Business Cycle Synchronization and Regional Integration: A Case Study for Central America

Norbert Fiess

Deeper trade integration between Central America and the United States, as envisaged under the Central American Free Trade Agreement, is likely to lead to closer links between Central American and U.S. business cycles. This article assesses the degree of business cycle synchronization between Central America and the United States—relevant not only for a better understanding of the influence of important trading partners on the business cycle fluctuations in the domestic economy but for evaluating the costs and benefits of macroeconomic coordination. JEL codes: F15, F42.

In early January 2003 the United States and Costa Rica, El Salvador, Guatemala, Honduras, and Nicaragua launched official negotiations for the Central American Free Trade Agreement (CAFTA, renamed DR-CAFTA after the Dominican Republic joined the negotiations in 2004).[1] Once ratified by all members, DR-CAFTA will expand trade barrier reductions similar to those in the North American Free Trade Agreement (NAFTA) to Central America. DR-CAFTA is part of a bigger project to promote regional integration throughout the Americas, with the ultimate aim of establishing a Free Trade Area of the Americas.

An open question for any trade integration initiative is the macroeconomic consequences and so the implications for macroeconomic policies. Like NAFTA, DR-CAFTA contains no explicit provisions on macroeconomic policy. But just as NAFTA has affected Mexico's macroeconomic dynamics (Lederman, Maloney, and Serven 2005), DR-CAFTA has the potential to change the macroeconomic dynamics between Central America and the United States, which could in turn alter the desirability to coordinate fiscal and monetary policies between these countries.

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1. This article's focus is limited to the initial CAFTA countries.

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Trade is often perceived as an important—if not the most important—transmission channel for business cycles from one country to another. Theoretically, the impact of trade integration on business cycle synchronization is unclear. Increased trade can lead business cycles to diverge or converge. If trade integration leads to increased interindustry trade as a part of a specialization process, business cycles are likely to diverge because shocks specific to particular industries will become responsible for shaping business cycles. But if trade integration leads to a higher share of intraindustry trade, business cycles will converge because industry-specific shocks will affect trading partners in a similar way.

If business cycles are similar and shocks are common, coordination of macroeconomic policies can become desirable, with a common currency as the ultimate form of policy coordination. But if shocks are predominately country-specific, resulting in little business cycle synchronization, independent monetary and fiscal policies are generally seen as important in helping an economy adjust to a new equilibrium. Clearly, if business cycles are affected predominately by country-specific shocks and are likely to continue to be so, intensified macroeconomic coordination as part of regional integration might do more harm than good.

Frankel and Rockett (1988) show that if macroeconomic coordination is based on the wrong economic model, it can make countries worse off than under noncooperation. The aim of this article is to come closer to the "true" economic model by providing information about the current trade structure and the degree of business cycle synchronization between Central America and the United States. Because both business cycle synchronization and trade structure are expected to change with trade integration, knowledge of the status quo will provide crucial information for future policy analysis.

This article does three things. First, it uses state-of-the-art econometric techniques to measure the degree of business cycle synchronization between Central America and the United States—its main trading partner. Second, it calculates inter and intraregional trade for Central America to quantify the relationship among trade intensity, trade structure, and business cycle synchronization; this is followed by a discussion of how trade integration within DR-CAFTA is likely to shape future business cycle patterns in the region. Third, it offers policy advice on the appropriateness of macroeconomic coordination for Central America conditional on its trade structure. Given El Salvador's unilateral dollarization in 2000, it seems highly relevant to inform the debate on this front.

Restricted data availability for Central America seriously limits the scope for econometric analysis. To maximize inference about the level of business cycle synchronization and the link between trade structure and business cycle synchronization in Central America, two sets of data are analyzed: annual data on GDP from 1965 to 2005 and monthly data on economic activity from 1995 to 2005. The annual data span a longer time period and allow an analysis of changes in business cycle synchronization over time. Because business cycles are usually defined as 6–32 quarters, the higher frequency of the monthly data should provide additional insight into business cycle synchronization over the more

recent period. Most Central American countries went from extreme instability marked by hyperinflation and civil war to a period of peace and economic reform in the 1990s. Thus, the later, more tranquil period is likely to be more useful for predicting future developments in business cycle synchronization.

Most of Central America's trade structure is interindustry, and current business cycle synchronization with the United States is low. Thus, to date neither the trade structure nor the degree of business cycle synchronization of Central America appears to make a compelling case for macroeconomic coordination within Central America or between Central America and the United States.

I. Business Cycle Synchronization in Central America

The degree of business cycle synchronization is important because it shows the necessity of independent fiscal and monetary policy. If business cycles are similar and shocks are common, coordination of macro policies can become desirable, with a common currency as the ultimate form of policy coordination. But if shocks are predominately country-specific, independent monetary and fiscal policies are usually seen as important in helping an economy adjust to a new equilibrium.

Data and Methodology

Because shocks are not directly observed, empirical studies rely on econometric methods for their identification. Bayoumi and Eichengreen (1993) and Helg and others (1995) adopt a structural vector autoregression approach, whereas Artis and Zhang (1995) develop an identification scheme based on cyclical components. Rubin and Thygesen (1996), Beine and Hecq (1997), and Beine, Candelon, and Hecq (2000) use a codependence framework. Filardo and Gordon (1994), Beine, Candelon, and Sekkat (1999), and Krolzig (2001) use a Markov switching vector autoregression model. This empirical work shows that it is important to distinguish between short- and long-run effects. Bayoumi and Eichengreen (1993), Helg and others (1995), and Rubin and Thygesen (1996) use differenced variables in the vector autoregression representation. However, such a specification does not allow for a long-run relationship among the variables. Beine, Candelon, and Hecq (2000) overcome this by investigating common trends and common cycles simultaneously, where evidence of a common European cycle is taken as evidence of perfect synchronization of shocks. Breitung and Candelon (2001) use a frequency domain common cycle test to analyze synchronization at different business cycle frequencies.

