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THE SIMULTANEOUS DETERMINATION OF INCOME AND EMPLOYMENT IN THE UNITED STATES — MEXICO BORDER REGION ECONOMIES

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INTRODUCTION

Background

Economic activity and the associated economic exchange in the United States-Mexican border region has become increasingly important in both an absolute and relative sense--especially in the twin city complexes--since the turn of the century. In particular, the changes since World War II have been dramatic. There is little reason to expect the trend will not continue for some time in the future.

The rapid growth, however, has been far from painless. For many years the Mexican government has been acutely aware of the particular economic problems associated with the burgeoning cities located on that country's side of the international boundary. Of particular concern have been the high rates of unemployment, the leakages of foreign exchange resulting from Mexican purchases in the U.S., and the need to provide an increasing volume of public works and services. Major government policies designed to cope with these problems were the Free Zone established in the 1930s, the National Border Development Program (PRONAF) of 1961, the Border Industrialization Program of 1965 and the provisions for duty free imports under the "gancho" program initiated in 1971.

In contrast, the U.S. border cities experienced relatively few problems; indeed they were the beneficiaries of the population build-up in the Mexican border region. Retail sales to Mexicans were extremely important, as was the relatively inexpensive supply of Mexican labor that would readily cross the boundary. In the late 1960s, however, it became increasingly apparent that the U.S. border

cities were increasingly dependent upon their Mexican counterpart. Three occurrences brought this sharply into focus. First,was the proposed U.S. legislation of the Burke-Hartly Bill that would have destroyed the Border Industrialization Program. Second, the increasing awareness in the U.S. of the undocumented worker problem in the 1970s focused attention on the border area. Third, the Mexican devaluation of the peso in 1976 shocked the U.S. border city retail sector that had long benefited from the greatly overvalued Mexican currency. With the recession that followed the devaluation U.S. authorities considered the border area a "depressed" region. Resources were mobilized to try to work independently and with Mexican counterparts to understand and to undertake policy measures to attack the peculiar problems of the border area. In 1977 both the Border Cities Commission and the Southwestern Border States Regional Consortium were established. More recently the new-found sources of Mexican energy have furthered interest in all matter of U.S.-Mexican relations, including the border region.

Research on Economic Exchange in the Border Economy

The events of the last fifteen years have clearly demonstrated the interdependence of the two-nation border economies. Indeed, scholars such as Dillman recognized this phenomenon and even classified them as symbiotic.[1] Yet, with the exception of Fernández, there has not been an attempt to specify the nature of economic growth and the economic interdependence of the border regions.[2] Fernández, however, takes a very broad approach to explain the historical development of the border in a Marxist framework of

historical materialism that really does not come to grips with the basic nature of the economic interdependence.

Economic interdependence and its relationships to trade and commerce in the border area have been studied, principally by scholars and researchers living in the border area and by government and private sector institutions, such as chambers of commerce, that have a direct economic interest in the region. Whereas numerous studies have described secondary economic data in the border region, relatively few have generated primary data.[3] These few studies have, however, clearly demonstrated the very strong propensities of border residents to spend significant proportions of their incomes across the border.[4]

What is missing at present is a generalized theory of economic development in the border region that incorporates conventional economic concepts and provides an empirically testable alternative explanation to that of Fernández. Moreover, a model of the border economy needs to be developed that would demonstrate the impact, on each side of the boundary, of changes in economic activity or the parameters of either economy. Such a model would be very useful for policy makers in both countries for predicting the results of changing economic conditions in either country, including deliberate attempts to bolster the border economy.

Objective of Paper

This paper expands upon a model developed by Ladman[5] to provide a vehicle to explain not only the historical development of the border area economy, but also to provide a useful instrument to

predict the impact of changes in economic activity in the two-nation region. The nature of the model clearly demonstrates the interrelatedness of the two-nation border economies with specific reference to trade and commerce. It also specifies the role that tourism and other exogenously determined economic activity play.

To this end the paper is organized as follows. First, a conceptual idea of the historical development of the border area is presented. Second, a specific model of a border area is specified. Third, the policy applications of the model are described. Fourth, recommendations for future research are set forth.

THE HISTORICAL GROWTH OF BORDER REGIONS

The Context of Border Region Growth

Export-based regional growth models such as those developed by North, Perloff and Stabler provide a good basis for understanding the history of economic growth in border regions.[6] Essentially these models argue that the dynamic factor in early regional growth is the expansion of production of "basic" goods and services in the region for export outside the region. Typically this refers to agricultural or mining activities, but it can also be manufactured products, or government spending for public works or programs that cause new production in the region.

Production originating from such sources creates a local demand for goods and services within the region which leads to the establishment of local or residentiary activities in trade, commerce and services. Thus there is a relationship between basic and residen-

tiary activities which shows the interactive effects of a change in basic production.

If backward linkages to the production of goods and services used in the basic or residentiary activities eventually become strong enough to warrant local production of these items, then additional residentiary activity will become established. It is possible that goods and services produced initially as residentiary activities will be exported from the region and also be classified as basic production. In this model it is the basic production that provides the dynamic elements as an engine of growth. If basic production expands, stagnates or declines over time the level of economic activity will move accordingly.

