What Difference Does a Country Make?

Open- and Closed-Loop Effects in North America*

Kenneth A. Reinert

Kalamazoo College

David W. Roland-Holst

Mills College, OECD Development Centre, and CEPR

May 1998

Abstract. Social accounting matrices (SAMs), originally developed to assist in analyzing income distribution issues in developing countries, now play an important part in the general equilibrium analysis of regional and global trade. One issue which has arisen is the question of when to move from a single-country model to a multi-country model and take on the additional data requirements involved. In this paper, we use the case of North America and the methodology of regional decompostion of fixed-price multipliers. We consider inter-country income effects in the form of open- and closed-loop multipliers and use these mutlipliers to shed light on the question: What difference does a country make in a multi-country model? (C6, F1)

* We would like to thank Hugh Arce, Gordon Blaney, Charles Bowman, Antonio Aguilar Bueno, Joseph Flynn, Joseph Francois, Luis Alberto Ibarra, Mark Planting, Erik Poole, Ronald Rioux, Clint Shiells, and Colleen Williams for data. Support for this research was provided by the U.S. Department of Labor, Bureau of International Labor Affairs. The views expressed below are those of the authors and should not be attributed to their affiliated institutions or the U.S. Department of Labor.

Kenneth A. Reinert (correspondence author): Kalamazoo College, 1200 Academy Street, Kalamazoo, MI, 49006 USA, 616-337-7027, kreinert@kzoo.edu. David W. Roland-Holst: Mills College, Oakland, CA 94613 USA, 510-430-2248, prospero@surf.com.

I. Introduction

Social accounting matrices (SAMs) were originally developed to assist in analyzing income distribution issues in developing countries.[1] Along with that role, they now play an important part in the general equilibrium analysis of regional and global trade. This newer role has been discussed in some detail by Reinert and Roland-Holst (1997). One issue which has arisen is the question of when to move from a single-country model to a multi-country model and take on the additional data requirements of enlarging the underlying SAMs required for the latter option. Surpisingly, in the case of the North American Free Trade Agreement (NAFTA), most of the models used were restricted to one or two of the three North American countries (see Francois and Shiells, 1994). This indicates some reluctance to add countries on to national or binational models.

In this paper, we address the North American case and use the regional decomposition of fixed-price multipliers to address the question of country inclusion in multi-regional models.[2] The method is presented in Section II and is applied to a 1991 SAM of North America in Section III. Our conclusions are presented in Section IV. For the interested reader, the construction of the SAM is briefly described in the appendix.

II. The Regional Decomposition of Multipliers

Define a n x n multi-country SAM as the matrix **S**. The row sums of **S** compose a column vector of incomes we denote as **y**. Column normalization of **S** yields the matrix of expenditure shares we denote as **A**. The income-expenditure identity can be written as:

$$\mathbf{y} = \mathbf{A}\mathbf{y} \tag{1}$$

We next partition the SAM into m endogenous accounts and k exogenous accounts. Equation (1) can then be rewritten as:

$$\begin{bmatrix} y_m \\ y_k \end{bmatrix} = \begin{bmatrix} A_{mm} & A_{mk} \\ A_{km} & A_{kk} \end{bmatrix} \begin{bmatrix} y_m \\ y_k \end{bmatrix} \tag{2}$$

[1] For reviews of this literature, see Pyatt and Round (1985).
[2] Such multipliers were introduced by Pyatt and Round (1979), Round (1985), and Round (1988). A related paper is given in Chapter 3 of Goodwin (1983).

We can express endogenous incomes as:

$\mathbf{y}_m = \mathbf{A}_{mm}\, \mathbf{y}_m + \mathbf{A}_{mk}\, \mathbf{y}_k$

or:

$$\mathbf{y}_m = \mathbf{A}_{mm}\, \mathbf{y}_m + \mathbf{x} \qquad (3)$$

where $\mathbf{x}$ is a m x 1 column vector of exogenous injections.

