographic characteristic on the size of the multiplier is: *POPDE*,+; *POPGR*, +; and *PDENS*, +.

Overall economic features are surprisingly heterogeneous across the nation's micropolitan counties. Non-earnings income, comprised of property income and transfer payments, now comprises a significant proportion of the personal income that is earned by households throughout the nation. The combined payments supplement the visible economic base of every micropolitan economy and can be assessed in either absolute or in relative terms (Gibson and Worden 1981). Consideration is given here to the percentage of all personal income that is not presently earned, *NINCP*, where the expected effect on local jobs is positive. Industrial specialization has long been known to affect the economic fortunes of non-metropolitan regions. Excessive specialization in either primary or secondary industries was certainly a significant drag on both population and employment growth in US micropolitan economies between 1980 and 2000 (Mulligan and Vias 2006; Kilkenny and Partridge 2009). Here a simple coefficient of specialization, *SPECI*, was calculated for each county where a high coefficient is expected to reveal that export jobs have a low propensity to create local jobs. A third key economic feature reflects fiscal policy and involves calculating the ratio between total taxes and total expenditures, *TAEXP*, in each micropolitan county. Areas with low net taxes or high expenditures are likely to enjoy a wider array of local industries because regional consumption is greater, especially when housing prices are lower (Oates 1969). So the expected effect of each county economic feature on the size of the multiplier is: *NINCP*, +; *SPECI*, −; and *TAEXP*, +. The fourth group of factors relates more to county location. Some counties are blessed with locations that provide them with abundant natural amenities. There is now wide realization that many service and trade activities, and even footloose manufacturing, respond strongly to the uneven geography of both human and natural amenities (Carruthers and Mundy 2006; Marans and Stimson 2011). This paper captures natural amenities with two separate variables: the standardized county-level index, *NATUR*, created by McGranahan (1999), which was generated from six separate environmental sub-indices; and coastal location, *COAST*, a dummy variable that distinguishes the 47 micropolitan counties that are found on either the ocean, Gulf of Mexico or Great Lakes. In both instances the expectation is that local employment is enhanced in those counties endowed with superior natural amenities. A third location variable recognizes that large, nearby cities can significantly influence the nature of local industries in micropolitan areas (Mushinski and Weiler 2002; Partridge et al. 2008). So consideration was given to the 2003 Beale code of each county, and those 274 counties that were found not to be adjacent to major metropolitan centres were distinguished from their adjacent counterparts by using a dummy variable, *NOADJ*. These non-adjacent counties were believed to be more insulated from the markets of big cities, thereby offering a degree of protection to local industries. So the expected effect of each county location variable on the size of the multiplier is: *NATUR*, +; *COAST*, +; and *NOADJ*, +.

As mentioned earlier, there was remarkably little inter-correlation among these various factors in the year 2000 (Mulligan and Vias 2011). The only Pearson correlation coefficient whose absolute value exceeded 0.40 was that between *POPDE* and *POVER*. Absolute values for 44 (80%) of the coefficients ranged between 0.00 and 0.19 while 10 (20%) others ranged between 0.20 and 0.39, suggesting that any multiple regression analysis should exhibit few problems with collinearity.

Table 4 shows the regression estimates for the two families of models where intercepts have been suppressed, the estimates for *b* and *d* are shown in absolute terms, but the other estimates are shown as Beta coefficients (because the dependent variables have different metrics). In the first family, the ACDS estimate of the multiplier is $M_1 = 2.040$ and that for IMPLAN is $M_1 = 2.160$, again indicating a very slight difference. The goodness-of-fit statistics indicate that the former model again outperforms the latter and that the contextual models are an improvement on the simple models outlined earlier. Here the very considerable gap seen in the STEE (computed as the standard estimation error divided by the mean of the dependent variable) of each model is especially revealing. Over and above the stronger bivariate relationship noted earlier, the 11 contextual factors also seem to play a somewhat stronger role in the ACDS estimation. Nevertheless, a handful of those factors appear to play a remarkably similar role in both approaches: non-earnings income, human capital, and recent population growth all inflate the estimate of local activity – and the multiplier effect – while the degree of industrial specialization deflates that estimate. A one standard deviation shift in human capital increases local employment by 0.079 standardized units in the ACDS model but, alternatively, increases local income by 0.199 standardized units in the IMPLAN model. In fact, all four of these pseudo-elasticities prove to be larger for IMPLAN. Population dependency and taxes both have a positive effect in ACDS but show no effect in IMPLAN. But the one glaring inconsistency concerns relative location: when isolated from a nearby metropolitan area the multiplier

