THE ROLE OF FACTOR SUPPLIES IN EMPLOYMENT GROWTH*

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ABSTRACT

Most predictions of employment and population growth, including those made in an input-output framework, have been the sum of independent estimates of employment growth in different sectors. An implicit assumption has been that rates of growth in the different export sectors are independent of one another. Although it has been widely recognized in theory that growth in one sector may limit growth in another sector by bidding up factor prices, most actual predictions have resulted from summing independent predictions of employment growth in the different sectors. The validity of this assumed independence will be tested using shift-share data. The standard application of shift-share methodology (explained below) contains an implicit assumption that the regional share component and the industrial mix component are independent of one another. Yet there are theoretical reasons for both positive and negative correlations between growth in the different sectors. Positive correlations could result from growth in one sector expanding the market for the second sector, as is recognized in export base and input-output models. This is offset by the tendency for growth in one sector to restrict growth in other sectors by bidding up the prices for factors of production, notably labor.

Which effect predominates is examined by regressing the regional share component of county employment growth on the industrial mix component. In most cases the competition for factors of production appears to be the most important effect. In all cases such competition seems to be important. These results are used to derive estimates of the local impact multiplier for employment and it is found to be substantially less than had previously been estimated.

Forecasting Methods

There are numerous methods which may be used for predicting employment growth. In broad outlines however two approaches have been followed, one based on supply and one based on demand. The supply based models have usually predicted population by some means, perhaps an assumption of historical migration plus natural increase. From this estimate of the population an estimate of the labor force has been made using assumed participation rates. The final estimate of employment has then been obtained by subtracting an estimated unemployment.

The most commonly used models for predicting employment are demand based models, such as input-output. These typically break the economy down into a number of sectors and make separate projections for each. While details vary the most common projedure is to make a national projection for employment in that industry and then estimate the proportion of national employment in the industry that will be found in the local area. A relatively naive model assumes that the area will maintain its historical share

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of the national industry. More sophisticated models examine the trend in the local share of national employment in the industry and project this forward.

After estimates of employment in separate sectors have been made,total employment is obtained by summing the estimates for the sectors. For the best estimate of total employment to be the sum of the estimates of employment in each sector it is necessary to assume that growth in one sector does not produce effects on growth in other sectors. To examine this assumption is one of the goals of this paper.

A very common modification of the above procedure is to divide the economy into two parts, one selling in a national market, and the other in a local market. A procedure of the above type is then used only to forecast employment in the part selling in a national market (the "export" sector). The total employment is then obtained by multiplying the employment in the "export" sector by a "multiplier" to obtain total employment.[1]

There are many demand based models that might be investigated. The one that will be examined here will be a form of "shift-share" analysis. While the data and conceptual framework employed here originated in the Office of Business Economics, they did not propose any particular use of their data for forecasting. The procedures discussed here, while apparently reasonable applications of the basic data, are not necessarily those that would be endorsed by the Office of Business Economics. The shift-share method of analysis will not be discussed in detail here since that has been done well elsewhere.[2]

In essence the procedure involves disaggregating the economy into a number of industrial sectors. Within each sector the total change in employment is divided into three components. (1) The national growth component is the change in employment that would result if local employment in the sector grew at the national rate. (2) The industrial mix component is the additional change in employment (minus the national growth component) that would result if employment in the local sector grew at the same rate as employment in that sector nationally. (3) The regional share (sometimes called the competitive component) is the algerbraic difference between the change in total employment and sum of the national growth and industrial mix components. It is thus a residual component.

For example consider an industry that locally employs 1,000 workers. Over a period of a decade the national employment rises by 20% for all industries, while national employment in that particular industry grows by 30%, and local employment in the industry grows by 400 individuals. If the local industry had grown at the 10% national rate,it would have experienced an increase in employment of 100. This is the national growth component of local employment change. If the local industry had grown at the same rate as the industry had nationally (20%), its local employment would have risen by 200. After subtracting the 100 workers that represent the national growth component of employment change,this gives the industrial mix component of +100. If the national growth and industrial mix components are subtracted from the total change in employment (400) the remaining growth in employment of 200 is the regional share component.

As can be seen the industrial mix component indicates how much of the local growth is due to having more (or less) rapidly growing industries than the rest of the nation. The employment growth rate for the nation is determined by two factors. One is how rapidly the national market for that commodity is growing. The other is the magnitude of changes in productivity, or how many men are required to supply a given amount of the good. For industries selling in a national market, and for industries where local rates of productivity change follow the national pattern, the industrial mix component should indicate the effects of market growth and productivity change on employment in that industry.

