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THE EFFECT OF TIME FRAME IN THE ESTIMATION OF EMPLOYMENT MULTIPLIERS

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The suitability of the economic base model for explanation of short-run as opposed to long-run regional economic change has been a source of some controversy since the exchanges of North (1955, 1956) and Tiebout (1956a, 1956b) thirty years ago. Since that time, the use of the economic base model for impact analysis and planning has increased, but the appropriate time frame for application of the model remains one of the more important issues associated with the theory (Williamson 1975). No clear consensus exists among economic theorists and those empirical studies that have addressed this question.

An empirical investigation of the temporal aspect of the economic base multiplier process is presented in this study. Following an approach developed by McNulty (1977), the base model is estimated for 13 periods. The periods range from one year to 13 years in length, increasing in one year increments. Using panel employment data for Illinois nonmetropolitan counties, the results of applying the model to different periods are compared.

The next section presents some theoretical considerations followed by an overview of empirical applications. The methodology applied to Illinois nonmetropolitan counties is discussed in the third section. The results of the analysis are presented next. The paper concludes with a summary of the study.

Theoretical Considerations

At issue is whether the economic base model is primarily a theory of short-run or long-run regional change. Tiebout (1962, p. 57) defines the short-run as periods of 2 years or less, the long-run as periods up to 25 years. These definitions will be followed in this analysis.

Theory stresses a division between those industries that export their goods or services to other regions (basic industries) and those that primarily serve local markets (nonbasic industries). An increase in export activity will cause income to flow into the local economy stimulating the demand for goods and services produced in local nonbasic sectors. The local responding of the increased income in local nonbasic sectors leads to further increases in local business activity as the rounds of spending continue (McNulty 1977). The initial impact of this multiplier effect, due to increased local spending, is thought to take place within a few years of the original increase in basic activity.

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In a longer time frame, an additional factor may cause the multiplier effect to increase. Tiebout (1962) suggests that in the long-run, increased local income from exports will result in a higher level of local investment. This new investment, consisting of additional new plant and equipment as well as housing, expands the local industrial base strengthening the multiplier effect.

Tiebout's position, that economic base theory applies to both short- and long-run change, is widely accepted. However, this view has been challenged. Williamson (1975) points out that in the short run, other factors, such as autonomous business investment or government expenditures, may be more important than export activity in explaining the growth or contraction of a local economy. In the long run, structural changes (such as in industrial mix), demographic factors (e.g., migration) and differences in resources (human and natural) may be more important than export activity in explaining economic change (Ledent 1978; Williamson 1975). If these other factors are more important than the export base in influencing regional growth and decline, the theory will have limited usefulness.

Previous Empirical Research

Although not leading to a resolution of the time frame controversy, several empirical studies provide insights into the appropriate time frame for economic base analysis.

Much of the relevant empirical research in this area uses regression analysis to study the relationship between basic and nonbasic activity. Generally, a measure of nonbasic economic activity (employment or income) is regressed on one or more variables reflecting basic activity. In terms of employment, this relationship is expressed by:

$$E_{nb} = a + b_1(E_{b1}) + b_2(E_{b2}) + \ldots + b_n(E_{bn}) \qquad [1]$$

where E_{nb} is total nonbasic employment and E_{b1} represents basic activity in sector i. The intercept is symbolized by a. Coefficient b_i is the expected change in the nonbasic sector resulting from a unit change in basic industry i. The traditional multiplier indicates the total change (rather than the nonbasic change alone) resulting from a unit change in the basic sector. Therefore, to compute the multiplier, the addition of unity to the estimated coefficient is required.[1]

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[1] The employment multiplier is defined as

$$\begin{aligned} m &= \Delta E_t/\Delta E_b \\ &= (\Delta E_{nb} + \Delta E_b)/\Delta E_b \\ &= \Delta E_{nb}/\Delta E_b/\Delta E_b \\ &= \Delta E_{nb}/\Delta E_b + 1 \end{aligned}$$

where ΔE_t, ΔE_b and ΔE_{nb} are the changes in total, basic and nonbasic employment, respectively. Since the estimated coefficient, $b_i = \Delta E_{nb}/\Delta E_b$ the multiplier, $m = b_i + 1$ (Park 1970).

Studies using cross-sectional models. In previous studies using cross-section models both the dependent and independent variables are measured over the same period. Thus, the existence of a lagged effect is not explicitly investigated. This is a major difference between the cross-section research and time-series studies discussed below. Rather than testing for the existence of a lag, estimation of the cross-section models allows evaluation of the ability of economic base theory to explain regional growth and decline over different time frames. That is, are changes in the export base important in explaining regional change in the long- as well as the short-run or do complicating factors limit the model's usefulness to a specific time frame?