Let us partition $\mathbf{A}_{mm}$ by country, where the subscripts 1, 2, and 3 denote Canada, the United States, and Mexico, respectively. Then we additively decompose the partitioned $\mathbf{A}_{mm}$ matrix as follows:

$$A_{mm} = \begin{bmatrix} A_{11} & 0 & 0 \\ 0 & A_{22} & 0 \\ 0 & 0 & A_{33} \end{bmatrix} + \begin{bmatrix} 0 & A_{12} & A_{13} \\ A_{21} & 0 & A_{23} \\ A_{31} & A_{32} & 0 \end{bmatrix}$$

$$\mathbf{A}_{mm} = \mathbf{B} + \mathbf{C} \qquad (4)$$

Substituting (4) into (3), we have:

$$\mathbf{y}_m = \mathbf{B}\mathbf{y}_m + \mathbf{C}\mathbf{y}_m + \mathbf{x} \qquad (5)$$

And we can put this into a reduced form as follows:

$\mathbf{y}_m = (\mathbf{I}\text{-}\mathbf{B})^{-1}\mathbf{C}\mathbf{y}_m + (\mathbf{I}\text{-}\mathbf{B})^{-1}\mathbf{y}_m$

$\mathbf{y}_m = [\mathbf{I} - (\mathbf{I}\text{-}\mathbf{B})^{-1}\mathbf{C}]^{-1}\, (\mathbf{I}\text{-}\mathbf{B})^{-1}\mathbf{x}$

$$\mathbf{y}_m = (\mathbf{I}\text{-}\mathbf{D})^{-1}\, (\mathbf{I}\text{-}\mathbf{B})^{-1}\mathbf{x} \qquad (6)$$

where $\mathbf{D} = (\mathbf{I}\text{-}\mathbf{B})^{-1}\mathbf{C}$

This was the equation used in Reinert, Roland-Holst, and Shiells (1993). For our purposes here, however, we take the decompostion one step further.

$\mathbf{y}_m = (\mathbf{I}\text{-}\mathbf{D}^2)^{-1}\, (\mathbf{I}\text{+}\mathbf{D})\, (\mathbf{I}\text{-}\mathbf{B})^{-1}\mathbf{x}$

$$\mathbf{y}_m = \mathbf{M}_3\, \mathbf{M}_2\, \mathbf{M}_1\, \mathbf{x} \qquad (7)$$

Let us interpret equation (7). Matrix $\mathbf{M}_1$ can be written as follows:

$$M_1 = \begin{bmatrix} (I - A_{11})^{-1} & 0 & 0 \\ 0 & (I - A_{22})^{-1} & 0 \\ 0 & 0 & (I - A_{33})^{-1} \end{bmatrix}$$

This is a block diagonal matrix of *intra-country multiplier* matrices, one for each country. The diagonal blocks correspond to the multipliers that would be obtained from three single-country SAMs studied in isolation. Put another way, they capture the income linkages of a single-country general equilibrium model.[3]

Matrix $\mathbf{M}_2$ can be written as follows:

$$M_2 = \begin{bmatrix} I & (I-A_{11})^{-1}A_{12} & (I-A_{11})^{-1}A_{13} \\ (I-A_{22})^{-1}A_{21} & I & (I-A_{22})^{-1}A_{23} \\ (I-A_{33})^{-1}A_{31} & (I-A_{33})^{-1}A_{32} & I \end{bmatrix}$$

This matrix contains the *open-loop effects* within North America. These consist of income effects transmitted from an endogenous account in one country to an endogenous account in another country. The open-loop effects are one component of the inter-country income effects caputured by multi-country general equilibrium models.

Finally, matrix $\mathbf{M}_3$ can be written as:

$$M_3 = \left[\begin{matrix} \left\{I-(I-A_{11})^{-1}A_{12}(I-A_{22})^{-1}A_{21}-(I-A_{11})^{-1}A_{13}(I-A_{33})^{-1}A_{31}\right\} \\ -(I-A_{22})^{-1}A_{23}(I-A_{33})^{-1}A_{31} \\ -(I-A_{33})^{-1}A_{32}(I-A_{22})^{-1}A_{21} \end{matrix}\right.$$