The regional share component indicates the amount of the employment change that is due to causes other than the community's industrial mix. The presence of a negative regional share indicates that the industries in the community are growing less rapidly than the corresponding industries on the national level. Likewise, a positive regional-share component indicates that the area's industries are growing more rapidly than the corresponding industries nationally. Thus, the regional share component is often interpreted as a measure of the general competitiveness of an area.

The Data Used

The industrial mix components and the regional share components utilized here will be those calculated by the Office of Business Economics using census data for 1940, 1950 and 1960.[3] They have been calculated for all states and for 3,102 counties or county equivalents for all three years. These calculations utilized a division of the economy into 38 industries (listed in Table 4 with their 1960 employments). It shoudl be noted that the armed forces are treated as one industry, and most of government administration as another. Agriculture, mining and construction each consist of a sector, while manufacturing is divided into ten sectors. Trade and services constitute the remaining sectors.

The Interaction Between the Industrial Mix and Regional Share Components

The discussion so far has treated the industrial mix and regional share components as independent. The standard projection methodology would project the industrial mix component by multiplying local employment in industry by the anticipated national growth in that industry. The projection of the regional share component would be made by using the previous period's regional share component.[4] This procedure implicitly assumes that the magnitude of the regional share component is not influenced by the magnitude of the industrial mix component. In other words, whether particular industries grow more or less rapidly in a certain locality than they do nationwide does not depend on the extent to which the local area has other industries that are fast or slow growing nationwide.

There are two reasons for expecting an association between the regional share component and the industrial mix component: one is the effect of overall regional growth on demand and the other is the effect on supply. The effect on demand arises because many industries such as trade and services sell to a local market. If the area has many rapidly expanding export industries, retail trade, personal services, and local government will probably be expanding at an above average rate. Thus these industries will show a positive regional share. Likewise, where the export industries are declining or growing slowly (such as agriculture or mining) it is to be expected that the local service industries will also show small employment growth. Again there is a positive correlation between the industrial mix component and the regional share component.

Most predictions for local areas, including those from input-output models, incorporate some recognition that certain industries serve local markets.[5] Since the shift-share data treat the industries serving local markets the same as they do industries serving national markets, a strong positive correlation between the industrial mix component and the regional share component is to be expected as a result of demand consideration.[6]

However, consideration of the role of supplies of factors of production leads one to expect a negative correlation between the industrial mix and regional share components. The ability of a particular area to expand its share of national employment in an industry depends on the availability (including price) of factors of production in that area relative to other areas. An area whose factors of production are underutilized relative to the rest of the nation would be expected to increase its share of national production in each of its industries.

To actually estimate the model sketched out would be very difficult. For the counties in the United States the only factor of production for which prices are available is labor, and even here there is the difficult problem of correcting for differences in quality. There is little knowledge of how changes in the demand for labor affect wage rates, and little knowledge of how these changes in turn affect the level of employment offered by various employers.

Because of lack of both theoretical and empirical knowledge, the intervening variable of factor prices will be ignored. Although many of the effects to be discussed are partially caused by changes in factor prices. Instead, the industrial mix component of employment change will be used as a surrogate for the availability of factors of production. It will be recalled that a positive industrial mix component indicates that an area has an above average proportion of rapidly growing industries. This would be expected to lead to a shortage of factors of production, expecially labor. Such a shortage might reveal itself in wages being bid up, or if wages remain unchanges each employer may observe that the quality of labor being obtained at the old wages had deteriorated. In addition, the expansion of production is likely to bid the prices of vacant plants up to the level at which new construction becomes practical, and then to bid the price of industrial sites up. Because of these effects on factor supplies, it is likely that within each export industry the local community's proportion of the national industry would decline. Those industries that were expanding would show some absolute growth,but would tend to locate new capacity elsewhere to avoid the labor shortage. Other industries, with a less buoyant national demand, might experience actual dpclines in employment as employers shifted operations to areas where costs had not risen.

No consider the case of a community whose dominant industries were actually declining nationwide. Such a community would develop a surplus of labor, reflecting itself in lower wages and better quality workers at the older wages. Prices for industrial sites would fall. If firms in the slow growing industry actually closed plants there would become available at low prices for utilization by other industries. The existing firms might decide to diversify into a new line of production in order to utilize their existing capital equipment, labor and management talent. Under these conditions, the area with the slow growing industries would have conditions favorable for the expansion of its share of national employment in any one industry. Hence, an area with an unfavorable industrial mix component should show a favorable regional share component.

Thus, for areas dominated by either fast or slow growing industries, considerations of factor supply indicate that there should be an inverse correlation between the industrial mix component and the regional share component. But, as explained earlier, demand consideration indicate that there should be a positive correlation between the industrial mix and the regional share components. Thus there are good theoretical reasons for anticipating either a positive or a negative correlation between the industrial mix component and the regional share component. Whether the supply or demand factors are actually more important can only be resolved by empirical tests.