Two types of cross-sectional models have been used: those employing variables measuring employment or income for a single year, and those that rely on variables reflecting change over a number of years. The first type of moedl, using data from a single year and no lagged variables, was used by Braschler and Kuehn (1976) to estimate multipliers for nonmetropolitan counties. The models explained a large proportion of the variation in the nonbasic sector reflected in significant t-statistics for most variables. These results support the applicability of the model to short-run analysis.

Cross-sectional studies using change variables generally utilize the following model:

$$\Delta E_{nb} = a + b_1(\Delta E_{bi}) + b_2(\Delta E_{b2}) + \ldots + b_n(\Delta E_{bn}) \qquad [2]$$

where ΔE_{nb} is the change (first difference) in total nonbasic employment and ΔE_{bi} represents the change in basic employment in sector i during the same period. The intercept is symbolized by a. The estimated coefficients b_i through b_n indicate the change in nonbasic economic activity due to changes in various basic sectors i through n.

Studies by Shahidsaless, et al. (1983), Shaffer (1983), and Braschler (1972) used variables reflecting changes in income or employment over a ten-year period. Apart from any theoretical considerations concerning the appropriate time frame, the availability of decimenial census data was undoubtedly a factor influencing the choice of the ten-year interval. In each case, the models explained a large proportion of the variation in the dependent variable suggesting that the use of a ten-year time frame may not be unreasonable. The sensitivity of the results to changes in endpoint years remains largely untested.

McNulty (1977) explicitly tested the appropriate time frame of economic base studies. His model resembled equation [2] except that changes in income rather than employment were used. The models were estimated for periods of 2, 4, 6, 9, 10 and 19 years using cross-sectional data for 41 SMSAs in the southeastern United States. For the five models using periods of 4 or more years the economic base model fit the data well, reflected in the high R^2 values and significant coefficients. In contrast, in the two models using two-year intervals, the R^2 values were quite low and t-statistics indicated that none of the coefficients of the independent variables were significant. McNulty concluded that economic base theory was appropriate for explaining long-run regional growth, but not applicable to short-run economic development.

Gerking and Isserman (1981) argue that this conclusion is invalid, since the existence of a lagged effect is not explicitly investigated by the model. McNulty, however, never claims to be testing for a lagged effect. Rather, the model simply investigates the relationship between aggregate regional changes in the basic and nonbasic sectors during time frames of different length.

Although their criticism does not validate McNulty's conclusion, Gerking and Isserman's comments do point out a weakness of McNulty's models: a lag between basic sector changes and nonbasic sector response, if it actually exists, would influence McNulty's results. Other things equal, if the models used periods that were shorter than the actual lag, the dependent variable (nonbasic sector change) would not reflect the full nonbasic response. Conversely, as the periods used in the model exceeded the actual lag, the variables would tend to be increasingly ambiguous measures, including a number of basic and nonbasic sector fluctuations.

In the first case, the model would be expected to underestimate the magnitude of the basic-nonbasic relationship, perhaps leading to insignificant results. This is a possible explanation of McNulty's failure to find significant coefficients for short periods. In the second case, where the model uses periods longer than actual lags, the gross level of aggregation reflected in the variables would be expected to lead to decreased explanatory power of the model.

Gerking and Isserman (1981) also argue that McNulty's use of R^2 as a criterion for evaluating the model is unacceptable because, under certain assumptions, the R^2 values would be expected to increase for longer time frames regardless of the actual explanatory power of the model. However, the results of the present study, reported below, suggest this analysis may be incorrect.

Time Series Evidence. Time series studies shed light on the timing of the impact of basic on nonbasic activity. Several studies (reviewed in Williamson 1975) applied a linear regression model to time-series employment data for a single region to estimate multiplier values. Most of the studies hypothesized a rapid adjustment in the nonbasic sector to changes in export employment represented by an unlagged relationship in the models (Lane, 1966; Park, 1970). Using monthly time-series employment data Henry and Nyankori (1981) found evidence for the existence of a short-run basic-nonbasic relationship, but did not test for an effect longer than two years. Giarratani and McNelis (1980) found little evidence that basic income changes caused nonbasic income changes within two years of the basic sector change, but no investigation of long-run effects was attempted. The use of state level data in the analysis might have obscurred relationships existing in smaller regions within the states.