$$\begin{matrix} -(I-A_{11})^{-1}A_{13}(I-A_{33})^{-1}A_{32} \\ \left\{I-(I-A_{22})^{-1}A_{21}(I-A_{11})^{-1}A_{12}-(I-A_{22})^{-1}A_{23}(I-A_{33})^{-1}A_{32}\right\} \\ -(I-A_{33})^{-1}A_{31}(I-A_{11})^{-1}A_{12} \end{matrix}$$

$$\left.\begin{matrix} -(I-A_{11})^{-1}A_{12}(I-A_{22})^{-1}A_{23} \\ -(I-A_{22})^{-1}A_{21}(I-A_{11})^{-1}A_{13} \\ \left\{I-(I-A_{33})^{-1}A_{31}(I-A_{11})^{-1}A_{13}-(I-A_{33})^{-1}A_{32}(I-A_{22})^{-1}A_{23}\right\} \end{matrix}\right]^{-1}$$

These closed-loop effects are a second component of the inter-country income effects captured by multi-country general equilibrium models. They measure the income

[3] Roland-Holst (1990) has shown that these SAM-based multipliers differ in significant ways from input-output multipliers.

effects that are transferred from an endogenous account in one country , through a second country, and to either the originating country or a third country.

Equation 7 can be rewritten as:

$$\mathbf{y}_m = [\mathbf{I} + (\mathbf{M}_1 - \mathbf{I}) + (\mathbf{M}_2 - \mathbf{I})\,\mathbf{M}_1 + (\mathbf{M}_3 - \mathbf{I})\,\mathbf{M}_2\,\mathbf{M}_1]\,\mathbf{x}$$
$$= (\mathbf{I} + \mathbf{N}_1 + \mathbf{N}_2 + \mathbf{N}_3)\,\mathbf{x} \qquad (8)$$

Equation 8 is an additive multiplier decomposition. It begins with the effects of the injection itself (the matrix $\mathbf{I}$). The matrix $\mathbf{N}_1 = (\mathbf{M}_1 - \mathbf{I})$ gives the intra-country effects net of the injection itself. The matrix $\mathbf{N}_2 = (\mathbf{M}_2 - \mathbf{I})\,\mathbf{M}_1$ gives the open-loop inter-country effects net of the intra-country effects. Finally, the matrix $\mathbf{N}_3 = (\mathbf{M}_3 - \mathbf{I})\,\mathbf{M}_2\,\mathbf{M}_1$ gives the closed-loop inter-country effects net of the open-loop and intra-country effects.

III. Multiplier Estimates

In implementing the multiplier decompostion of Section II, we must first decide which accounts are to be treated as endogenous and which are to be treated as exogenous. We follow Pyatt and Round (1979) in assuming that the commodity accounts, non-tax, value-added accounts and the enterprise accounts for each county are endogenous. Pyatt and Round assume that the household account is endogenous, while the government and capital accounts are exogenous. In our North American SAM, these accounts are aggregated into three domestic final demand accounts, one for each country. For this reason, we first treat domestic final demand accounts as exogenous in what we call Multiplier Analysis I and then as endogenous in what we call Multiplier Analysis II. We follow Pyatt and Round in assuming that the rest of the world account, the tariff accounts, and the value-added tax accounts are exogenous.

Table 1 presents a set of calculated, additive, open-loop multipliers for Multiplier Analysis I. In particular, it presents the diagonals of selected partitions of matrix $\mathbf{N}_2$.[4] What is most apparent from the information presented in this table is the hub-and-spoke nature of the three North American economies. Exogenous expenditures in Canada and Mexico have large, open-loop impacts on the United States. These can be seen in the

[4] All multiplier calculations were made using the Matrix Accounts Transformation System (MATS) written by Dominique van der Mensbrugghe and David Roland-Holst.

