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One Money or Many? On Analyzing the Prospects for Monetary Unification in Various Parts of the World

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November 1993

Department of Economics

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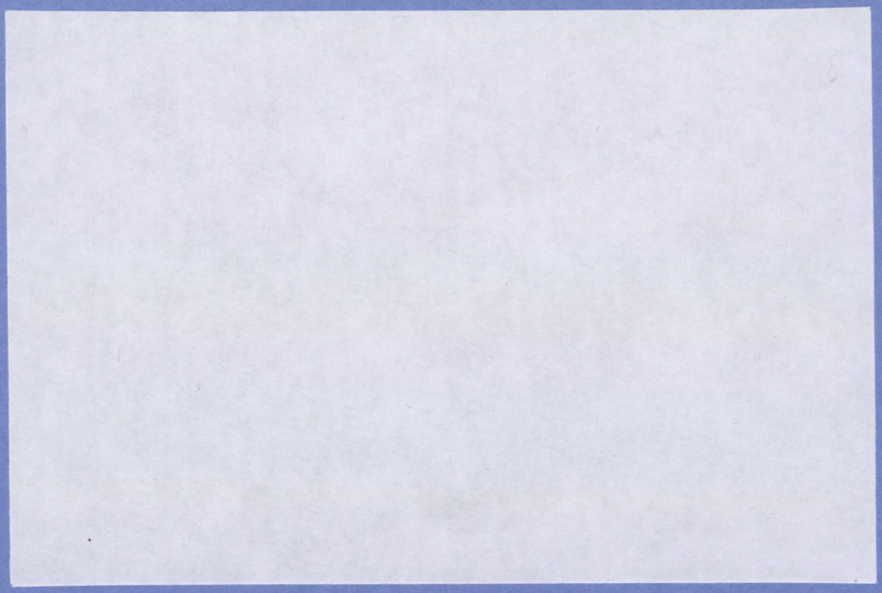

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Abstract

The literature on optimal currency areas identifies the symmetry of disturbances and the speed with which economies adjust as key criteria affecting the decision of whether to form a monetary union. This paper uses structural vector autoregression techniques to examine these issues for three regions: Western Europe, the Americas, and East Asia. The results suggest three country groupings that best satisfy these criteria: Northern Europe (Germany, France, the Netherlands, Belgium, Denmark, Austria, and possibly Switzerland); Northeast Asia (Japan, Taiwan, and Korea); and Southeast Asia (Hong Kong, Singapore, Malaysia, Indonesia, and possibly Thailand).

I. Introduction

Recent years have witnessed a number of developments with the potential to transform national and international monetary arrangements. The Maastricht Treaty is an important step toward the adoption of a single European currency by at least some EC member states. Political disintegration in the former USSR, Yugoslavia and Czechoslovakia, which spells the end of three existing monetary unions, represents a series of significant steps in the other direction. Looking further into the future, the move towards regionally-based free-trade areas in North America, East Asia, and South America may eventually prompt policymakers in these parts of the world, as in Europe, to contemplate the creation of a single regional currency.[1]

These developments have rekindled interest in the literature on optimal currency areas initiated by Mundell (1961), which compares gains and losses from monetary unification. In Mundell's framework, the gains from a common currency stem from lower transaction costs and the elimination of exchange rate variability. Losses come from the inability to pursue independent monetary policies and to use the exchange rate as an instrument of adjustment. As observed by Mundell, the size of these losses depends on the incidence of disturbances and speed with which the economy adjusts. If disturbances and responses are similar across regions, symmetrical policy responses will suffice, eliminating the need for policy autonomy. Only if disturbances are asymmetrically distributed across countries or speeds of adjustment

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[1]For a detailed discussion of regional trading arrangements in these areas, see Torre and Kelly (1992).

differ markedly will there be the need for distinctive national macroeconomic policies and may the constraints of monetary union bind.

These are not, of course, the only factors influencing the choice of international monetary arrangements. Mundell (1961) himself emphasized also the importance of factor mobility for facilitating adjustment. McKinnon (1963) argued that the gains from unification were likely to be an increasing function of the openness of the constituent economies to intra-regional trade, since openness magnifies the gains associated with the reductions of the transaction costs. Kenen (1969) proposed that the diversification of the economy be used to assess the appropriateness of a currency area, the argument being that highly diversified economies were less likely to experience asymmetric shocks of the type that independent exchange rates are useful for offsetting.

Several recent papers have investigated the incidence of disturbances as a way of analyzing the suitability of different groups of nations for monetary union. Much of this literature focuses on Europe, where the issue has particular immediacy. One approach has been to compare the variability of relative prices in existing monetary unions like the US and Canada with those in the EC (Poloz 1990, Eichengreen, 1992a, De Grauwe and Vanhaverbeke 1991). A limitation of this approach is that the movement of relative prices conflates the effects of disturbances and responses; it is not possible to identify the structural parameters of interest on the basis of the behavior of such semi-reduced-form variables. Other authors (Cohen and Wyplosz 1989, Weber 1990) consider the behavior of output itself, attempting to distinguish common from idiosyncratic national shocks. These authors compute

sums and differences in output movements for groups of European countries, interpreting the sums as symmetric disturbances and the differences as asymmetric ones. The problem with this approach is that output movements are not the same thing as shocks; they too conflate information on disturbances and responses. Nor is it possible on the basis of this approach to distinguish disturbances emanating from different sources, such as impulses to demand related to the conduct of monetary and fiscal policies versus shifts in supply associated with the shocks to the real economy.

This paper uses a structural vector autoregression approach developed by Blanchard and Quah (1989) to identify aggregate demand and supply disturbances and to distinguish them from subsequent responses.[1] These measures can be utilized to identify groups of countries suited for monetary union. The estimated disturbances point to more clear-cut groupings than the time series on output and prices from which they are derived. Vector autoregression identifies three sets of countries that, on the basis of their macroeconomic disturbances and responses, are plausible candidates for monetary unification: a Northern European group comprised of Germany and a subset of other potential participants in EMU (France, the Netherlands, Belgium, Denmark, Austria, and perhaps Switzerland); a Northeast Asian bloc (Japan, Korea, and Taiwan); and a Southeast Asian area (made up of Hong Kong, Singapore, Malaysia, Indonesia, and possibly Thailand). Notably absent from this list are countries in either North or South America.

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[1]We have used this approach previously in a series of related papers (Bayoumi and Eichengreen, 1992a, b, 1993) to analyze EMU, its possible extension to the EFTA countries, and NAFTA, respectively.

The plan of the paper is as follows. The next section presents a selective survey of the literature on optimum currency areas in order to provide a context in which to interpret our results. Sections III and IV describe the methodology used to distinguish disturbances and adjustment dynamics and the data used in the analysis. Sections V and VI report the estimates and discuss their implications. Fully drawing out those implications requires a metric or basis for comparison. Section VII therefore presents results using regional data for an existing monetary union: the United States.

II. Optimum Currency Areas

In this section we present a selective survey of the literature on optimum currency areas in order to provide a context for our empirical analysis. We highlight aspects and ambiguities of that literature relevant to the analysis presented below; for more comprehensive surveys the reader may consult Ishiyama (1975) or Tavlas (1992).

Mundell, in his seminal contribution, highlighted two criteria relevant to the decision of whether to abandon policy autonomy for a monetary union: the nature of disturbances and the ease of response. We consider them in turn.

A. Nature of Disturbances

If two regions experience the same disturbances, they will presumably favor the same policy responses.[1] Abandoning policy autonomy for monetary unification will then entail

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[1] Strictly speaking, this assumes that preferences in the two countries are the same. Corden (1972) suggests that differences in preferences across countries can also obstruct movement toward monetary union.

relatively little cost. It is curious that the magnitude of disturbances, as opposed to their correlation, has received little attention in the literature. Consider a set of disturbances that are negatively correlated across a pair of countries. If those disturbances are of negligible size, the two countries may still incur only minor costs from forsaking policy autonomy, since output, unemployment and other relevant variables will barely be perturbed from their equilibrium levels. Clearly, discussions of monetary unification focusing on the nature of disturbances should consider their size as well as their cross-country correlation.

The subsequent literature has followed Kenen (1969) in linking structural characteristics of economies, and in particular the sectoral composition of production, to the characteristics of shocks. It suggests that economies which share the same industries are likely to experience similar aggregate disturbances insofar as economy-wide disturbances are the aggregates of industry-specific shocks. If disturbances are imperfectly correlated across industries, diversified economies may experience smaller aggregate disturbances than highly specialized ones. In particular, if two economies specialize in sectors that produce and utilize primary products, respectively, then there is good reason to anticipate that the disturbances they experience will be negatively correlated.