The nature of the lag between basic and nonbasic change was explicitly tested using time-series analysis in several studies. Sasaki (1963) and Weiss and Gooding (1968) tested alternate lag structures as long as three years for the basic sector variables. The authors concluded that the multiplier effect was essentially completed within one year. Although the results from most time-

series studies suggest that the multiplier effect may be a short-run phenomena, the small number of observations in the studies precluded thorough investigation of longer run effects.

In contrast to Sasaki (1963) and Weiss and Gooding (1968), Moody and Puffer (1970) applied a partial adjustment model to time-series data and concluded that the multiplier process takes decades to be completed. However, Gerking and Isserman (1981) suggest that these results may be sensitive to the bifurcation method used by Moody and Puffer to divide economic activity into basic and nonbasic.

To summarize, several empirical studies have investigated whether economic base theory is more properly thought of as an explanation of short-run rather than long-run regional growth and decline. Cross-section evidence is mixed. The single year study of Braschler and Kuehn (1976) supports the model's applicability to short-run changes. But McNulty's (1977) investigation using change variables indicates that the economic base model provides a poor explanation of short-run development but is appropriate for longer run changes. The results of the cross-sectional studies using ten-year change variables (Shahidsaless, et al. 1983, Shaffer 1983, and Braschler 1972) also support the suitability of the model for long-run analysis.

With the exception of Moody and Puffer (1970), time-series studies indicate that if basic change has an impact on the nonbasic sector, only a short lag is required. However, the time-series results do not necessarily contradict the cross-section results. Although in a particular region, the multiplier process may only require a short response period, cross-sectional studies may be useful for estimating general basic-nonbasic sector relationships which can be generalized across a number of regions, regardless of the nature of the lag. While heterogeneity of the regions allows the results to have greater universality, it also contributes to less precise estimates for any single region.

Thus, the empirical evidence does not provide a clear resolution to the question of the most appropriate time frame for economic base analysis. A subsidiary question, regarding the sensitivity of the results to endpoint values, also remains unanswered.

Methodology

To provide more evidence on the time frame question the model in equation [2] was estimated with data from Illinois nonmetropolitan counties using different time intervals. Basic employment is divided into three sectors: manufacturing, agriculture and other basic employment.

The model was estimated several times using variables reflecting employment change over various time periods. The periods ranged from a single year to 13 years, increasing the length by one year increments. Comparison of the results from the alternate time frames provides evidence on the appropriate time frame for base studies. Using one and two year periods, the ability of the base model to explain short-run change can be evaluated by goodness-of-fit measures and t-tests of individual coefficients. Longer run applicability can be evaluated with the longer periods.

The stability of the multiplier values with changes in endpoints is investigated by varying the initial and terminal years of the periods. For example, results based on a 10-year period beginning in 1969 can be compared to results using the change between 1970-80.

In order to estimate the coefficients of equation [2], employment must be divided between basic and nonbasic. Methodology developed by Braschler and Kuehn (1976) was followed for the bifurcation. Employment in the agriculture, mining, manufacturing, and federal government sectors were assumed to be entirely basic in nature. For all other industries, basic employment was determined by a modification of the location quotient method where the average nonmetropolitan county economy in one of two size classes was used as the baseline economy. The 79 nonmetropolitan Illinois counties were divided between those less than and those greater than 20,000 in 1980 population. The values for the dependent variable, total nonbasic employment, were determined by subtracting estimated total basic employment from total employment for each county.

The data used to estimate equation [2] consist of annual employment for the 79 nonmetropolitan counties in Illinois for the years 1969 to 1982. Central place theory suggests larger economies will have relatively larger service sectors resulting in less leakage and higher multiplier values. This implies that dividing economies by size into more homogeneous groups may improve estimation. Empirical research by Bender (1984) and Braschler (1976) supports this notion. Metropolitan counties were excluded from the analysis. Forty Illinois counties had a 1980 population of less than 20,000 and 39 counties had a larger 1980 population. A Chow test (Chow 1960) of the regressions based on this division yielded significant F-statistics (.05 level) for more than 90 percent of the regressions suggesting that this division of counties was appropriate.[2]

Bureau of Economic Analysis data provided the bulk of the observations. However, data for certain sectors for some counties in some years were not available. Missing employment data was allocated between sectors by assuming that the county employment mix was an average of the distributions of the previous and following years. If data for one of these years was withheld, the available distribution was used. If sufficient data were not available to follow this procedure, data from *County Business Patterns* were used. There is no reason to expect that any bias introduced by this procedure would systemically bias the results.

