EconomicLetter

Ties that Bind: Bilateral Trade's Role in Synchronizing Business Cycles

by Ananth Ramanarayanan

How can small amounts of trade transmit large fluctuations across countries? An intriguing explanation involves intermediate goods.

For most of the past year, economies in all parts of the world have been weakening—from outright recessions in the U.S. and parts of Europe to sharply slower growth in China, India and other emerging economies. The pattern provides the latest example of international business-cycle synchronization—the tendency for countries to experience macroeconomic fluctuations of similar timing and magnitude.

While today's synchronization isn't unusual, it raises questions about the forces that transmit economic fluctuations from one country to another. An important factor to consider is international trade. Over long periods of time, countries with deeper trade ties are more closely synchronized. This occurs even though trade with any particular partner makes up a fairly small part of economic activity in most countries.

How can small amounts of trade transmit large fluctuations across countries? An intriguing explanation involves intermediate goods—raw materials and parts used as inputs to production. By linking different stages of production across countries, they have the potential to magnify trade links' impact on business-cycle synchronization.

This explanation has received more attention recently because production chains are becoming increasingly global due to advances in transportation and communications technologies as well as liberalization of trade policies.
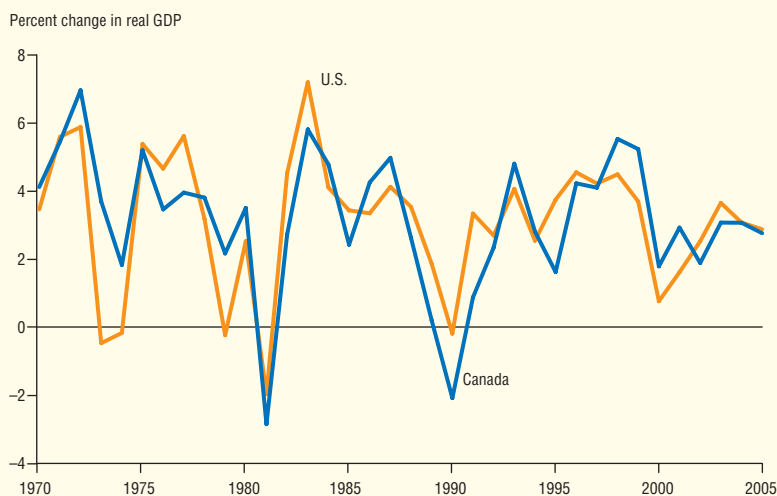
Trade and Synchronization

For the U.S., Canada and Germany, fluctuations in real gross domestic product (GDP) growth have
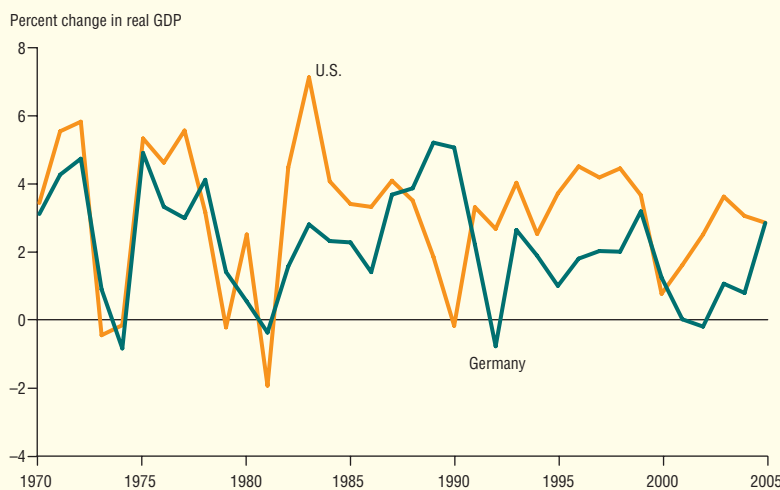
Chart 1
U.S. More in Sync with Canada than Germany

A. U.S. and Canada Highly Correlated...

Percent change in real GDP

B. ...U.S. and Germany Less So

Percent change in real GDP

SOURCE: Organization for Economic Cooperation and Development's annual national accounts database.

been of similar magnitude in recent decades. Moreover, the three economies' business cycles have generally been synchronized—for example, all declined in the early 1980s.

However, it quickly becomes clear that U.S. GDP growth has been more closely aligned with Canada than Germany (*Chart 1*). From 1970 to 2005, the correlation was 0.76 between

the U.S. and Canada but only 0.44 between the U.S. and Germany.