The analysis here uses annual data on real GDP and trade figures for 1965–2002 and monthly data on industrial production and economic activity for 1995–2002. Data on GDP are from the International Monetary Fund's International Financial Statistics database, data on industrial production are from each country's central bank statistics, and data on trade are from the World Bank's World Integrated Trade Solution database and the International Monetary Fund's Direction of Trade Statistics database.

The key variable is the degree of business cycle synchronization between countries *i* and *j*. Frankel and Rose's (1998) approach is used to measure this variable; the correlation between the cyclical component of the output in countries *i* and *j* is computed, with a higher correlation implying a higher degree of business cycle synchronization. The cyclical component of output is obtained using different de-trending methods. Given the lack of consensus on the optimal procedure and the sensitivity of the cycle to the de-trending method, this approach should provide a robustness check of the results. For de-trending, first-differencing and band-pass filtering (Baxter and King 1999) are used for the annual data and spectral analysis for the monthly data.

Two aspects of business cycle synchronization are analyzed here. First is the degree of business cycle synchronization, which is measured using simple contemporaneous correlations between the cyclical components of economic activity (at monthly and annual frequencies) across countries. Regression analysis is then used to study whether the sensitivity of business cycles to developments in major trading partners has changed over time.

Second is the link between trade integration on business cycle synchronization, which is assessed using measures of bilateral trade intensity and trade structure in combination with the measure of the degree of business cycle synchronization.

Measuring the Degree of Business Cycle Synchronization

ANNUAL DATA: 1965–2005. Band-pass filtered data, the preferred method for business cycle extraction in this section, show that in Central America business cycle synchronization is highest among Costa Rica, El Salvador, Guatemala, and Honduras (table 1). Nicaragua and Panama appear to follow a different cycle, as correlation across business cycles is in most cases negative, though not statistically significant.[2]

Correlation with the U.S. business cycle is also high. In Costa Rica, El Salvador, and Honduras business cycle synchronization with the United States appears even higher than with regional neighbors, indicating that bilateral relationships with the United States through trade and remittances are more important than regional effects. Somewhat surprising, business cycle synchronization between the United States and Panama, which adopted full dollarization in 1904, appears to be much lower than synchronization between the United States and the rest of Central America, except Nicaragua. On the basis of the business cycle synchronization, the rest of Central America would be better candidates for a currency union with the United States than Panama would be. In fact, business cycle synchronization between the United States and Costa Rica, El Salvador, Guatemala, and Honduras is higher than the EU average (table 2).

2. Results based on first differences, reported in supplemental appendixes S-1 and S-2, broadly confirm the band-pass filtered results. The supplemental appendixes are available at http://wber.oxfordjournals.org.

TABLE 1. Business Cycle Synchronization, Band-Pass Filter, Central America

Country	Costa Rica	El Salvador	Guatemala	Honduras	Nicaragua	Panama
Costa Rica	1.000					
El Salvador	0.604[a]	1.000				
Guatemala	0.632[a]	0.238	1.000			
Honduras	0.524[a]	0.442[a]	0.590[a]	1.000		
Nicaragua	−0.214	0.015	−0.142	−0.157	1.000	
Panama	−0.007	−0.062	−0.087	−0.011	0.088	1.000
Argentina	0.354[a]	0.111	0.187	0.043	−0.086	0.148
Brazil	0.350[a]	0.028	0.407[a]	0.174	−0.162	−0.001
Mexico	0.151	−0.335	0.395[a]	0.168	−0.255	0.323
Canada	0.621[a]	0.276	0.492[a]	0.359[a]	−0.214	−0.336
United States	0.687[a]	0.506[a]	0.463[a]	0.679[a]	−0.163	−0.148
France	0.239	0.113	0.394	0.152	−0.170	−0.138
Germany	0.167	0.107	0.308	0.107	−0.138	0.280
Portugal	0.124	−0.088	0.504[a]	0.423[a]	−0.127	−0.085
Spain	0.175	0.136	0.389[a]	0.057	0.167	−0.218
United Kingdom	0.402[a]	0.479[a]	0.241	0.459[a]	−0.268	−0.323

Note: Displays bilateral correlations of the cyclical components of band-pass filtered annual GDP data.

[a]Significant at the 5 percent level.

Source: Author's calculations based on data described in the text.

Business cycle synchronization between Argentina and Brazil, two Common Market of the South (Mercosur) countries, is lower than among Costa Rica, El Salvador, and Guatemala. While business cycle synchronization is also substantial between Canada and the United States, it is surprisingly low between Mexico and the United States.

Appendix table A-1 shows business cycle synchronization among Central American countries after controlling for the common impact of the U.S. business cycle using a two-step procedure. First, the cyclical component of GDP in Central America is regressed on a constant and then on the cyclical component of the United States. Second, the regression residuals are correlated to assess the degree of business cycle synchronization in Central America, which is independent from the U.S. business cycle.[3] Once the common impact of the U.S. business cycle is removed, only synchronizations between Costa Rica and El Salvador, Costa Rica and Guatemala, and Guatemala and Honduras are affected by common factors other than the U.S. business cycle. Because these countries also account for the largest share of intraregional trade, this finding supports the often postulated positive relationship between trade intensity and business cycle symmetry.

3. The regression was $y_i = \alpha_t + y_{US} + \varepsilon_i$, where y_i is the cyclical component of the band-pass filtered GDP in Central American country i, y_{US} is the component in the United States, and ε_i is the ordinary least squares regression residual (which is orthogonal to the U.S. cyclical component). The regressions correct for serial correlation and heteroscedasticity.