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[2] The F-tests to determine whether a structural difference exists between the smaller and larger population counties yielded F values of .874 to 27.729. The critical F-value (.05 level) is approximately 2.51. The test revealed that the division of counties was not significant for regressions using four of the shorter periods (1969-1970, 1969-1972, 1970-1972 and 1970-1973), but was significant for the remaining 23 pairs of regressions. The tests indicated that as periods lengthened divergence between the smaller and larger economies increased.

Results

The regression estimates for equation [2] for 13 different time periods are presented in Table 1 and 2. With the exception of the longest period, two sets of results were obtained for each of the periods by using 1969 or 1970 as the initial year of the period. Data limitations precluded estimation of a 13-year period beginning in 1970.

The results for the 40 nonmetropolitan counties of less than 20,000 population (Table 1), show that the R^2 values are not as high as those in some previous research, but the associated F-statistics are all significant at the .01 level. The regression results for the 39 nonmetropolitan counties in the larger population group indicate a less consistent pattern. The F-statistics for 7 of the 8 models using a time frame of four years or less are significant at the .05 level, but of the remaining 17 models using longer periods less than half are significant at that level. These results suggest that the base model performs reasonably well for both the short- and long-run analysis for smaller economies, but is less satisfactory for larger economies, especially for long-run analysis. The finding is in contrast with McNulty (1977) who found that the model explained long-run but not short-run changes. the divergence of the results may be partially due to differences in methodology and the sample.[3]

Gerking and Isserman (1981: 454) reject the use of R^2 values of regressions to indicate the relative explanatory power of similar models using different time frames. They argue that, given several assumptions, the sum of the squares of the regression errors (SSE) will be roughly constant, but the total sum of squares (SST) would be expected to increase with longer periods. If this relationship between SSE and SST is true, then R^2 would be expected to be higher for longer periods, regardless of the actual explanatory power of the models, since $R^2 = 1 - (SSE/SST)$.

Contrary to this expectation, the SSE values in this study were not constant. For all groups of regressions, the magnitude of SSE increased with period length, until highs were observed for periods of approximately ten years.[4] The nonconstancy of the SSE values suggests that the rejection of the validity of the R^2 is unwarranted for this study.

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[3] Unlike the present research, McNulty's (1977) study used income rather than employment data and divided activity between basic and nonbasic sectors by use of an assumption method rather than the modified location quotient technique used here. His sample consisted of SMSAs rather than nonmetropolitan counties.

[4] For example, using 1969 as the initial year of ther period, the values of SSE for small county regressions were found to be 114, 279, 469, 632, 1,270, 2,424, 2,968, 2,729, 3,568, 4,507, 4,658, 4,353, and 4,207 for periods that increased from 1 to 13 years. Similar patterns of increase were observed for larger county regressions, and for periods starting in 1970.

TABLE 1

Basic Sector Employment Multipliers for Nonmetropolitan Illinois Counties of Less Than 20,000 Population