Economic activity in the border region has the characteristics which fit this model. Most economic activity along the vast Mexican-U.S. border is concentrated in urban regions which are aptly described as twin city complexes. Historical as well as present economic activity is directly related to the production of basic goods and services that, in turn, has led to the creation of residentiary economic activity. The existence of the border per se has created additional basic activities that are peculiar to a border region to accompany those originating from natural resources such as agricultural and mining production. Examples include: export-import related activities such as government customs and customs brokerage services; government migration-related services; tourism services; location-specific manufacturing activities such as the Border Industrialization Program; and special government expenditure programs

designed to resolve special problems associated with the border economy. Spending by temporary residents, such as migrants from the interior of Mexico, is also important, especially since one of the major factors explaining growth to the Mexican border cities appears to be the possibilities of using these sites as points of departure for the United States.[7]

A complicating factor, which is not included in the above exposition, is the existence of an artificial, politically-determined boundary which separates the two cities. Thus, in what otherwise might be characteristized as a single region, there are two national subregions where the economies of two nations are juxtaposed alongside each other. That these two economies are at different stages of economic development and unequal distances from other major economic centers in the interiors of their countries means that there are differences not only in factor and product prices, but also in the availability and quality of factors, goods and services. These differences between twin cities, along with a relatively open border, lead to a considerable amount oi border crossing of both factors and products for use within the twin city complex.

The result is that the twin cities become so interdependent that the level of economic activity in one city is very dependent upon the level of activity in the other. This interdependence can be specified by constructing a model which incorporates the features of the foreign trade multiplier, showing the impact of trade and factor payments between the two cities through a succession of repercussions that take place as a result of a change in economic activity in one or

both of the cities.

A model which incorporates these features is specified in the following section, but first it is useful to use the conceptual framework to trace the economic growth process of a twin city border complex.

The Process of Border Region Growth

Each twin city complex is unique with respect to the specific factors that have influenced and conditioned its growth. Yet there is sufficient commonality in the characteristics associated with these factors to generalize the process of development of a twin city complex.

The fact that economic activity in the border region is concentrated in the twin city complexes is not surprising. These complexes have grown in areas which were utilizing the natural resource base for the production of agriculture or mining products, as exemplified by Mexicali-Calexico and Agua Prieta-Douglas, respectively. Trade routes connected these cities with the interiors of their countries. Other complexes had their beginnings as border sites on trade routes such as Cd. Juarez-El Paso. Some grew in response to the growth of work, trade and tourism opportunities in major population centers such as existed in Southern California and that stimulated the expansion of Tijuana.

Therefore, in each twin city complex the initial factors which established economic activity were basic in nature. These led to the development of residentiary activities, but, for reasons mentioned previously, the growth of residentiary activity took place on both

sides of the border. In particular it was especially important in the development of the trade, commerce and service sectors.

The major burst in border economy growth, however, came with population growth in the twin city complexes. In the United States, in spite of the population shift to the Southwest and Southern Pacific regions, population growth was not concentrated along the border except in Southern California. In the other major border urban area, El Paso, the major stimulus to growth was the establishment of Fort Bliss. In both regions the stimuli did not come from the border economy but rather for other reasons.

In contrast, in Mexico the border per se played a major role in causing rapid population growth in that part of the country. High rates of unemployment or underemployment in the interior of the country in combination with government-sanctioned higher wages in the border area and the opportunities to work in the United States caused considerable migration to the border area with a resultant increase in residentiary activity on both sides of the border. The magnitude of the Mexican linkages with the U.S. border cities rapidly increased with the relative growth in population on the Mexican side of the border, thereby increasing the dependence of U.S. border cities on their Mexican counterparts.

As the local market has expanded in the twin cities, backward linkages have led to residentiary manufacturing. Favorable labor market conditions have also been a factor. Thus with time the twin-city economies have become more integrated. Yet fundamentally these twin cities remain export-based economies. There is little reason to

expect this to change over the distant future. Furthermore, population and employment trends in Mexico strongly suggest that migration to the border will continue apace. Thus the forecast is for more interdependence and the creation of more trade and commerce on both sides of the border.

A MODEL OF THE BORDER REGION ECONOMY

The Setting

The basic model assumes there are two border cities or regions, A and B, as well as "the rest of the world," which includes the remainder of the country of each border region, and other countries in the world. All propensities to consume and impo:t are assumed to be linear, and all prices are assumed to remain constant as output is varied. Thus real income and nominal income always move in the same direction. Trade in goods and services then generates income in each border city. For example, purchases by individuals in B from A will generate income and employment in A. In addition, some of the income thus earned in A will be spent in B in accordance with A's propensity to import from B, causing a repercussion effect that will generate income in B. The interaction continues in this manner until the repercussion effects have dampened out. Thus interdependence is established in such a way that income and employment in each city will in part determine income and employment in the other city.

The Model

Identities expressing the level of income in each border region are as follows:[8]

$$Y_A = C_A + \overline{I}_A + \overline{G}_A + (X_A^B - M_A^B) + (\overline{X}_A^R - M_A^R) \qquad (1)$$

$$Y_B = C_B + \overline{I}_B + \overline{G}_B + (X_B^A - M_B^A) + (\overline{X}_B^R - M_B^R) \qquad (2)$$

where C, I, G, X and M represent domestic consumption spending, domestic investment spending, government spending, exports and imports, respectively. Superscripts on X refer to the destinations of the exports (R denoting the rest of the world), and those on M to the origins of the imports. Thus in the case of A, Y_A is composed of income earned through consumption spending (C_A), investment spending ($\overline{I}_A$), government spending ($\overline{G}_A$), the excess of exports to the border country over imports from the border country ($X_A^B - M_A^B$), and the excess of exports to the rest of the world over imports from the rest of the world ($\overline{X}_A^R - M_A^R$).