TABLE 2. Business Cycle Synchronization, Other Free Trade Agreements

	Mercosur		NAFTA			European Union				
Country	Argentina	Brazil	Mexico	Canada	United States	France	Germany	Portugal	Spain	United Kingdom
Costa Rica	0.354[a]	0.350[a]	0.151	0.621[a]	0.687[a]	0.239	0.167	0.124	0.175	0.402[a]
El Salvador	0.111	0.028	−0.335	0.276	0.506[a]	0.113	0.107	−0.088	0.136	0.479[a]
Guatemala	0.187	0.407[a]	0.395[a]	0.492[a]	0.463[a]	0.394[a]	0.308	0.540[a]	0.389[a]	0.241
Honduras	0.043	0.174	0.168	0.359[a]	0.679[a]	0.152	0.107	0.423[a]	0.957	0.459[a]
Nicaragua	−0.086	−0.162	−0.255	−0.214	−0.163	−0.170	−0.138	−0.127	0.167	−0.268
Panama	0.148	−0.001	0.323	−0.336	−0.148	−0.138	0.280	−0.085	−0.218	−0.323
Argentina	1.000	0.202	0.093	−0.095	−0.033	−0.212	0.273	−0.091	−0.067	−0.100
Brazil		1.000	0.122	0.514[a]	0.286	0.080	0.070	0.209	0.223	0.320
Mexico			1.000	0.161	0.086	−0.007	0.156	0.159	0.013	−0.290
Canada				1.000	0.771[a]	0.338[a]	−0.088	0.170	0.370[a]	0.607[a]
United States					1.000	0.337[a]	0.104	0.292	0.329	0.727[a]
France						1.000	0.372[a]	0.656[a]	0.711[a]	0.482[a]
Germany							1.000	0.328[a]	0.348[a]	−0.044
Portugal								1.000	0.559[a]	0.431[a]
Spain									1.000	0.429[a]
United Kingdom										1.000

Note: Displays bilateral correlations of the cyclical components of band-pass–filtered annual GDP data.

[a]Significant at the 5 percent level.

Source: Author's calculations based on data described in the text.

MONTHLY DATA: 1995–2004. The business cycle is usually defined in the range of 6–32 quarters, and thus the low frequency of annual data might be insufficient to fully assess business cycle synchronization. This section complements the analysis of the previous section by using monthly data, where output is proxied by seasonally adjusted monthly indices of industrial production and economic activity. Because the data cover a relatively short time span of less than 10 years, at most two to three business cycles are likely to be captured. Unfortunately, neither monthly nor quarterly data exist on a consistent basis prior to 1995.

To make the most of the short time span, spectral analysis is used to estimate the correlation at different frequencies, and the average coherence at business cycle frequency (6–32 quarters) of year-over-year changes in monthly economic activity is used as a summary measure of business cycle synchronization (Anderson, Kwark, and Vahid 1999; Garnier 2004). The advantage of using cross-spectral densities over simple correlations in the analysis of business cycle synchronization is twofold. First, spectral analysis avoids possible business cycle distortions due to filtering; it is well known that the cycles change with the de-trending method (Canova 1998). Second, contemporaneous correlation is unable to take lagged co-movement into account. Because coherence measures the correlation between two series in the frequency domain and provides information on the phase lead or lag, spectral analysis provides a richer analysis of business cycle dynamics. While the coherence shows to what extent two business cycles are dominated by the same frequency, the phase lag shows to what extent elements with the same frequency lag each other. In sum, a high degree of business cycle synchronization implies a high coherence and a low phase lag.

Coherence and phase lag are calculated from the spectral density function.[4] To calculate the average coherence at business cycle frequency, the spectral coherence $\rho_{xy}(\omega)$ is calculated between series x and y at each frequency, assuming that frequencies are independent across and between series:

$$\rho_{xy}(\omega) = \frac{F_{xy}(\omega)}{\sqrt{F_x(\omega)F_y(\omega)}}. \tag{1}$$

Frequencies outside the business cycle ranges are omitted, and the average coherence is then calculated as the average over frequencies within the business cycle band. A high average coherence consequently implies that two series are dominated by the same frequencies within the business cycle frequency bands.

4. The cross-spectral density $F_{xy}(\omega)$ between series x and y is the Fourier transformation of the cross-covariance function $C_{xy}(\tau)$, where $-\infty \leq \tau \leq \infty$ is the lag. The cross-spectral density $F_{xy}(\omega)$ is defined as

$$F_{xy}(\omega) = \frac{1}{2\pi} \int_{-\infty}^{\infty} \mathrm{e}^{-i\omega\tau} C_{xy}(\tau) \mathrm{d}\tau.$$

The average coherence at business cycle frequency between year-over-year growth rates of economic activity between 1995 and 2004 broadly confirms the findings of the previous section (table 3).

Within Central America, business cycle synchronization is found to be the highest between Costa Rica and El Salvador, El Salvador and Guatemala, El Salvador and Nicaragua, and Honduras and Nicaragua. Business cycle synchronization with the United States is the highest for Costa Rica, El Salvador, and Honduras but lower than for NAFTA and Mercosur member countries.[5]

The higher level of business cycle synchronization between Mexico and the United States, as well as between Argentina and Brazil, is explained partly by the long time period (1965–2005) under consideration. Business cycle synchronization between Mexico and the United States has increased substantially since the mid-1990s, which Cuevas, Messmacher, and Werner (2002) attribute to increasing integration due to NAFTA.[6]

Changes in Business Cycle Synchronization over Time

Except Costa Rica, Central American countries suffered deep crises prior to the 1990s: from hyperinflation in Nicaragua to civil war in El Salvador. These episodes, which led to low growth and high volatility, clearly marked business cycles, and are likely to have affected the degree of business cycles synchronization with the United States.

A basic regression analysis is used to assess changes in business cycle synchronization. Annual growth rates of GDP in Central American countries were regressed against their lagged values and that of U.S. GDP growth. The regressions take the following general form, with coefficient estimates reported in table 4:

$$\begin{aligned}\Delta y_i = {} & \alpha_0 + \text{dum90} + \beta_1 \Delta y_{i,t-1} \\ & + \beta_2 \Delta y_{i,t-1} \times \text{dum90} \\ & + \sum_{k=0}^{n} \delta_{1,k} \Delta y_{\text{US},t-k} \\ & + \sum_{k=0}^{n} \delta_{2,k} \Delta y_{\text{US},t-k} \times \text{dum90} \end{aligned} \tag{2}$$

5. The phase lag is not reported here because it is very poorly estimated if the coherence is small, which is the case for most country pairings in table 3.