B. Ease of Response

If market mechanisms adjust smoothly and restore equilibrium rapidly, asymmetric disturbances need not imply significant costs for entities denied the option of an independent policy response. Even large shocks which displace macroeconomic variables from normal levels will have relatively small costs if the initial equilibrium is restored quickly.

Mundell focused on labor mobility as an adjustment mechanism. If asymmetric shocks raising unemployment in one region relative to another elicit labor flows from the former to the latter, unemployment may return to normal levels before significant costs have been incurred even if the authorities lack policy instruments useful for expediting adjustment. Blanchard and Katz (1992) have recently affirmed the importance of this mechanism in one existing monetary union, the United States. It is clear from their work that migration is but one of several channels through which adjustment to asymmetric shocks can occur, however. Equilibrium is also restored through adjustments in relative wages (upward in regions experiencing positive shocks, downward in others), by the changes in labor-force participation induced by these wage changes, and by capital mobility (into those regions experiencing temporary negative disturbances). Blanchard and Katz conclude, however, that for the United States the Mundellian assumption that labor mobility is the principal channel for adjustment is broadly consistent with the facts. They also identify differences across regions in the importance of the different adjustment mechanisms: in the US manufacturing belt, for example, relatively little adjustment occurs through changes in relative wages.

C. Implications for Policy

The implication for policy is that countries experiencing large asymmetric disturbances are poor candidates for forming a monetary union because these are the countries where policy autonomy has the greatest utility. Indeed, this is the implication we use in this paper to interpret our empirical results. Before proceeding, however, it is worth noting several qualifications.

First, even if countries experience large, asymmetric disturbances, it need not follow that policy autonomy is useful for facilitating adjustment. If money is neutral, it will not help to offset disturbances to output. Most of the recent literature on monetary policy, though written by authors approaching the question from very different perspectives, does support the view that monetary initiatives affect relative prices and quantities, however (see for example Romer and Romer 1989, Eichenbaum and Evans 1993). In models with coordination failure, nominal contracting and other sources of inertia, monetary policy can speed adjustment whether the disturbance in question is a supply shock that permanently shifts the long run equilibrium or a demand shock that temporarily displaces output and prices from invariant steady state levels.

Second, even countries which value policy autonomy may be willing to abandon monetary independence if they retain other flexible policy instruments, of which fiscal policy is the obvious candidate. In practice, the high mobility of capital and labor in a monetary union constrains the fiscal flexibility of constituent jurisdictions. If mobile factors of production are able to flee the taxes needed to service heavy debt burdens, governments may find themselves unable to finance budget deficits by borrowing on capital markets cognizant of this constraint on the authorities' capacity to tax. Bayoumi et al. (1993) estimate that state governments in the US, which operate in an environment of high factor mobility, find themselves rationed out of the capital market when their debt/income ratios approach 9 per cent. In addition, worries that participants in a monetary union will free ride by issuing debt in excess of their ability to service it, forcing other countries to bail out the spendthrift

members, has led the architects of the CFA franc zone and the EC's prospective monetary union to adopt statutes designed to limit the fiscal autonomy of constituent jurisdictions. Finally, there is the fact that, for political reasons, fiscal policy is less easily adapted than monetary policy to changing economic conditions. For all these reasons, fiscal policy is likely to be an imperfect substitute for the abandoned monetary instrument.

A third qualification is that policymakers may systematically misuse policy rather than employing it to facilitate adjustment. In countries that succumb repeatedly to hyperinflation, for example, it is hard to argue that forsaking monetary policy autonomy is costly. One interpretation of asymmetrically distributed aggregate demand shocks is that the countries concerned are poor candidates for monetary union, because policymakers can use demand-management instruments to offset demand shocks emanating from other sources. But if domestic policy itself is the source of the disturbances, monetary unification with a group of countries less susceptible to such pressures may imply a welfare improvement. This suggests, when identifying countries likely to benefit from monetary union, considering high inflation economies whose demand disturbances are poorly correlated with those of an anchor country prepared to offer price stability.

A fourth and final qualification is that the nature of disturbances may be correlated with other characteristics of countries also affecting their suitability for participation in a monetary union. Take for instance Kenen's point that a high degree of specialization in production is likely to be associated with asymmetric shocks and therefore with floating exchange rates between separate currencies. A high degree of specialization also implies that

floating exchange rates may be very disruptive of living standards. Fixing the value of the national currency in terms of a country's dominant export commodity, this being the implication of adopting a floating rate, will subject households to fluctuations in their purchasing power; the latter may prefer the government to insure them against those purchasing-power risks by stabilizing the value of the currency in terms of some broader aggregation of goods (i.e. by fixing the exchange rate or joining a monetary union). In practice, a high degree of specialization appears to be one of the strongest empirical correlates of the decision to peg the exchange rate.

All of these qualifications should be kept in mind when interpreting the results that follow.

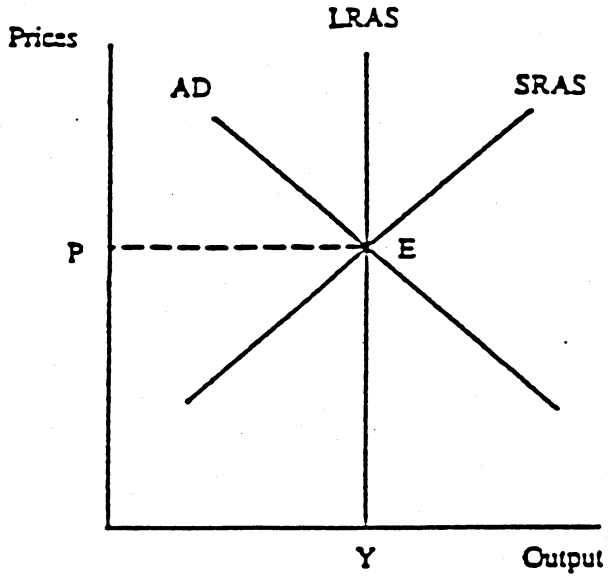
III. Methodology

In this section we describe the methodology used to estimate aggregate demand and supply disturbances. Our methodological point of departure is the familiar diagram reproduced as the top panel in Chart 1. The aggregate demand curve (labelled AD) is downward sloping in price-output space, reflecting the fact that lower prices raise real money balances and therefore product demand. The short-run aggregate supply curve (SRAS) is upward sloping under the assumption that capacity utilization can be varied in the short run to exploit the profit opportunities afforded by changes in aggregate demand. The long-run aggregate supply curve (LRAS) is vertical since capacity utilization eventually returns to normal, preventing demand shocks from permanently affecting the level of production.

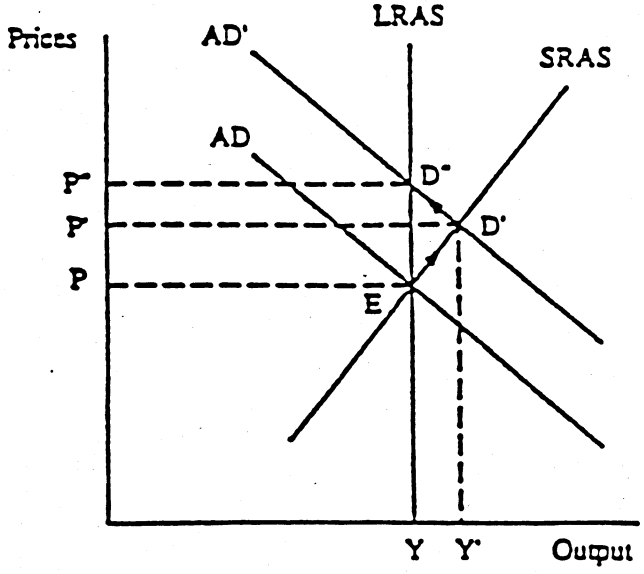
Chart 1

The Aggregate Demand and Supply Model

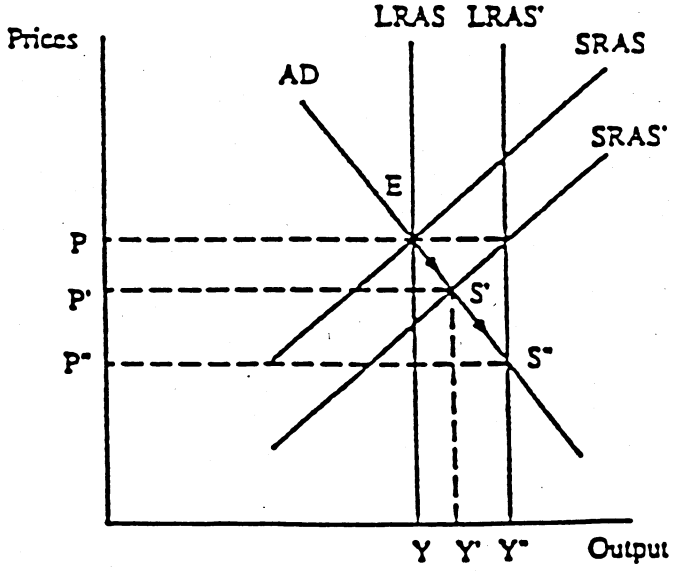
(a) The Model



(b) A Demand Shock



(c) A Supply Shock



The effect of a positive demand shock is shown in the left half of the lower panel. As the aggregate demand curve shifts from AD to AD', the short-run equilibrium moves from its initial point E to the intersection of SRAS with AD' and output and prices rise. As the aggregate supply curve becomes increasingly vertical over time, the economy moves gradually from the short-run equilibrium D' to the long-run equilibrium D". The economy traverses the new aggregate demand curve, output falls back to its initial level, and the price level continues to rise. The response to a positive demand shock is a short-term rise in production followed by a gradual return to the initial level of output, and a permanent rise in prices.