(us,cn) and (us,mx) columns. The United States has a much more diversified import structure than Canada and Mexico. Consequently, exogenous expenditures in the United States have small open-loop impacts on Canada and Mexico. These can be seen in the (cn,us) and (mx,us) columns. Canada and Mexico, the spokes in the hub-and-spoke structure, have relatively weak linkages between them. Their very small open-loop effects can be seen in columns (mx,cn) and (cn,mx). The largest open-loop effects tend to occur in non-electrical machinery, electrical machinery, and transporation equipment, sectors where there is a high degree of integration among the three economies. For example, the last column (us,mx) shows that in 1991 a US dollar increase in exogenous expenditures on non-electrical machinery in Mexico results in an increase of US 46 cents in non-electrical machinery incomes in the United States. The equivalent for Canada (us,cn) is US 43 cents.

Table 2 presents a set of calculated, additive, open-loop multipliers for Multiplier Analysis II, and a comparison of Tables 1 and 2 show the impact of making the domestic final demand sector endogenous. What is apparent here is that endogenizing domestic final demand only has a significant impact on the multipliers where the underlying trade likages were already present in the form of strong likages in Table 1. The reader needs to exercise caution in interpreting the results of Table 2. Recall that domestic final demand includes government and investment demands along with household demand. It is highly unlikely that government and investment demands would respond in the manner implicit in making them endogenous in a linear multiplier model. To put it more simply, the results of Table 2 are over-estimates.

Table 3 presents a set of calculated, additive, closed-loop multipliers for Multiplier Analysis I. In particular, it presents the diagonals of selected partitions of matrix $\mathbf{N}_3$. Table 4 presents the same information for Multiplier Analysis II. The results of these two tables directly address the question posed in this paper: What difference does a country make? The open-loop effects of Tables 1 and 2 are not crucial to the decision to include an additional country in a multi-country, general equilibrium model. The closed-loop effects of Tables 3 and 4, however, are crucial to this decision. Let us consider a few examples.

The (cn,cn) column in Table 3 and Table 4 reveal that, in the transportation equipment sector of Canada, a US dollar increase in exogenous demand causes increased income in Canada of between US 3 and 6 cents *by way of linkages through the United States and Mexico*. A single-country model of Canada joining NAFTA (e.g. Cox, 1994) would not capture this link. For the transportion equipment sector in the United States, column (us,us) shows a similar figure is between US 3 and 9 cents. The (cn,mx) column shows that a US dollar increase in exogenous demand for transportation equipment in Mexico causes increased income in Canada of between US 3 and 7 cents in Canada *by way of the United States*.

In the context of NAFTA modeling, models that include the United States and Mexico (e.g. Burfisher, Robinson, and Thierfelder, 1994) probably capture the important linkages as far as Mexico is concerned. The closed-loop multipliers in columns (mx,mx) and (mx,us) are uniformly low. This is a reflection of the hub-and-spoke structure described above and does not generalize to other North-South regional modeling exercises. Indeed, the general conclusion one can make from Tables 3 and 4 is that, while including a country will not "make a difference" in most sectors, it certainly will in many. In the present example, a country makes a difference in the paper, chemical, rubber, non-ferrous metals, non-electrical machinery, electrical machinery, and transportation equipment sectors.

IV. Conclusions

Initially formulated to address questions of income distribution in the development process, social accounting matrices now form the empirical foundation (implicitly if not explicitly) of applied general equilibrium modeling in a large number of fields. Especially in the area of applied trade policy modeling, many modelers face the question of when to move from a single-county model to a multi-country model. Associated with the SAM framework is a multiplier analysis which, as we have shown here, offers a useful analytical framework with which to address this question. Adding a country to a general equilibrium analysis of trade makes a difference where closed-loop effects are important. In the case of North America, these appear to be important in a number of key sectors.

Consequently, some single-country models of NAFTA are lacking in a significant way. A country *can* make a difference for model results.

Appendix: SAM Construction

This appendix provides a brief description of the construction of the 1991 social accounting matrix (SAM) of North America.[5] Construction of the 1991 North American SAM began with the transformation of 1991 national accounts for each country into three separate macroeconomic SAMs. For this purpose, Canadian macroeconomic data were taken from Statistics Canada (1993a and 1993b), U.S. macroeconomic data were taken from U.S. Department of Commerce (1992b), and Mexican macroeconomic data were taken from OECD (1992), Banco de México (1993), Instituto National de Estadística, Geographía e Informática (1992), and International Monetary Fund (1993). Next, individual macroeconomic SAMs were joined together into a North American macroeconomic SAM using market exchange rates from International Monetary Fund (1993) and aggregate trade flows taken from International Monetary Fund (1992). Adjustments for maquiladora trade were made with data from Banco de México (1993), and factor service and capital flows were added using data from U.S. Department of Commerce (1992a) and Statistics Canada (1993b).

