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Economic Integration in Central America and the Caribbean

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The costliness of economic integration is partly dependent upon whether shocks to regions or groups of nations are symmetric or asymmetric in their impacts. This paper uses a structural vector autoregressive model to determine whether exogenous shocks have symmetric or asymmetric effects for a group of Caribbean and Central American nations. The results indicate that there are likely to be significant costs to extensive economic integration in these regions. There is support for integration encompassing limited combinations of countries.

I. Introduction

Efforts at economic integration are under way in many areas of the world. The European community continues to press forward from its custom union base with its aim being complete economic integration. The new market economies of Eastern Europe are, for the most part, anxious to join in this effort. The creation of NAFTA has initiated efforts aimed at the economic integration of North America with the intent of perhaps expanding the number of countries included. With the rapid growth of the East and Southeast Asian economies discussions on various forms of economic integration are beginning to occur.

Neither Central America nor the Caribbean have been immune to such trends. One aspect of this integration process involves the formation of currency unions. This can involve the use of a common currency, the fixing of exchange rates among all members of such a union, or the fixing of exchange rates to the same outside (outside of the region) currency, say the dollar. In fact, of the ten Caribbean countries analyzed in this paper, two are in a currency union (St. Vincent and Dominica) and three are pegged to the dollar (Belize, Barbados, and the Bahamas). Puerto Rico, also included in this study, holds Common Wealth status with the U.S. and uses the dollar as its currency. In Central America one country, Panama, uses the American dollar. Thus much of the Caribbean and some of Central America are already, to some extent, integrated.

Of course, it is hoped that such efforts aimed at economic integration will bring economic benefits. These benefits are thought to flow from the expanded flow of trade and investment which will occur among members of such regional groups. There is, of course, some uncertainty as to whether these benefits will occur and under what circumstances they are likely to occur. With respect to currency unions, the fixing of exchange rates between members can certainly increase trade and investment flow. However, it may make responding to exogenous shocks

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that much more difficult and thus impose significant economic costs on member nations.

The above concerns flow from the optimal currency literature. This literature argues that if exogenous shocks have symmetrical effects upon a group of nations, then it is optimal to establish a currency union (fixing exchange rates among the member nations). Alternatively, if exogenous shocks have asymmetric effects, then the scope for currency integration is limited. This paper seeks to measure the symmetry or asymmetry of shocks effecting the Caribbean and Central America utilizing a structural vector autoregressive model.

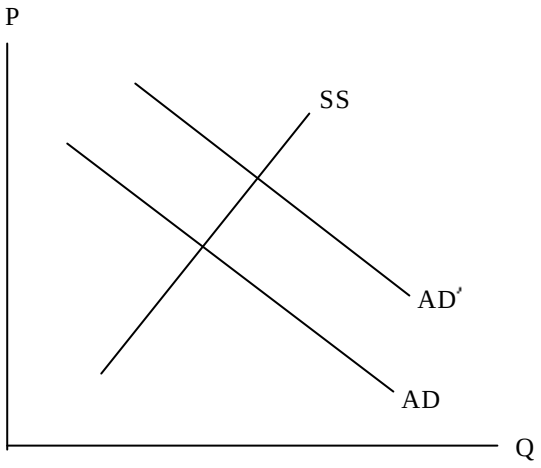
The paper is organized as follows. The first section will present a brief discussion of Mundell's theory of optimum currency areas. Section Two will present the empirical methodology while Section Three will analyze the results. Finally, Section Four will Summarize the results.

II. Optimum Currency Areas

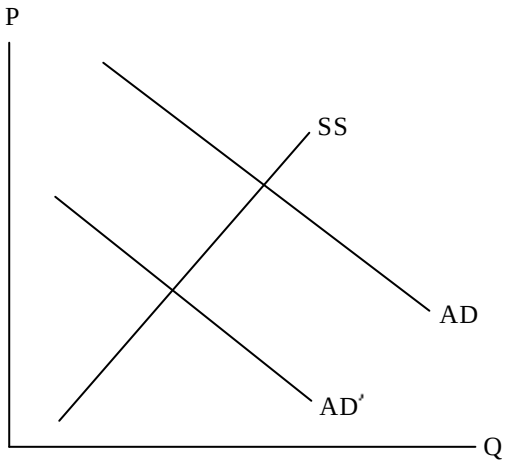
The optimal currency area literature originates with Mundell's classic 1961 paper.[1] The literature seeks to identify different macroeconomic characteristics which would determine the range of territory within which one currency should be used, i.e., in the case of countries this literature seeks to identify those conditions which are conducive to the formation of a currency union. Good surveys of this literature can be found in the work of Ishiyama (1975) and Tavlas (1993). One of the most important conclusions of this literature is "that a national currency whose supply can be independently controlled and whose rate of exchange against foreign currencies can therefore vary is most beneficial for countries experiencing different disturbances than neighbors and consequently valuing monetary autonomy to facilitate adjustment."[2] This paper concentrates on the measurement of these disturbances in a sample of Caribbean and Central American countries. Before actually measuring these disturbances the issue is discussed in light of Mundell's paper and a brief review of mechanisms of adjustment to asymmetric shocks is presented.