The effects of a positive supply disturbance (like a favorable technology shock) that permanently raises potential output is shown in the right-hand bottom panel. The short- and long-run aggregate supply curves shift to the right by the same amount, displacing the short-term equilibrium from E to S'. On impact, output rises while prices fall. As the supply curve becomes increasingly vertical over time, the economy moves from S' to S", leading to further increases in output and additional declines in prices. Whereas demand shocks affect output only temporarily, supply shocks affect it permanently. And whereas positive demand shocks raise prices, positive supply shocks reduce them.

External as well as internal disturbances are readily incorporated into the aggregate-demand-aggregate-supply framework. Consider for example an oil price rise. For oil-importing countries such a disturbance should be treated first and foremost as a supply shock. The change in the relative price of inputs lowers the value of the existing capital

stock, reducing the equilibrium level of output. But there are also negative repercussions on demand owing to the adverse movement in the terms of trade; this, however, is not likely to be large in the case of oil-importing countries since the proportion of total demand which is associated with oil consumption is relatively small. The impact on aggregate demand is therefore likely to be swamped by the macroeconomic policy response to the oil price shock.

The same need not be true for countries where output is dominated by production of oil or other raw materials. There a change in relative prices is likely to show up as both an aggregate supply disturbance and an aggregate demand disturbance. A rise in oil prices is likely to affect Indonesia, for example, both by raising the underlying level of output through the increased incentive to produce oil and by boosting aggregate demand through the favorable impact of the terms of trade on real incomes. In such cases it may be difficult to distinguish between the aggregate supply and aggregate demand disturbances caused by a change in raw material prices.

We estimate our model using a procedure proposed by Blanchard and Quah (1989) for distinguishing temporary from permanent shocks to a pair of time-series variables, as extended to the present case by Bayoumi (1992). Consider a system where the true model can be represented by an infinite moving average representation of a (vector) of variables, X_t, and an equal number of shocks, ϵ_t. Using the lag operator L, this can be written as:

$$X_t = A_0\epsilon_t + A_1\epsilon_{t-1} + A_2\epsilon_{t-2} + A_3\epsilon_{t-3} \ldots. = \sum_{i=0}^{\infty} L^i A_i \epsilon_t \quad (3.1)$$

where the matrices A_i represent the impulse response functions of the shocks to the elements of X.

Specifically, let X_t be made up of change in output and to the change in prices, and let ϵ_t be demand and supply shocks. Then the model becomes

$$\begin{bmatrix} \Delta y_t \\ \Delta p_t \end{bmatrix} = \sum_{i=0}^{\infty} L^i \begin{bmatrix} a_{11i} & a_{12i} \\ a_{21i} & a_{22i} \end{bmatrix} \begin{bmatrix} \epsilon_{dt} \\ \epsilon_{st} \end{bmatrix} \quad (3.2)$$

where y_t and p_t represent the logarithm of output and prices, ϵ_{dt} and ϵ_{st} are independent supply and demand shocks, and a_{11i} represents element a_{11} in matrix A_i.

The framework implies that while supply shocks have permanent effects on the level of output, demand shocks have only temporary effects. (Both have permanent effects upon the level of prices.) Since output is written in first difference form, the cumulative effect of demand shocks on the change in output (Δy_t) must be zero. This implies the restriction,

$$\sum_{i=0}^{\infty} a_{11i} = 0. \quad (3.3)$$

The model defined by equations (3.2) and (3.3) can be estimated using a vector autoregression. Each element of X_t can be regressed on lagged values of all the elements of X. Using B to represent these estimated coefficients, the estimating equation becomes, where e_t represents the residuals from the equations in the vector autoregression. In the case

$$\begin{aligned} X_t &= B_1X_{t-1} + B_2X_{t-2} + \ldots + B_nX_{t-n} + e_t \\ &= (I-B(L))^{-1}e_t \\ &= (I + B(L) + B(L)^2 + \ldots)e_t \\ &= e_t + D_1e_{t-1} + D_2e_{t-2} + D_3e_{t-3} + \ldots \end{aligned} \tag{3.4}$$

being considered, e_t is comprised of the residuals of a regression of lagged values of Δy_t and Δp_t on current values of each in turn; these residuals are labeled e_{yt} and e_{pt}, respectively.

To convert equation (3.4) into the model defined by equations (3.2) and (3.3), the residuals from the VAR, e_t, must be transformed into demand and supply shocks, ϵ_t. Writing $e_t = C\epsilon_t$, in the two-by-two case considered, four restrictions are required to define the four elements of the matrix C. Two of these restrictions are simple normalizations, which define the variance of the shocks ϵ_{dt} and ϵ_{st}. A third restriction comes from assuming that demand and supply shocks are orthogonal.

The final restriction, which allows the matrix C to be uniquely defined, is that demand shocks have only temporary effects on output. As noted above, this implies equation (3.3). In terms of the VAR:

$$\sum_{i=0}^{\infty}\begin{bmatrix} d_{11i} & d_{12i} \\ d_{21i} & d_{22i} \end{bmatrix}\begin{bmatrix} c_{11} & c_{12} \\ c_{21} & c_{22} \end{bmatrix} = \begin{bmatrix} 0 & . \\ . & . \end{bmatrix} \tag{3.5}$$

This restriction allows the matrix C to be uniquely defined and the demand and supply

shocks to identified.[1]

Clearly, it is controversial to interpret shocks with a permanent impact on output as supply disturbances and shocks with a temporary impact on output as demand disturbances. Doing so implies adopting the battery of assumptions implicit in the aggregate-supply-aggregate-demand model of Chart 1. One can think of frameworks other than the standard aggregate-supply-aggregate-demand model in which that association breaks down. It is conceivable that temporary supply shocks (for example, an oil price increase that is reversed subsequently) or demand shocks with permanent effects on real variables (for example, a permanent increase in government spending) dominate our data. Here a critical feature of our methodology comes into play. While restriction (3.5) defines the response of output to the two shocks, it says nothing about the response of prices. The aggregate-supply-aggregate-demand model predicts that positive demand shocks should raise prices while positive supply shocks should lower them. Since these responses are not imposed, they can be thought of as "over-identifying restrictions" useful for testing our interpretation of permanent output disturbances in terms of supply and temporary ones in terms of demand.

We find that the restriction is satisfied for most of the countries studied. However, several countries that are heavily dependent on raw material production fail to satisfy the prediction of a negative price response to permanent disturbances. As discussed earlier, this probably reflects the fact that for raw-material producers positive supply shocks are

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[1]Note from equation (3.4) that the long run impact of the shocks on output and prices is equal to $(I-B(1))^{-1}$. The restriction that the long run effect of demand shocks on output is zero implies a simple linear restriction on the coefficients of this matrix.

associated with increases in the relative price of raw materials (improvements in the terms of trade) and hence with positive aggregate demand shocks. For such countries "supply shocks" also have aggregate demand effects, producing the perverse behavior of prices.[1] We present some evidence in support of this interpretation below.

IV. Data

Annual data on real and nominal GDP were collected for three regions: Western Europe (hereinafter Europe), East Asia (hereafter Asia) and the Americas. The European data include fifteen countries, ten members of the EC plus the five members of EFTA.[2] Eleven Asian countries are studied, including all the members of ASEAN except Brunei, plus Australia and New Zealand, with which ASEAN has a free trade agreement.[3] Thirteen countries were considered in the Americas, including the three nations involved in discussions of the North American Free Trade Area (NAFTA) and the potential members of

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[1]This mismeasurement only affects aggregate demand disturbances that are associated with the terms of trade. Other disturbances, such as those associated with macroeconomic policy, should still be measured correctly.

