A Theoretical Critique of Shift and Share Analysis: A General Equilibrium Approach

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Introduction

Shift-share analysis has generated a substantial amount of controversy regarding its theoretical validity. In spite of these criticisms, efforts have been made to improve its original purpose as a device for ex post analyses of the components of employment changes (Herzog and Olsen 1977) and its ability to forecast regional employment change (Stevens and Moore 1980).

The conventional criticisms leveled against the shift-share technique have largely stemmed from the structural form of the model, with its emphasis on employment change in the nation and resulting effects on the region (Houston 1967; Stilwell 1969), and on the functional form of the model in terms of additive versus multiplicative relationships and asymmetry between variables (Esteban-Marquillas 1972; Theil and Gosh 1980; Saskashita 1973).

A specific and complete critique of the shift-share analysis is contained in Martin (1976) and Beaudry and Martin (1979). The latter analysis indicates methods available to correct the problems of aggregation and interaction (interpenetration) of the structural and competitive effects. In particular, these authors argue (1979, 390) that the term “competitive advantage” is a misnomer because this expression is an unreliable sign of a region’s competitive advantage. Their position is based on situations when measurements derived using the shift-share technique produce empirical results indicating a competitive advantage for an industry in a region, when in fact the industries under examina-
tion are producing non-traded goods. Beaudry and Martin (1979, 390) conclude that for industries that export to other regions the shift-share measure of competitive advantage is correct.

This paper will demonstrate on theoretical grounds that even in the case where industries are involved in producing traded goods, the shift-share method for measuring competitive advantage cannot be conceptually valid when commodities differ in their factor intensities and regions vary in their relative factor endowments.

The Shift-Share Model

The shift-share model may be stated in the form given by Stevens and Moore (1980):

\[
e_i^t = e_i^{t-1} (E_i^t / E_i^{t-1}) + e_i^{t-1} (E_i^t / E_i^{t-1} - E_i^t / E_i^{t-1}) + e_i^{t-1} (E_i^t / E_i^{t-1} - E_i^t / E_i^{t-1})
\]

where \(e_i\) and \(E_i\) are regional and national employment in industry \(i\); \(e\) and \(E\) are regional and national total employment in all industries; and \(t-1\) and \(t\) are the beginning and end of the analysis period.

Equation (1) has three constituent elements that may be expressed as a rate of change:

- **National share:** \(NS_i = e_i^{t-1} (E_i^t / E_i^{t-1})\)
- **Industry mix:** \(IM_i = e_i^{t-1} (E_i^t / E_i^{t-1} - E_i^t / E_i^{t-1})\)
- **Regional shift:** \(RS_i = e_i^{t-1} (e_i^t / e_i^{t-1} - e_i^t / e_i^{t-1})\)

Equation (1) apportions an industry's employment change in a region to share effects (\(RP_i = NS_i + IM_i\)), and shift or competitive effect (\(RS_i\)).

The share component of a region's employment change in a specific industry is standardized; that is, every industry in all regions in the analysis has precisely the same rate of employment change attributed to it on the basis of national aggregate employment growth rates (\(NS_i\)). As well, each region's specific industries have attributed to them the difference between the national growth rate of a specific industry and the national all-industry growth rate (\(IM_i\)). This standardization procedure regarding the two share-elements of regional growth is used as the conceptual basis for asserting that regional employment growth in excess of the national standardized values originates from region-specific competitive advantages such as regional factor supply changes, regional technical change, improved efficiency due to factor reallocation, and regional comparative locational advantage.

For purposes of further analysis, the shift-share identity can be expressed as relative rates of change indicated in equation (5):

\[
d_e = dE_e + dE_i / dE + de_i / dE_i
\]

where \(de_i / dE_i\) is the shift component.

The Argument

The major purpose of literature utilizing shift-share analysis is to identify industries that have an economic competitive advantage in a region. As expressed by Steven and Moore (1980), the method is used:

... to emphasize, especially, the part of regional growth or decline in an industry which is region-specific. The regional shift component is intended to provide a measure of the relative performance of the region in a particular industry. Positive shift could then be associated with the comparative locational advantage of the region for that industry...

This paper will demonstrate that the shift-share technique is not sufficiently generalized as to reliably identify industries in a region that have a competitive advantage. This specific analytical approach, emphasizing the shortcomings of the shift (competitive) element is an acceptable strategy; as Buck (1970) has pointed out, the shift-share equation is an identity, so it does not matter whether critical concentration is given the shift or share component, since if one is given the other is determined. Two cases specific to the shift component will be developed: the first critique will be based on labour-output transformation differences between industries on an intraregional basis; the second critique demonstrates intraregion transformation differences between labour and output on an interregional basis under conditions of factor immobility and mobility between regions.