Mundell (1961) argued that in situations of sticky wages and prices and low factor mobility, country specific shocks could have severe consequences on real variables if the nominal exchange rate is fixed. For example, assume that two economic regions, A and B, utilize the same currency (or have permanently fixed exchange rates between each other). If exogenous shocks have an asymmetric impact on the two regions this implies that a positive demand shock in region A is matched by a negative demand shock in region B. The impact of this asymmetry is illustrated in Figure 1. In this figure AD and AD′ represent aggregate demand before and after the shock and SS represents the short-run aggregate supply curve. As can be seen, output and prices will increase in region A while they will decrease in region B. With the exchange rates between regions fixed there is no way that consistent policy choices can be used to deal with the differing problems in the two regions. If the government chooses to respond to the inflationary problems of region A by reducing aggregate demand, then unemployment in region B will be exacerbated. Alternatively, if the government expands aggregate demand to deal with the unemployment problems in region B, the inflation problem faced by A will be worsened. A currency union of these two regions imposes significant costs on the society.

1. Mundell R.A. (1961), "A Theory of Optimum Currency Areas," *American Economic Review*, 657-665.
2. See Eichengreen (1994).



Region A



Region B

Figure 1

Alternatively, if demand shocks are symmetric in regions A and B, then a positive demand shock in the former is matched by a positive shock in the latter. Prices and output will rise in both countries and a common policy to reduce inflation could be followed. In this case, the creation of a currency union does not impose significant adjustment costs on the participants.

The above analysis presumes that the only mechanism that regions have for adjusting to asymmetric shocks is the exchange rate. Thus the formation of a currency union eliminates this mechanism thus imposing significant costs on regions experiencing asymmetric shocks. However, as Mundell (1961) himself has pointed out, the mobility of labor between two regions may also serve as a mechanism of adjustment. The greater the mobility the less need there is for different policy responses in the two regions to prevent high unemployment from occurring in one relative to the other. Ingram (1973) has further argued that the mobility of physical capital can, under certain conditions, serve as a substitute for a lack of labor mobility. Atkeson and Bayoumi (1991) have also proposed that financial capital mobility can also serve, to some extent, as a substitute for physical capital mobility. Finally, Sachs and Sala-i-Martin (1992) have indicated that regional adjustment can be attained through fiscal transfers from economically expanding regions to contracting regions. In summery, asymmetric shocks impose costs on regions within a currency union. The response of regions to such shocks can involve various forms of adjustment (physical capital movement, financial capital movement, labor mobility, and fiscal transfers).

Empirical attempts at measuring the extent of asymmetric shocks have often examined the variability of prices and output among regions. However, almost all of these attempts involve a common problem. Empirical analysis indicating that prices or output among a group of nations tend to move together would, for example, seem to indicate symmetric responses with respect to shocks. However, these approaches tend to confuse information on the symmetry of shocks and the adjustment to these shocks.[3] For example, one approach is to compute the variability of real exchange rates between regions. The argument is that changes in prices reflect changes in demand and supply affecting one region relative to another. Thus Poloz compared the variability of regional exchange rates within Canada with real exchange rates between France, the United Kingdom, Italy, and Germany. The conclusion was that the variability among Canadian provinces was greater than that among the four countries. Thus the implication would seem to be that the four European nations could successfully form a currency union. The difficulty with this interpretation is that the relative prices of the products between two regions (nations) may show little variability, but this could be the result of two different factors. First, it may indicate that the two regions face symmetric shocks. Alternatively, it may be the result of factors of production moving out of regions where prices are falling and into regions where they have begun to rise. Thus the analysis confuses the degree of symmetry of shocks with the adjustment process.