Years in Period	Period	Change in Manufacturing Employment	Change in Agricultural Employment	Change in Other Basic Employment	Constant	$\bar{R}^2$ F
1	1969-70	.295**	.230	.533**	-13.961	.355**
		(3.477)	(.455)	4.223)	(.945)	8.689
	1970-71	.516**	-.656	.104	50.747**	.504**
		(5.213)	(1.260)	(.603)	(4.553)	14.200
2	1969-71	.368**	.024	.677**	50.315*	.405**
		(4.085)	(.475)	(3.707)	(2.438)	8.169
	1970-72	.502**	.596	.199	45.362**	.661**
		(7.141)	(1.740)	(1.069)	(3.264)	26.293
3	1969-72	.407**	.423	.409*	46.670	.432**
		(5.149)	(1.066)	(2.11)	(1.866)	10.880
	1970-73	.575**	.728**	3.17*	92.606**	.727**
		(9.431)	(2.339)	(2.147)	(5.407)	35.686
4	1969-73	.495**	.664**	.139	108.998**	.523**
		(2.910)	(6.28)	(.715)	(4.017)	15.815
	1970-74	.579**	.946**	1.055	166.182**	.639**
		(7.886)	(2.895)	(.543)	(7.043)	24.060
5	1969-74	.510**	.848*	.093	191.05**	.430**
		(5.283)	(2.167)	(.403)	(5.550)	10.810
	1970-75	.863**	.542	.244	297.445**	.456**
		(5.663)	(1.067)	(.321)	(8.305)	11.896
6	1969-75	.493**	.329	.571*	288.454**	.291**
		(2.910)	(.628)	(2.286)	(6.006)	6.335
	1970-76	.922**	.180	.628*	317.943**	.602**
		(7.443)	(.769)	(1.194)	(8.205)	20.688
7	1969-76	.746**	.555	.383	340.551**	.459**
		(4.859)	(.998)	(1.524)	(6.885)	12.013
	1970-77	.932**	.230	.116	237.982**	.687**
		9.188	(.472)	(.729)	6.66	29.526
8	1969-77	.862**	.190	.146	268.522**	.559**
		(6.680)	(.357)	(.768)	(5.862)	17.482
	1970-78	.928**	-.280	-.045	283.370**	.682**
		(9.153)	(.483)	(.241)	(6.057)	28.929
9	1969-78	.898**	-.318	-.040	307.871**	.567**
		(7.107)	(5.16)	(.176)	(5.084)	17.991
	1970-79	.949**	-.273	.298	328.142**	.558**
		(6.394)	(.433)	(1.237)	(6.325)	17.410
10	1969-79	.736**	-.191	.519*	330.802**	.447**
		(4.286)	(.296)	(2.087)	(5.115)	11.505
	1970-80	.876**	-.653	.295	275.799**	.440**
		(5.402)	(.928)	(1.227)	(3.951)	11.194
11	1969-80	.664**	-.541	.461	265.355**	.336**
		(3.778)	(.792)	(1.889)	(3.172)	7.578
	1970-81	.803**	-.780	.506*	244.462**	.506**
		(6.122)	(1.128)	(2.351)	(3.419)	14.295
12	1969-81	.670**	-.760	.559**	227.255**	.421**
		(4.698)	(1.169)	(2.524)	(2.719)	10.436
	1970-82	.855**	-1.365*	.728**	207.379**	.519**
		(5.653)	(2.123)	(3.814)	(2.575)	15.005
13	1969-82	.647**	-1.181	.741**	183.662	.434**
		(4.137)	(1.926)	(3.751)	(1.997)	10.951

Note: The dependent variable is the change in nonbasic employment.
( ) Absolute value of t-statistic; * Significant at .05 level, two tail test; ** Significant at .01 level, two tail test.

TABLE 2

Basic Sector Employment Multipliers for Nonmetropolitan Illinois Counties of More Than 20,000 Population

Years in Period	Period	Change in Manufacturing Employment	Change in Agricultural Employment	Change in Other Basic Employment	Constant	$\bar{R}^2$ F
1	1979-70	.319**	.382	.477**	43.663	.291**
		(4.125)	(.351)	(2.809)	(.924)	6.195
	1970-71	.158	-1.831	-.284	203.988**	.075
		(1.169)	(.844)	(.792)	(2.912)	2.033
2	1969-71	.426**	-.832	.652*	252.829**	.226**
		(3.717)	(.681)	(2.575)	(2.759)	4.696
	1970-72	.339*	-1.234	.175	57.173	.149*
		(2.586)	(1.098)	(.761)	(.772)	3.213
3	1969-72	.518**	-.863	.582**	60.583	.348**
		(4.477)	(1.040)	(3.096)	(.678)	7.751
	1970-73	.571	-1.552	.507*	132.556	.506
		(5.838)**	(1.681)	(2.522)	(1.858)	14.000
4	1969-73	.635**	-.920	.750**	126.185	.586*
		(7.148)	(1.272)	(4.428)	(1.520)	18.909
	1970-74	.747**	-1.235	.890**	397.329**	.368**
		(4.693)	(1.081)	(3.085)	(3.910)	8.385
5	1969-74	.702**	-.881	.947**	413.607**	.420**
		(5.075)	(.909)	(3.968)	(3.522)	10.189
	1970-75	-.253	.856	.034	1047.397**	.000
		(.919)	(.507)	(.089)	(8.093)	.524
6	1969-75	-.021	.751	.320	1070.029**	.000
		(.099)	(.500)	(.964)	(6.638)	.626
	1970-76	-.346	.005	.081	1267.216**	.008
		(1.115)	(.003)	(.222)	10.083	1.100
7	1969-76	-.188	-.116	.236	1278.673**	.006
		(.669)	(.072)	(.667)	(8.554)	1.080
	1970-77	.044	2.122	.575	1098.407**	.068
		(.155)	(1.294)	(1.652)	(8.477)	1.721
8	1979-77	.071	1.633	.638	1159.396**	.089
		(.285)	(1.072)	(1.953)	(7.771)	2.232
	1970-78	.383	(.902)	1.009*	1342.600**	.116*
		(1.213)	(1.026)	(2.386)	(6.130)	2.659
9	1969-78	.311	1.177	1.014*	1356.704**	.146*
		(1.091)	(.719)	(2.667)	(5.423)	3.172
	1970-79	.347	1.647	1.096**	1365.718**	.181**
		(1.209)	(1.007)	(3.103)	(7.208)	3.802
10	1979-79	.278	1.078	1.089**	1394.14**	.221**
		(1.064)	(.720)	(3.341)	(6.613)	4.597
	1970-79	.139	.268	.803*	1256.531**	.126
		(.842)	(.155)	(2.646)	(4.803)	2.831
11	1969-80	.199	.035	.966**	1200.000**	.209**
		(1.329)	(.029)	(3.402)	(4.188)	4.352
	1970-81	.150	-.396	.870*	1177.740**	.117
		(1.021)	(.225)	(2.643)	(4.145)	2.685
12	1969-81	.237	-.566	1.107**	1205.641**	.216**
		(1.693)	(.378)	(3.528)	3.624	4.491
	1970-82	.079	.078	.492	1396.093**	.000
		(.602)	(.049)	(1.439)	4.333	.784
13	1969-82	.146	-1.549	.790*	1352.833**	.065
		(1.143)	(.109)	(2.282)	(3.978)	1.882