[2]The full set of European countries is Germany, France, Italy, the Netherlands, Belgium, Denmark, the U.K., Spain, Portugal, Ireland, Switzerland, Austria, Sweden, Norway, and Finland. Luxembourg was excluded because it is so small and Greece because of its eastern location. The same methodology can in fact be applied to Greece and yields sensible results, as we show in Bayoumi and Eichengreen (1993).

[3]The countries are Japan, Korea, Taiwan, Hong Kong, Singapore, Malaysia, Thailand, Indonesia, the Philippines, Australia and New Zealand.

the Southern Cone free-trade area MERCOSUR.[1] For each of these countries, we attempted to assemble consistent data for as long a period as possible. The European data are drawn from OECD Annual National Accounts and span the period 1960-90, while for Asia (except Taiwan) and the Americas they come from the World Bank publications and cover the somewhat shorter period 1969-89. The data for Taiwan are drawn from national sources.

Before estimating and analyzing supply and demand disturbances, we consider the data directly. Table 1 reports the mean and standard deviation of growth (measured as the change in the logarithm of real output) and inflation (the change in the logarithm of the GDP deflator) for each country, along with regional averages. Since growth and inflation are measured as the change in the logarithm of real GDP and of the GDP deflator, respectively, a value of 0.01 represents a change of roughly 1 percent.

The simple averages highlight the high rates of growth achieved over the last 20 years in Asia and the high levels of inflation prevalent in Latin America. The standard deviations suggest significant regional differences, with Europe displaying the most stable growth and inflation rates, followed by Asia and then the Americas. There are pronounced variations within groups: the United States and Canada behave differently from the rest of the Americas, as do Japan and Australia from the rest of Asia.

Tables 2 and 3 report correlation coefficients between GDP growth and inflation,

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[1]The full set of countries is the United States, Canada, Mexico, Columbia, Venezuela, Ecuador, Peru, Brazil, Bolivia, Paraguay, Uruguay, Argentina, and Chile.

Table 1. Basic Statistics

	Growth		Inflation	
	Mean	SD	Mean	SD
GER	0.029	0.022	0.039	0.016
FRA	0.034	0.017	0.068	0.031
NTH	0.032	0.022	0.051	0.028
BEL	0.032	0.021	0.051	0.024
DEN	0.027	0.023	0.072	0.024
AUT	0.034	0.02	0.045	0.018
SWI	0.024	0.026	0.044	0.022
ITA	0.036	0.023	0.098	0.053
UNK	0.024	0.021	0.081	0.051
SPA	0.041	0.026	0.102	0.043
POR	0.044	0.033	0.122	0.072
IRE	0.04	0.022	0.086	0.052
SWE	0.027	0.018	0.072	0.026
NOR	0.037	0.018	0.065	0.033
FIN	0.037	0.023	0.081	0.036
Average	0.033	0.022	0.072	0.035
JAP	0.043	0.02	0.045	0.047
TAI	0.083	0.035	0.066	0.07
KOR	0.085	0.038	0.122	0.078
THA	0.07	0.031	0.067	0.051
HKG	0.08	0.046	0.085	0.038
SGP	0.075	0.034	0.042	0.044
MAL	0.066	0.033	0.046	0.06
INO	0.062	0.023	0.147	0.103
PHL	0.037	0.045	0.127	0.091
AUS	0.031	0.019	0.094	0.029
NZL	0.025	0.042	0.086	0.059
Average	0.06	0.033	0.084	0.061
USA	0.028	0.025	0.058	0.024
CAN	0.038	0.023	0.067	0.031
MEX	0.04	0.041	0.34	0.233
COL	0.043	0.02	0.211	0.034
VEN	0.015	0.043	0.159	0.156
ECU	0.056	0.069	0.217	0.148
PER	0.015	0.065	0.697	0.776
BRA	0.051	0.048	0.809	0.661
BOL	0.016	0.038	0.746	1.194
PAR	0.058	0.045	0.165	0.076
URY	0.016	0.045	0.476	0.127
ARG	0.006	0.043	1.184	0.771
CHL	0.023	0.075	0.581	0.61
Average	0.031	0.045	0.439	0.372

Table 2. Correlations of Growth Across Different Geographic Regions

Western Europe

	GER	FRA	NTH	BEL	DEN	AUT	SWI	ITA	UNK	SPA	POR	IRE	SWE	NOR	FIN
GER	1.00														
FRA	0.73	1.00													
NTH	0.78	0.80	1.00												
BEL	0.71	0.82	0.78	1.00											
DEN	0.66	0.55	0.63	0.47	1.00										
AUT	0.71	0.78	0.71	0.78	0.44	1.00									
SWI	0.55	0.62	0.55	0.60	0.28	0.62	1.00								
ITA	0.48	0.67	0.60	0.66	0.26	0.58	0.54	1.00							
UNK	0.50	0.46	0.38	0.33	0.53	0.26	0.30	0.31	1.00						
SPA	0.55	0.76	0.64	0.70	0.33	0.64	0.51	0.51	0.45	1.00					
POR	0.55	0.69	0.56	0.64	0.34	0.63	0.61	0.63	0.50	0.52	1.00				
IRE	0.14	0.13	0.22	0.13	−0.13	0.13	0.03	0.08	0.01	0.21	0.12	1.00			
SWE	0.42	0.51	0.60	0.57	0.38	0.37	0.40	0.38	0.35	0.46	0.22	−0.06	1.00		
NOR	0.12	0.12	0.34	0.12	0.46	0.10	−0.05	0.26	0.05	0.05	0.01	−0.17	0.19	1.00	
FIN	0.45	0.44	0.29	0.54	0.27	0.46	0.52	0.30	0.25	0.39	0.29	−0.02	0.62	−0.05	1.00

East Asia

	JAP	TAI	KOR	THA	HKG	SGP	MAL	INO	PHL	AUS	NZL
JAP	1.00										
TAI	0.62	1.00									
KOR	0.06	0.31	1.00								
THA	0.34	0.33	0.41	1.00							
HKG	0.47	0.79	0.27	0.21	1.00						
SGP	0.43	0.33	−0.04	0.42	0.46	1.00					
MAL	0.38	0.30	0.14	0.47	0.52	0.82	1.00				
INO	0.13	0.41	0.13	0.36	0.42	0.47	0.49	1.00			
PHL	0.17	0.11	0.01	0.02	0.16	0.05	0.02	−0.11	1.00		
AUS	0.41	0.28	0.16	0.30	0.16	0.02	0.20	0.08	−0.11	1.00	
NZL	−0.08	−0.27	−0.32	−0.19	−0.48	0.18	−0.04	−0.01	0.02	−0.31	1.00

The Americas

	USA	CAN	MEX	COL	VEN	ECU	PER	BRA	BOL	PAR	URY	ARG	CHL
USA	1.00												
CAN	0.78	1.00											
MEX	0.34	−0.01	1.00										
COL	0.56	0.44	0.39	1.00									
VEN	0.50	0.37	0.03	0.44	1.00								
ECU	0.53	0.28	0.51	0.47	0.47	1.00							
PER	0.15	−0.15	0.37	0.41	0.46	0.14	1.00						
BRA	0.42	0.12	0.38	0.61	0.34	0.58	0.51	1.00					
BOL	0.55	0.20	0.62	0.42	0.41	0.53	0.20	0.46	1.00				
PAR	0.26	−0.01	0.83	0.42	0.13	0.36	0.33	0.35	0.62	1.00			
URY	0.36	0.08	0.34	0.51	0.33	0.00	0.48	0.34	0.38	0.59	1.00		
ARG	0.30	0.17	−0.03	0.44	0.34	0.12	0.33	0.48	0.02	0.09	0.33	1.00	
CHL	0.38	0.54	0.11	0.34	−0.03	−0.18	−0.06	−0.05	0.04	0.41	0.46	0.19	1.00

Table 3. Correlations of Inflation Across Different Geographic Regions

Western Europe

	GER	FRA	NTH	BEL	DEN	AUT	SWI	ITA	UNK	SPA	POR	IRE	SWE	NOR	FIN
GER	1.00														
FRA	0.49	1.00													
NTH	0.68	0.46	1.00												
BEL	0.57	0.67	0.64	1.00											
DEN	0.67	0.80	0.72	0.75	1.00										
AUT	0.74	0.69	0.69	0.76	0.84	1.00									
SWI	0.60	0.18	0.55	0.38	0.39	0.60	1.00								
ITA	0.34	0.91	0.29	0.59	0.63	0.59	0.00	1.00							
UNK	0.48	0.75	0.49	0.64	0.65	0.50	0.08	0.72	1.00						
SPA	0.28	0.77	0.33	0.58	0.64	0.57	−0.12	0.83	0.69	1.00					
POR	−0.07	0.60	−0.25	0.34	0.21	0.22	−0.31	0.74	0.44	0.70	1.00				
IRE	0.49	0.80	0.60	0.55	0.72	0.60	0.23	0.69	0.68	0.60	0.33	1.00			
SWE	0.30	0.69	0.26	0.60	0.48	0.46	0.06	0.78	0.82	0.74	0.70	0.60	1.00		
NOR	0.53	0.63	0.38	0.41	0.62	0.51	0.19	0.66	0.63	0.39	0.25	0.58	0.50	1.00	
FIN	0.37	0.66	0.51	0.73	0.73	0.69	0.29	0.63	0.60	0.53	0.30	0.46	0.49	0.47	1.00