The implication of the above analysis is that if one can isolate the shocks from the adjustment process in the data on output and prices for two countries, then one can correlate those shocks across countries to determine whether they are symmetric or asymmetric in nature. If they are symmetric in nature (the shocks are positively correlated) then the countries could

3. See Bayoumi and Eichengreen (1992).

be united into a currency union without the fear of significant adjustment costs. Alternatively if they are asymmetric across nations, then the creation of a currency union will create significant adjustment costs.

In this paper a methodology to isolate the shocks from the adjustment process will be used in which two types of shocks will be analyzed, those coming from the demand side and those coming from the supply side. Assuming that the long-run supply curve of an economy is vertical, then demand shocks are transitory is nature in terms of the impact on output. Alternatively, supply side shocks are permanent in that they alter the output level in the long-run. Thus in this paper currency unions are indicated when demand and supply shocks are symmetric across a group of nations, while significant adjustment costs to the formation of a currency union are indicated when demand and supply shocks are asymmetric within a group of nations.

III. Empirical Methodology

In order to implement the methodology discussed above, a major obstacle must be overcome. The exogenous shocks are not immediately observable from time series data on output and prices for a particular nation. Following Bayoumi and Eichengreen (1992), real supply shocks, ε_{1t}, and nominal demand shocks, ε_{2t}, are assumed to be the sources of variation in output, y_t, and price, p_t. Assuming the original variables are characterized by unit root processes, the vector $\Delta X_t = [\Delta y_t, \Delta p_t]'$ is stationary and can be written as an infinite moving average process

$$\Delta X_t = A(L)\varepsilon_t$$

or

$$\begin{bmatrix} \Delta y_t \\ \Delta p_t \end{bmatrix} = \begin{bmatrix} a_{11}(L) & a_{12}(L) \\ a_{21}(L) & a_{22}(L) \end{bmatrix} \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix}, \tag{1}$$

where $a_{ij}(L)$ are polynomials, and A_i are matrices in the lag operator, L. The time paths of the effects of various shocks on the growth rate of output and prices are given by the coefficients of the polynomials $a_{ij}(L)$. Moreover, coefficient $a_{ij}(k)$ in the $a_{ij}(L)$ polynomial is the response of variable i to a unit shock in ε_{jt} after k periods. This paper adopts the notation such that $a_{ij}(1)$ is the sum of all the moving average coefficients and gives the cumulative effect of ε_{jt} on variable i over time. The shocks can be normalized such that the variance-covariance matrix of exogenous shocks is the identity matrix:

$$E(\varepsilon_t \varepsilon_t') = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}. \tag{2}$$

In order to identify this model, one can estimate a finite order bivariate VAR

$$\Delta X_t = B_1 \Delta x_{t-1} + \cdots + B_k \Delta X_{t-k} + \varepsilon_t, \tag{3}$$

where the maximum lag length k is chosen such that residuals ε_{it} (i = 1, 2, 3,$\cdots$) approximate white noise, and

$$E(\varepsilon_t \varepsilon_t') = \sum = \begin{bmatrix} \sigma_{11} & \sigma_{12} \\ \sigma_{21} & \sigma_{22} \end{bmatrix}. \tag{4}$$

Since the elements of ΔX_t are stationary, the system can be inverted to obtain the moving average representation:

$$\Delta X_t = e_t + C_1 e_{t-1} + C_2 e_{t-2} \cdots = \sum_{j=0}^{\infty} C_j e_{t-j} = C(L) e_t. \tag{5}$$

The relationship between the orthogonal (pure) innovations ε_t and the composite innovations e_t is

$$e_t = A_0 \varepsilon_t. \tag{6}$$

Thus the following relationship exists between the variance-covariance matrices:

$$E(e_t e_t') = A_0 E(\varepsilon_t \varepsilon_t') A_0' \quad \text{and} \tag{7}$$

$$\sum = A_0 A_0'. \tag{8}$$

Since $\sum$ is a symmetric matrix with known elements, it imposes one restriction on the matrix of contemporaneous effects, A_0, which has four elements. Three additional restrictions are needed to identify A_0, so that the orthogonal shocks ε_{it} can be recovered using Equation (6). The traditional method is to pick A_0 as the Choleski factorization of $\sum$, which has been criticized on the grounds that it imposes an arbitrary structure on the orthogonal ε_{it} sequences. Blanchard and Quah (1989) propose an interesting way of circumventing the problem of arbitrary identification. This can be seen from the relationship between the matrices of long term effects. If we evaluate the polynomials embedded in Equations (1) and (5) at $L = 1$ and note the relationship in Equation (6), then

$$A(1) = C(1) A_0, \tag{9}$$

where $C(1)$ contains known elements. In order to identify the shocks, we impose the following restriction on the long run matrix A(1): the aggregate supply curve is vertical in the long

run. This corresponds to the restriction that $\alpha_{12}(1) = 0$ in Equation (1). Once A_0 is identified one can recover the orthogonal shocks using Equation (6).