The Relationship Between State Regional Share Components and State Industrial Mix Components

The above hypothesis as will be tested using both state and county data. The state data will be used first because it avoids certain complexities associated with the county data. Thus, the state regional share component (in a percentage form) was regressed on the state industrial mix component (also in percentage form). The equation for the forties was (Standard errors in parenthesis. REGS45 = regional share component for 1940-1950, INDM45 = industrial mix component 1940-1950):

(Eq. 1)

REGS45 = 1.725% - .3989 INDM45
(.1831)

Standard error = 11.3673% R^2 = 9.17%

While, for the fifties the equation was:

(Eq. 2)

REGS56 = 1.617% - .1793 INDM56
1(.3025)

Standard error = 15.38% R^2 = 0.74%

For both decades the coefficients were negative, although the coefficient for the fifties was not significantly so (t = -.59). For the forties, the coefficient was significantly negative at the 95% confidence level, but not at the 99% level. (t = -2.18). In both decades, the effect of competition for factors of production exceeds that of demand consideration.

The Relationship Between the Industrial Mix Component, and the Regional Share Component for Counties

When the 1940-1950 regional share component in percentage form was regressed on the 1940-1950 industrial mix component for counties, the following equation was obtained:

(Eq. 3)

$$REGS45 = 1.570\% - .06607\ INDM45$$
$$(.02516)$$

Standard error = 19.14% $R^2 = 0.22\%$

When the same equation was calibrated for the period 1950-1960, the resulting equation was:

(Eq. 4)

$$REGS56 = 3.501\% + .2733\ INDM56$$
$$(.027590)$$

Standard error = 18.76% $R^2 = 3.07\%$

Although the large number of observations insures that the negative coefficient is statistically significant at better than the 95% level(t = 2.63) for the forties, the percentage of the variance explained is low. If there was just one effect operating, this would indicate that the effect was not very strong. However, the low percent of the variance explained is not cause for worry since there are two opposing effect operating here, and the goal is to compare their relative strengths. During this decade, the effect of factor availability slightly exceeded the effect of growth induced demand. During the fifties the roles reversed themselves and there was a positive, definitely significant (t = 9.905) correlation between the two components of growth. This indicates that the effect of the induced demand from rapid industrial growth more than offset the negative effects of competition for factors of production.

In interpreting these equations it must be recalled that they included all industries, some of whose markets are primarily local. If consideration had been limited to just the "export" industries, there probably would have been a strong negative correlation in both cases. This is certainly true for the forties, and it is highly likely that the induced demand for the local industries from having rapidly growing export industries would have resulted in a coefficient higher than .273 if there was no competition for factors of production. Thus, both equations can be interpreted as showing that competition for factors of production is important.

When working with simple cross-sectional regressions of the above type there is always a risk that the observed correlation is spurious. Both the industrial mix variables and the regional share variables may be influenced by a common factor. This will produce a correlation but does not indicate any causal connection. There is no way to tell if the observed correlation is due to such factors or is really due to the industrial mix causing the regional share component to change. A stronger test is needed.

Such a test is to examine what happens when the industrial mix component changes. If a cause of positive or negative regional share components is a positive or negative industrial mix component, it is to be expected that changes in the industrial mix component will produce corresponding changes in the regional share component. We would thus expect a correlation between changes in the industrial mix component, and changes in the regional share component.

To examine this hypothesis, the change in the percentage regional share component (DREGS) between the forties and the fifties was regressed on the change in the percentage industrial mix component (DINDM) between the same two decades. The resulting equation was:

(Eq. 5)

$$\text{DREGS} = 2.88505\% - \underset{(.05199)}{.49721}\ \text{DINDM}$$

Standard error = 22.0138% $\quad$ $R^2 = 2.87\%$

When the regional share component is expressed as a percentage there is a highly significant inverse relationship between the changes in the industrial mix component and the changes in the regional share component (t = 9.56). In particular, an autonomous increase in employment of 100 (due to a favorable industrial mix) will be offset by a decrease in employment of 49.72 individuals due to decreased availability of factors of production. The final increase in employment is only about half of the number of jobs directly resulting from the favorable industrial mix. This result is more remarkable when it is realized that it includes the effect of the increased market for local production resulting from the initial employment increase.