Note: The dependent variable is the change in nonbasic employment.
( ) Absolute value of t-statistic; * Significant at .05 level, two tail test; ** Significant at .01 level, two tail test

Chow tests were conducted to determine whether the relationship between the basic and nonbasic sectors changed when using different time frames. The F-statistics between the regressions using one and nine year periods (for which the manufacturing multipliers were lowest and highest, respectively) were found to be significant (.01 level) for both county groups.[5] Multicollinearity was not found to be a problem. Most correlation coefficients between variables were less than .200 in absolute value. The largest (in absolute value) was -.729.

The addition of unity to an estimated coefficient provides the multiplier. For example, the manufacturing coefficient for the 1969-74 period for the smaller population counties (Table 1) is .510. This indicates that in the smaller counties, each additional 100 manufacturing jobs in the 1969-74 period was associated with an increase in county nonbasic employment of 51 jobs during that period. The multiplier of 1.510 indicates the total increase in jobs (including the manufacturing job) per unit increase in manufacturing employment.

The estimated values of the manufacturing multipliers were less than 2.00 in every case. These estimates are somewhat lower than those found in some previous studies. This may be due to the bifurcation method used to divide basic and nonbasic activity. The entire manufacturing sector was assumed to be basic. This minimizes intraregional trade and biases the multiplier downward (Kuehn, et al. 1985).

Using a stepwise regression procedure, it was found that in almost all cases, more than half the total explanation of variation was provided by the manufacturing variable. The agriculture variable coefficient was significant in only 5 of the 50 regressions and added little explanatory power to the models. McNulty (1977), Shaffer (1983) and Shahidsaless, et al. (1983) also reported insignificant agriculture variable coefficients in some cases. In this study, the insignificance of the agricultural variable coefficients may be due to the relative lack of variation in the variable in comparison to other variables. For example, in most cases, the standard deviation of the agricultural change variable was less than a quarter of the standard deviation of the manufacturing sector variable. Also, the bifurcation technique, in which all agricultural product is assumed to be exported, tends to underestimate multipliers (Kuehn, Procter, and Braschler, 1985) and may be partially responsible for the insignificant agriculture coefficients.

The other basic sector variable reflects all basic employment not in the manufacturing or agriculture sectors. It includes the mining and federal government sectors as well as portions of the remaining sectors. The coefficients of the other basic sector variable were found to be significant in a little more than half of the regressions. The significance of the variable did not

[5] F-values for regressions for small counties were found to be 8.700 and 7.299 for the periods beginning in 1969 and 1970, respectively. The corresponding F-values for the larger population counties were 13.822 and 9.597. The critical value of the F-statistic (.01 level) is approximately 2.6.

exhibit any clear-cut relation to the length of the period under consideration. The aggregated nature of the variable (consisting of basic employment in several diverse sectors) may have obscured significant relationships between basic employment and nonbasic employment in specific sectors.