Trade patterns influence changes in other countries' correlations with the U.S. Over the past few decades, U.S. trade flows have slowly shifted toward North America and away from the rest of the world as a result of changes in trade policies, including Mexico's liberalization of the 1980s, the formation of

the European Union in 1992 and the North American Free Trade Agreement in 1994 (*Chart 2*). The U.S. remained highly correlated with Canada and Mexico and gradually became less correlated with Europe and Japan.[1]

The pattern holds across a broader set of countries.

For a sample of 25 industrialized economies, business-cycle correlation tends to rise with bilateral trade intensity, measured by both trading partners' imports as a share of their combined GDP (*Chart 3*).[2]

Chart 2
Trade Patterns Shape Synchronization

A. U.S. Flows Shift Toward North American Partners

Percent, 10-year moving average

Europe and Japan

Canada and Mexico
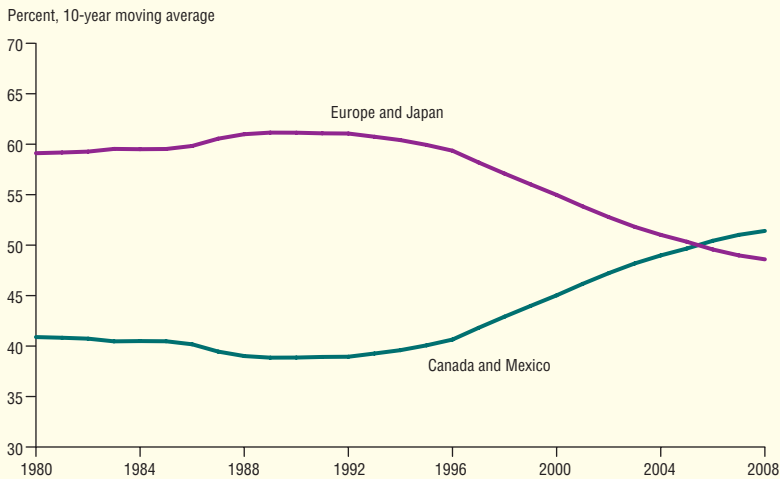
NOTE: The two series are the sum of U.S. imports from each region, plus each region's imports from the U.S., normalized so that the two total 100.

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

B. U.S. Highly Synchronized with North American Partners

Correlation with U.S. real GDP growth, previous 10 years at each date

Canada and Mexico

Europe and Japan
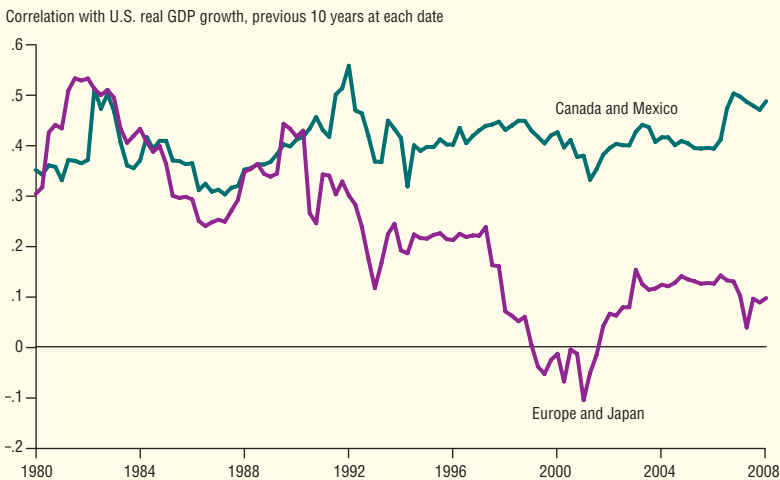
NOTE: The aggregate of Canada and Mexico includes only Canada until 1980.

SOURCES: "Financial Globalization and Real Regionalization," by Jonathan Heathcote and Fabrizio Perri, *Journal of Economic Theory*, vol. 119, no. 1, 2004, pp. 207–43. Mexico is from the Organization for Economic Cooperation and Development's quarterly national accounts database.

Business-cycle correlation tends to rise with bilateral trade intensity, measured by both trading partners' imports as a share of their combined GDP.

These findings seem intuitive: Countries that trade a lot with each other have interconnected economies, and it's natural to expect fluctuations in one country to affect these close trading partners.