The next stage of SAM construction involved estimation of the 26 sectoral accounts of each country. Labor value added, property value added, indirect business taxes, value added taxes (for Mexico), domestic final demand, imports, exports, and inter-industry transactions were disaggregated for each country into the 26 sectors. For labor value added, property value added, indirect business taxes, value added taxes, and domestic final demand, this was done using shares from input-output accounts. For Canada, we used 1990 Statistics Canada input output accounts. For the United States, we used 1987 U.S. Department of Labor input-output accounts.[6] In the case of Mexico, we used 1989 SECOFI input output accounts.[7] For imports and exports, the disaggregation

[5] A more detailed description is available from the authors upon request.

[6] These are census based. At the time of the work on the SAM, the 1987 U.S. Department of Commerce input-output accounts were not available.

[7] SECOFI is the acronym for Secretaría de Comercio y Fomento Industrial.

was conducted using 10-digit HTS data for the United States and 3-digit SITC data for all three countries. The former were obtained from U.S. Department of Commerce data tapes, and the latter were obtained from United Nations data tapes. Canadian tariffs were estimated from the 1990 input-output data, U.S. tariffs were estimated from the Department of Commerce data, and Mexican tariffs were estimated from data presented in General Agreement on Tariffs and Trade (1993).

For Canada and the United States, 1991 interindustry transactions were estimated using make and use tables for 1990 and 1987, respectively. Make and use tables were balanced using 1991 gross activity output output and the RAS procedure.[8] We then removed activity accounts using the Pyatt (1985) procedure. For Mexico, the 1989 transactions matrix was updated to 1991 using 1991 value added, final demand, import and export data.

[8] On the RAS procedure, see Schneider and Zenios (1990).

Table 1. 1991 Open-Loop Multiplier Estimates for Multiplier Analysis I (cents per US dollar of new, exogenous demand)[a]

Sector[b]	(us,cn)	(mx,cn)	(cn,us)	(mx,us)	(cn,mx)	(us,mx)
agricult	12.0	0.3	1.8	1.3	0.9	6.8
mining	5.6	0.1	1.7	0.6	0.3	10.2
petrol	3.8	0.3	7.4	3.0	0.1	19.4
foodproc	8.9	0.1	0.9	3.2	0.1	8.5
beverages	1.7	0.2	1.0	4.3	0.0	0.8
tobacco	0.9	0.0	0.4	0.1	0.0	0.0
textiles	25.6	0.3	0.7	1.2	0.1	12.0
apparel	17.5	0.1	0.4	0.8	0.1	18.8
leather	8.8	0.1	0.4	1.3	0.0	7.6
paper	12.2	0.0	6.5	0.2	0.2	19.1
chemical	23.4	0.2	2.0	0.3	0.1	15.9
rubber	30.2	0.4	2.4	0.4	0.1	24.0
monmetmn	13.0	0.3	1.8	1.0	0.0	3.9
ferrous	19.8	0.1	2.9	0.6	0.2	20.3
nonferrs	24.4	0.0	10.2	1.4	0.1	21.3
woodmetl	13.5	0.1	3.3	0.8	0.1	21.4
nnelcmac	42.7	0.7	2.6	0.5	0.2	46.1
elecmach	36.2	1.1	2.6	2.7	0.1	31.5
trnseqpt	31.0	1.4	9.4	1.3	0.4	35.8
othmanuf	28.7	2.6	0.7	0.7	0.0	14.9

[a] This table presents $N_2(i,j)$, the additive, open-loop, inter-country multiplier effect of a change in exogenous demand for the sector in country j on income of the sector in country i, i,j = Canada (cn), United States (us), Mexico (mx). In Multiplier Analysis I, the domestic final demand account is exogenous.