The Single-Region Case: A General Equilibrium Model

The intraregional general equilibrium model consists of region \(j=1\), and two industries \(i=1, 2\). Industry \(i=1\) produces a labour-intensive commodity \(c_1\), while \(i=2\) produces a capital-intensive commodity \(c_2\), and \(c_1\) is more labour intensive at all factor price ratios. The regional production function is homogeneous of degree one, with pure and perfect competition in factor and commodity markets. Two factors of production exist, labour \((N)\), which is relatively abundant in the region, and
capital (K), both of which are fixed in quantity and perfectly mobile between industries \( i = 1, 2 \).

In output space an increase in demand for \( C_1 \) originated by a change in consumer preference will result in an increase in price and output of \( C_1 \). In factor markets the increase in \( p(C_1) \) produces a declining labour/capital ratio in the production of \( C_1 \), since changes in industry labour inputs \( (e) \) on the factor market contract curve are specified in relation to commodity price change as follows:

\[
de\frac{e}{dp}(C_1) > 0 \tag{6}
\]

and

\[
d\frac{e_i^2}{dp}(C_1) < d\frac{e_i^1}{dp}(C_2) \tag{7}
\]

That is, as the increased demand for the labour-intensive \( C_1 \) causes its output to increase, the output of the capital-intensive \( C_2 \) must contract, freeing labour at a lesser rate than when the output of \( C_2 \) expands, contracting output of the labour-intensive \( C_1 \).

**The Analysis**

To demonstrate a case in which the shift-share technique lacks general theoretical validity in identifying the industry having a competitive advantage in the region, specifically assume that factor and commodity markets are in equilibrium with \( p(C_2) > 1 \), indicating that consumer demand favours the consumption of the capital-intensive \( C_2 \). For purposes of analysis, assume that demand, price, and therefore output alternately grows for \( C_1, C_2 \) from this initial equilibrium position.

The relative impacts on industry labour employment resulting from alternate output growth of \( C_1, C_2 \) can be evaluated from equation (7), such that \( d\frac{e_i^2}{dp}(C_2) > d\frac{e_i^1}{dp}(C_1) \).

That is, as the demand, price and output of \( C_2 \) increases, the output of the labour-intensive \( C_1 \) must decline, freeing relatively larger amounts of labour than capital. As the demand and price of \( C_1 \) increases, the output of the capital-intensive \( C_2 \) must decline, freeing relatively lesser amounts of labour.

Substituting these respective industry rates of change of labour inputs occurring over time into the shift element of equation (5), \( d\frac{e_i^2}{dp} / dE_i > d\frac{e_i^1}{dp} / dE_i \), where \( dE_i \) is of common value. Shift-share analysis indicates that commodity \( C_2 \) of industry \( i = 2 \) has a competitive advantage over commodity \( C_1 \) of \( i = 1 \) in the region.

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2 Indicating an Edgeworth box with labour endowment on the horizontal axis as the contract curve is assumed concave from above; thus output of \( C_i = 0 \) in the lower left origin of the box.
ologies, but with differing endowments of capital and labour, such that \( N_1 > N_2 \) and \( K_1 < K_2 \), \( j=1,2 \). Two commodities \( c_1, c_2 \) are produced in \( j=1,2 \), possessing technologies as indicated in the previous intraregional case. Rates of change of labour inputs into the production of \( c_1, c_2 \) are expressed on the contract curve as functions of commodity prices, so that in \( j=1,2 \):

\[
de/dp (c_j) > 0, \text{ and } de/dp (c_j) > 0. \tag{8}
\]

and \( de/dp (c_1) < de/dp (c_2) \), \( j=1,2 \), since any expansion of the output of commodity \( c_1 \) frees less labour and more capital as the output of the capital-intensive \( c_2 \) contracts. Because of the relative abundance of labour in \( j=1 \), any change in output levels of \( c_1, c_2 \) on the respective regional factor contract curves will produce the following industry employment effects; if for example the demand for \( c_1 \) expands in both regions:

\[
\begin{align*}
de / dp (c_1) &> \frac{de}{dp} (c_1) \quad (9a)
\end{align*}
\]

or, if the demand for \( c_2 \) expands in both regions:

\[
\begin{align*}
de / dp (c_2) &> \frac{de}{dp} (c_2) \quad (9b)
\end{align*}
\]

That is, as the demand and price for commodity \( c_1 \) or \( c_2 \) increases equivalently in the two regions, the resultant rate of increase of labour employment will be greater in region \( j=1 \) because labour is cheaper in this relatively labour-abundant region.