In explaining how trade generates synchronization in economic fluctuations, standard theories of international business cycles focus on consumer demand.[3] When one country experiences high growth, its consumers have more money to spend on both domestic and imported goods. The country's close trading partners then see increasing demand for their exports, which creates positive business-cycle correlations by stimulating production and growth.

However, a counteracting effect shouldn't be ignored. If growth prospects are better abroad than at home, households and businesses have an incentive to invest overseas and reduce production at home, expecting to receive inflows of foreign investments during better times. This leads to negative business-cycle correlations.

Which of these two effects dominates depends on a number of factors. They include the degree of financial and trade openness as well as consumers' willingness to substitute between domestic and imported goods.

The Trade Conundrum

Standard theories may identify the transmission channels, but they can't explain one puzzling aspect of trade and synchronization. How can fluctuations between close trading partners be strongly correlated when trade volumes are small?
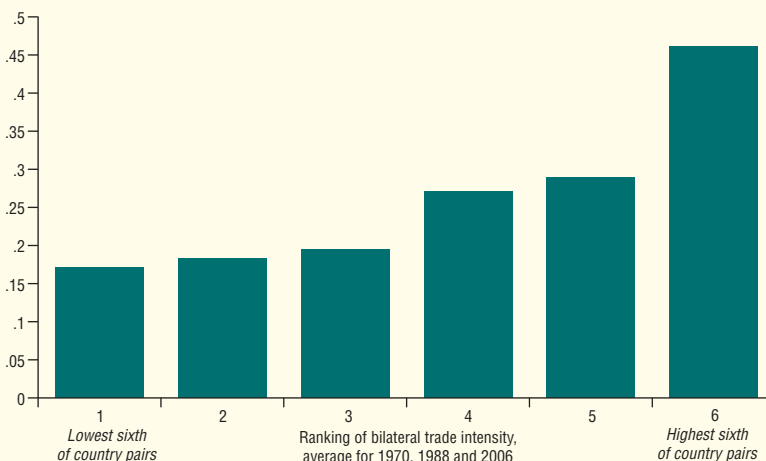
The average bilateral trade intensity of the 25 countries in Chart 3 was 0.5 percent of GDP in 2006. The U.S. and Canada, two of the world's most integrated economies, had bilateral trade of only 3.6 percent of their combined GDP. It's possible that factors besides trade volume determine the degree of synchronization, and the same factors also raise trade intensity.

Similar industries in different countries may face the same shocks, which would create synchronized fluc-

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Chart 3
Synchronization Rises with Trade Intensity

Average correlation of GDP growth within group, 1970–2006

Ranking of bilateral trade intensity, average for 1970, 1988 and 2006

1 — Lowest sixth of country pairs
6 — Highest sixth of country pairs

NOTE: Trade intensity is measured as the sum of each country's imports from the other, divided by the sum of both countries' GDP.

SOURCES: International Monetary Fund's Direction of Trade Statistics; Organization for Economic Cooperation and Development's annual national accounts database.

tuations at the industry level, regardless of the level of trade. For example, world oil prices affect energy-intensive industries in every country. In this scenario, economies that are more alike in industrial structure would appear more correlated at the aggregate level.[4]

Even at the industry level, however, output synchronization tends to rise with trade intensity. For example, U.S. and Canadian industries become more correlated as the amount of trade increases within the industry (*Chart 4*).[5] So there must be something more going on.

That brings us to intermediate goods, a large and growing segment of international trade. Trade in inputs may serve as an amplifying force to allow relatively small import and export volumes to impact production in large parts of an economy.

For many countries, intermediate products make up a significant share of traded goods, providing interconnections that link production across economies (*Table 1*).

Consider the auto industry. It accounts for more than a quarter of trade between the U.S. and Canada. Within the industry, a large part of trade involves goods in intermediate stages of production—parts are manufactured in one country and shipped to another for further processing or final assembly.

Recent work suggests trade in intermediate goods—not just overall trade—is an important determinant of international transmission of business-cycle fluctuations.[6] For the U.S. and Canada, cross-country industry pairs that are closely tied through trade in intermediate inputs display more synchronized fluctuations than industry pairs with less intensive links (*Chart 5*).