[b] Sectors are: agriculture; mining; petroleum; food processing; beverages; tobacco; textiles; apparel; leather; paper; chemicals; rubber; non-metalic mineral products; iron and steel; non-ferrous metals; wood and metal products; non-electrical machinery; electrical machinery; transportaiton equipment; other manufactures. Service sectors have been excluded due to a lack of data on trade in services among the North American countries.

Table 2. 1991 Open-Loop Multiplier Estimates for Multiplier Analysis II (cents per US dollar of new, exogenous demand)[a]

Sector[b]	(us,cn)	(mx,cn)	(cn,us)	(mx,us)	(cn,mx)	(us,mx)
agricult	22.9	0.6	3.9	2.9	1.3	18.9
mining	8.4	0.1	2.6	0.9	0.3	13.5
petrol	15.7	0.4	10.7	3.8	0.2	35.5
foodproc	26.3	0.4	3.3	2.1	0.2	28.5
beverages	4.4	0.2	1.5	0.8	0.0	3.8
tobacco	2.5	0.0	0.5	0.1	0.0	1.6
textiles	30.5	0.4	1.1	1.5	0.2	16.5
apparel	21.9	0.1	0.8	1.1	0.1	24.5
leather	9.0	0.1	0.6	1.4	0.0	8.7
paper	24.6	0.1	9.9	0.5	0.3	33.0
chemical	38.8	0.4	3.9	1.1	0.1	32.3
rubber	36.6	0.5	3.1	0.6	0.1	30.5
monmetmn	16.5	0.4	2.3	1.3	0.0	7.3
ferrous	24.7	0.1	3.7	0.9	0.2	26.0
nonferrs	27.7	0.0	10.9	1.6	0.1	25.0
woodmetl	29.6	0.2	6.4	1.5	0.2	39.4
nnelcmac	51.7	0.8	4.2	0.9	0.2	54.3
elecmach	52.5	1.2	4.6	3.5	0.2	48.2
trnseqpt	53.0	1.7	14.9	2.2	0.5	60.2
othmanuf	37.4	2.7	1.2	0.9	0.0	23.9

[a] This table presents $N_2(i,j)$, the additive, open-loop, inter-country multiplier effect of a change in exogenous demand for the sector in country j on income of the sector in country i, i,j = Canada (cn), United States (us), Mexico (mx). In Multiplier Analysis II, the domestic final demand account is endogenous.

[b] Sectors are: agriculture; mining; petroleum; food processing; beverages; tobacco; textiles; apparel; leather; paper; chemicals; rubber; non-metalic mineral products; iron and steel; non-ferrous metals; wood and metal products; non-electrical machinery; electrical machinery; transportaiton equipment; other manufactures. Service sectors have been excluded due to a lack of data on trade in services among the North American countries.

Table 3. 1991 Closed-Loop Multiplier Estimates for Multiplier Analysis I (cents per US dollar of new, exogenous demand)[a]

Sector[b]	(cn,cn)	(us,cn)	(mx,cn)	(cn,us)	(us,us)	(mx,us)	(cn,mx)	(us,mx)	(mx,mx)
agricult	0.2	0.0	0.1	0.0	0.3	0.0	0.1	0.1	0.1
mining	0.1	0.0	0.0	0.0	0.2	0.0	0.2	0.0	0.1
petrol	0.2	0.1	0.1	0.0	0.7	0.0	1.0	0.1	0.4
foodproc	0.1	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0
beverages	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
tobacco	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
textiles	0.1	0.1	0.2	0.0	0.3	0.0	0.1	0.1	0.1
apparel	0.1	0.1	0.1	0.0	0.2	0.0	0.1	0.1	0.2
leather	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.1
paper	0.6	0.1	0.0	0.0	0.6	0.0	1.0	0.1	0.0
chemical	0.4	0.1	0.1	0.0	0.5	0.0	0.3	0.1	0.0
rubber	0.7	0.3	0.1	0.0	0.8	0.0	0.5	0.2	0.1
monmetmn	0.2	0.0	0.1	0.0	0.3	0.0	0.1	0.0	0.0
ferrous	0.5	0.1	0.1	0.0	0.6	0.0	0.5	0.1	0.1
nonferrs	2.0	0.5	0.3	0.2	2.6	0.0	1.7	0.5	0.2
woodmetl	0.4	0.1	0.1	0.0	0.6	0.0	0.6	0.1	0.2
nnelcmac	1.1	0.9	0.2	0.0	1.3	0.0	1.2	0.7	0.2
elecmach	0.8	0.9	0.9	0.0	1.7	0.1	0.7	0.5	0.7
trnseqpt	2.9	1.3	0.4	0.2	2.8	0.1	3.3	0.1	0.5
othmanuf	0.2	0.5	0.2	0.0	0.3	0.0	0.1	0.1	0.1