The Analysis

To demonstrate that shift-share lacks theoretical generality in this interregional case, specifically assume that factor and commodity markets, \( j=1,2 \) are in general equilibrium with equivalent factor and commodity prices.

For purposes of analysis, assume that demand increases equivalently for \( c_2 \) in both regions \( (dp (c_2) > 0) \) \( j=1,2 \). The relative impacts on regional labour employment resulting from the output increase in \( c_2 \) can be evaluated from equation \( 9(b) \) such that \( j=1 \):

\[
\begin{align*}
de / dp (c_2) &> \frac{de}{dp} (c_2) \quad (9b)
\end{align*}
\]

That is, as the demand and price for commodity \( c_1 \) or \( c_2 \) increases equivalently in the two regions, the resultant rate of increase of labour employment will be greater in region \( j=1 \) because labour is cheaper in this relatively labour-abundant region.

The Critique: Output and Cost Response

Given the assumptions regarding increased demand of the capital-intensive \( c_2 \), and the relative abundance of capital in \( j=2 \), output response in respect to the capital-intensive \( c_2 \) will differ in the two regions for equivalent increases in demand such that \( \frac{dc_2}{dp(c_2)} > \frac{dc_1}{dp(c_1)} \), since region \( j=2 \) is relatively capital-abundant.

This result demonstrates that \( j=2 \) possesses a regional output advantage in the production of \( c_2 \). Moreover, given that commodity \( c_2 \) is more capital intensive than \( c_1 \) and that capital is cheaper in \( j=2 \) due to its relative abundance, less input costs per unit of output are incurred in this region when output for \( c_2 \) expands equivalently in both regions. This conceptually correct analysis establishes industry \( i=2 \), when producing in region \( j=2 \), as possessing a regional competitive efficiency advantage, contrary to the results obtained through the shift-share technique. This analysis demonstrates that shift-share analysis will always identify the relatively labour-abundant region as providing a competitive advantage regardless of the factor-intensity characteristics of the commodity or industry under consideration.

The Two-Region Case: Interregional Factor Mobility

The purpose of this analysis is to demonstrate that shift-share analysis lacks sufficient theoretical generality to consistently identify regions offering competitive advantage to an industry under the more realistic assumption of interregional factor mobility.

The Analysis

If, as noted in the previous model, the demand for the capital-intensive commodity \( c_2 \) increases equivalently in regions \( j=1,2 \), the labour-capital ratio rises in both regions since the expansion of industry \( c_2 \) causes a relatively greater release of labour than capital as the labour-intensive industry \( i=1 \) contracts. As a result, wage-rates decline in both regions; however, since region \( j=1 \) is relatively labour abundant, wage-rates will decline faster in that region (Rybczynski 1955). Therefore, given the assumption of interregional factor mobility, labour will flow from region \( j=1 \) to \( j=2 \), and capital will flow in the reverse direction (Borts 1960).

If the process of interregional factor transfers is realistically assumed not to be instantaneously complete, so that both regions do not immediately achieve equivalent factor endowments, then the relative rates of employment change in the two regions will again be characterized by the same inequality sign indicated in equation \( 9(b) \), since region \( j=2 \) remains the relatively labour-abundant.
interregional factor endowments are equalized. This relative difference in the rate of change of labour employment between the two regions under conditions of interregional factor mobility will, however, be reduced compared to that of equation (9b), since labour flows to region $j=2$, increasing its relative labour abundance, and capital flows to region $j=1$, increasing its relative capital abundance. Until complete equality is achieved in factor endowments in both regions the inequality in equation (9b) must hold, so that substituting these relative regional rates of change of labour employment into the shift element of equation (5) again incorrectly identifies the labour-abundant region $j=1$ as providing a competitive advantage to the capital-intensive commodity $c_2$, contrary to the conclusions obtainable from the Heckscher-Ohlin hypothesis.

Conclusions

This paper has demonstrated that shift-share analysis is not sufficiently theoretically generalized to produce a consistent measure of competitive advantage of a specific industry in a region, or between regions. This lack of generality stems from the method's use of labour inputs as the sole measure of economic performance, while ignoring the theoretically superior approach contained in the Heckscher-Ohlin hypothesis, in which relative transformation rates of labour and capital are both related to output change in an industry.

References


