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Globalization and Monetary Policy Institute



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Letter from the President

five years ago, I made an extended trip to Asia, visiting Japan, Singapore, Hong Kong, China and South Korea. That trip impressed upon me how the fortunes of some of the biggest Asian economies had diverged since I was a member of the team of U.S. officials that met with China's leader, Deng Xiaoping, in 1979 to settle outstanding counterclaims between China and the U.S. and I lived and worked in Japan a decade later.

I arrived in Japan just as the great real estate and stock market bubbles of the 1980s were about to burst. But for most of the 1980s, commentators here and in Europe were obsessed with the prospect of Japanese manufacturing eclipsing manufacturing in the West. Over the

subsequent quarter century, Japan has languished, while China has grown by leaps and bounds.

Over the past year, there have been encouraging signs from Japan that its decades-long struggle with deflation may be coming to an end. Structural reforms—which are essential to boosting the country's long-term growth rate—may prove more challenging. China continues to grow at rates that put it on track to be the world's largest economy before the end of this decade.

As China grows in importance in the global economy, it is essential that the leading policymakers there have a clear understanding of how we at the Federal Reserve operate. Globalization means that policy actions by the major central banks have global repercussions, and it is important that the motivation for the Fed's actions be understood, not just in the U.S. but around the world.

At the time of my trip to Asia, one of the best-sellers in China was a book titled *Currency Wars* (货币战争) by Song Hongbing. This book was widely read by many leading Chinese policymakers and unfortunately propagated many myths about the way the Fed operates.

This past year, one of the economists we hired to develop our research program on the implications of globalization for monetary policy—Jian Wang—undertook on his own time to write a book titled *Demystifying the Fed* (还原真实的美联储). I think this book is a valuable contribution to greater understanding between the U.S. and China, and it has already become a best-seller in China.

This is just one of the highlights from the Dallas Fed's Globalization and Monetary Policy Institute over the past year. This annual report contains a series of essays summarizing the activities of the excellent group of researchers we have working here at the institute, and I recommend you read it carefully to get a sense of the broad range of work going on in this important area of economic study.

A handwritten signature in black ink that reads "Richard W. Fisher". The signature is fluid and cursive, with a large, sweeping initial 'R'.

Richard W. Fisher
President and CEO
Federal Reserve Bank of Dallas

It is important that the motivation for the Fed's actions be understood, not just in the U.S. but around the world.

Cheaper by the Box Load: Containerized Shipping a Boon for World Trade

By Janet Koech



It's hard to believe that a vessel 20 stories tall, a quarter-mile long and made from eight Eiffel Towers' worth of steel can float, much less be the future of cargo transportation between continents.

But the world's newest and largest container-ship, the Maersk Triple E, may become the most common class of cargo carrier on the seas. Copenhagen-based Maersk chose the name to reflect the ship's economies of scale, energy efficiency and environmental improvement. With a capacity of 18,000 standard 20-foot containers, or TEUs, the Triple E can hold the equivalent of 36,000 cars.¹

Ever-larger ships have made transportation costs a smaller part of the prices consumers pay—and helped create a world in which Americans consume goods from around the globe. Ports and canals are expanding to accommodate them. The Triple E, which sails the Suez Canal between Europe and Asia, is so massive it can't yet navigate North American ports or even the expanded Panama Canal.

A vessel the size of the Triple E was unimaginable a half-century ago when the first container-ship, the Ideal X, sailed from Newark, N.J., to Houston with 58 containers. The early container-ships—modified bulk vessels or tankers—could transport 1,000 TEUs or fewer. The increasing use of ships dedicated to container handling led to the construction of larger containerships.² Capacity quickly expanded from about 4,000 TEUs in the 1980s to more than 6,000 in the 1990s and 10,000 in the early 2000s.

Falling transportation costs have contributed to segmentation of production networks—components are now made wherever it is most cost-effective. Marc Levinson, author of *The Box: How the Shipping Container Made the World Smaller and the World Economy Bigger*, notes that “low

transport costs help make it economically sensible for a factory in China to produce Barbie dolls with Japanese hair, Taiwanese plastics and American colorants, and ship them off to eager girls all over the world.”³

By sharply cutting costs and enhancing reliability, container-based shipping has enormously increased the volume of international trade, made complex supply chains possible, facilitated the development of just-in-time logistics and simplified the large-scale transport of consumer goods. The separate evolution of telecommunications systems further increased the efficiency of cargo handling and flows at major ports.

The economic integration of widely separated regions has increased with expanded international trade, financial flows and movement of people. Efficiently distributing freight and transporting people have always been important aspects of maintaining the cohesion of economic systems, from empires to modern nation states and economic blocs. The opposite—poor transportation and communication infrastructure and remoteness—isolates countries from international markets, inhibiting their participation in global production networks. Transport costs are especially pronounced for landlocked countries, which are concerned not only about the quality of their transport networks, but also the ease of movement of goods across boundaries.