East Asia

	JAP	TAI	KOR	THA	HKG	SGP	MAL	INO	PHL	AUS	NZL
JAP	1.00										
TAI	0.81	1.00									
KOR	0.69	0.70	1.00								
THA	0.77	0.89	0.62	1.00							
HKG	0.25	0.60	0.37	0.61	1.00						
SGP	0.68	0.83	0.58	0.90	0.71	1.00					
MAL	0.50	0.54	0.37	0.63	0.66	0.63	1.00				
INO	0.71	0.86	0.65	0.85	0.71	0.86	0.75	1.00			
PHL	−0.04	−0.07	−0.22	0.10	−0.02	0.21	0.23	0.11	1.00		
AUS	0.76	0.58	0.73	0.53	0.17	0.58	0.29	0.55	−0.06	1.00	
NZL	−0.60	−0.33	−0.61	−0.39	0.12	−0.38	−0.20	−0.34	−0.41	−0.60	1.00

The Americas

	USA	CAN	MEX	COL	VEN	ECU	PER	BRA	BOL	PAR	URY	ARG	CHL
USA	1.00												
CAN	0.90	1.00											
MEX	−0.56	−0.64	1.00										
COL	0.04	−0.04	0.28	1.00									
VEN	0.10	−0.12	−0.02	0.22	1.00								
ECU	−0.32	−0.51	0.51	0.44	0.72	1.00							
PER	−0.41	−0.50	0.22	0.29	0.67	0.81	1.00						
BRA	−0.52	−0.63	0.46	0.35	0.60	0.87	0.96	1.00					
BOL	−0.49	−0.43	0.29	0.05	−0.17	0.19	0.06	0.18	1.00				
PAR	−0.41	−0.55	0.47	0.31	0.55	0.68	0.51	0.62	0.27	1.00			
URY	−0.19	−0.26	−0.13	−0.11	0.27	0.10	0.10	0.07	0.13	0.51	1.00		
ARG	−0.47	−0.49	0.12	0.20	0.47	0.66	0.83	0.79	0.33	0.26	0.05	1.00	
CHL	0.61	0.47	−0.51	−0.09	−0.01	−0.31	−0.46	−0.55	−0.26	−0.28	0.38	−0.37	1.00

respectively, for each of our three regions. European growth rates fall into three groups. A core of five countries (Germany, France, the Netherlands, Belgium, and Austria) have growth rates that are highly correlated both within the group and with other European economies; an intermediate group of six countries (Italy, Spain, Portugal, Switzerland, Sweden, and Finland) have relatively high correlations with the aforementioned core countries and with their immediate neighbors but not with other European countries; while a third group (made up of the U.K., Ireland, Norway, and Finland) have relatively idiosyncratic output fluctuations. In contrast, cross-country correlations of European inflation rates do not suggest the existence of clearly-defined country groupings.[1]

The Asian economies exhibit less coherent output fluctuations than do countries in Europe, although two overlapping sub-regions with relatively high correlations can be distinguished, the first comprising Japan, Taiwan, Hong Kong and Singapore, the second Hong Kong, Singapore, Malaysia, and Indonesia. Unlike Europe, however, inflation rates in Asia display a distinct regional pattern. Japan, Taiwan, Korea, Thailand, Singapore and Australia exhibit high inter-country inflation correlations, as do Hong Kong, Singapore, Thailand, Malaysia, and Indonesia.

Growth and inflation correlations for the Americas are shown in the bottom panel of Tables 2 and 3. While US and Canadian output growth rates are correlated, as expected, the correlations between these two countries and Mexico, the third nation involved in NAFTA

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[1]In particular, the U.K., Ireland, Norway, and Finland are not so obviously atypical from the perspective of inflation as from that of output.

negotiations, are far from high. Mexican inflation is negatively correlated with that of the other two countries. The same pattern holds between the US and the South American economies, with growth being correlated positively and inflation negatively. Within South America, the output data reveal two overlapping country groups with reasonably high within-group correlations: Columbia, Venezuela, Ecuador, Peru, and Brazil; and Brazil, Bolivia, Paraguay, and Uruguay. Inflation shows a different pattern, with high inflation countries like Peru, Brazil, Argentina and, somewhat more surprisingly, Ecuador and Venezuela displaying higher cross correlations than the other countries.

When assessing the significance of these correlations it is desirable to exclude that part accounted for by the international business cycle, since only deviations from common movements are important in assessing the suitability of a group of countries for monetary unification. Correlations between output growth and inflation in the G-3 (the US, Germany, and Japan) were used as the basis for our choice of the underlying correlation. In both cases the correlations between these economies was approximately 0.5, implying a critical value for positive correlations of 0.74.[1]

This criterion highlights a limited number of significant correlations. While over half

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[1]The statistic 1/2 ln((1+r)/(1-r)) is distributed normally, with a mean of 1/2 ln((1+ρ)/(1-ρ)) and a variance of (T-3), (Kendal and Stuart, 1967, pp. 292-293) where r is the estimated correlation coefficient and p is the null value of the correlation coefficient. Since the data for Western Europe cover a longer time span, they have a smaller variance. It turns out, however, that the critical value for the 5 percent significance level for Western Europe was almost identical to that for the 10 percent significance level for the East Asian and American data. Hence, by using a different level of significance between these two data sets a uniform critical value of r=0.74 can be employed.

of the correlations of output growth rates between Germany, France, the Netherlands, Belgium, and Austria are significant, the rest of Table 2 yields only 5 significant correlations, one of which is between the US and Canada. While Europe shows no pattern of significant correlations for inflation, in Asia a distinct regional pattern does emerge, with Japan, Taiwan, and Korea as well as Singapore, Thailand, and Indonesia exhibiting significant inter-country correlations. US and Canadian inflation rates are significantly correlated, as are those of Ecuador, Peru, and Brazil.

Speaking loosely, then, five regions displaying sympathetic comovements in output or prices have been identified: Germany and her immediate neighbors; Japan and Taiwan; Singapore, Thailand, and Indonesia; the US and Canada; and Ecuador, Peru, and Brazil. Whether these correlations in output and prices are consistent with correlations in underlying disturbances is the question to which we now turn.

V. Estimation

Equation 3.4 was estimated for each of the 39 countries. Lags were set to two in all cases since the Schwartz-Bayes information criterion indicated that most of the models had an optimal lag length of either one or two. (A uniform lag of two was chosen in order to preserve symmetry of specification across countries.) Allowing for lags, the estimation period was 1963-90 for the European economies; for all Asian and American economies except Brazil and Peru it was 1972-89. Brazil and Peru experienced very high inflations at the end of the period, rendering it impossible to estimate the model using data for the full

period. Accordingly, the sample period for Brazil and Peru was truncated at 1986 and 1987, respectively. (The model could be estimated for economies such as Mexico, which experienced high inflation in the past but where the inflation rate had declined to moderate levels by 1989.)

The estimation results generally accord with the aggregate-supply-aggregate-demand framework of Section II. The "over-identifying restriction" that positive aggregate demand shocks should be associated with increases in prices was satisfied in 36 of 39 cases (Norway, the Philippines, and Uruguay were the exceptions). The price response to a supply shock was perverse in six cases (Norway, Hong Kong, Singapore, Malaysia, Indonesia, and Uruguay). Three of these countries (Norway, Malaysia, and Indonesia) are major raw material producers, while Hong Kong and Singapore are centers of entrepot trade in primary commodities. As discussed earlier, for raw material producers supply disturbances may be closely linked to changes in the terms of trade, causing the perverse price response.