6. That business cycle synchronization can increase significantly with structural reform has been documented in the case of Mexico and the United States. Cuevas, Messmacher, and Werner (2002) attribute higher business cycle synchronization between Mexico and the United States during the 1990s to increasing integration due to NAFTA.

TABLE 3. Average Coherence at Business Cycle Frequency

Country	Costa Rica	El Salvador	Guatemala	Honduras	Nicaragua	Argentina	Mexico	Canada	France
Costa Rica			0.381						
El Salvador	0.524[a]								
Guatemala	0.381	0.534[a]							
Honduras	0.456	0.340	0.381						
Nicaragua	0.393	0.510[a]	0.421	0.544[a]					
Mexico	0.332	0.453	0.242	0.366	0.288	0.537[a]		0.361	0.345
United States	0.454	0.427	0.336	0.421	0.322	0.486	0.468	0.554[a]	0.429
Brazil	0.318	0.322	0.382	0.319	0.272	0.500[a]	0.608[a]	0.467	0.319
Germany	0.510[a]	0.536[a]	0.604[a]	0.529[a]	0.248	0.355	0.447	0.584[a]	0.601[a]

Note: Displays the bilateral average coherences of monthly data of economic activity.

[a]Significant at the 5 percent level.

Source: Author's calculations based on data described in the text.

TABLE 4. Changes in Business Cycle Synchronization with the United States over Time

Country	δ_1	δ_2	$\delta_1 + \delta_2$	R^2	GDP growth volatility (coefficient of variation) 1965–89	1990–2005
Costa Rica	0.630[a]	0.808[a]	1.438	0.36	0.82	0.57
El Salvador	−0.153[a]	0.552[a]	0.400	0.58	3.47	0.55
Guatemala	0.426[a]	0.308[a]	0.734	0.53	0.86	0.32
Honduras	0.790[a]	−0.339	0.451	0.26	0.81	0.76
Nicaragua	−0.295	0.842[a]	0.547	0.56	23.88	0.71
Panama	−0.091	1.488[a]	1.397	0.46	1.50	0.60
United States					0.73	0.49
Mexico	0.432[a]	1.106[a]	1.538	0.62	0.83	1.04 [1990–95] 0.65 [1996–05]

Note: Coefficients δ_1 and δ_2 are from regression 2. Coefficient δ_1 measures the sensitivity of economic developments in Central American countries to developments in the United States. Relationship ($\delta_1 + \delta_2$) indicates how this sensitivity has changed over time. The last two columns compare volatility, based on the coefficient of variation over two periods: 1965–89 and 1990–2005. A low coefficient indicates a more tranquil period. Comparative statistics for Mexico and the United States are included. To account for Mexico's Tequila Crisis of 1994–95, the coefficient of variation is calculated for two additional subperiods: 1990–95 and 1996–2005. The regressions for Mexico also include a dummy variable for the Tequila Crisis.

[a]Significant at the 10 percent level or higher.

Source: Author's calculations based on data described in the text.

where Δy_i is the annual GDP growth rate of Central American country i, $\Delta y_{US,t}$ is the annual U.S. GDP growth rate, dum90 is a bivariate dummy variable that takes the value of one from 1990 onwards. Several lag structures were explored, but additional lags of the dependent and independent variables proved generally insignificant even though contemporaneous lags are usually highly significant.

This simple regression allows two issues to be assessed. First is how sensitive the dependent variable is to developments in the United States (as given by δ_1). Second is how this sensitivity has changed over time (as given by $\delta_1 + \delta_2$) and whether the changes are statistically significant. The sensitivity to developments in the United States has generally increased over time and the negative co-movement with the United States for Honduras and Nicaragua (see table 4) appears to vanish in the 1990s, indicating that the end of the civil war most likely lessened the impact of country-specific shocks.[7] For Costa Rica, Mexico, and Panama the sensitivity coefficient becomes larger than one, which indicates that GDP in these countries may respond more than proportionally to changes in U.S. output.[8]

7. There also appears to be a positive link between the size of the sensitivity coefficient and the macroeconomic volatility. The sensitivity coefficient is generally higher during more tranquil periods.

8. Lederman, Maloney, and Serven (2005) report a similar finding for Mexico.

Table 4 also explains an apparent contradiction between the correlation results of the longer, annual sample and the shorter, monthly correlation exercise reported in previous sections. Because business cycle synchronization between Mexico and the United States increased significantly during the 1990s, it is not surprising to find substantially higher correlation in the more recent sample. Cuevas, Messmacher, and Werner (2002) attribute higher business cycle synchronization between Mexico and the United States during the 1990s to increased integration due to NAFTA.

II. Trade Structure and Business Cycle Synchronization

The impact of trade liberalization on business cycle synchronization is theoretically ambiguous. Standard trade theory (Heckscher–Ohlin) predicts that removing trade barriers leads to an increasing specialization in production, which leads to interindustry trade patterns. As industry-specific specialization increases, industry-specific shocks—for example, a shock to commodity prices—will make business cycles more dissimilar and hence decrease business cycle synchronization.

Experience from developed countries, however, shows a trend toward intraindustry rather than interindustry trade. If intraindustry trade is vertical—for example, particular countries specialize in different production stages of the same good—industry-specific shocks will make business cycles more similar. The same results occur if intraindustry trade is horizontal—for example, countries trade and compete with the same products. In that case industry-specific shocks are also expected to increase business cycle synchronization.[9] To summarize, intraindustry trade, vertical or horizontal, is expected to increase business cycle synchronization.

Central America's Trade Structure

Appendix tables A-2 and A-3 provide information about Central America's trade structure. Trade patterns of NAFTA countries and some EU and Mercosur countries are again provided for comparison. Trade (measured as the ratio of bilateral exports to total exports) in Central America is not predominantly intraregional as it is for EU, Mercosur, and NAFTA members. Even within the so-called Northern Triangle (El Salvador, Guatemala, and Honduras) and between El Salvador and Nicaragua, bilateral exports as a ratio of total exports barely exceed 10 percent. The United States is by far Central America's most important trading partner, although trade with the European Union is somewhat significant. As exports to the United States appear to be under-reported, U.S. imports from Central America are provided as an

9. The authors thank an anonymous referee for noting that horizontal intraindustry trade leaves the field open for asymmetric "taste" shocks to occur, such as shifts away from Fiat cars to BMWs. In this context business cycles would become less similar.

alternative measure. On the basis of this measure, exports to the United States account for more than 60 percent of total exports in Costa Rica, El Salvador, and Guatemala.