Although the above results are statistically significant, only a small amount of progress has actually been made towards explaining the values for the percentage regional share for the fifties. Only 2.8% of the change in the regional share component can be explained. The above equation (Eq. 5) can be used for forecasting by using the predicted change in the industrial mix component to predict the change in the regional share component. This predicted change is then added to the value observed in the previous decade (here the forties) to obtain a prediction of the regional share component for the coming decade (the fifties). If the industrial mix predictions are perfectly accurate (impossible), the standard error of Equation 5 gives the expected error for the prediction. This standard error is 22.01%, a rather large error. This exceeds the standard error of 18.763% obtainable by making the regional share component a function of the current industrial mix (Eq. 4).

Yet, we have shown that there is a relationship between the industrial mix component and the regional share component. There should be a way to use this information for purposes of prediction. The simplest way to do this is to incorporate the industrial mix component into the regression which includes the historical regional share component. Such an equation was actually estimated using the total change in employment for the fifties (TOTALC56) as the dependent variable:

(Eq. 6)

$$\text{TOTALC56} = 16.14\% + \underset{(.0157)}{.2779}\ \text{REGS45} + \underset{(.02460)}{1.1275}\ \text{INDM56}$$

Standard error = 16.60% $\quad$ $R^2 = 46.2\%$

By definition the total change in employment is composed of the national growth component plus the industrial mix component plus the regional share component. And since:

(Eq. 7)

growth in employment 1950-1960 = 14.4%

Therefore

(Eq. 8)

REGS 56 = 2.7% + .2779 REGS 45 + .1275 INDM 56

(.0157) (.0246)

The standard error of this equation (Eq. 8) is the error obtainable in predicting the total change in employment (Eq. 7) if the industrial mix component is known. Since the coefficient for the industrial mix component is 5.2 times tis standard error, there can be little doubt that predictions of the regional share component made from the previous decade's regional share component can be improved by using the industrial mix component. The best predictions for the percentage total employment change can be obtained from the equation including both the regional share component for the previous decade (the forties), and the industrial mix component for the coming decade. Such predictions with a perfect knowledge of national employment growth in the different industries would have a standard error of 16.6%. This is only slightly better than a standard error of 18.8%[7] obtained by projection from the historical percentage change in employment. How much of this improvement for 18.8% to 16.6% standard error is actually obtainable depends on how accurately the industrial mix component can be predicted. This will depende on how accurately the national employment in 38 industries can be projected.

The conclusions about forecasting accuracy are rather discouraging. Even assuming perfection in forecasting employment in the national industries, predictions for county employment will have a standard error of at least 16.6%. This indicates that the user of forecasts should always consider several outcomes and struggle to retain flexibility.

The Relationship Between the Numerical Regional Share Components and the Numerical Industrial Mix Components

Regressions with all observations weighted equally are dominated by the numerous, small, rural counties. To see if the conclusions drawn for these counties also hold for the large, urban counties the same regressions were also run with the numerical size of the components are variables. For 1940-1950 a regression of the regional share component on the industrial mix component gave:

(Eq. 9)

REGS 4050 = -0.1 - .9180 INDM 4050

(158.1) (.0226)

Standard error = 8806. R^2 = 34.70%

The same regression for the decade of the fifties gave:

(Eq. 10)

REGS 5060 = 0.6 - .8748 INDM 5060

(290.024) (.0485)

Standard error = 16.153 R^2 = 10.51%

The two equations have very similar coefficients, although the fit was better for the forties. Since the constant term is only fractionally above zero, both equation indicate that the regional share component is approximately proportional to the industrial mix component. Both coefficients for the industrial mix component are negative and have high t values (-40.6 for 1940-1950, and -19.1 for 1950-1960).

While the t statistic greatly overstates the precision of the coefficient estimates, it is clear that they are negative and large. The negative values for the coefficients are even more significant when it is realized that there are strong forces from the demand side making for a positive coefficient. The magnitude of the coefficients suggests that for every 100 jobs created in a rapidly growing industry, there will be an offset of 87 to 91 jobs due to a shortage of factors of production producing declines in the area's share of national employment within the different sectors. This appears implausible high.

These regressions are dominated by the very largest counties, which typically contain a large central city. Such central city counties typically have a very favorable industrial mix both because of the absence of slow growing industries (such as agriculture, mining, and textiles), and because of the presence of fast growing service industries. These central city counties are losing industry and population to their suburbs. Since the data used here is on a place of residence basis, a combination of rapidly growing industries and an actual decline in employment is possible. Such a combination will actually be observed for certain regions. (See below).