The pattern of multipliers for the manufacturing and agricultural sectors are depicted in Figures 1a and 1b, respectively. Only those multipliers based on statistically significant coefficients (.05 level) are plotted. The multipliers are plotted against the length of the period, the one year period being the leftmost value. The periods increase in length by single year, increments moving to the right, until a maximum length of 13 years is reached. Lines connect multipliers that share common initial years and county population groups. For example, the multipliers for periods beginning in 1969 for smaller population counties (connected with solid lines) range from approximately 1.300 for the one-year period 1969-1970 to 1.650 for the 13-year period 1969-1982.

The multipliers for the manufacturing sector present the most interesting pattern. For the smaller population counties, the manufacturing multipliers generally increased with longer periods until highs of 1.898 and 1.949 were reached for the nine year periods beginning in 1969 and 1970, respectively. The values generally declined as the period lengthened beyond nine years.

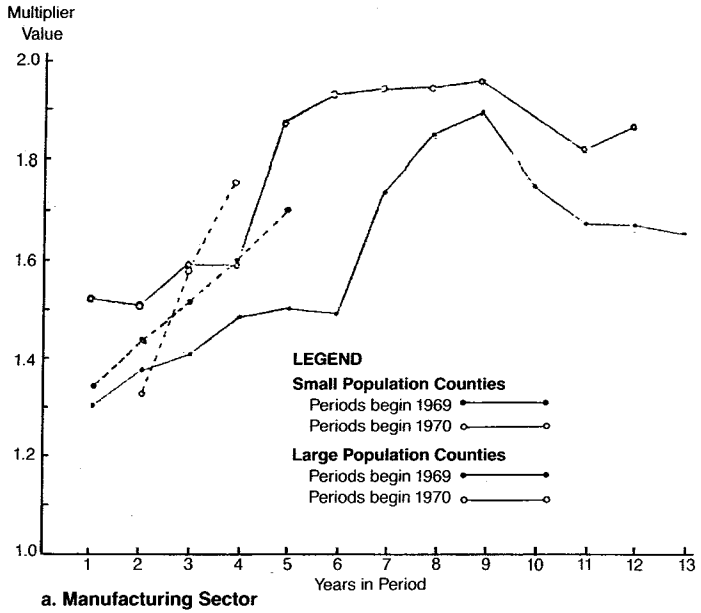
The pattern of rising multiplier values would be expected if the multiplier process requires several years. As the time periods used in the models lengthened, a greater proportion of the total nonbasic response would be reflected in the dependent variable, and coefficients would increase.

The declining values for periods longer than nine years may be due to the influence of factors excluded from the model. Structural changes in the county economies (such as a trend towards specialization, leading to less local interdependence) may be responsible for the observed declining multipliers.

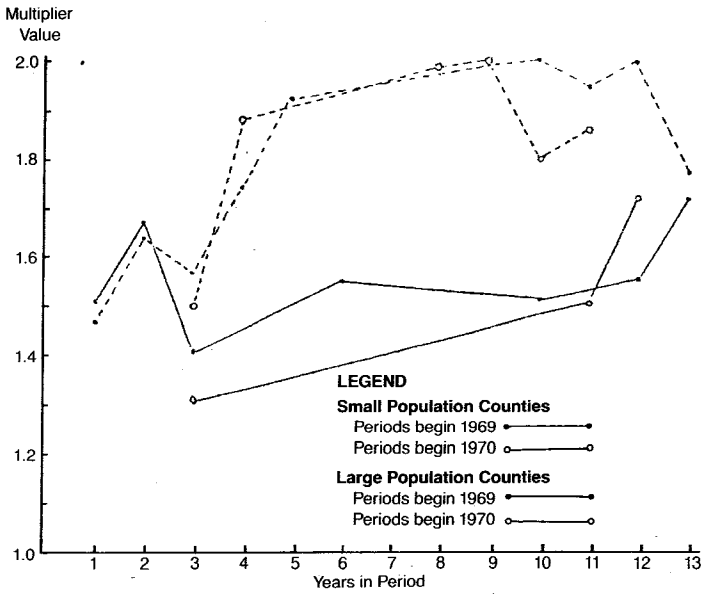
Research by Bender and Parcels (1983) and Bender (1984) indicates that the nonbasic response to basic sector changes is sensitive to the pattern of basic changes. The change variables used in the present analysis ignore all fluctuation in employment between the initial and terminal year. Thus, the pattern of basic employment change would not be reflected in the variables and may partially account for the results using longer periods.

The manufacturing multipliers for the larger population counties show a pattern of increase for shorter time periods, but the manufacturing coefficients are insignificant for longer periods. Since larger regions tend to be less dependent on exports than smaller economies, other factors — structural and demographic — might be more important in the larger regions than export activity as time goes on.