[a] This table presents $N_3(i,j)$, the additive, closed-loop, inter-country multiplier effect of a change in exogenous demand for the sector in country j on income of the sector in country i, i,j = Canada (cn), United States (us), Mexico (mx). In Multiplier Analysis I, the domestic final demand account is exogenous.

[b] Sectors are: agriculture; mining; petroleum; food processing; beverages; tobacco; textiles; apparel; leather; paper; chemicals; rubber; non-metalic mineral products; iron and steel; non-ferrous metals; wood and metal products; non-electrical machinery; electrical machinery; transportaiton equipment; other manufactures. Service sectors have been excluded due to a lack of data on trade in services among the North American countries.

Table 4. 1991 Closed-Loop Multiplier Estimates for Multiplier Analysis II (cents per US dollar of new, exogenous demand)[a]

Sector[b]	(cn,cn)	(us,cn)	(mx,cn)	(cn,us)	(us,us)	(mx,us)	(cn,mx)	(us,mx)	(mx,mx)
agricult	1.2	1.1	0.8	0.2	2.4	0.2	1.1	1.1	0.7
mining	0.5	0.3	0.2	0.1	0.8	0.0	0.6	0.3	0.2
petrol	1.5	1.3	0.4	0.3	3.7	0.1	2.7	1.6	0.9
foodproc	1.2	1.6	0.8	0.2	3.3	0.2	1.2	1.6	0.8
beverages	0.2	0.3	0.2	0.0	0.6	0.0	0.2	0.3	0.2
tobacco	0.1	0.1	0.0	0.0	0.3	0.0	0.1	0.1	0.0
textiles	0.3	0.6	0.4	0.0	1.2	0.0	0.3	0.5	0.2
apparel	0.3	0.4	0.3	0.0	0.9	0.0	0.4	0.5	0.3
leather	0.1	0.0	0.1	0.0	0.2	0.0	0.2	0.1	0.2
paper	2.1	1.3	0.2	0.3	3.4	0.1	2.6	1.4	0.2
chemical	1.3	1.6	0.5	0.2	3.4	0.1	1.2	1.5	0.5
rubber	1.1	1.0	0.3	0.1	2.1	0.1	0.9	0.9	0.2
monmetmn	0.5	0.4	0.3	0.1	1.0	0.1	0.3	0.3	0.2
ferrous	1.0	0.7	0.3	0.1	1.7	0.1	1.0	0.7	0.3
nonferrs	2.4	1.0	0.4	0.3	3.7	0.1	2.2	1.0	0.4
woodmetl	1.8	1.7	0.4	0.3	4.1	0.1	2.3	1.9	0.5
nnelcmac	2.1	2.1	0.5	0.2	3.3	0.1	2.2	1.8	0.5
elecmach	2.0	3.0	1.4	0.3	5.5	0.2	2.0	2.6	1.3
trnseqpt	6.3	4.8	1.0	1.0	9.0	0.4	6.9	4.4	1.1
othmanuf	0.5	1.5	0.3	0.1	1.8	0.1	0.4	0.9	0.2

[a] This table presents $N_3(i,j)$, the additive, closed-loop, inter-country multiplier effect of a change in exogenous demand for the sector in country j on income of the sector in country i, i,j = Canada (cn), United States (us), Mexico (mx). In Multiplier Analysis II, the domestic final demand account is endogenous.
[b] Sectors are: agriculture; mining; petroleum; food processing; beverages; tobacco; textiles; apparel; leather; paper; chemicals; rubber; non-metalic mineral products; iron and steel; non-ferrous metals; wood and metal products; non-electrical machinery; electrical machinery; transportaiton equipment; other manufactures. Service sectors have been excluded due to a lack of data on trade in services among the North American countries.