Table 4. Factors affecting the size of the marginal multiplier

	ACDS	ACDS	IMPLAN	IMPLAN
EXPRT	1.040 (105.4)		1.160 (20.3)	
TOTAL		0.516 (220.5)		0.666 (75.4)
NINCP	0.041 (5.0)	0.020 (5.1)	0.095 (3.1)	0.066 (5.7)
POVER	–0.006 (–0.5)	–0.001 (–0.1)	–0.050 (–1.2)	0.012 (0.8)
DEGRE	0.079 (9.2)	0.036 (8.5)	0.199 (6.5)	0.058 (4.7)
POPDE	0.055 (4.6)	0.026 (4.6)	–0.014 (–0.3)	–0.015 (–0.9)
POPGR	0.067 (8.4)	0.030 (7.7)	0.177 (6.3)	0.052 (4.6)
PDENS	–0.010 (–1.3)	–0.007 (–1.9)	0.067 (2.3)	–0.011 (–1.0)
SPECI	–0.047 (–5.7)	–0.021 (–5.2)	–0.121 (–4.2)	–0.030 (–2.6)
TAEXP	0.033 (4.0)	0.016 (4.0)	0.032 (1.1)	0.008 (0.7)
NATUR	0.013 (1.6)	0.006 (1.6)	–0.009 (–0.3)	–0.012 (–1.0)
COAST	0.009 (1.1)	0.003 (0.8)	0.031 (1.1)	0.000 (0.0)
NOADJ	0.030 (3.6)	0.018 (4.4)	–0.118 (–4.0)	–0.024 (–2.1)
STEE	0.128	0.062	0.483	0.189
ADRSQ	0.969	0.993	0.592	0.937

Notes: Estimates for control factors are Beta coefficients; *t*-scores are in parentheses; STEE is the standardized regression error.

estimate of a micropolitan county is significantly inflated for ACDS but is significantly deflated for IMPLAN.

Once again, the second family of models generates somewhat higher estimates of the economic base multiplier: $M_2 = 2.066$ for ACDS and $M_2 = 2.994$ for IMPLAN. So the difference in the two multiplier estimates is significantly widened when using the alternative economic base logic. But the marginal effects of the various factors noted above remain largely intact, where IMPLAN once gain generates somewhat higher estimates of the Beta coefficients. Outside of the sign reversal again seen for geographic non-adjacency, this is all very encouraging because it indicates that the key marginal relationships of the two approaches are very similar despite the fact that their underlying methodologies are so very different.

Table 5 provides a further round of insights using the standard economic base logic where export activity drives local activity. Similar results occur for the second family. Tax and revenue data were not available for all counties so only 566 observations are now used. In Table 5 the first two rows of figures indicate the alternative industry-specific estimates for local activity that when summed necessarily equal the alternative estimates for *EXPRT* shown in the top row of Table 4. The discrepancies shared earlier for the average multiplier are again immediately evident. IMPLAN generates much higher estimates of local activity in manufacturing (0.542 versus 0.048) but ACDS generates substantially higher estimates of local activity in both trade (0.223 versus 0.095) and services (0.404 versus 0.198). Below those figures, the signs for the 11 regional factors are shown in pairs for each of the 8 industries, but only when those signs are significant at the 0.10 level. So, for instance, the two signs –,+ given to *POPGR* in manufacturing indicates a negative effect was found for recent population growth using ACDS but a positive effect was found when using IMPLAN. Of the 88 overall possible outcomes, 59 significant signs were found in the ACDS model and 45 significant signs were found in the IMPLAN model. In 34 of those cases a significant industry-specific factor was identified for both models and in 27 of those 34 cases both signs were the same. Of the seven sign reversals, three appeared in the non-adjacency estimates, which is not surprising in light of earlier findings. Some factors that did not show up in the aggregate results of Table 4 now prove to be important; for example, both population dependency and taxes are now prominent influences in multiple industries when using the IMPLAN approach. Most important, though, the same four factors

Table 5. Factors affecting the composition of the marginal multiplier

	PRIMA	CONST	MANUF	TCPUT	TRAD	FIRES	SERVS	GOVT
ACDS	0.021	0.101	0.048	0.105	0.223	0.066	0.404	0.071
IMPLAN	0.024	0.105	0.542	0.072	0.095	0.053	0.198	0.071
NINCP	+,	+,+	–,	,+	+,+	+,+	+,+	+,
POVER		–,–				–,–	+,–	–,
DEGRE	+,	+,+	,–	,+	,+	+,+	+,+	+,+
POPDE	+,	+,	–,–	+,	+,	+,	+,+	+,+
POPGR	+,	+,+	–,+	+,+	+,+	+,+	+,+	+,
PDENS			+,				–,	–,
SPECI	–,+		–,–	–,–	–,–	–,–	–,–	
TAEXP	+,	+,+		+,	+,+	+,	+,+	–,
NATUR		+,			+,	+,+	–,	+,
COAST			–,				+,	–,+
NOADJ		,–	–,–	+,	+,–	+,–	+,–	–,

Notes: The two rows of figures are local activity estimates; paired signs indicate only those estimates significant at the 0.10 level where the first sign is ACDS and the second sign is IMPLAN.

that proved so visible in the overall estimates of local activity – non-earnings income, human capital, recent population growth, and relative location – also exhibited very pervasive influences across the entire array of industries. In fact, of all the 11 factors used in the various regressions, only population density and a coastal location had a decidedly limited impact on the various industry-specific estimates of local activity.