As a final result of the above estimation process a series of exogenous demand and supply shocks will be obtained for each country. Then correlations of these exogenous shocks will be computed among a number of nations within a group. If the correlation among supply shocks for a group of nations is positive and significant, then one can argue that there is symmetry in supply shocks among those nations. Alternatively, if the correlation of supply shocks among the groups of nations is negative or not significantly different from zero, then one can conclude that an asymmetric relationship for supply shocks exists among the groups of nations. The same sort of approach can be used to analyze demand shocks and to ascertain whether such shocks are symmetric or asymmetric among the groups of nations under consideration.

The data utilized in this paper is drawn from two different regions: the Caribbean and Central America. The Caribbean is represented by: Trinidad and Tobago, St. Vincent, Belize, Dominica, Dominican Republic, Guyana, Haiti, Jamaica, Barbados, the Bahamas, and Puerto Rico (Common Wealth with the United States). For Central America the countries are: Mexico, Guatemala, Nicaragua, Honduras, Costa Rica, El Salvador, and Panama. The data available for each nation from the World bank included real GDP, a price index, and GDP per capita for the time period 1960-1992. The results of the analysis are presented in the next section.

IV. Empirical Results

The results of the correlation of demand and supply shocks for the Caribbean are presented in Tables 1 and 2. High positive correlations indicate symmetrical exogenous shocks and indicate that a basis for a currency union exists. Those correlation coefficients in bold type are significant at the 5% level. As can be seen, there is symmetry in exogenous shocks from the supply side in only a few countries. However, if the reader will remember, St. Vincent and Dominica are already members of a currency union and Belize, Barbados, and the Bahamas peg their currencies to the dollar. Thus there is already economic integration, to some extent, of these economies. As one can see, the correlations among the Bahamas, Barbados, and Dominica are all significant and positive and so is the correlation between St. Vincent and Dominica. Thus these regions are likely reaping positive gains from their integration. In addition, positive correlations also hold for the Dominican Republic, Trinidad and Tobago, and Belize. However, there is not a lot of evidence of gains for integration among any broader or more extensive group of countries in the Caribbean.

On the demand side, there seems to be greater evidence of correlation. Specifically, symmetric exogenous shocks occur for Trinidad-Tobago, Belize, Dominica, Haiti and Barbados. In addition, there are positive correlations among Puerto Rico, St. Vincent, and Barbados. Thus evidence from the demand side correlations indicates potential gains for a more extensive group of countries than do the correlations from the supply side.

Table 1 Correlations of Supply Shocks of the Caribbean Countries

	TTO	VCT	BLZ	DMA	GUY	HTI	JAM	BRB	PRI	BHA	DOM
Trinidad/Tobago	---	-0.04	**0.54**	-0.25	-0.04	0.13	0.15	-0.28	-0.21	-0.18	**0.29**
St. Vincent		---	0.21	**0.36**	-0.53	0.08	0.05	0.12	0.13	0.26	0.18
Belize			---	-0.02	-0.02	0.19	-0.01	-0.15	-0.28	-0.18	**0.33**
Dominica				---	-0.21	-0.27	-0.15	0.13	0.17	**0.37**	0.26
Guyana					---	-0.01	-0.03	**0.33**	0.03	-0.10	0.01
Haiti						---	0.30	0.11	-0.05	-0.03	0.19
Jamaica							---	**0.29**	0.01	-0.02	0.21
Barbados								---	0.19	**0.33**	0.24
Puerto Rico									---	0.28	0.11
Bahamas										---	0.18
Dominican R.											---