Appendix table A-4 provides information on the importance of intraindustry trade in Central America based on the adjusted Grubel–Lloyd intraindustry trade index, AIIT:

$$\text{AIIT} = \frac{\sum_{i}^{n}(X_i + M_i) - \sum_{i}^{n}|X_i - M_i|}{\sum_{i}^{n}(X_i + M_i) - \left|\sum_{i}^{n} X_i - \sum_{i}^{n} M_i\right|}, \tag{3}$$

where X is exports of industry i and M is imports. The AIIT, which adjusts for trade imbalances, can take values between zero (no intraindustry trade) and one (all trade is intraindustry). Intraindustry trade appears to be somewhat important within Central America. But except Costa Rica (0.3), there is virtually no evidence of intraindustry trade with the United States. For El Salvador and Guatemala intraindustry trade appears to be quite high with Brazil and Mexico.

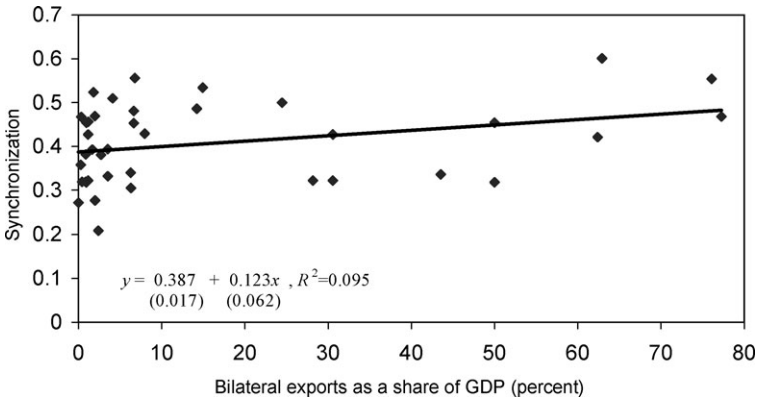
Business Cycle Synchronization and Trade

Empirical evidence on trade integration and business cycle synchronization is somewhat mixed. Frankel and Rose (1998), Choe (2001), Calderon, Chong, and Stein (2002), and Calderon (2003), to name a few, find that a higher trade intensity tends to increase business cycle synchronization. Shin and Wang (2003) find that increasing trade itself does not necessarily lead to more synchronized business cycles, with evidence for East Asia suggesting that only the expansion of intraindustry trade had such an effect. But Garnier (2004) finds only weak or no relations between intraindustry trade and business cycle synchronization for 16 developed countries and concludes that intraindustry trade at most only partially explains business cycle transmission. The low correlations reported by Calderon, Chong, and Stein (2002) suggest a similar interpretation for trade intensity and business cycle synchronization.

A cross-plot of bilateral export to GDP ratios and average coherence at business cycle frequency fails to show a positive relationship between trade intensity and business cycle synchronization (figure 1), a finding in line with other research.[10] The slope of the regression line, however, is quite flat because most countries fall into a relatively narrow range of business cycle synchronization, independent of their level of trade intensity. For example, despite a big difference in trade intensity, France and Mexico have a similar degree of business cycle synchronization with the United States. This seems to support

10. The results are similar if bilateral exports as a share of total exports are used as a measure of trade intensity.

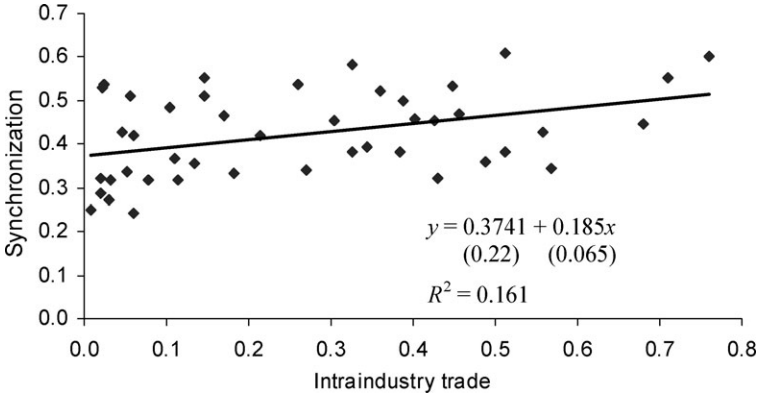
FIGURE 1. Trade Intensity and Business Cycle Synchronization



Note: Regression is based on country pairings based on countries listed in appendix table A-4. Numbers in parentheses are standard errors. *Source*: Author's calculations based on data described in the text.

Kenen's (2000) argument that business cycle symmetry is only partly explained by trade intensity. In other words, for El Salvador to reach Mexico's level of business cycle synchronization with the United States—which is only slightly higher in GDP terms—El Salvador would have to more than double its exports to the United States. Figure 2 shows a similar regression for trade intensity and intensity of intraindustry trade. As explained by Shin and Wang (2003) and Garnier (2004), the link between intraindustry trade and business synchronization is found to be stronger and more significant.