Even without a decline in employment, there may be a spurious negative correlation between the industrial mix and the regional share components of growth. This is because, to a first approximation, the population of a fully built up urban county may be constant, and this will in turn produce an approximately constant total employment. Thus, growth in employment from a positive industrial mix component must be offset by a negative regional share component. The resulting negative correlation between the industrial mix and the regional share components is due to competition for living space, rather than to competition for factors of production. Likewise, a suburban county may show a large regional share component only because of overflow from a nearby city. Although these biases partially cancel each other when examining all counties in a large area, there is no assurance that the concealing is complete.[8] These biases could be avoided by using the metropolitan area as the unit of anlaysis. This was not done here because the original data was on a county basis, and resources were not avaialbe to aggregate the data into metropolitan areas.[9]

When the above equation was estimated in a first difference form by regressing the change in the numerical regional share component (CREGS) on the change in the numerical industrial mix component,(CINDM) the following was obtained:

(Eq. 11)

$$\text{CREGS} = .8 + \underset{(.0545)}{.5162}\ \text{CINDM}$$

Standard error = 8841. R^2 = 2.61%

In the first difference cross sectional equation, the coefficient for the change in industrial mix component is <u>positive</u>. It is very difficult to reconcile the positive coefficient for the first difference equations with the negative coefficients observed in the two simple cross-sectional equations (for the forties and for the fifties). The explanation is probably in sampling variability.

Although the t statistic is large enough (t = 9.473) that for homoscedastic data, the hypothesis of no correlation could be rejected, the present data is highly heteroscedastic. The standard error of the above equation is 8841. Counties which had a <u>change</u> in regional share of less than this had very little effect on the coefficients of the equations. In practice, the regional share and industrial mix components for successive decades are closely correlated. The numerical sizes of the county regional share and industrial mix components can be accurately predicted from the same component for the previous decade. (R^2 = 82.63% for the numerical industrial mix component).[9] This means that for counties the change in either component tended to be small. Thus, a few very large counties with large changes in their regional share or industrial mix components could have produced the results observed.

Regional Equations

Table 1 shows the results of the simple regressions of the percentage regional share equations on the percentage industrial mix components for different regions of the county.[10] In the forties the coefficient is negative in all cases except for the Plains, and the West. In the latter two cases the positive coefficient is not statistically significant. In contrast the negative coefficient for the South is significant at the 95% significance level, as are the negative coefficients for the three components of the Manufacturing Belt (New England, the Mid-East, and the Great Lakes). For the Manufacturing Belt as a whole the negative coefficient was highly significant (t = -6.993). It appears that for most of the country, the effect of factor availability outweighed the effect of demand. When allowance is made for the positive correlation that would be expected if only demand factors were operative, it is clear that limitations in the supply of factors were significant for all parts of the country during the forties.

The picture changes when we examine the fifties. Now all coefficients are positive except for New England and the Mid-East. In the latter two cases the negative coefficients are not statistically significant. The positive coefficients are all significant at the 95% level except for the Manufacturing Belt (which includes both New England and the Mid-East). Except for the South and the West, the magnitude of the coefficients are clearly less than would be expected if the availability of factors of production did not limit growth. The coefficients for the South (.4233) and the West (.4751) are appreciably higher. Still, these appear to be below those that would prevail if factor supplies were not a constraint.

It is not clear what causes the differences between regions. The most likely explanation is differences in the mobility of factors of production, primarily labor. In regions where labor is highly mobile, factor availability will play a smaller role. In such areas, the effect of demand will tend to produce a positive correlation between the regional share and industrial mix components (or to make for a lesser negative correlation).The greater mobility of labor in the West[11] provides an apparent reason for it having the most positive coefficient in the simple correlations for both the forties and the fifties, and for it having the second highest coefficient in the first difference equations.

Regional Numerical Equations

For the nations as a whole, the behavior of the large urban counties was examined by regressing the numerical regional share component on the numerical industrial mix component. This procedure will be repeated for the different regions. However, because each region is dominated by a relatively few large counties, the precision of the estimates is not high. The regional equations are given in Table 3.

The results are especially good for the Manufacturing Belt and its component parts. However, part of these good results may simply reflect the ability of the equation to fit a few large cities in each region. Because of the highly heteroscedastic data, the consistently high t values do not necessarily indicate that the coefficients are statistically significant.

The general pattern of coefficients for the numerical equations follow the pattern for the percentage equations. Except for the South and West, all coefficients are negative for both decades. Only the coefficient for the West is highly positive, reaching a value of 1.8139 for the fifties (possibly due to the very large values of both components for Los Angeles). Many of the negative coefficients have values in excess of one. It would be implausible for the effect of the industrial mix component on the regional share component to be actually this large. A coefficient over one indicates that the regional share effect exceeds the industrial mix component with the result that areas with rapidly growing industries actually show a decline in total employment. As discussed above the most likely cause of the high coefficients is that the sample is dominated by large counties, typically containing the central city of a metropolitan area.