Some evidence that this is the case can be found in Table 4, which shows the correlation between the estimated supply shocks and the change in the terms of trade (measured as the change in the logarithm of the ratio of the domestic output price and the aggregate OECD price deflator, both in dollars). For the 20 industrial countries plus Korea and Taiwan the correlations are generally small or negative, with a mean of -0.02. In contrast, the other countries in the East Asian region (with the exception of the Philippines), which contain 4 of the 6 perverse price responses to supply shocks, all have large positive correlations. In Central and South America five countries (Mexico, Argentina, Bolivia,

Table 4. Correlation of Supply Disturbances with Changes in Terms of Trade

Country	Corr	Country	Corr	Country	Corr
GER	0.12	JAP	0.10	USA	−0.10
FRA	−0.10	TAI	−0.31	CAN	−0.17
NTH	0.04	KOR	0.01		
BEL	0.37	AUS	−0.02	MEX	0.77
DEN	0.08	NZL	−0.32	COL	0.07
AUT	0.09			VEN	−0.13
SWI	−0.19	THA	0.31	ECU	−0.14
ITA	−0.16	HKG	0.18	PER	0.29
UNK	−0.13	SPG	0.43	BRA	0.14
SPA	−0.06	MAL	0.20	BOL	0.31
POR	0.32	INO	0.29	PAR	−0.17
IRE	0.08	PHL	0.00	URY	−0.07
SWE	−0.14			ARG	0.47
NOR	0.07			CHL	0.48
FIN	0.00				

Chile and Peru), all of which are significant raw material exporters, have large positive correlations, while the other six do not. The relatively closed nature of these economies over the sample period, and hence limited impact of the terms of trade on demand, presumably explains why there are so few perverse price responses in this part of the world.

VI. Estimation Results

A. Correlations of Disturbances

We focus first on supply disturbances since, given the underlying model, these are unaffected by changes in demand-management policies and are more likely to be invariant with respect to alternative international monetary arrangements. Table 5 shows the correlation of supply disturbances within the three regions, with significant correlations highlighted.[1] The results for Europe indicate that all but two of the supply shocks for Germany, France, the Netherlands, Belgium, Denmark, and Austria are significantly correlated. Switzerland's supply shocks display significant correlations with those for most of these countries as well. The six other significant positive correlations in the European bloc do not suggest a consistent regional pattern (with the exception of the positive correlation between Spain and Portugal).

The results for Asia also paint a coherent picture. Supply disturbances to Japan,

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[1]As with the raw data, the correlations of the G-3 economies were examined to obtain a reference value for the underlying correlations. Since these correlations were universally small, we set this value equal to zero, implying a 5 percent critical value of r=+/-0.37 for the Western European data and a 10 percent value of +/-0.39 for the other two regions.

Table 5. Correlations of Supply Disturbances Across Different Geographic Regions

Western Europe

	GER	FRA	NTH	BEL	DEN	AUT	SWI	ITA	UNK	SPA	POR	IRE	SWE	NOR	FIN
GER	1.00														
FRA	0.52	1.00													
NTH	0.54	0.36	1.00												
BEL	0.62	0.48	0.56	1.00											
DEN	0.68	0.54	0.56	0.37	1.00										
AUT	0.41	0.28	0.38	0.47	0.43	1.00									
SWI	0.38	0.25	0.58	0.47	0.36	0.36	1.00								
ITA	0.21	0.28	0.99	−0.00	0.15	0.06	−0.04	1.00							
UNK	0.12	0.12	0.13	0.12	−0.05	−0.25	0.16	0.28	1.00						
SPA	0.33	0.21	0.17	0.23	0.22	0.25	0.07	0.20	0.01	1.00					
POR	0.21	0.33	0.11	0.40	−0.04	−0.03	0.13	0.22	0.27	0.51	1.00				
IRE	−0.00	−0.21	0.11	−0.02	−0.32	0.08	0.08	0.14	0.05	−0.15	0.01	1.00			
SWE	0.31	0.30	0.43	0.06	0.35	0.01	0.44	0.46	0.41	0.20	0.39	0.10	1.00		
NOR	−0.27	−0.11	−0.39	−0.26	−0.37	−0.21	−0.18	0.01	0.27	−0.09	0.26	0.08	0.10	1.00	
FIN	0.22	0.12	−0.25	0.06	0.30	0.11	0.06	−0.32	−0.04	0.07	−0.13	−0.23	−0.10	−0.08	1.00

East Asia

	JAP	TAI	KOR	THA	HKG	SGP	MAL	INO	PHL	AUS	NZL
JAP	1.00										
TAI	0.61	1.00									
KOR	0.46	0.54	1.00								
THA	0.32	0.59	0.36	1.00							
HKG	0.29	0.28	0.05	0.31	1.00						
SGP	−0.10	0.25	0.02	0.29	0.63	1.00					
MAL	−0.02	0.06	−0.03	0.35	0.47	0.71	1.00				
INO	0.14	−0.03	−0.10	0.13	0.53	0.55	0.52	1.00			
PHL	0.10	0.37	−0.11	−0.06	0.05	0.05	−0.03	0.03	1.00		
AUS	0.12	0.21	0.19	0.14	−0.16	−0.22	0.03	0.09	0.23	1.00	
NZL	0.01	0.19	−0.25	0.15	−0.12	0.13	−0.11	0.01	−0.06	−0.41	1.00

The Americas

	USA	CAN	MEX	COL	VEN	ECU	PER	BRA	BOL	PAR	URY	ARG	CHL
USA	1.00												
CAN	−0.47	1.00											
MEX	−0.59	0.35	1.00										
COL	−0.02	0.05	0.25	1.00									
VEN	0.09	0.34	−0.42	0.15	1.00								
ECU	−0.02	0.37	0.27	0.20	0.36	1.00							
PER	−0.40	0.05	0.37	0.07	0.10	0.28	1.00						
BRA	0.24	0.13	−0.08	0.07	0.13	0.40	0.38	1.00					
BOL	−0.65	0.22	0.65	0.18	0.00	0.29	0.54	0.17	1.00				
PAR	−0.34	0.45	0.37	0.06	0.12	−0.07	0.16	0.22	0.39	1.00			
URY	0.27	−0.31	−0.26	−0.35	0.05	−0.21	0.01	−0.06	−0.20	−0.08	1.00		
ARG	−0.30	0.08	−0.18	0.10	0.27	−0.01	0.36	0.34	0.06	0.06	−0.48	1.00	
CHL	−0.18	0.03	0.23	0.09	−0.33	−0.41	0.19	−0.23	0.17	0.21	−0.33	0.21	1.00

Taiwan, and Korea are significantly correlated, as are those to Hong Kong, Singapore, Malaysia, and Indonesia. The only other significant positive correlation is that between Taiwan and Thailand, reflecting the intermediate position of this last country, whose supply shocks display large but generally insignificant correlations with those of the seven Asian countries listed above. The Philippines, Australia, and New Zealand have no significant positive correlations with other countries. Australia and New Zealand have the only significantly negative correlation in the region, indicating that, despite trade and investment links, these countries experience very different underlying supply disturbances.

The results for the Americas reveal only five significant positive correlations and no well-defined regional country groups. Indeed, there are eight significant negative correlations, of which two are those for the US and Canada and for the US and Mexico. It would appear that the NAFTA countries are affected by very different supply conditions. The negative US-Canadian correlation is particularly interesting since the raw data indicate that both growth and inflation were positively (and significantly) correlated (as are the demand disturbances between these economies--see below).

To test the robustness of this result, we re-ran the model using OECD data, which covers the longer period 1960-90. Supply shocks between the US and Canada continue to be negatively correlated over this longer period, although at -0.12 the correlation coefficient is smaller in absolute value than in the results from the shorter period.[1]

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[1]In contrast, the positive correlation between their demand disturbances becomes larger when the extended data set is used. In a more detailed study focusing on NAFTA and using regional data for both the U.S. and Canada (Bayoumi and Eichengreen, 1992b), we come to

B. Correlation of Demand Shocks

Since demand disturbances include the impact of monetary and fiscal policies, they are less likely to be informative about regional patterns than the supply disturbances. As Table 6 shows, all the regions feature a number of significant correlations, but no clear geographic pattern emerges in either Europe or the Americas. Asia does show one geographic group of countries with highly correlated demand shocks, namely Hong Kong, Singapore, Malaysia, Indonesia, and Thailand, which is similar to one of the groupings also identified by the supply disturbances.

Overall, the correlations of the estimated disturbances provide a significantly more coherent picture than that which emerges from the raw data. They isolate three groups of countries that, on the basis of the correlation of their disturbances, could be potential candidates for monetary unification: Germany and her Northern European neighbors; Japan, Taiwan, and Korea; and Hong Kong, Singapore, Malaysia and Indonesia plus (possibly) Thailand. No such groupings are apparent in the Western Hemisphere. In particular, disturbances to the potential NAFTA partners tend to be negatively correlated, while the correlation of disturbances between potential partners in MERCOSUR is small and insignificant.

C. Size of Disturbances

In addition to providing estimates on the correlation of disturbances, our results also

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the same overall conclusion, namely that the U.S., Canada, and Mexico do not form a particularly homogeneous regional grouping from the point of view of macroeconomic disturbances.