Relationships linking consumption and imports to income are summarized as follows:

$$C_A = \overline{c}_A + c_A(Y_A - \overline{T}_A) \qquad (3)$$

$$C_B = \overline{c}_B + c_B(Y_B - \overline{T}_B) \qquad (4)$$

$$M_A^B = X_B^A = \overline{m}_A^B + m_A^B(Y_A - \overline{T}_A) \qquad (5)$$

$$M_B^A = X_A^B = \overline{m}_B^A + m_B^A(Y_B - \overline{T}_B) \qquad (6)$$

$$M_A^R = \overline{m}_A^R + m_A^R(Y_A - \overline{T}_A) \qquad (7)$$

$$M_B^R = \overline{m}_B^R + m_B^R(Y_B - \overline{T}_B) \qquad (8)$$

Letters carrying a "bar" over them denote autonomous spending. Lower-case letters without the bar denote marginal propensities to spend. $\overline{T}_A$ and $\overline{T}_B$ represent autonomous taxes imposed on the border regions. Thus equation (7) states that spending by A on imports

from the rest of the world is composed of an autonomous spending

component ($\overline{m}_A^R$) and an induced spending component [$m_A^R(Y_A - \overline{T}_A)$] equal to

the marginal propensity to import from the rest of the world times

the income in A. Note that investment in each country ($\overline{I}_A$, $\overline{I}_B$) and

exports of each country to the rest of the world ($\overline{X}_A^R$, $\overline{X}_B^R$) are assumed

to be invariant to changes in income.

Substituting equations (3) through (8) into identities (1) and

(2), the following equations are obtained:

$$Y_A = [\overline{c}_A + c_A(Y_A - \overline{T}_A)] + \overline{I}_A + \overline{G}_A[\overline{m}_B^A + m_B^A(Y_B - \overline{T}_B)] -$$

$$[\overline{m}_A^B + m_A^B(Y_A - \overline{T}_A)] + \overline{X}_A^R - [\overline{m}_A^R + m_A^R(Y_A - \overline{T}_A)] \quad (9)$$

$$Y_B = [\overline{c}_B + c_B(Y_B - \overline{T}_B)] + \overline{I}_B + \overline{G}_B[\overline{m}_A^B + m_A^B(Y_A - \overline{T}_A)] -$$

$$[\overline{m}_B^A + m_B^A(Y_B - \overline{T}_B)] + \overline{X}_B^R - [\overline{m}_B^R + m_B^R(Y_B - \overline{T}_B)] \quad (10)$$

These equations summarize the dependence of income in each border

region on several factors. For example, the level of income in A

is composed of several elements: the autonomous expenditures,

($\overline{c}_A$, $\overline{m}_B^A$, $\overline{m}_A^B$, $\overline{m}_A^R$, $\overline{T}_A$, $\overline{I}_A$, $\overline{G}_A$, and $\overline{X}_A^R$); the marginal propensity to consume

home-goods, (c_A); the marginal propensities for A to import from

the border region (m_A^B), and from the rest of the world (m_A^R); B's

marginal propensity to import from A, (m_B^A); and national income in

B, (Y_B).

This is presented in Figure 1. Equation (9) is represented by

$Y_A(Y_B)$, because once Y_B is known, Y_A can be determined. The slope

of this curve is $m_B^A/[s_A + (m_A^B + m_A^R)]$, where s_A is the marginal pro-

pensity to save in A, with $s_A = 1 - c_A$. Equation (10) is labeled

$Y_B(Y_A)$, and its slope is $[s_B + (m_B^A + m_B^R)]/m_A^B$, where $s_B = 1 - c_B$ is

the marginal propensity to save in B. Where the two curves inter-sect, equilibrium values of income are obtained (Y_B^*, Y_A^*) that satisfy both equations (9) and (10).

Equilibrium Incomes

Equations (9) and (10) can be solved for equilibrium values of Y_A and Y_B. They can be re-arranged so that only Y_A appears on the left-hand side of equation (9), and only Y_B on the left-hand side of equation (10). The Y_B equation can then be substituted into the Y_A equation, which can be solved for the equilibrium value of Y_A. This equation can then be substituted back into the equation for Y_B, which can be solved for the equilibrium value of Y_B. This procedure yields two equations for the equilibrium values of Y_A and Y_B:

$$Y_A = D_A S_A + R_A S_B \tag{11}$$

$$Y_B = R_B S_A + D_B S_B \tag{12}$$

where
$$S_A = \bar{c}_A + \bar{I}_A + \bar{G}_A + (\bar{m}_B^A + \bar{X}_A^R) - (\bar{m}_A^B + \bar{m}_A^R) + [(m_A^B + m_A^R) - c_A]\bar{T}_A - m_B^A \bar{T}_B,$$

$$S_B = \bar{c}_B + \bar{I}_B + \bar{G}_B + (\bar{m}_A^B + \bar{X}_B^R) - (\bar{m}_B^A + \bar{m}_B^R) + [(m_B^A + m_B^R) - c_B]\bar{T}_B - m_A^B \bar{T}_A,$$

and
$$D_A = \frac{s_B + (m_B^A + m_B^R)}{[s_A + (m_A^B + m_A^R)][s_B + (m_B^A + m_B^R)] - m_A^B m_B^A},$$

$$R_A = \frac{m_B^A}{[s_A + (m_A^B + m_A^R)][s_B + (m_B^A + m_B^R)] - m_A^B m_B^A},$$

$$R_B = \frac{m_A^B}{[s_A + (m_A^B + m_A^R)][s_B + (m_B^A + m_B^R)] - m_A^B m_B^A} \, ,$$

$$D_B = \frac{s_A + (m_A^B + m_A^R)}{[s_A + (m_A^B + m_A^R)][s_B + (m_B^A + m_B^R)] - m_A^B m_B^A} \, .$$

Equations (11) and (12) show that equilibrium values of Y_A and Y_B depend upon six elements: two expenditure terms and four multiplier terms. S_A is the sum of autonomous spending components in A, and S_B is a similar sum for B. D_A is the "direct" multiplier for A; it transforms autonomous spending in A into income in A. R_A is the "cross" multiplier for A; it transforms autonomous spending in B into income in A. Similarly, D_B and R_B are the direct and cross multipliers for B, respectively. Equations (11) and (12) are thus the foundation for all multiplier analysis. They are general formulas, applicable to any change--or combination of changes--in the autonomous elements.