In the U.S., for example, production of automobiles and auto parts uses a relatively high amount of imported inputs from Canada's rubber and plastics manufacturers, and the correlation between real value added in U.S. automobiles and Canadian plastics is high at 0.7. At the opposite

Chart 4
Trade Ties Key at Industry Level, Too

Correlation of industry value added in U.S. and Canada, 1971–2003
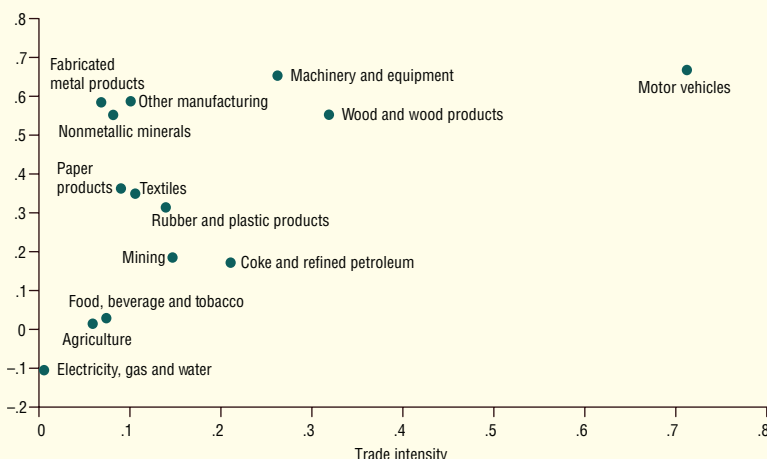
NOTE: Trade intensity is measured as the sum of U.S. imports from Canada and Canadian imports from the U.S. within each industry, divided by the sum of the two countries' value added in the industry.

SOURCE: Organization for Economic Cooperation and Development's industry structural analysis database.

Table 1
Intermediate Goods Vital to Trade

Country	Intermediate goods (percent of imports)	Year
Australia	35	1994–95
Brazil	52	1996
Canada	39	1997
China	62	1997
Czech Republic	49	1995
Denmark	35	1997
Finland	56	1995
France	47	1995
Germany	43	1995
Greece	27	1994
Hungary	57	1998
Italy	51	1992
Japan	50	1995
Korea	63	1995
Netherlands	34	1995
Norway	32	1997
Poland	49	1995
Spain	52	1995
United Kingdom	37	1998
United States	34	1997

NOTE: The figures represent the fraction of imported agriculture, mining and manufacturing used as intermediate inputs by the agriculture, mining and manufacturing sectors.

SOURCE: Organization for Economic Cooperation and Development's benchmark input–output tables.

end of the spectrum, the U.S. rubber and plastics industry imports no inputs from Canada's food industry, and the value-added correlation between U.S. plastics and Canadian food is close to zero.

Such industry-level findings suggest that intermediate inputs may be key to why countries that trade intensely are more correlated at the aggregate level. Foreign growth makes more imported inputs available and lowers their prices, which potentially generates higher home-country production of goods that heavily use those intermediate goods.[7]

Improved efficiency at Canadian plastics manufacturers might allow U.S. auto plants to benefit from lower prices for imported parts. If cheaper inputs generate significant production increases and real value added at U.S. plants, it would provide a channel for trade to transmit fluctuations across borders. Moreover, the channel would be distinct from other transmission mechanisms that might be at work at the same time.
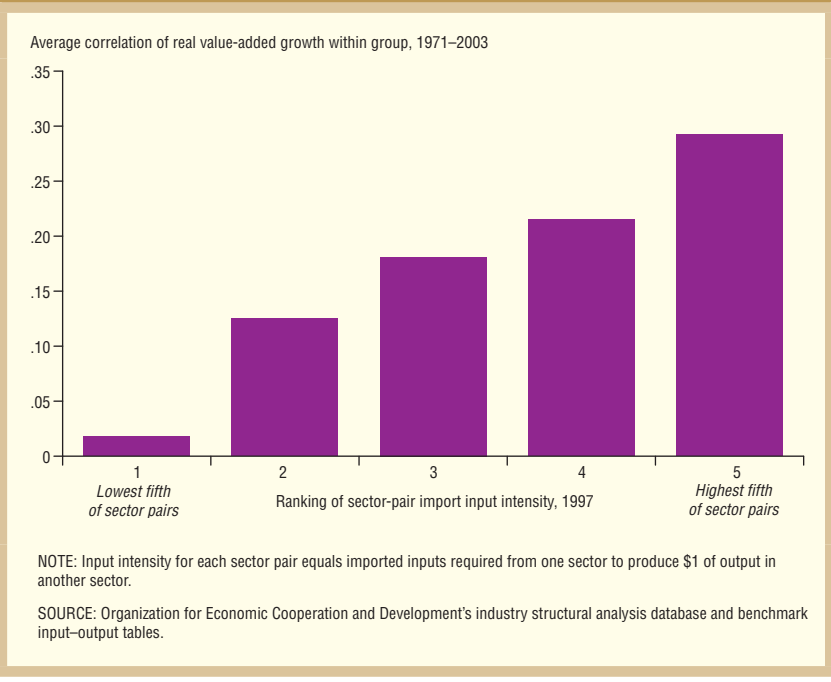
Determining the role of intermediate inputs in trade can be difficult. A significant problem comes in the construction of national income accounts. The data are calculated with base-period prices—those prevailing before any changes in the supply of imports. Foreign inputs are subtracted from real GDP, so cheaper imports don't show a significantly positive effect on measured economic performance. (*See box titled "How Base-Period Pricing Misses Trade's Impact."*)