Table 6. Correlations of Demand Disturbances Across Different Geographic Regions

Western Europe

	GER	FRA	NTH	BEL	DEN	AUT	SWI	ITA	UNK	SPA	POR	IRE	SWE	NOR	FIN
GER	1.00														
FRA	0.30	1.00													
NTH	0.21	0.34	1.00												
BEL	0.36	0.53	0.52	1.00											
DEN	0.34	0.32	0.20	0.30	1.00										
AUT	0.32	0.50	0.29	0.56	0.30	1.00									
SWI	0.18	0.42	0.37	0.28	0.22	0.45	1.00								
ITA	0.22	0.62	0.24	0.49	0.06	0.44	0.32	1.00							
UNK	0.09	0.20	−0.05	−0.03	−0.00	−0.15	−0.08	0.05	1.00						
SPA	−0.10	0.53	0.11	0.26	0.25	0.30	0.04	0.43	0.23	1.00					
POR	0.24	0.47	0.05	0.45	0.30	0.60	0.36	0.63	0.24	0.32	1.00				
IRE	0.06	0.09	0.39	0.00	0.34	−0.12	0.19	−0.08	0.25	0.02	−0.01	1.00			
SWE	0.10	0.18	0.29	0.36	0.18	0.02	−0.07	0.25	0.18	−0.01	0.08	0.30	1.00		
NOR	−0.24	0.01	−0.14	−0.24	−0.11	−0.16	−0.11	−0.30	0.13	0.14	−0.19	−0.20	−0.11	1.00	
FIN	0.10	0.47	0.32	0.60	0.36	0.53	0.30	0.65	0.16	0.40	0.54	0.17	0.33	−0.21	1.00

East Asia

	JAP	TAI	KOR	THA	HKG	SGP	MAL	INO	PHL	AUS	NZL
JAP	1.00										
TAI	−0.01	1.00									
KOR	0.19	0.33	1.00								
THA	−0.04	0.54	0.32	1.00							
HKG	0.23	0.22	0.05	0.43	1.00						
SGP	−0.09	0.44	0.27	0.70	0.37	1.00					
MAL	0.12	0.41	0.43	0.58	0.54	0.67	1.00				
INO	0.16	0.17	0.17	0.36	0.62	0.64	0.58	1.00			
PHL	0.29	0.09	0.16	0.15	−0.19	−0.05	−0.11	0.04	1.00		
AUS	0.22	0.20	0.45	0.32	0.32	0.34	0.50	0.05	−0.01	1.00	
NZL	0.00	−0.39	−0.41	0.10	0.43	0.13	0.06	0.09	−0.06	0.21	1.00

The Americas

	USA	CAN	MEX	COL	VEN	ECU	PER	BRA	BOL	PAR	URY	ARG	CHL
USA	1.00												
CAN	0.30	1.00											
MEX	−0.12	0.37	1.00										
COL	0.07	−0.09	−0.27	1.00									
VEN	0.06	0.47	0.20	0.29	1.00								
ECU	0.19	0.28	−0.21	0.24	0.61	1.00							
PER	0.20	0.27	0.50	−0.33	0.05	−0.09	1.00						
BRA	0.03	0.59	0.27	0.08	0.70	0.52	0.35	1.00					
BOL	0.09	0.07	0.06	−0.02	−0.20	−0.19	0.18	0.02	1.00				
PAR	0.11	0.50	0.23	0.39	0.51	0.13	−0.04	0.38	−0.18	1.00			
URY	0.35	0.04	−0.01	0.07	−0.26	−0.45	0.25	0.24	−0.13	0.08	1.00		
ARG	0.08	0.07	0.08	−0.08	0.35	0.29	0.35	0.15	0.01	0.33	−0.41	1.00	
CHL	0.50	0.66	0.06	0.21	0.37	0.37	−0.26	0.11	0.26	0.37	−0.24	0.05	1.00

convey information about their size and the speed at which the economy adjusts. The larger are disturbances, the more disruptive will be their effects, and the greater the premium that will be placed, given any cross-country correlation, on instruments (like monetary policy) that might be used to offset them. Similarly, the slower the response of an economy to disturbances, the larger the costs of permanently fixing the exchange rate and foregoing policy autonomy.

Since our econometric procedure restricts the variance of the estimated disturbances to unity, their magnitude can be inferred by considering the associated impulse response functions, which trace out the effect of a unit shock on prices and output. For the supply disturbances an obvious measure is the long-run output effect, which measures the shift in potential supply (see Chart 1). For demand disturbances, as a measure of size we calculated the sum of the first-year impact on output and prices, which measures the short-term change in nominal GDP.

Table 7 suggests that countries in Europe and Asia face similarly-sized supply shocks on average, while the Americas experience supply shocks almost twice this size. The Americas also experience relatively large demand shocks, seven times as large as Europe's and more than three times as large as those of Asia. This is consistent with the greater variability of growth and (especially) inflation in the Western Hemisphere.[1] There is also some evidence that the groups we have identified on the basis of the underlying correlations

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[1]Much of this instability plausibly reflects unstable macroeconomic policies. Correspondingly, the United States, Canada face demand disturbances whose sizes are more akin to those in Europe than to those of the other countries in the region.

Table 7. Size and Speed of Adjustment to Disturbances

	Supply Disturbances		Demand Disturbances	
	Size	Speed	Size	Speed
GER	0.022	1.193	0.015	0.659
FRA	0.034	0.243	0.014	0.101
NTH	0.033	0.692	0.019	0.511
BEL	0.028	0.668	0.020	0.508
DEN	0.022	1.104	0.017	0.135
AUT	0.018	0.999	0.017	0.415
SWI	0.031	0.997	0.016	0.858
ITA	0.03	0.427	0.036	0.380
UNK	0.018	0.425	0.019	0.016
SPA	0.057	0.083	0.015	0.123
POR	0.061	0.426	0.026	0.367
IRE	0.021	1.222	0.038	0.382
SWE	0.03	0.261	0.012	0.419
NOR	0.031	0.651	0.034	0.704
FIN	0.018	0.875	0.027	0.684
Average	0.03	0.684	0.022	0.417
JAP	0.012	1.67	0.017	0.270
TAI	0.021	1.47	0.049	0.673
KOR	0.029	0.89	0.038	0.115
THA	0.026	1.38	0.042	1.279
HKG	0.023	1.59	0.044	1.190
SPG	0.032	1.35	0.028	1.072
MAL	0.032	1.04	0.063	1.607
INO	0.013	1.24	0.071	1.335
PHL	0.089	0.59	0.081	1.475
AUS	0.011	0.92	0.017	0.910
NZL	0.060	0.65	0.031	0.291
Average	0.032	1.16	0.044	0.929
USA	0.028	0.27	0.015	0.078
CAN	0.020	1.05	0.028	0.703
MEX	0.059	0.78	0.072	0.865
COL	0.026	0.82	0.027	0.720
VEN	0.062	0.81	0.074	0.949
ECU	0.162	0.40	0.076	0.987
PER	0.050	1.17	0.062	0.452
BRA	0.084	0.71	0.068	0.983
BOL	0.069	0.59	0.636	1.302
PAR	0.094	0.46	0.064	0.719
URY	0.049	1.01	0.074	1.227
ARG	0.033	1.14	0.438	1.126
CHL	0.064	1.21	0.251	0.548
Average	0.062	0.80	0.145	0.820

experience smaller underlying disturbances, which lends further support to the viability of these regional groupings as monetary unions.

D. Speed of Adjustment

The speed of adjustment is summarized by the response after two years as a share of the long-run effect.[1] The second and fourth columns of Table 7 display the results. Asia has the fastest adjustment, with almost all of the change in output and prices occurring within two years. Next come the Americas, where on average some 80 percent of adjustment is completed in two years. In Europe, by contrast, only around half of the change occurs within this time span. The Northern European economies (particularly Germany, Switzerland, the Netherlands and Belgium) are characterized by relatively fast adjustment, while those of Southern Europe (Italy, Spain, and for these purposes, France) exhibit large demand disturbances and relatively slow responses. The Philippines and New Zealand and the US and Canada appear to be less flexible than other economies in their respective regions.

VII. US Regional Data

In this section we compare the results reported above with those derived using regional data for the United States.[2] The US is a smoothly-functioning continental monetary

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[1]While the choice of the second year as the numerator in this calculation is somewhat arbitrary, calculations using other years produced similar results.

[2]Bayoumi and Eichengreen (1993) analyze regional U.S. data in more detail.

union whose regions are of roughly comparable size, in terms of population and global economic significance, to many of the countries in our sample. Hence, US data provide a useful benchmark for gauging the implications of our results for the viability of other potential monetary unions.