FIGURE 2. Intraindustry Trade Intensity and Business Cycle Synchronization

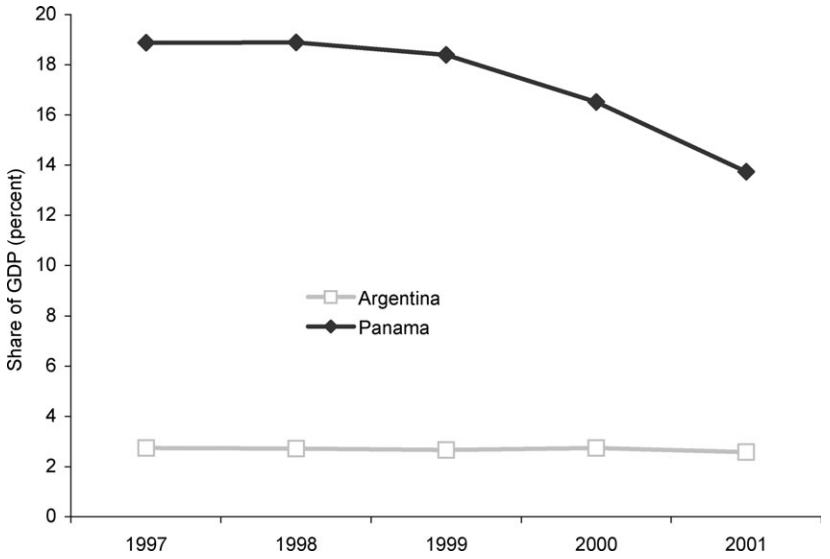


Note: Regression is based on country pairings based on countries listed in appendix table A-4. Numbers in parentheses are standard errors. *Source*: Author's calculations based on data described in the text.

Some studies argue that that macroeconomic coordination, and in particular exchange rate stability, per se can lead to higher trade and as a consequence more synchronized business cycles. Frankel and Rose (1998, 2002) show that larger trade flows are associated with greater business cycle correlation and argue that increased trade flows can be the result of monetary and economic integration. Fontagné and Freudenberg (1999) establish a negative relation between intraindustry trade and exchange rate volatility and draw attention to the fact that monetary integration, by suppressing exchange rate uncertainty, has promoted intraindustry trade in Europe. If trade structure is a good proxy for output structure, business cycles should become more synchronized because cycles will be increasingly affected by the same shocks.

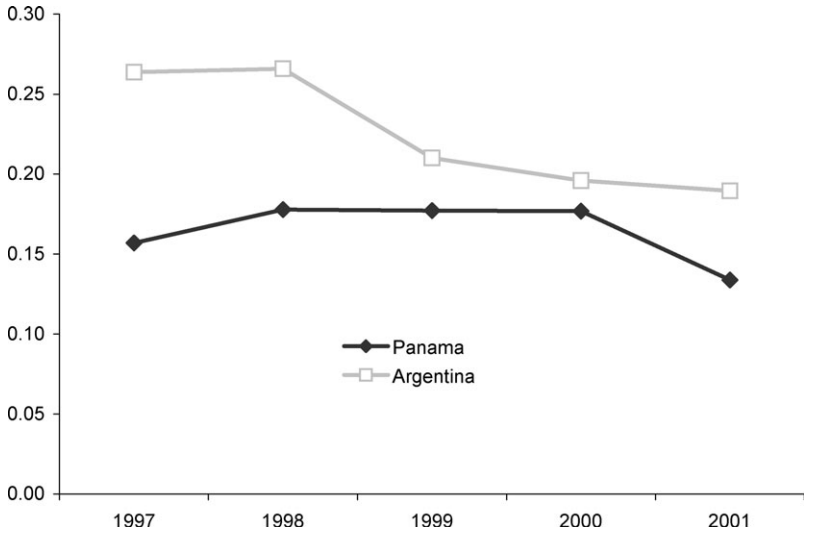
Panama dollarized in 1990 and Argentina adopted a currency board that anchored the currency to the U.S. dollar between 1991 and 2001. Both countries fully eliminated exchange rate volatility with respect to the dollar during these periods. Given this high level of monetary integration, Frankel and Rose (1998) and Fontagné and Freudenberg (1999) predict an increase in bilateral trade and intraindustry trade with the United States for both countries. But trade as a percentage of GDP as well as intraindustry trade with the United States declined, providing little empirical support that exchange rate stability alone promotes trade (figures 3 and 4). This exercise is far from being conclusive. Nevertheless, this finding might not be too surprising, given that Kenen (2000) and Hughes-Hallet and Piscitelli (1999) question a causal link

FIGURE 3. Trade between the United States and Argentina and the United States and Panama, 1997–2001



Source: Bilateral trade data from the U.S. Census Bureau.

FIGURE 4. Grubel–Lloyd Index for Argentina and Panama, 1997–2001



Note: Calculation of the Grubel–Lloyd index uses data at the three-digit level of the Standard International Trade Classification. *Source*: Intraindustry trade data from the Hamburg Institute of International Economics.

between business cycles and trade, when countries are not similar enough. Hughes-Hallet and Piscitelli (1999) demonstrate that a currency union increases business cycle synchronization only after sufficient symmetry exists in institutional structures and market responses across countries. This is likely to be the case for most Latin American countries and the United States (Lederman, Maloney, and Serven 2005).

Business Cycle Synchronization and Remittances

While trade is often perceived as the most important channel of business cycle synchronization, financial integration is increasingly being recognized as another. Worker remittances provide a growing financial link between Central America and the United States, and they are likely to increase even further in the context of CAFTA; in particular, if provisions are made for temporary or permanent migration of labor. This section assesses the impact of worker remittances on business cycle synchronization.

There is little theoretical guidance on how worker remittances are expected to affect business cycle synchronization. Nevertheless, it seems plausible that under certain conditions worker remittances can contribute to synchronization between recipient and sending countries, with the adjustment taking place in the recipient country. For this to be the case, remittances would need to be countercyclical to economic activity in the recipient country, with remittances

TABLE 5. Correlation between Remittances and GDP

Country	Correlation with own GDP	Correlation with U.S. GDP	Remittances as share of GDP in 2004 (percent)
Argentina	−0.270 (0.42)	0.460 (0.15)	0.2
Brazil	−0.376 (0.08)	0.103 (0.65)	0.4
Mexico	−0.650 (0.02)[b]	0.341 (0.11)	2.5
Costa Rica[a]			1.6
El Salvador	−0.147 (0.47)	0.284 (0.17)	16.1
Guatemala	−0.656 (0.01)[b]	−0.178 (0.52)	9.3
Honduras	−0.230 (0.54)	0.210 (0.44)	15.4
Nicaragua	−0.503 (0.12)	0.376 (0.25)	11.4
Panama	−0.412 (0.05)[b]	0.112 (0.62)	0.9

Note: Numbers in parentheses are *p*-values.