References

Burfisher, ME., S. Robinson, and K.E. Thierfelder, "Wage Changes in a U.S.-Mexico Free Trade Area: Migration vs. Stolper-Samuelson Effects," in J.F. Francois and C.R. Shiells (eds.), *Modeling Trade Policy: Applied General Equilibrium Assessments of North American Free Trade*, Cambidge University Press, Cambridge, 1994, 195-222.

Cox, D.J, "Some Applied General Equilibrium Estimates of the Impact of a North American Free Trade Agreement on Canada," in J.F. Francois and C.R. Shiells (eds.), *Modeling Trade Policy: Applied General Equilibrium Assessments of North American Free Trade*, Cambidge University Press, Cambridge, 1994, 100-123.

Francois, J.F. and C.R. Shiells (eds.), *Modeling Trade Policy: Applied General Equilibrium Assessments of North American Free Trade*, Cambidge University Press, Cambridge, 1994.

Goodwin, R.M., *Essays in Linear Economic Structures*, Macmillan, London, 1983.

Pyatt, G., "Commidity Balances and National Accounts: A SAM Perspective," *Review of Income and Wealth*, 31:2, June 1985, 155-169.

Pyatt, G. and J.I. Round, "Accounting and Fixed-Price Multipliers in a Social Accounting Matrix Framework," *Economic Journal*, 89:356, December 1979, 850-873.

Pyatt, G. and J.I. Round (eds.), *Social Accounting Matrices: A Basis for Planning*, World Bank, Washington, D.C., 1985.

Reinert, K.A. and D.W. Roland-Holst, "Social Accounting Matrices," in J.F. Francois and K.A. Reinert (eds.), *Applied Methods for Trade Policy Analysis: A Handbook*, Cambridge University Press, Cambridge, 1997, 94-121.

Reinert, K.A., D.W. Roland-Holst, and C.R. Shiells, "Social Accounts and the Stucture of the North American Economy," *Economic Systems Research*, 5:3, 1993.

Roland-Holst, D.W., "Interindustry Analysis with Social Accounting Methods," *Economic Systems Research*, 2:2, 1990, 125-145.

Round, J.I., "Incorporating the International, Regional, and Spatial Dimension into a SAM: Some Methods and Applications," in F. Harrigan and P.G. McGregor (eds.), *Recent Advances in Regional Economic Modeling*, Pion, London, 1988, 24-45.

Round, J.I., "Decomposing Multipliers for Economic Systems Involving Regional and World Trade," *Economic Journal*, 95:378, June 1985, 383-399.

Schneider, M.H. and S.A. Zenios, “A Comparative Study of Algorithms for Matrix Balancing,” *Operations Research* 38:3, May-June 1990, 439-455.

Data Sources

Banco de México, *The Mexican Economy 1993*, Mexico City, 1993.

General Agreement on Tariffs and Trade, *Trade Policy Review: Mexico 1993*, Geneva, 1993.

Instituto Nacional de Estadística, Geographía e Informática, *Sistema de Cuentas Nacionales de Mexico: Cálculo Preliminar*, Mexico City, 1992.

International Monetary Fund, *Direction of Trade Statistics Yearbook 1992*, Washington, D.C., 1992.

International Monetary Fund, *International Financial Statistics*, Washington, D.C., 1993.

Organization for Economic Co-operation and Development, *OECD Economic Surveys: Mexico*, Paris, 1992.

Statistics Canada, *National Income and Expenditure Accounts*, Ottawa, 1993a.

Statistics Canada, *Canada’s Balance of International Payments*, Ottawa, 1993b.

U.S. Department of Commerce, *Survey of Current Business* 72 (June 1992a).

U.S. Department of Commerce, *Survey of Current Business* 72 (July 1992b).