Applications of the Model

Suppose that $\overline{G}_A$ rises by $\Delta \overline{G}_A$. Then, as equations (11) and (12) show, Y_A will increase by $\Delta Y_A = D_A(\Delta \overline{G}_A)$, and Y_B will increase by $\Delta Y_B = R_B(\Delta \overline{G}_A)$, where $\Delta \overline{G}_A = \Delta S_A$.

Figure 1 illustrates the outcome. The initial equilibrium is at E_1, with incomes of Y_{A1} and Y_{B1}. $E_1 A$ is the vertical shift of $Y_A(Y_B)$. Point A indicates the increase in Y_A that would be predicted--$\hat{Y}_A$--by the "domestic" multiplier formula, $\dfrac{1}{s_A + (m_A^B + m_A^R)}$. It indicates the value of Y_A obtained when the contribution of border region B in generating Y_A is ignored. But because of the positive slope of $Y_B(Y_A)$, point A understates the true increase

in Y_A. The new equilibrium is at E_2, and the total rise in Y_A is the amount E_1B, to Y_{A2}. AB is the "foreign repercussion" effect. As Y_A increases, so do A's imports from B. This raises Y_B, and B's imports from A, further raising Y_A. And so on. This interaction is the movement from point A to point E_2, raising Y_A from $\hat{Y}_A$ to Y_{A2}, and raising Y_B from Y_{B1} to Y_{B2}. Incomes in both countries rise. This analysis illustrates the impact of a change in any element of S_A--not only $\bar{G}_A$--when S_B is held constant.

The impact of simultaneous changes in S_A and S_B can also be determined. Suppose total expenditure in B remains constant, but there is a switch away from domestic consumption and into A's exports. Now $\Delta S_A = \Delta \bar{m}_B^A$, and $\Delta S_B = \Delta \bar{c}_B = -\Delta \bar{m}_B^A$. Let $\Delta S_A = \Delta S$. Then $\Delta S_B = -\Delta S$, and the income change in each country will be:

$$\Delta Y_A = D_A(\Delta S) - R_A(\Delta S)$$
$$= (D_A - R_A)(\Delta S)$$

$$\Delta Y_B = D_B(-\Delta S) + R_B(\Delta S)$$
$$= (R_B - D_B)(\Delta S)$$

The outcome is illustrated in Figure 2. The increase in A's exports thrusts $Y_A(Y_B)$ upward to $Y_A'(Y_B)$, and the equivalent decline in consumption expenditure in B moves $Y_B(Y_A)$ leftward to $Y_B'(Y_A)$. These two shifts will not be of the same magnitude unless each region's domestic multiplier happens to be the same. The initial rise in expenditure in A affects income directly in A and indirectly in B, changing the equilibrium from E_1 to $\hat{E}$. Y_A rises by $A\hat{E}$, with $A\hat{E} = D_A(\Delta S)$; Y_B rises by E_1A, with $E_1A = R_B(\Delta S)$. The initial decline in expenditure in B affects income directly in B and indirectly

in A, altering the equilibrium from $\hat{E}$ to E_2. Y_B falls by $B\hat{E}$, with $B\hat{E} = -D_B(\Delta S)$. Y_A falls by BE_2, with $BE_2 = -R_A(\Delta S)$. The net effect is for Y_A to rise by CE_2 and for Y_B to drop by CE_1. Note that $CE_2 = (D_A - R_A)(\Delta S)$, and $CE_1 = (R_B - D_B)(\Delta S)$. The indirect effects dampen the direct effects. E_1A is the rise in Y_B via the cross multiplier due to the increase in Y_A resulting from the autonomous increase in A's exports. Similarly, BE_2 is the decline in Y_A via the cross multiplier transmitted to A as a consequence of the autonomous decline in expenditure in B.

The multiplier formulas also indicate how changes in any of the six marginal propensities result in changes in Y_A and Y_B. If a marginal propensity changes, the slope of one or each of the income curves changes, rotating the curves to a higher or lower position. A new set of equilibrium incomes results, which may be larger or smaller than the original values.

Another objective might be to increase the joint income of the two border regions rather than A's or B's income alone. For example, consider additional investment in A as opposed to B. Joint income, Y, is simply the sum of the regional incomes: $Y = Y_A$ to Y_B. Substituting from equations (11) and (12) for Y_A and Y_B and re-arranging, $Y = (D_A + R_B)S_A + (D_B + R_A)S_B$.

If A's investment increases by $\Delta \overline{I}_A$, $\Delta S_A = \Delta \overline{I}_A$, and $\Delta S_B = 0$. Thus Y rises by:

$$\Delta Y = (D_A + R_B)(\Delta S)$$

$$= \frac{s_B + (m_B^A + m_B^R) + m_A^B}{[s_A + (m_A^B + m_A^R)][s_B + (m_B^A + m_B^R)] - m_A^B m_B^A}(\Delta S)$$

(If, on the other hand, B's investment is increased instead by the same amount, $\Delta S_B = \Delta \overline{I}_B$, and $S_A = 0$. Joint income increases by:

$$\Delta Y = (D_B + R_A)(\Delta S)$$

$$= \frac{s_A + (m_A^B + m_A^R) + m_B^A}{[s_A + (m_A^B + m_A^R)][s_B + (m_B^A + m_B^R)] - m_A^B m_B^A}(\Delta S)$$

Examination of the numerators of the final expressions shows that joint income will rise by a greater amount if the investment occurs in the border region with the smaller leakage into savings and imports from the rest of the world.