7 Concluding remarks

This paper adopts the economic base perspective and estimates single multipliers for micropolitan counties across the US in the year 2000. Two very different estimation methodologies are used to generate these alternative estimates – not only are the economic activities measured in different units (employment versus income) but the separation of total activity into its two constituent parts is achieved by entirely different means. One approach uses results from a new shortcut approach, one calibrated by the Arizona Community Data Set (ACDS), and here the results generally conform to those of traditional economic base analysis. The other approach, however, generates results for individual counties directly from the widely used IMPLAN input-output model. The IMPLAN income-based estimates, reflecting the same eight major industries adopted for the ACDS calibration, were next combined in such a way that they could be directly compared to the results of the more straightforward ACDS approach.

A variety of comparisons were then made across 577 micropolitan counties. One main finding is that IMPLAN (ACDS) in general assigns somewhat lower (higher) amounts of overall export activity and therefore generates somewhat higher (lower) aggregate economic base multipliers. This is true both for the average (ratio) and marginal versions of those multipliers. Moreover, there is ample evidence that IMPLAN generates much higher estimates of local manufacturing while ACDS generates somewhat higher estimates of local trade and local services. These tendencies in part cancel out and thereby narrow the difference in the overall multiplier estimates, at least for the standard economic base logic. IMPLAN also generates very low figures for exports and, thus, very high estimates for economic base multipliers when those micropolitan counties are highly specialized in trade activities. The possibility exists that this problem arises in part because of the different ways that IMPLAN estimates regional purchasing coefficients across the various regional industries (Rickman and Schwer 1993).

A number of the social sciences perform a double test to substantiate the relationships that might exist between two theoretical entities. The entities are first related to one another (the direct test) and then they are functionally related to other entities (the indirect test). In a sense these two fundamental tests have been applied to the alternative modelling methodologies of interest to this paper. The first of these tests – where comparability of the alternative multipliers was disclosed – was encouraging by itself because the two approaches to generating economic base multipliers are so very different. But the second test – where the directional effects of other regional factors were identified – was even more encouraging because these factors might interact with the alternative industry-specific estimates in very different ways. But several of the most important regional attributes, like human capital and specialization, were found to affect the alternative multiplier estimates in much the same way. All in all, then, the economic base properties of ACDS and IMPLAN appear to be remarkably similar.

Given that IMPLAN is more data ravenous and its application is significantly more technical, this is an especially good result for the ACDS approach. However, other work is needed to see if this comparability holds up for different levels of industrial disaggregation, for different-sized regional economies, or for other points in time. But the overall finding – that the estimates of the two economic base approaches prove to be comparable – should be recognized by all regional science practitioners as being a very positive result. More applied research is needed to clarify not only the similarities and dissimilarities, but also the strengths and weaknesses, of the wide array of impact models that regional scientists now have at their disposal (An et al. 2004).

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Resumen. Muchos profesionales locales y regionales siguen utilizando la versión de multiplicador único para el análisis de la base económica (exportación) en la evaluación de proyectos. Sin embargo, las estimaciones fiables de este multiplicador requieren que la fragmentación de la actividad total en sus componentes de exportación (básico) y local (no básico) sea lo suficientemente precisa para todos los sectores. Este artículo compara el multiplicador de la base económica generado mediante un enfoque simplificado, calibrado mediante el Conjunto de Datos de la Comunidad de Arizona, con el generado por el popular modelo de IMPLAN de input-output. La comparación se hizo para 577 condados micropolitanos (ninguno metropolitano) de Estados Unidos en el año 2000. Aunque ambos enfoques no se parecen en absoluto, generan multiplicadores de la base económica comparables. Por otra parte, un serie de atributos regionales, como el capital humano y la especialización, afectan de la misma manera a ambos estimadores de los multiplicadores.

要約：多くの地域および地方の開発事業者は、依然として、経済基盤（移出基盤）の単純な乗数理論による分析方法を使用してプロジェクトの評価を行なっている。しかし、この乗数の推計が信頼性の高いものであるには、業種にかかわらず全活動が、移出（基盤）と域内（非基盤）とに、理論的に正確に区別されなければならない。本論文では簡略アプローチから得られる経済基盤乗数、すなわちアリゾナコミュニケーションデータセット（ACDS）により較正された経済基盤乗数と、標準的なIMPLAN投入産出モデルから得られた経済基盤乗数を比較する。比較は、2000年の米国の郡の577の小都市（ミクロポリタン、メトロポリタン以外のすべての都市）を対象に行う。この2つの比較アプローチは全く異なるものであるが、比較可能な経済基盤乗数が得られる。さらに、2つの乗数の推計には、人的資本や特化などの様々な地域属性によりどちらもよく似た影響がみられる。