Regional regressions of the change in the numerical regional share component on the change in the numerical industrial mix component were made. For the sake of completeness they are reported in Table 2 (left side). However, the accuracy of these equations is probably even lower than for the simple regressions reported above. Not only are there a limited number of large urban counties in each region, but due to the high degrees of correlation between regional share and industrial mix components in successive decades, most of the changes in the components are relatively small. Thus, the results for any one region may be dominated by a few or even one large urban county.

The high variability in the values for the coefficients may merely reflect the above statistical problems. All coefficients are positive except for the Mid-East and the South. This is a contrast with the first difference results for the percentage equations where all coefficients except one were negative. In the numerical first difference equations the highest coefficients are for New England and the Plains, both of which are positive and in excess of one. Great significance should not be attached to these equations because of the difficulties mentioned.

The Local Employment Multiplier

A major problem in regional economics is the impact on total employment of an autonomous expansion in employment in a particular sector. For instance, the Bureau of Reclamation seeks to estimate the total increase in employment that results from the provision of a certain number of irrigated farms on a new irrigation project. Such estimates (expressed in terms of the increase in income, rather than employment) provide the basis for the Bureau's estimates of secondary benefits. Likewise, the Economic Development Administration attempts to attract new industry under the assumption that the net increase in employment will be at least as large as the number of jobs in the new industry.

In estimating the increase in total employment resulting from a particular project or plant the usual procedure has been to assume that employment in other export sectors is unchanged and then to estimate the induced employment (or income) in the local market industries. The net result is that the total increase in employment it takes to be greater than the increase in employment in the establishment or plant being considered, often by a factor of two.[13] The theoretical defect in this approach is that it excludes the possibility of growth of one industry absorbing the labor and other factors of production required for growth of another industry.

Probably the most important result of the research reported on here is that the multiplier is not nearly as large as has been assumed. The change in imployment caused by having rapidly growing industries is an exogeneous input to the system. It is comparable to any other exogeneous change in employment such as the opening or closing of a new establishment. Thus the ratio of the sum of the regional share component and the industrial mix component to the industrial mix component, is an estimate of the regional impact multiplier that includes both the demand and supply effects. This is in turn one plus the regression coefficient of the regional share component on the industrial mix component.

Using this procedure the state multiplier can be estimated to have been .601 for the forties, (with a standard error of .1831) and .820 for the fifties with a standard error of .3025. Both of these estimates are several standard deviations away from the multiplier of two often used as a rule of thumb. (7.65 deviations for the forties and 3.9 deviations for the fifties). This result is made more surprising when it is realized that states are large geographical areas able to supply most of their trade, service, and governmental functions from within their own borders. In addition, many manufacturing industries are dependent on the intra-state market.

None of the regressions developed here support high estimates of the county impact multiplier. For the smaller rural counties the simple percentage equation indicates a local impact multiplier of .939 for the forties, and 1.273 for the fi ties. The first difference percentage equations give a multiplier of only .4838, (due to the large negative coefficient in the regression of change in regional share component on the change in the industrial mix component).

For the large urban counties the simple, numerical regressions gave a multiplier of only .0820 for the firties, and .125 for the fifties. Both equations are implausible low,indicating an increase in total employment of only one job for every twelve (the forties)or eight (the fifties) exogenous jobs added to the economy. These low values are probably a result of the rapid suburbanization of the large urban areas.

A very much larger estimate for the large, urban counties results from regressing the change in the regional share component on the change in the industrial mix component. This procedure gives a multiplier of 1.5162.

The range between the values estimated by the first difference procedure 1.5162 and that estimated by simple regression (.0820 or .125) is disturbingly large. It is hard to reconcile the different results. Perhaps the most likely explanation is that the secular trend towards the suburbs has produced the results observed in the simple regressions, but that an autonomous increase in employment (such as an increase in the national demand for the area's dominant industries) can stop or reverse this trend.

In general, the best estimates of the multiplier are the first difference equations[14] since these show the actual effect of an increase or decrease in the demand for an areas exports. There is no reason for the effects of charges in export (basic) employment arising from other sources to differ from the above. Thus the best estimates of the local impact multiplier is about 1/2 when the small rural counties are given a high weight, and 1/2 when the large, urban counties are given the dominant weight.