Numerical Examples of the Model

The multiplier analysis can also be illustrated with numerical examples. Table 1 lists three different sets of values for the six marginal propensities, and the corresponding values for the four multipliers. Consider a simple example where investment in B rises by $100. In case I this initiates a $100 increase in A's income $[\Delta Y_A = R_A(\Delta \overline{I}_B) = 1(\$100) = \$100]$ and a $500 increase in B's income $[\Delta Y_B = D_B(\Delta \overline{I}_B) = 5(\$100) = \$500]$. The cross multiplier operates on A and the direct multiplier on B. In case II the propensities in A remain the same, but those in B are doubled. The effects of this doubling are concentrated on B: the income increment in B is only half that of case I. But the effects on income in A are the same as in case I: proportional changes in the marginal propensities in border region B do not change the final outcome on A. In case III all values of the marginal propensities remain the same as in case II except for B's import propensities, which are lowered.

TABLE 1

NUMERICAL EXAMPLES OF THE MULTIPLIER EFFECTS

	CASE I	CASE II	CASE III
s_A	0.20	0.20	0.20
m_A^B	0.25	0.25	0.25
m_A^R	0.05	0.05	0.05
s_B	0.10	0.20	0.20
m_B^A	0.10	0.20	0.15
m_B^R	0.05	0.10	0.05
D_A	2.5	2.5	2.4615
R_A	1.0	1.0	0.9231
D_B	5.0	2.5	3.0769
R_B	2.5	1.25	1.5385
ΔY_A	\$100.00	\$100.00	\$ 92.31
ΔY_B	\$500.00	\$250.00	\$307.69

When the marginal propensities to save are the same in the two
border regions, as they are in cases II and III, the distribution
of the aggregate income change over the two border regions depends
on the marginal propensities to import. In case II B gets 71.4
percent of the aggregate rise in income ($250 out of $350), and A
28.6 percent. In case III, with smaller import propensities in B,
less of the initial income expansion in B gets transmitted to A.
B now gets 76.9 percent of the aggregate income rise ($307.69 out
of $400), with only 23.1 percent going to A.

The Local Balance of Trade

Of major concern in border regions is the "local" balance of
trade: the concern that one border region not spend an excessive
proportion of its income on imports from the border region.
The local trade balance for A is $B_A = X_A^B - M_A^B$, or:

$$B_A = [(\overline{m}_B^A + m_B^A(Y_B - \overline{T}_B)] - [(\overline{m}_A^B + m_A^B(Y_A - \overline{T}_A)] \quad (13)$$

This equation represents an infinite family of parallel local trade-
balance lines in terms of Y_A and Y_B, with slope m_B^A/m_A^B. Each depict
a specific local trade balance for A. The line for $B_A = 0$ (that is,
truly "balanced" trade) is graphed in Figure 3 as BB. If the equili-
brium point described by the intersection of $Y_A(Y_B)$ and $Y_B(Y_A)$ lies
on BB, local trade will be "balanced"; otherwise it will not. For
a positive value of B_A, signifying a "favorable" local trade balance
for A, the line will be to the right of BB (such as AA); for a
negative value of B_A, to the left of BB (such as CC). Any equili-
brium point will lie on one such line, and the actual local trade
balance will be the associated value of B_A.

Determining the impact of autonomous expenditure changes on the local trade balance is straightforward. If autonomous investment rises in B, the $Y_B(Y_A)$ line in Figure 3 moves rightward. The new equilibrium occurs further to the right along $Y_A(Y_B)$, and on a new trade balance line more favorable to A under normal circumstances.[9]

The multipliers determine the exact impact of any expenditure change on the local trade balance. Suppose B initiates an autonomous increase in imports from A of $\Delta \overline{m}_B^A$, which it finances by an equal decrease in domestic consumption. Then from equation (13) the alteration in the local trade balance will be:

$$B_A = \Delta \overline{m}_A^B + m_B^A(\Delta Y_B) - m_A^B(\Delta Y_A).$$

From equations (11) and (12) it is clear that $\Delta Y_A = (D_A - R_A)(\Delta \overline{m}_B^A)$ and $\Delta Y_B = (R_B - D_B)(\Delta \overline{m}_B^A)$. Substituting these expressions into the prior equation and simplifying, the change in the local trade balance is:

$$\Delta B_A = [1 + m_B^A(R_B - D_B) - m_A^B(D_A - R_A)](\Delta \overline{m}_B^A)$$

$$= \frac{s_A s_B + s_A m_B^R + s_B m_A^R + m_A^R m_B^R}{[s_A + (m_A^B + m_A^R)][s_B + (m_B^A + m_B^R)] - m_A^B m_B^A}(\Delta \overline{m}_B^A)$$

There are three separate elements affecting A's local trade balance: the initial rise in A's exports exerts a favorable influence on A's balance; the decline in B's consumption expenditures reduces B's income, which lowers income-induced exports from A and partially offsets the improvement in A's trade balance; and the increase in A's income resulting from the initial rise in exports to B gets partially

spent on imports from B, further offsetting the improvement in A's
trade balance. The net effect on A's balance is, however, positive.
The net effect on B's balance is of course negative and of equal
magnitude, since $\Delta B_B = -\Delta B_A$.

An additional problem for the governments of the two border
regions is the regulation of border region investment. Suppose
the objective is to invest in both regions, but without disturbing
the local trade balance. Officials want to set A's investment growth
equal to some proportion of B's investment growth: $\Delta \bar{I}_A = \alpha(\Delta \bar{I}_B)$.
And officials wish to constrain the investment so that there is no
induced change in the local trade balance: $m_A^B(\Delta Y_A) = m_B^A(\Delta Y_B)$. How
can this be done?