The reasoning begins with the assumption that producers had been getting the maximum output from their inputs in the base year. If calculated with last year's prices, GDP can't be higher this year, even with lower prices and greater availability of imports. Strong foreign growth reflected in lower import prices doesn't translate into higher domestic growth.

For many years, researchers

Determining the role of intermediate inputs in trade can be difficult. A significant problem comes in the construction of national income accounts. The data are calculated with base-period prices.

Chart 5
U.S.–Canada Industry Correlation Rises with Dependence on Imported Inputs

Average correlation of real value-added growth within group, 1971–2003

| | 1 Lowest fifth of sector pairs | 2 | 3 | 4 | 5 Highest fifth of sector pairs |

Ranking of sector-pair import input intensity, 1997

NOTE: Input intensity for each sector pair equals imported inputs required from one sector to produce $1 of output in another sector.

SOURCE: Organization for Economic Cooperation and Development's industry structural analysis database and benchmark input–output tables.

have known that national accounts methodology doesn't allow changes in the terms of trade—the price of a country's imports relative to the price of its exports—to translate into measurable changes in real GDP.[8] We need a deeper explanation for the links between trade and business-cycle synchronization—especially trade in intermediate inputs.

The explanation could involve a combination of factors. One relatively unexplored channel is the presence of multinational corporations. They account for the bulk of international trade in developed economies as they spread their production chains across many locations.[9]

Multinationals make up a large part of domestic output in many countries. Firm-level shocks or innovations are easily transmitted to countries where large corporations have plants. Country pairs hosting plants of the same firm—and thus likely engaged in a lot of trade in intermediate goods— would experience the same effects. Future research along these lines could reveal whether this feature of the world economy accounts for the links between trade and macroeconomic fluctuations.

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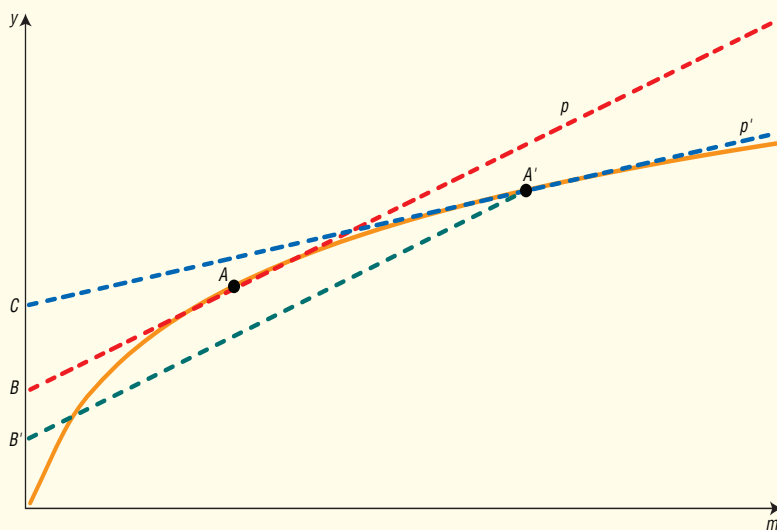
Notes

[1] In this calculation, Europe includes these 15 countries: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden and the U.K.

[2] This point was first illustrated in "The Endogeneity of the Optimum Currency Area Criteria," by Jeffrey A. Frankel and Andrew K. Rose, *Economic Journal,* vol. 108, no. 449, 1998, pp. 1009–25. The sample of countries included in Chart 3 is Australia, Austria, Belgium/ Luxembourg, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Korea, Mexico, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the U.K. and the U.S. Belgium and Luxembourg are treated as one country because, until 1997, their international trade statistics were collected together.