The pattern of the multipliers for the other basic sector is presented in Figure 1b. As expected, the multipliers for the smaller counties are generally smaller than their large county counterparts, reflecting the greater leakages found in the smaller economies. The patterns of multipliers of the other basic sector are based on fewer multipliers and are more erratic than those of the manufacturing sector. With a few exceptions, the other basic sector multipliers for the two



a. Manufacturing Sector



b. Other basic employment sector

Figure 1. Employment multipliers for 13 periods

groups of counties exhibited similar patterns; generally increasing as the periods lengthened.

Endpoint sensitivity. To investigate the sensitivity of the multiplier values to the endpoints of periods, the results for periods of equal length, but using different years as endpoints, were compared. For the smaller population counties, use of 1970 rather than 1969 as the initial year resulted in greater explanatory power (in 10 of 12 cases) as indicated by the R^2 values and associated F-statistics. No such pattern was evident in considering the larger county economies, but the overall fit diverged substantially for some periods when varying the initial year. For example, when the model was estimated for five year intervals, use of the period beginning in 1969 yielded an R^2 value of .420 compared to .000 for the 1970-1975 period.

Divergence of the estimated manufacturing sector multipliers in smaller counties can be seen in Figure 1 by comparing the two solid lines. The upper solid line represents periods in which 1970 is the initial year, the lower solid line, periods beginning with 1969. In both cases, multiplier estimates reach a peak using the nine year interval, but are higher for all periods when 1970 is used as the initial year. The difference is greatest for the five and six year intervals in which the estimates differ by more than .35. The use of 1969 rather than 1970 generally seems to make little difference for the large county manufacturing multipliers and the multipliers for the other basic sectors.

The findings using different endpoints suggest that results based on a single period should be viewed with caution and, if possible, checked against results based on other time periods.

The fact that a substantial portion of the variation in nonbasic employment is not explained by the model (reflected in the significant R^2 values and intercept terms) suggests that other factors besides export activity are of influence. If these other factors are correlated with the basic sector variables in the model, multiplier estimates are subject to specification bias (Findyck and Rubinfeld, 1982).

Summary and Conclusions

For smaller economies, the economic base theory explained the data reasonably well in both the short-run and the long-run. For larger non-metropolitan economies, the model performed fairly well in the short-run, but was inconsistent for periods longer than four years. The opposite pattern was suggested by the results of cross-sectional research for metropolitan areas by McNulty (1977). McNulty suggested that economic base theory "provides a very poor explanation of short-run regional economic development" (p. 367) but was useful for analyzing long-run growth.

Considering the results of this study, in the context of previous research, suggests that the ability of economic base theory to explain regional economic change depends on the time frame considered, and size of the economies under investigation. However, it must be emphasized that the results of each empirical study are influenced by the type of methodology used. Particularly, the results may be sensitive to the technique of identifying basic economic

activity (Park, 1970; Kuehn, et al. 1985). Since all nonsurvey techniques are based on somewhat dubious assumptions and appear to be somewhat inaccurate (Isserman, 1980), cautious evaluation of the validity of theory is suggested.

For smaller counties in this study, a pattern of rising, then declining manufacturing multiplier values was observed as the time frame lengthened. Further research is needed to determine the stability of, and reasons for, this pattern.

The fact that manufacturing multiplier values peaked using a nine year period (for smaller counties), and the other basic employment multipliers were near their highest values using a ten year time frame suggest the use of a decade in previous studies (Schaffer, 1983; Shahidsaless, et al. 1983; and Braschler, 1972) is not inappropriate, and such studies may measure multipliers near their maximum value. Those studies which use much shorter periods may underestimate multiplier values.

Comparison of results based on periods of equal length but using different endpoints suggests that the reliability of the results may be increased by using estimates based on more than a single period. A division between expanding and contracting counties (Shaffer, 1983), consideration of locational factors (Shahidsaless, et al. 1983) and the use of income data might improve the explanatory power of the models.

In conclusion, the results of the present study document the usefulness of economic base analysis for short-run analysis (contrary to the findings of McNulty, 1977), but suggest that the applicability of economic base analysis may depend on the size of the economies under investigation and methodological considerations, as well as the length of time frame employed. The fact that much of the variation in nonbasic economic activity is not explained by the models emphasizes that economic base analysis alone will not provide a comprehensive understanding of economic growth and decline. Rather, it may serve as a useful component of a comprehensive program for community economic development.

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