The task is to find the appropriate value for α. If changes
in local exports and imports balance, the conditions for equilibrium
are that investment changes in each border region must be equal to
induced savings plus induced imports from the rest of the world in
each region (for, otherwise, incomes would continue to change).
These two relationships can be explicitly stated:[10]

$$\Delta \bar{I}_A = s_A(\Delta Y_A) + m_A^R(\Delta Y_A)$$
$$= (s_A + m_A^R)(\Delta Y_A)$$

$$\Delta \bar{I}_B = s_B(\Delta Y_B) + m_B^R(\Delta Y_B)$$
$$= (s_B + m_B^R)(\Delta Y_B)$$

Since α is merely the ratio between $\Delta \bar{I}_A$ and $\Delta \bar{I}_B$, the prior two
equations yield:

$$\alpha = \frac{\Delta \bar{I}_A}{\Delta \bar{I}_B} = \frac{(s_A + m_A^R)(\Delta Y_A)}{(s_B + m_B^R)(\Delta Y_B)}$$

(From the final equation in the last paragraph $\Delta Y_A/\Delta Y_B$ can be obtained:
$\Delta Y_A/\Delta Y_B = m_B^A/m_A^B$. Substituting this equation into the one above determines a final expression for α:

$$\alpha = \frac{(s_A + m_A^R)m_B^A}{(s_B + m_B^R)m_A^B}$$

This is the ratio between investment in A and B which will allow parallel growth of the two regions without disturbing the local balance of trade. The income growth which will occur in each region from the investment expansion can be obtained in the usual manner from the multiplier formulas.

Monetary Considerations

Some assumptions incorporated into the model exert an important influence on income determination. Of primary importance is that prices are assumed to remain stable so that attention can be focused on movements in real income, at least up to the point of full employment. In reality, prices can creep upward even during periods of substantial unemployment, and when prices and output change simultaneously, nominal income (pY) and real income (Y) do not necessarily rise and fall together.

This does not mean that the income-expenditure approach phrased in real terms is inappropriate for determining income levels in the two border regions. On the contrary, the point is that it is essential to make clear the monetary assumptions involved, so that appropriate adjustments can be made for the evaluation of alternative policies. For example, it would be impossible to specify in any exact manner the impact of a devaluation on the local trade balance

without explicitly including in the model monetary characteristics of the two border regions. This is a straightforward, albeit some-what involved, extension of the basic model. The local trade balance in this case would be expressed as $T_A = p_A X_A^B - r p_B M_A^B$, where p_A and p_B are the prices of output in A and B, respectively, and r is the rate of exchange in units of A's currency per unit of B's currency. Under these conditions a change in the local trade balance can occur for reasons other than autonomous expenditure or income changes: alterations in the prices and exchange rate will affect T_A as well. Other elements of the model also need to be altered, and the general solution of the system is more complex than the simple multipliers of equations (11) and (12). Such a solution will not be presented here, but it can be said that the requirements for a devaluation in A to improve A's local balance of trade reduces to a condition similar to, but more stringent than, the simple Marshall-Lerner condition where the sum of the export and import elasticities must exceed unity. The point is that such policy questions can be answered within the general framework of income determination laid out here. It is only necessary that appropriate adjustments of the assumptions be made to fit the specific set of policies under consideration.

POLICY APPLICATIONS

Short-run

The model not only presents a conceptual view of the economic interdependence of adjacent border regions but also provides a use-

ful instrument to policy makers for predicting the short-run impact on each border region of changes in economic activity that occur in either region. Specifically, as demonstrated above, the expected short-run impacts on income and the local balance of trade resulting from any changes in autonomous expenditure, relative prices, and/or the parameters of the model in the two regions can be readily measured. Moreover, the total expected changes in income are easily disaggregated to estimate the changes in saving and all types of expenditure included in the model.

The capabilities of the model as a predictive instrument are particularly applicable to the actual conditions that reign in the border region. Whereas there is a truly interdependent or symbiotic relationship between the economies of the two regions, many of the the factors which give rise to direct changes in the overall level of economic activity are exogenously determined. The additional economic activity and the economic interdependence which comes about through the repercussions, described by the direct and cross multipliers, are the indirect effects of the changes in the exogenously determined autonomous expenditures.

Price levels in the two border cities and consequently the rate of exchange between the two countries' currencies are also largely exogenously determined in the larger economies of the two countries. Thus, should changes in these variables occur, the model would serve to predict the consequences of changes in income and balance of trade for the two cities.

Therefore the predictive features of the model are useful in showing the impacts associated with changes imposed by events largely determined outside the border region. Given the actual situation in the two countries of the relative rates of inflation, the managed float of the peso, the threat of devaluation, the precariousness of government budgets and the vagaries of external demand for goods and services produced in the border region, the model offers considerable potential for predicting the impacts of changes in direct spending in the production of these goods and services on the local economy, both through the direct effects and through the indirect effects.

Policy makers may be tempted to use the multiplier theory as an argument for protectionist trade restrictions. Exports obtained through subsidies, as well as imports denied through quotas and tariffs, so the argument may go, are ideal creators of regional income. This analysis is at best short-sighted, as it completely ignores what may well be serious retaliations on the part of the government across the border, as well as unfavorable alterations in relative prices. When retaliatory actions and possible relative price changes are taken into account, it is difficult to use multiplier analysis as an argument for protection.