Data on real and nominal gross state product were collected for 1963-86. These were aggregated into seven regions, in contrast to the eight regions used by the Bureau of Economic Analysis (BEA). The difference is due to our decision to amalgamate two of the smallest regions, the Rocky Mountains and the South West, which have similar economic structures and need to be combined to comprise a region comparable in size to other US regions and foreign countries analyzed in this paper.[1] The combined region, which we call the West, is still relatively homogeneous, being made up of two regions both of which are heavily specialized in primary production, and has about 15 percent of the US population, close to the average for the seven regional divisions.

The over-identifying restriction regarding the simulated response of prices was satisfied for every region but the West, where supply shocks were associated with a rise in prices rather than a fall. Like most of the countries with perverse price responses to supply shocks, this region is dependent on raw material production (especially crude oil).

Table 8 reports the correlations of demand and supply disturbances to the seven US regions; Table 9 shows the magnitude of disturbances and the regions' speed of adjustment to

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[1]The seven resulting regions are New England, Mid East, Great Lakes, Plains, South East, West and Far West.

Table 8. Correlation of Disturbances in US

Supply Disturbances, US Regions

	NENG	MIDE	GRTL	SEST	PLNS	FWST	WEST
NENG	1.00						
MIDE	0.86	1.00					
GRTL	0.77	0.81	1.00				
SEST	0.34	0.30	0.46	1.00			
PLNS	0.44	0.67	0.66	0.49	1.00		
FWST	0.62	0.52	0.65	0.43	0.32	1.00	
WEST	0.07	−0.18	−0.11	−0.33	−0.66	0.26	1.00

Demand Disturbances, US Regions

	NENG	MIDE	GRTL	SEST	PLNS	FWST	WEST
NENG	1.00						
MIDE	0.79	1.00					
GRTL	0.66	0.60	1.00				
SEST	0.63	0.51	0.79	1.00			
PLNS	0.51	0.50	0.70	0.69	1.00		
FWST	0.59	0.33	0.64	0.43	0.30	1.00	
WEST	0.26	0.28	0.03	−0.27	−0.23	0.30	1.00

Table 9. US Regional Disturbances

	Supply Disturbances		Demand Disturbances	
	Size	Speed	Size	Speed
NENG	0.032	1.15	0.015	0.43
MIDE	0.030	0.88	0.013	0.17
GRTL	0.040	0.63	0.040	0.05
SEST	0.024	0.07	0.015	0.29
PLNS	0.024	0.08	0.024	0.10
FWST	0.020	0.71	0.018	0.55
WEST	0.044	1.41	0.011	0.32
Average	0.028	0.59	0.021	0.27

them. Six of the seven regions exhibit highly correlated supply disturbances, the exception being the West. 12 of the 15 cross-correlations for these regions are greater than 0.37, the significance level used in earlier analysis. Three regions, namely New England, the Mid-East and Great Lakes ("the Manufacturing Belt"), have exceptionally highly correlated supply disturbances, with higher correlations than those for any of the countries analyzed above. The other correlations are of a similar magnitude to those found in the earlier analysis. By contrast, supply disturbances to the West are negatively correlated with most other regions, presumably reflecting the importance of the oil industry.

The demand disturbances show a similar pattern. Correlations among the six regions other than the West are almost always significant, plausibly reflecting the effects of national macroeconomic policies, while correlations between the West and the rest of the country are smaller. The high cross-correlations within the US contrast with the results reported in Table 6, consistent with our interpretation of these disturbances as reflecting macroeconomic policy.

Table 9 reports the size of the underlying disturbances and the speed of adjustment. The size of disturbances is similar to that found in Europe and, for the supply disturbances, Asia as well. Speeds of adjustment are comparable to those for the countries we have identified as potential participants in monetary unions.

Comparing the results for the US regions with those for the potential monetary unions we have identified in Europe and East Asia, several features stand out. Most regions of the United States experience supply disturbances that are significantly more correlated than in

any of the possible monetary unions identified earlier in previous sections; the correlation coefficients between the New England, Mid-East and Great Lakes regions are all over 0.75, which is higher than any of the equivalent correlations across countries. On the other hand, the United States also contains one region, the West, whose underlying supply disturbances are negatively correlated with those for the rest of the country, which is not true for any of the potential unions which have been identified. Finally, US regions face supply disturbances of a magnitude similar to those faced by individual countries, and the speed of adjustment of US regions is not quicker than that of the countries we have identified as potential monetary union members.

Of course, these features are not necessarily exogenous with respect to the existence of the US currency union. The north east of the United States has presumably become more integrated over time, the West more specialized in raw material production, as a result of the existence of a single currency. The speed of response to disturbances may also be affected by the inability of regions to adjust by changing the exchange rate vis-à-vis one another. Overall, the results nonetheless suggest that several potential monetary unions in other parts of the world are relatively similar in key respects to the US currency union.

VIII. Conclusions

The paper has considered the incidence of supply and demand shocks in Western Europe, East Asia and the Americas as a way of identifying countries experiencing similar economic disturbances and hence satisfying one of the conditions for forming an optimum

currency area. To do this we have implemented a procedure for recovering aggregate demand and aggregate supply disturbances from time series data.

The results suggest the existence of three regional groupings whose economies that face similar underlying disturbances: a Northern European bloc (Germany, France, the Netherlands, Belgium, Denmark, Austria, and possibly Switzerland); a Northeast Asian bloc (Japan, Taiwan, and Korea); and a Southeast Asian bloc (Hong Kong, Singapore, Malaysia, Indonesia, and possibly Thailand). The correlations among supply shocks to these regions are not dissimilar from those found in regional data for the United States. In contrast, the United States faces very different disturbances from Canada and Mexico, the other two countries involved in NAFTA negotiations which might conceivably lead to discussions of a common currency one day. The same is true of the members of MERCOSUR.

We then considered the size of disturbances and the speed of adjustment of the economies experiencing them. The results reinforce those derived from the correlation analysis. In Western Europe, where adjustment tends to be sluggish, implying higher costs of monetary unification, Germany and her immediate neighbors (with the notable exception of France) display the speediest responses. In Asia, where responses are faster, New Zealand and the Philippines, which both have relatively idiosyncratic disturbances, also have slow responses. In the Americas, in addition to there being little correlation of supply disturbances across countries, disturbances are large, rendering the region a still less plausible candidate for monetary unification. Finally, there does not appear to be much difference in the size of disturbances and speed of adjustment of the countries we have

identified on the basis of these criteria as plausible candidates for monetary union and the disturbance sizes and adjustment speeds evident in regional data for an existing monetary union, the United States.

The potential monetary unions we have identified share several features. They tend to be contiguous geographic areas, with only a few exceptions (such as the inclusion of Hong Kong in the Southeast Asian region, although even there the countries in question all border a common body of water). Germany and her neighbors, another potential grouping, have a history of economic integration and policy cooperation. The members of our Northeast Asian bloc (Japan, Korea, and Taiwan) share direct foreign investment and component-supply links. Our Southeast Asian grouping of Hong Kong, Singapore, Malaysia, Indonesia, and Thailand represents the next wave of Asian industrialization and contains the region's two major financial and commercial centers.

Strikingly, these regions do not correspond closely to formal trade blocs either current or prospective. The region centered on Germany excludes over half of the current members of the EC and includes two long-standing members of EFTA. Japan, Taiwan, and Korea share no formal preferential trading arrangements. The Southeast Asian grouping excludes the Philippines, which is a member of ASEAN, and includes Hong Kong, which is not. The results indicate little similarity between the disturbances experienced by the prospective members of MERCOSUR and are even more negative about the suitability for monetary union of the prospective members of NAFTA. As the example of the EC shows, this need not preclude these regional trading organizations from moving toward fixed exchange rates

and, ultimately, monetary union, although it suggests that they will have to surmount obstacles along the way.

The limitations of the analysis should be recalled. We have focused on aggregate disturbances, ignoring other factors such as the level of intra-regional trade which may also be relevant to the benefits of monetary union. We have based inferences about the future on data from the past whose properties may not be invariant to the monetary regime. These and other caveats notwithstanding, our analysis has clear implications. It suggests that a European monetary union might run more smoothly if limited to a subset of EC members. It indicates that conditions are more conducive to monetary unification in East Asia than the Americas. It implies, other things equal, that ASEAN is more likely than either NAFTA or MERCOSUR to be a catalyst for negotiations to stabilize bilateral exchange rates and for eventual moves to establish a regional currency.

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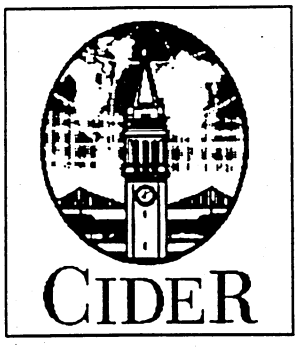

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