[a]Correlations are not reported because too few observations are available.

[b]Significant at the 5 percent level.

Source: Author's calculations based on data described in the text.

increasing during times of crisis, and pro-cyclical with economic activity in the sending country, with a growing economy providing a larger outflow of remittances. This would create forces to pull the business cycle of the receiving country toward the business cycle of the sending country. But if remittances are uncorrelated with the economic activity in the sending country and pro-cyclical with economic activity of the recipient country, business cycles could become more dissimilar.

Simple correlations between changes in remittance flows and GDP growth provide weak evidence that remittances are countercyclical (table 5). Correlations are significant only in Guatemala, Mexico, and Panama. There is also some indication that remittance flows are positively correlated with economic growth in the United States but not at a statistically significant level. The observed correlation patterns suggests that except Guatemala, Mexico, and Panama, worker remittances do not appear to significantly smooth asymmetric shocks. A general lack of significant correlation with economic activity in the United States further suggests that remittances do not contribute in a major way to the synchronization of business cycles between Central America and the United States.

III. SUMMARY AND CONCLUDING REMARKS

This article offers the following findings:

- Business cycle synchronization within Central America is quite low compared with synchronization in NAFTA and the European Union, but not compared with synchronization in Mercosur.

- Business cycle synchronization in Central America is highest between Costa Rica and El Salvador, El Salvador and Guatemala, El Salvador and Nicaragua, and Honduras and Nicaragua.
- Costa Rica and Honduras have a higher degree of business cycle synchronization with the United States than with any other Central American country. However, business cycle synchronization with the United States is still below the levels of business cycle synchronization among NAFTA and Mercosur members.
- Central American countries have become more sensitive to developments in the U.S. economy.
- Unlike trade in NAFTA, the European Union, and Mercosur, trade in Central America is not predominantly intraregional. The United States is by far Central America's most important trading partner.
- Except for Costa Rica, there is virtually no evidence of intraindustry trade between Central America and the United States. The level of intraindustry trade within Central America is comparable to that of Mercosur, but less than in NAFTA (Canada and the United States) and the European Union (France and Germany).
- The degree of business cycle synchronization seems only weakly related to trade intensity and trade structure (intraindustry trade), although the relationship between intraindustry trade and business cycle synchronization is slightly stronger. As such, the gain in business cycle synchronization through trade expansion seems quite low.
- Macroeconomic coordination per se is unlikely to promote business cycle synchronization or trade because institutional structures and market responses in Central America and the United States lack sufficient symmetry.
- Remittances provide a growing financial link between Central America and the United States. But there is little evidence that remittances lessen the impact of asymmetric shocks or contribute in a major way to the synchronization of business cycles between Central America and the United States.

Neither Central America's trade structure nor its degree of business cycle synchronization makes a compelling case for macroeconomic coordination within Central America or between Central America and the United States. Central America's trade structure is predominately interindustry, and the current level of business cycle synchronization with the United States is not that high, despite an increase since the mid-1990s.

Clearly, trade integration is a dynamic process, and as trade intensities and compositions of trade flows change so will business cycle patterns. To fully assess the consequences of closer trade integration for the conduct of

macroeconomic policies, information about the future evolution of trade structures in DR-CAFTA are needed. If trade becomes more intraindustry (vertical or horizontal), business cycles are expected to become more similar, and independence of macro policy will be less of a concern. However, if trade integration takes the form of higher interindustry trade, business cycles are likely to diverge from current levels, and the ability to conduct independent macro policies will grow more important.

While information about the future developments of trade patterns within DR-CAFTA is not available, Mexico's experience in NAFTA might provide some guidance. Trade between Mexico and the United States has grown exponentially since the signing of NAFTA—from $89.5 billion in 1993 to $275.3 billion in 2004. The United States has become not only Mexico's top trading partner but also its main investor. Since 1994 the United States has accounted for 62 percent of all foreign direct investment in Mexico. But the two economies are increasingly linked not only through trade and investment but also through worker remittances. In 2005 worker remittances from the United States accounted for 3 percent of Mexico's GDP. Closer economic integration through NAFTA has had a clear impact on business cycle synchronization. Cañas, Coronado, and Gilmer (2006) find that based on the coincidence indexes for economic activity for both countries the degree of business cycle synchronization since 1993 is about a third higher than in 1980–93.

Since the signing of NAFTA there has also been a consistent upward trend in intraindustry trade between Mexico and the United States. According to Bruehlhart and Thorpe (2001), between 1980 and 1998 the unadjusted Grubel–Lloyd index for manufacturing products between Mexico and the United States grew from 0.36 to 0.61.[11] Mexico's dramatic shift in intraindustry trade with the United States is explained mostly by increased vertical intraindustry trade in textiles and apparel and in auto industries (Burfisher, Robinson, and Thierfelder 2001). The increase in vertical intraindustry trade has been accompanied by higher business cycle synchronization. Cuveas, Messmacher, and Werner (2002) claim that macroeconomic synchronization between Mexico and the United States has increased substantially due to NAFTA.

Despite the higher level of business cycle synchronization between Mexico and the United States, Cuevas, Messmacher, and Werner (2002) and Lederman, Maloney, and Serven (2005) do not advocate adopting common stabilization policies in NAFTA. Most of their arguments transfer directly to DR-CAFTA. Despite increased sensitivity to the U.S. economy, idiosyncratic shocks continue to be important for Mexico, and idiosyncratic volatility remains higher in Mexico than in the United States. Lederman, Maloney,

11. For products at the three-digit level of the Standard International Trade Classification. At the same time, intraindustry trade with Canada remained at a relatively constant low level of 0.17.

and Serven (2005) argue that nominal price and wage flexibility are lacking in Mexico, and NAFTA does not provide unrestricted labor mobility or mechanisms of fiscal redistribution to facilitate Mexico's adjustment to shocks in the absence of independent stabilization policies. A similar case can be made for Central America because idiosyncratic volatility is also higher and DR-CAFTA, like NAFTA, does not come with any built-in shock absorbers.