TABLE 1

Regressions of Percentage Regional Share Component on

Percentage Industrial Mix Component

		1940-1950					1950-1960				
%	OBS	C	Coefficient	st. Error	T	R^2	C	Coeff.	St. Error	T	R^2
All	3102	-01.57049	-.0660726	.191375	-2.62593	.22	03.50112	+.273277	18.7632	9.90509	3.07
New England	67	-10.5308	-.390139	.113722	-2.54145	9.04	-03.21976	-.182084	10.915	-.11652	.02%
Mid East	178	-02.92197	-.480762	.149057	-3.92180	8.04	-02.61307	-.0484454	17.8902	-.286193	.05
Lakes	436	01.43268	-.101127	.0977626	-2.08494	.99	+00.0144123	+.161273	12.6939	2.36273	1.27
Mfg. Belt	681	-01.91881	-.317461	.120023	-6.99322	6.72	-01.48119	+.0569828	14.1070	+.971830	.14
Plains	696	02.29187	+.0636244	.132088	1.22255	.21	-01.86181	+.151061	15.334	+2.70639	1.04
South	1306	01.40867	-.0896164	.210126	-2.25703	.39	+08.00363	+.423277	19.1290	9.18829	6.88
West	419	09.85700	+.256026	.273603	2.22660	1.18	-11.6285	+.475145	.254564	4.22870	4.11

TABLE 2

Regressions of the Change in Regional Share Component on the Change in Industrial Mix Component

		Numerical Equations	Unweighted				Percentage Equations				
%	# OBS	C	Coeff.	St. Error	T	R^2	C	Coeff.	St. Error	T	R^2
All	3102	-.798389	+.516223	8,841.50	+9.47252	2.81	-02.88505	-.497211	22.0138	-9.56335	2.87
New England	67	+2733.36	+1.15403	8,633.27	2.78992	10.69	+05.71797	-1.32537	11.5019	-3.774546	17.98
Mid East	178	-408.424	-.142828	20,600.6	.456730	.12	-00.337165	-.981502	15.7356	-4.22824	9.22
Great Lakes	436	-330.758	+.901291	5,937.82	17.7422	42.04	-03.41738	+.0268287	12.4251	.205114	.01
Mfg. Belt	681	-74.8944	+.662608	12,077.6	+7.45044	7.56	-01.57926	-.438366	13.8544	3.84571	2.13
Plains	696	-322.320	+.1.20530	4,178.54	5.1444	3.67	-05.80083	-.063408	17.0139	.458610	.03
South	1306	+196.058	-.921003	4,974.30	-9.12203	6.00	-01.62546	-.626517	23.6100	-9.03968	5.90
West	419	+1268.95	+.642165	14,898.0	3.01826	2.14	-02.55264	-.385042	32.0632	-1.82041	.79

TABLE 3

Regressions of the Numerical Regional Share Component on the

Numerical Industrial Mix Component

		1940-1950					1950-1960				
%	OBS	C	Coeff.	St. Error	T	R^2	C	Coeff.	St. Error	T	R^2
All	3102	-.116342	-.917970	8805.84	-40.5903	34.70	.384255	-874798	16153.1	-19.0786	10.51
New England	67	-1527.23	-1.5009	4633.71	-21.2367	87.40	-879.378	-1.15696	13,033.7	-5.89532	34.84
Mid East	178	+1299.13	-1.78425	14,054.7	-25.0902	78.15	+3131.33	-2.44695	29,882.9	-15.1539	56.61
Great Lakes	436	+543.283	-1.06036	4828.15	-57.7936	88.50	-303,098	-1.87545	10,945.8	-33.1712	71.71
Mfg. Belt	681	147.695	-1.33616	9,416.71	-47.9519	77.20	479.150	-2.07891	18,430.8	-31.4815	59.34
Plains	696	-575.298	-.986262	2711.52	-20.7527	38.29	-1191.30	-1.64882	6327.20	-14.4995	23.25
South	1306	+943.428	+.163937	3986.42	+3.36893	.86	+1072.92	.407114	6628.32	+5.04452	+1.91
West	419	+1823.79	+.9343392	10,602.0	13.0513	29.00	+2605.45	1.81392	16,975.8	19.3690	47.35

TABLE 4

1960 EMPLOYMENT

	INDUSTRY	1960
1.	Agriculture	4,256,734
2.	Forestry and fisheries	93,150
3.	Mining	654,006
4.	Contract construction	3,815,937
5.	Food and kindred products mfg.	1,822,477
6.	Textile mill products mfg.	954,036
7.	Apparel mfg.	1,159,163
8.	Lumber, wood products, furniture mfg.	1,067,252
9.	Printing and publishing mfg.	1,141,192
10.	Chemicals and allied products mfg.	864,542
11.	Electrical and other machinery mfg.	3,055,447
12.	Motor vehicles and equipment mfg.	841,861
13.	Other transportation equipment mfg.	976,837
14.	Other and miscellaneous mfg.	5,630,279
15.	Railroads and railway express	941,214
16.	Trucking and warehousing	911,454
17.	Other transportation	887,245
18.	Communications	819,649
19.	Utilities and sanitary service	893,565
20.	Wholesale trade	2,212,984
21.	Food and dairy products stores	1,689,688
22.	Eating and drinking places	1,801,667
23.	Other retail trade	6,088,296
24.	Finance, insurance and real estate	2,694,630
25.	Hotels and other personal services	1,941,530
26.	Private Households	1,916,964
27.	Business and repair services	1,610,728
28.	Entertainment, recreation services	502,879
29.	Medical, other professional services	7,577,846
30.	Public administration	3,202,890
31.	Armed forces	1,733,402
32.	Industry not reported	2,603,085

FOOTNOTES

[1]Some procedures express employment in the industries selling in a local market as a function of the income generated in the export sector, or as a function of the wages paid.