Table 2 Correlations of Demand Shocks of the Caribbean Countries

	TTO	VCT	BLZ	DMA	GUY	HTI	JAM	BRB	PRI	BHA	DOM
Trinidad/Tobago	---	-0.26	**0.43**	**0.35**	0.21	**0.48**	-0.24	**0.32**	0.06	-0.02	0.24
St. Vincent		---	-0.25	-0.08	-0.04	-0.11	0.10	-0.10	**0.28**	0.18	0.19
Belize			---	0.23	0.04	**0.38**	-0.33	**0.61**	-0.07	-0.14	**0.31**
Dominica				---	-0.13	**0.29**	-0.28	**0.44**	0.11	-0.01	0.26
Guyana					---	-0.39	0.20	0.11	-0.12	-0.23	0.00
Haiti						---	-0.45	0.04	-0.10	0.02	0.18
Jamaica							---	-0.24	-0.16	-0.41	-0.03
Barbados								---	**0.31**	0.13	0.18
Puerto Rico									---	**0.31**	0.21
Bahamas										---	0.26
Dominican R.											---

The correlations on the supply side for central America seem to be limited with the most extensive list of countries experiencing symmetric exogenous supply shocks being Honduras, Mexico, and Guatemala. This seems to indicate that economic integration among this limited group of countries is likely to be beneficial.

The correlation of exogenous demand shocks reveals more symmetry than those for supply. Specifically, Guatemala, Nicaragua, Honduras, and El Salvador have positive and significant correlations. Thus these results seem to indicate that economic integration of this group of nations would be beneficial.

Table 3 Correlation of Supply Shocks of the Central American Countries

	MEX	GTM	NIC	HND	CRI	SLV	PAN
Mexico	---	0.18	0.00	**0.35**	0.24	0.02	0.00
Guatemala		---	0.08	**0.41**	0.57	-0.06	-0.09
Nicaragua			---	-0.01	0.24	0.23	**0.46**
Honduras				---	**0.39**	0.06	0.03
Costa Rica					---	0.20	0.02
El Salvador						---	-0.19
Panama							---

Table 4 Correlation of Demand Shocks of the Central American Countries

	MEX	GTM	NIC	HND	CRI	SLV	PAN
Mexico	---	-0.15	0.10	0.21	-0.22	-0.25	0.19
Guatemala		---	**0.32**	**0.49**	0.25	**0.66**	0.08
Nicaragua			---	**0.39**	-0.11	**0.31**	0.00
Honduras				---	0.12	**0.35**	-0.04
Costa Rica					---	0.16	0.21
El Salvador						---	-0.03
Panama							---

The above analysis is somewhat contradictory. The supply shocks are less symmetric than the demand shocks. In addition, the conclusions concerning the gains from integration for either the Caribbean or Central America are different for supply relative to demand shocks. In order to clarify the analysis variations in real output were decomposed into those originating from demand and supply shocks. Obviously, since it was assumed that the long-run aggregate supply curve is vertical then in the long-run demand shocks will have no impact on output and thus all the variation in output will be attributable to supply shocks. However, one can ask just how long is the long-run? In other words, if demand shocks dominate supply shocks for periods of ten or more years one could argue that the correlations of demand side shocks should be used to derive conclusions concerning the gains from economic integration.[4] Alternatively, if supply shocks dominate both the short and long-run, then the results from correlating supply side shocks should be used to draw conclusions concerning the formation of a currency union.

The results of decomposing the variance of real output are presented in Tables 5 and 6 for the Caribbean and Central America respectively. As one can see, supply shocks account for the bulk of the variation in output for both sets of nations both in the short- and long-run. Only in Jamaica do demand shocks predominate during the first four years. The implication

4. For all of the calculations the vector moving average representation of the VAR is truncated at twenty-four years. Thus we suppose that aggregate demand shocks die out after twenty-four years.

then is that conclusions concerning the usefulness of a currency union should be based upon the correlation of supply side shocks. Based on this evidence beneficial economic integration would be limited to relatively small subgroups in both in Caribbean and Central America.