While many autonomous expenditure changes affect income favorably in each region, others affect the two incomes differentially. This situation may arise, for example, with a devaluation or a change in consumer tastes for domestically produced goods over

imports. The impact on joint regional income can be different still, as income changes in the two countries may cancel rather than rein-force one another. For example, an autonomous increase in A's exports financed by an equal reduction in consumption in country B will increase (decrease) joint regional income if the sum of B's marginal propensities to save and to import from the rest of the world is greater than (less than) the same sum for A.

Long-run Economic Growth

The model as presented is used in a comparative static context because it does not contain inherent dynamic elements. This does not, however, preclude it from being useful in understanding economic growth. First, as outlined previously, the model provides a framework for conceptualizing the economic interdependence of the border region. Second, expected changes in the level of income, as well as in the different types of spending and saving resulting from anticipated or planned changes in autonomous expenditure, are readily estimated. The model, however, does not predict changes in the structure of the economy. These predicted changes would have to be obtained by reviews of the periodical census data and/or other surveys. Changes in the structure should not, however, change the principal concepts and workings of the model. Rather they simply would require a reestimation of the parameters.

CONCLUSIONS AND RECOMMENDATIONS

To date research on the structure and interdependence of the two-nation economy along the U.S.-Mexican border has been fragmented. These studies have been useful in understanding the interdependence of the border region. However, no attempt has been made to develop a theoretical model of the border region that not only contributes to an understanding of growth in the region but also allows for quantitative estimation of the impacts of changes in factors that influence the border economy, viz. autonomous spending, monetary variables and parameters that define economic relationships in the economy. The importance of developing such a model increases with the growing importance placed on the border region by each country.

The model presented in this paper incorporates these features and thus provides an avenue for future research of the border economy. The direction of such research would be to apply the model to a specific two-nation border region, such as a twin city complex. This would require the specification of the economic structure of the region and estimation of the parameters of the model. The model could then be used to determine the imapct in each border area of autonomous changes in expenditure. The model could be extended to include monetary variables, which would extend the capabilities of the model to analyze changes in prices and exchange rates.

At present there are at least two attempts to initiate similar research. First, in 1979 the California Border Area Research Center at San Diego State University received a grant from the Southwest Border Regional Commission to develop and begin to implement the

basic components of an information system for data on both sides of the border. Such data should be useful in estimating the parameters for the model developed here as well as for the planned input-output study for the Tijuana-San Diego Region. Second, in the near future the U.S. Department of Housing and Urban Development will be issuing a major contract to undertake an input-output study for the El Paso-Cd. Juarez complex. These efforts at launching input-output studies are laudable and, once implemented, will provide considerable new knowledge about the structure and interdependence of the specific border regions under study. Input-output analysis is not the only, nor the most sophisticated, empirical technique capable of estimating the model represented in this paper, however. For example, simultaneous-equations estimation techniques, such as two- and three-stage least squares, may provide additional insight into the interdependent behavior that occurs in the two-nation border region.

The model outlined in this paper clearly identifies the residentiary nature of the economic exchange that occurs in border regions, and how basic economic production, such as the provision of tourism services, is the driving force behind the exchange. The empirical estimation of models such as the one presented in this paper will mark a major step forward in both understanding these basic economic relationships and in predicting the consequences of proposed policies or other exogenous changes in economic activity.

FOOTNOTES

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2. Raúl A. Fernández, The United States-Mexico Border, A Politico-
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3. Good examples of studies reporting secondary data are: Norris
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    Department of Economics, San Diego State University, n.d.; and
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4. This paper will not attempt to inventory all such studies.
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6. Douglas North, "Location Theory and Regional Economic Growth," Journal of Political Economy (June, 1955) 243-258; Harvey S. Perloff, How A Region Grows, Area Development in the U.S. Economy, Supplementary Paper No. 17, Published for the Committee for Economic Development (New York, 1963); and J.C. Stabler, "Exports and Evolution: The Process of Regional Change," Land Economics 1 (1968), 11-23.

7. Michael J. Greenwood and Jerry R. Ladman, "An Economic Analysis of Migration in Mexico," Annals of Regional Science, XII (July 1978), 26.

8. The model developed here draws on the work of numerous previous authors. Fritz Machlup, International Trade and the National Income Multiplier (Philadelphia, 1950); Romney Robinson, "A Graphical Analysis of the Foreign Trade Multiplier," The Economic Journal, 62 (Sept. 1952), 546-564; J. J. Polack, An International Economic System (Chicago, 1953); and Edward E. Learner and Robert M. Stern, Quantitative International Economics (Chicago, 1970).

9. Each trade balance line has a slope of m_B^A/m_A^B. Thus the condition which must hold in order for this "normal" effect to occur is

$$\frac{m_B^A}{m_A^B} > \frac{m_B^A}{s_A + (m_A^B + m_A^R)}$$

the slope of $Y_A(Y_B)$ appearing as the right-hand term. In order for an abnormal effect, it is necessary that $s_A + m_A^R < 0$.