[2] See Ashby, Lowell D. - "Growth Patterns in Employment by County 1940-1950 and 1950-1960," Office of Business Economics, Department of Commerce, 1965 and Ashby, Lowell D. - "The Geographical Redistribution of Employment: On Examination of the Elements of Change" - Survey of Current Business,Vol. 44, No. 10, Oct. 1964, 13-20.

[3]"Growth Patterns in Employment by County, 1940-1950 and 1950-1960.

[4]For a test of the accuracy of this prediction methodology see "Shift and Share Projections of Regional Economic Growth:An Empirical Test", Journal of Regional Science, Vol. 9, No. 1, 1969, pp. 1-18.

[5]Discussions of these local multiplier and input-output studies can be found in the following:

Pfouts, Ralph W., Editor - "The Techniques of Urban Economics Analysis", Chandler Davis Publishing Co. 1960.

Nourse, Hugh O. - "Regional Economics" - McGraw Hill 1968, Chapter 7.

Isard Walter et al. - "Methods of Regional Analysis: and Introduction to to Regional Science" - MIT Press 1960, Chapter 6 - Regional Cycle and Multiplier Analysis and Chapter 8 - Interregional and Regional Input-Output Techniques.

[6]One study using the same OBE data used here made the employment in the non-commodity producing industries a function of employment in the commodity producing industries. See Robert Kirt - "Grow Potential Identification and Public Investment Strategy" - Regional Science Perspectives - Vol. 1, 1971, No. 1 - p. 113

[7]Unpublished paper by Edward Miller "The Role of Factor Supplied in Employment Growth: Some Experiments with Shift-Share Analysis."

[8]Because the biases are spread out over more suburban than central city counties, the suburban error tends to dominate in the percentage equations,while for the numerical equations the large absolute size of the components for the central city counties causes them to be more important.

[9]Such aggregation is relatively straightforward since the components for any area are the sum of the components for the parts.

[10]The regions used were based on those used by the Office of Business Economics in publishing the raw data. The Pacific and Mountain regions were consolidated. The author could see little justification for the OBE Southwestern Region consisting of Arizona, New Mexico, Texas, and Oklahoma. Thus Arizona and New Mexico were added to the Western Region, Texas to the Southern and Oklahoma to the Great Plains. Since one goal of the project was to improve the forecasting models of the New England Regional Commission, New England was retained as a region in spite of its small number of counties (67). The final regions used were New England (Connecticut, Massachusetts, Rhode Island, New Hampshire, Vermont, and Maine). The mid-East (New York, New Jersey, Pennsylvania, Delaware, Maryland and the District of Columbia), the Great Lakes (Ohio, Indiana, Illinois, Michigan and

Wisconsin),the Great Plains (Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas, Oklahoma), and South (Virginia, North Carolina, South Carolina,Georgia, Florida, West Virginia,Kentucky, Tennessee, Alabama Mississippi, Arkansas, Louisiana, and Taxas) and the West (the remainder of the country including Alaska and Hawaii). For some purposes New England, the Mid-East, and the Great Lakes will be combined and referred to as the Manufacturing Belt.

[11]John B. Lansing and Eva Mueller "The Geographical Mobility of Labor"- Survey Research Center, University of Michigan, Ann Arbor,1967, pp.113-115.

[12]For a discussion of whether such benefits really exist see Otto Eckstein "Water REsources Development" -Harvard University Press, Cambridge Mass. 1958 - pp. 206-212.

[13]Among the authors who have taken the multiplier to be about 2 are: Homer, Hoyt, Vining, R. and P. E. Simpson, all mentioned in footnoted in Isard, Walter - Editor - Methods of Regional Analysis and Introduction to Regional Science - MIT Press - 1960 pp. 190 and 211.

[14]Unfortunately the effects of heteroscedasticity are likely to be even more serious for the first difference equations than for the simple equations. Due to the high correlation between mix components for successive decades, the change in a component will be small. In addition, for the numerical value for the change in a component to be large the county must have a large total employment. Since only a few counties both have large populations, and experience large (percentage) changes in the industrial mix components, there is an increased risk of the results being dominated by only a few exceptional large counties.