Further, that the Mexican economy responds more than proportionally to shocks in the United States indicates that Mexico would require a higher dosage for the treatment of the same shock. A common policy response would not be able to effectively counteract output and employment fluctuations in Mexico. The picture is even more complex for Central America, where the same shock would require a larger policy response for Costa Rica and Panama, but a smaller dosage for the remaining countries.

Finally, policy transmission channels are different and require the ability to apply stabilization policies in different quantities. Lederman, Maloney, and Serven (2005) argue that Mexico's lower level of financial development and domestic credit to the private sector implies that interest and credit channels are less developed relative to United States, while exchange rate channels are more important for Mexico because trade accounts for a larger share of GDP. Central America appears an even greater mismatch in this respect; it lags far behind Mexico in terms of financial sector development but leads Mexico in terms of openness.

Appendix

Table A-1. Business Cycle Synchronization, Orthogonal to U.S. Business Cycle

Country	Costa Rica	El Salvador	Guatemala	Honduras	Nicaragua
Costa Rica	1.000				
El Salvador	0.409[a]	1.000			
Guatemala	0.488[a]	0.006	1.000		
Honduras	0.104	0.157	0.421[a]	1.000	
Nicaragua	−0.141	0.115	−0.076	−0.063	1.000
Panama	0.134	0.014	−0.021	0.118	0.065

Note: Displays bilateral correlations of the cyclical components of band-pass filtered annual GDP data orthogonal to the U.S. business cycle.

[a]Significant at the 5 percent level.

Source: Author's calculations based on data described in the text.

TABLE A-2. Central America's Trade Structure: Bilateral Exports as a Share of Total Exports, 1995–2001 (percent)

Country	Costa Rica	El Salvador	Guatemala	Honduras	Nicaragua	Argentina	Mexico	Canada	France
Costa Rica		4.4	3.5	1.1	4.8	0.1	0.2	0.0	0.0
El Salvador	2.3		9.9	3.1	11.1	0.1	0.2	0.0	0.0
Guatemala	3.2	12.4		2.5	2.8	0.1	0.4	0.0	0.0
Honduras	1.7	6.8	2.0		5.3	0.0	0.1	0.0	0.0
Nicaragua	2.9	3.8	3.1	2.2		0.0	0.1	0.0	0.0
Mexico	1.1	0.7	2.3	0.3	2.8	1.2		0.5	0.4
Brazil	0.1	0.0	0.0	0.0	0.0	26.9	0.5	0.4	0.7
United States	21.3	11.1	50.7	61.1	38.0	9.4	87.1	85.3	7.3
Germany	3.6	6.1	3.3	3.8	9.9	2.3	0.9	0.9	15.7
European Union	16.0	10.7	10.4	12.2	23.1	18.5	3.6	4.9	61.6
Free trade zone	39.1	54.5							
U.S. reported imports c.i.f.	62.4	68.1	66.3						

Note: Data are averages for 1995–2001. The table should be read column-wise, where each row represents the share in total column-countries exports. As an example, the top-left figure indicates that exports from Costa Rica to El Salvador represent 2.3 per cent of Costa Rica's total exports.

Source: International Monetary Fund's Direction of Trade Statistics.

TABLE A-3. Central America's Trade Structure: Bilateral Exports as a Share of GDP, 1995–2001 (percent)

Country	Costa Rica	El Salvador	Guatemala	Honduras	Nicaragua	Argentina	Mexico	Canada	France
Costa Rica		0.8	0.7	0.6	1.2	0.01	0.05	0.01	0.01
El Salvador	0.8		1.8	1.5	2.9	0.01	0.05	0.00	0.01
Guatemala	1.1	2.3		1.2	0.7	0.01	0.11	0.01	0.00
Honduras	0.6	1.3	0.4		1.4	0.00	0.03	0.00	0.00
Nicaragua	1.0	0.7	0.6	1.1		0.00	0.01	0.00	0.00
Mexico	0.4	0.1	0.4	0.2	0.7	0.1		0.2	0.1
Brazil	0.0	0.0	0.0	0.0	0.0	2.4	0.1	0.13	0.1
United States	7.1	2.1	9.5	30.1	9.8	0.8	24.1	30.3	1.6
Germany	1.2	1.1	0.6	1.9	2.6	0.2	0.3	0.3	3.3
European Union	5.3	2.0	1.9	6.0	5.9	1.6	1.0	1.7	13.2
Free trade zone	13.0	10.1							
U.S. reported imports c.i.f.	19.4	11.8	11.7						

Note: Data are averages for 1995–2001. Interpretation of this table is as follows. The table should be read column-wise, where each row represents the share of bilateral exports in the column-countries GDP. As an example, the top-left figure indicates that exports from Costa Rica to El Salvador represent 0.8 per cent of Costa Rica's GDP.

Source: International Monetary Fund's Direction of Trade Statistics and International Financial Statistics database.

TABLE A-4. Intraindustry Trade, 2001

Country	Costa Rica	El Salvador	Guatemala	Honduras	Nicaragua	Argentina	Mexico	Canada	France
El Salvador	0.36								
Guatemala	0.38	0.45							
Honduras	0.40	0.27	0.33						
Nicaragua	0.34	0.15	0.21	0.15					
Mexico	0.18	0.43	0.42	0.11	0.02	0.26		0.49	0.57
Brazil	0.30	0.05	0.05	0.06	0.02	0.10	0.46	0.66	0.56
United States	0.08	0.43	0.51	0.03	0.28	0.39	0.51	0.17	0.11
Germany	0.06	0.02			0.01	0.13	0.79	0.33	0.70

Note: A five-digit level of disaggregation is used.

Source: Author's calculations based on trade data from the UN Commodity Trade Statistics (Comtrade) database.

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