10. An identity exists for Y_A in addition to equation (1): $Y_A = C_A + S_A$, where in this footnote S_A represents savings in A. Thus eliminating C_A from these two identities, $\overline{I}_A + (\overline{X}_A^R - M_A^R) + (X_A^B - M_A^B) - S_A$. Since changes in X_A^B must equal changes in M_A^B, and $\overline{X}_A^R$ is constant, $\Delta \overline{I}_A - \Delta M_A^R = \Delta S_A$, or $\Delta \overline{I}_A = \Delta S_A + \Delta M_A^R$. Relating ΔS_A and ΔM_A^R to income in A, $\Delta \overline{I}_A = s_A(\Delta Y_A) + m_A^R(\Delta Y_A)$. Collecting terms, $\Delta \overline{I}_A = (s_A + m_A^R)(\Delta Y_A)$, which is the equation in the text for A. An equation can be derived for B in similar fashion.
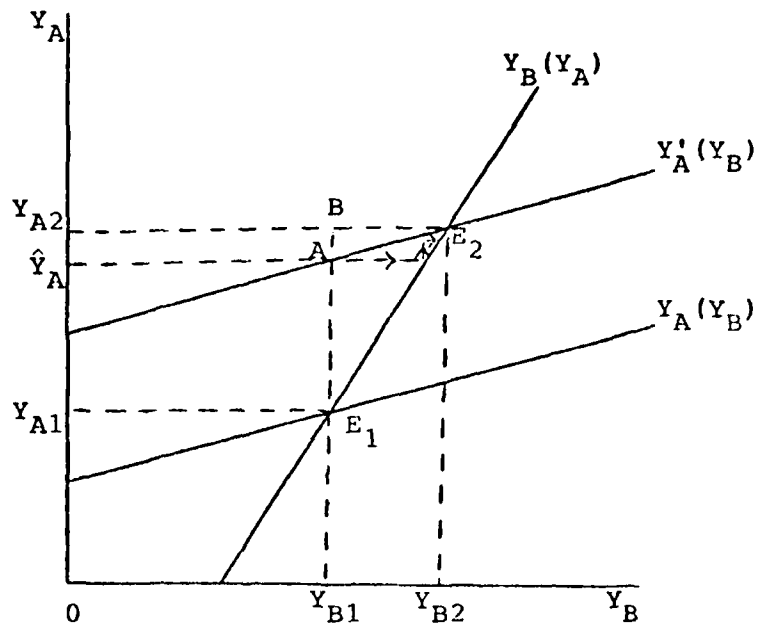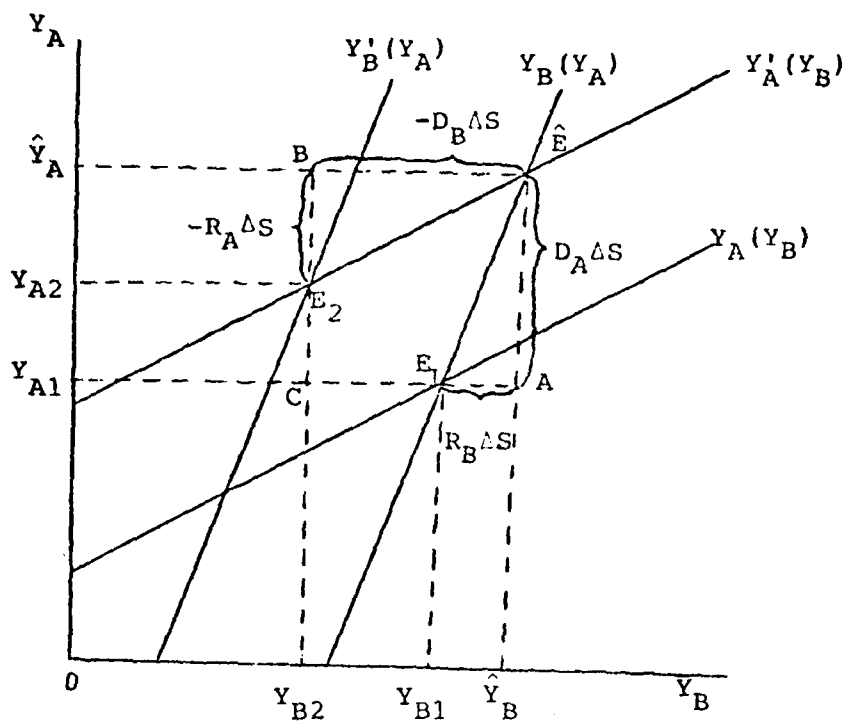
FIGURE 1: EQUILIBRIUM VALUES OF Y_A AND Y_B

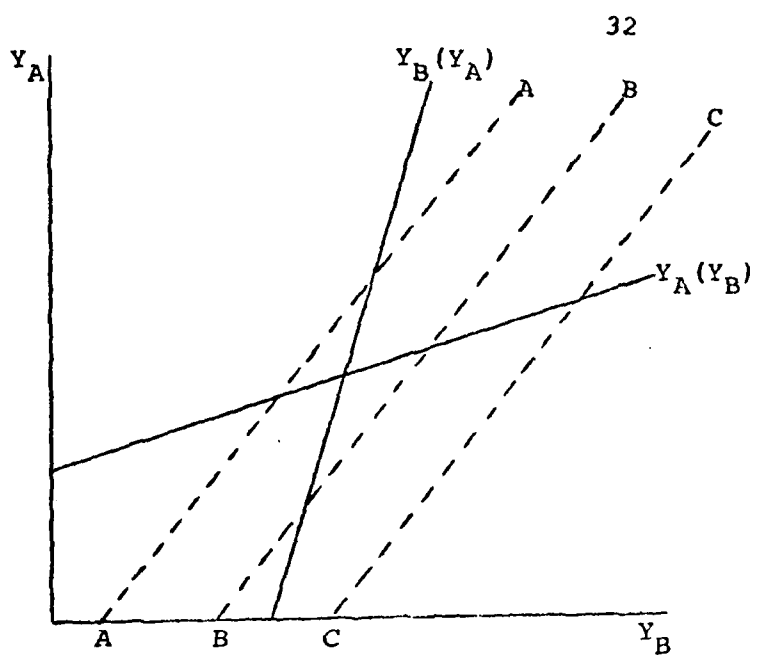FIGURE 2:   EXPENDITURE SWITCH IN B

FIGURE 3:   THE LOCAL BALANCE OF TRADE

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