Table 5 Variance Decomposition of Real Output

	Percentage of variance of real output attributed to							
	supply shocks				demand shocks			
	horizon: years				horizon: years			
	1	2	4	10	1	2	4	10
Trinidad	60.1	88.0	98.5	99.9	29.9	12.0	1.5	0.1
St. Vincent	84.5	99.8	99.9	99.9	5.5	0.2	0.1	0.1
Belize	98.5	98.5	99.9	99.9	1.5	1.5	0.1	0.1
Dominica	98.5	96.4	99.9	99.9	1.5	2.6	0.1	0.1
Dominican Republic	80.7	91.7	99.0	99.9	19.3	8.3	1.0	0.1
Guyana	98.5	98.6	99.1	99.8	1.5	1.4	0.9	0.2
Haiti	94.5	99.0	99.9	99.9	5.5	1.0	0.1	0.1
Jamaica	2.1	2.9	23.9	97.9	97.9	97.1	72.1	2.3
Barbados	63.7	83.8	94.9	99.9	36.3	16.2	5.1	0.1
Puerto Rico	40.2	73.5	93.5	99.9	59.8	26.5	6.5	0.1
Bahamas	76.0	87.8	99.5	99.9	24.0	12.2	0.5	0.1

Table 6 Variance Decomposition of Real Output

	Percentage of variance of real output attributed to							
	supply shocks				demand shocks			
	horizon: years				horizon: years			
	1	2	4	10	1	2	4	10
Mexico	55.8	80.2	99.4	99.9	44.2	19.8	0.6	0.1
Guatemala	98.5	99.2	99.9	99.9	1.5	0.8	0.1	0.1
Nicaragua	94.3	93.4	98.5	99.9	5.7	6.6	1.5	0.1
Honduras	99.7	98.4	99.9	99.9	0.3	1.6	0.1	0.1
Costa Rica	97.4	99.8	99.9	99.9	2.6	0.2	0.1	0.1
El Salvador	98.4	97.6	99.1	99.9	1.6	5.4	3.5	0.1
Panama	99.4	97.6	99.1	99.9	0.6	2.4	0.9	0.1

V. Summary

Mundell's theory of optimum currency areas indicates that economic regions should adopt a single currency or fixed exchange rates among regions if exogenous economic shocks are symmetric across the regions involved. Thus positive demand shocks in region A are associated with positive demand shocks in region B. Positive supply shocks in region B are associated with positive supply shocks in region A. If shocks, demand and supply, are asymmetric across regions then the adjustment costs involved in the creation of a currency union are likely to

be substantial.

This paper measured the symmetry or asymmetry of shocks affecting the Caribbean and Central America utilizing a structural vector autoregressive model. The results indicated limited symmetry in supply shocks in both regions. However, demand shocks were more symmetrical across a significant subset of nations in both regions. The variance decomposition of real output indicated that variations in real output were determined, for the most part, by supply shocks. The implication then is that a currency union organized in either the Caribbean or Central America would not likely yield significant benefits for extensive groups of nations. However, there are smaller subsets of such nations which either already benefit from some integration or who have the potential to benefit from integration. In the Caribbean these would be the Bahamas, Barbados, and Dominica, a second group made up of St. Vincent and Dominica, and a third group composed of Trinidad and Tobago, Dominican Republic, and Belize. In Central America Honduras, Mexico, and Guatemala would likely benefit from economic integration.

References

Atkeson, A., and T. Bayoumi (1991), "Do Private Markets Insure Against Regional Shocks in a Common Currency Area: Evidence from the U.S.," unpublished paper, University of Chicago.

Bayoumi, T., and B. Eichengreen (1992), "Shocking Aspects of European Monetary Integration," NBER Working Paper, No. 3949, January.

Blanchard, O., and D. Quah (1989), "The Dynamic Effects of Aggregate Demand and Supply Disturbances," *American Economic Review*, September, 655-673.

Eichengreen, B. (1994), *International Monetary Arrangements for the 21st Century*, The Brookings Institution.

Ingram, J. (1973), "The Case for European Monetary Integration," *Princeton Essays in International Finance*, No. 98, April.

Ishiyama, Y. (1975), "The Theory of Optimum Currency Areas: A Survey," *IMF Staff Papers*, 22, 344-383.

Mundell, R.A. (1961), "A Theory of Optimum Currency Areas," *American Economic Review*, 657-665.

Poloz, S.S., "Real Exchange Rate Adjustment Between Regions in a Common Currency Area," unpublished manuscript, Bank of Canada.

Sala-i-Martin, X., and J. Sachs (1992), "Fiscal Federalism and Optimum Currency Areas: Evidence for Europe from the United States," in *Establishing a Central Bank*: *Issues in Europe and Lessons from the U.S.*, eds. by Canzoneri, M.B., W. Grilli, and P.R. Masson, Cambridge: Cambridge University Press, 195-219.

Tavlas, G. (1993), "The 'New' Theory of Optimum Currency Areas," *The World Economy*, 16, 663-685.