[3] See, for example, "International Real Business Cycles," by David K. Backus, Patrick J. Kehoe and Finn E. Kydland, *Journal of Political Economy,* vol. 100, no. 4, 1992, pp. 745–75.

[4] Two relevant papers are "Trade, Finance, Specialization, and Synchronization," by Jean Imbs, *Review of Economics and Statistics*, vol. 86, no. 3, 2004, pp. 723–34, and "Determinants of Business Cycle Comovement: A Robust Analysis," by Marianne Baxter and Michael A. Kouparitsas, *Journal of Monetary Economics*, vol. 52, no. 1, 2005, pp. 113–57. Imbs argues that industry structure matters for business-cycle synchronization, while Baxter and Kouparitsas, using different methods, show that it does not.

[5] This finding is confirmed for a larger set of countries in "Putting the Parts Together:

How Base-Period Pricing Misses Trade's Impact

A diagram helps explain why GDP figures don't fully account for trade's impact on synchronization.[1]

In the figure below, the orange line represents the amount of output y (measured on the vertical axis) that can be produced with a given amount of imported intermediate inputs m (measured on the horizontal axis), keeping hours worked and other inputs to production fixed. The shape of this curve reflects the idea that more imported intermediate goods generates more output, but at a diminishing rate.

Producers would optimally choose to purchase imported inputs up to the point that an additional increment in output just equals the price paid for inputs. If the price of imports is given by the slope of the red dotted line, labeled p, production takes place at point A. The height of point A is gross output, but to calculate GDP, we compute value added by subtracting the value of inputs purchased from the value of output produced to arrive at point B.

Now, consider a reduction in the price of imports. This is shown as the dotted blue line, labeled p'. Production now takes place at point A', but to calculate real GDP, we subtract inputs at the price of the previous period, p. This leads to point B', while the nominal value of GDP is measured at point C. Although imports have become cheaper, resulting in a higher nominal value of output, real GDP falls from B to B'.

Note
[1] "This figure is a modified reproduction of Figure 1 in "Technology and the Demand for Imports," by Ulrich Kohli, *Southern Economic Journal*, vol. 50, no. 1, 1983, pp. 137–50.

Trade, Vertical Linkages, and Business Cycle Comovement," by Julian di Giovanni and Andrei A. Levchenko, University of Michigan, Research Seminar in International Economics Working Paper no. 580, September 2008.

[6] Recent examples are di Giovanni and Levchenko (2008) and "Vertical Specialization, Intra-industry Trade, and Business Cycle Comovement," by Eric C. Y. Ng, University of Western Ontario, Working Paper, October 2007.

[7] Two recent papers that assess the ability of this mechanism to account for the data are "Trade, Production Sharing, and the International Transmission of Business Cycles," by Ariel Burstein, Christopher Kurz and Linda Tesar, *Journal of Monetary Economics*, vol. 55, no. 4, 2008, pp. 775–95, and "Vertical Specialization and International Business Cycle

Synchronization," by Costas Arkolakis and Ananth Ramanarayanan, Federal Reserve Bank of Dallas, Globalization and Monetary Policy Institute Working Paper no. 21, October 2008.

[8] Papers making this point include "Technology and the Demand for Imports," by Ulrich Kohli, *Southern Economic Journal,* vol. 50 , no. 1, 1983, pp. 137–50, and, more recently, "Are Shocks to the Terms of Trade Shocks to Productivity?" by Timothy J. Kehoe and Kim J. Ruhl, *Review of Economic Dynamics*, vol. 11, no. 4, 2008, pp. 804–19.

[9] For example, data from the Bureau of Economic Analysis show that, in 2005, 70 percent of U.S. exports and 69 percent of U.S. imports involved U.S.-based multinational companies or U.S. affiliates of foreign companies.

A New View of Globalization

Globalization is increasingly changing how nations interact in the economic sphere. In 2007, the Federal Reserve Bank of Dallas created the Globalization and Monetary Policy Institute to explore the deepening economic integration among countries and better define the forces that shape the world economy. The institute is particularly interested in furthering our understanding of how these changes alter the environment in which monetary policy decisions must be made. Read more about the mission of the institute, the influential people behind it and current research at **http://dallasfed.org/institute/index.cfm**.