Globalization Is Not New

Containerization, along with other technological innovations in maritime, air and land-based systems, has reduced transport costs, improved efficiency and increased trade. This has accelerated the pace of global economic integration in recent decades. However, integration of world economies is not new. Historians single out two episodes



of significant advancement in global economic integration. The first, from 1870 to 1913, was ended by the two world wars and the Great Depression, according to Kevin O'Rourke and Jeffrey G. Williamson in their textbook on globalization and history.⁴ Postwar economic reintegration started in 1950 and continues today. During both episodes, transportation costs fell, reflecting productivity gains from innovations in transport technology.

Estimates of merchandise trade as a share of world output rose from the beginning of the 19th century until 1913, substantially dropped in the years leading to 1950, and recovered and surpassed 1913 levels by 1973 before continuing to still-higher levels (*Table 1*).

Between 1950 and 2012, the volume of exports increased an average of 6 percent annually, paced by rapid industrialization in developing countries beginning in the 1990s. Exports' share of gross domestic product (GDP) surged in the postwar period to 25 percent in 2012 from 14 percent in 1960 (*Chart 1*).

Other factors contributing to increased economic interdependence include falling tariffs and increased demand for goods and services amid rising income levels and living standards. This article focuses on the role of transportation technology, particularly containerization, in facilitating integration.

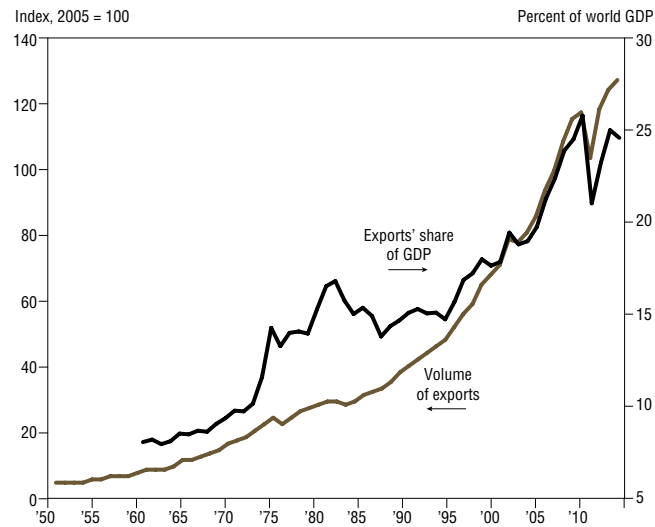
Technological Advances, Falling Transport Costs

Transport innovations enable production specialization and the division of labor, widening

market areas and enhancing trade opportunities. Mechanized transport and industrial production facilitated mass production and global and regional trade. The development of high-capacity, low-cost mechanized transport networks and terminals dates back to the late 18th century.⁵ Before that, the speed and efficiency of transport were very low and the cost of traveling long distances was prohibitively high. Largely subsistence economies created little demand for transport, and trade was minimal. Only the most prized

Chart 1

World Exports Substantially Increase in Most Recent Era of Globalization



SOURCES: International Monetary Fund; World Bank's World Development Indicators database; World Trade Organization.

Table 1

World Merchandise Exports as a Share of Gross Domestic Product

Year	1820	1850	1913	1929	1950	1973	1998	2005	2012
Percent	1	4.6	7.9	9	5.5	11.4	17.6	22.4	24.6

SOURCES: *Monitoring the World Economy, 1820–1992*, by Angus Maddison, Paris: OECD Publishing, 1995, for 1820–1950 data; World Bank and International Monetary Fund for post-1950 data.



merchandise—gold and silver, silk, spices, jewels and medicines—moved between continents. Land transportation was especially slow and costly before the introduction of steam railways and iron steamships, major 19th century innovations that helped create high-volume international trade.

Merchandise exports as a proportion of world output grew from just 1 percent in 1820 to about 8 percent in 1913, enabled by numerous transport innovations, low-cost mass-produced goods in Europe and North America and low-tariff trade. This growth in world trade created economic convergence and initiated interdependence among increasingly specialized economies.

Modes of transportation and technology evolved from small to large, slow to fast, simple to complex and rigid to flexible in accordance with internationally accepted standards. In Great Britain, canals were built in the 1760s to transport via horse-drawn barges the growing volumes of industrial raw materials, goods and foodstuffs. The canals, which replaced inadequate roads that

stifled economic expansion, slashed transport costs and increased speed and reliability. For instance, the Bridgewater Canal in 1764 cut by one-third the average delivery cost per ton of coal transported seven miles to Manchester. The cost savings encouraged investment in a limited network of canals that helped kick-start localized industrialization in Britain's coalfields.⁶

Steam-powered railways created a cheap mode of transport that could move raw materials, goods and passengers and surmount difficult topography. Steam railways, together with steam-powered textile mills, helped Manchester become the world's first industrial city. By 1830, the first commercial rail line was built, linking Manchester to Liverpool, 40 miles away. Soon, rails were laid throughout developed countries, and by 1850, railroad towns were being established as trains provided new access to resources and markets in vast territories.

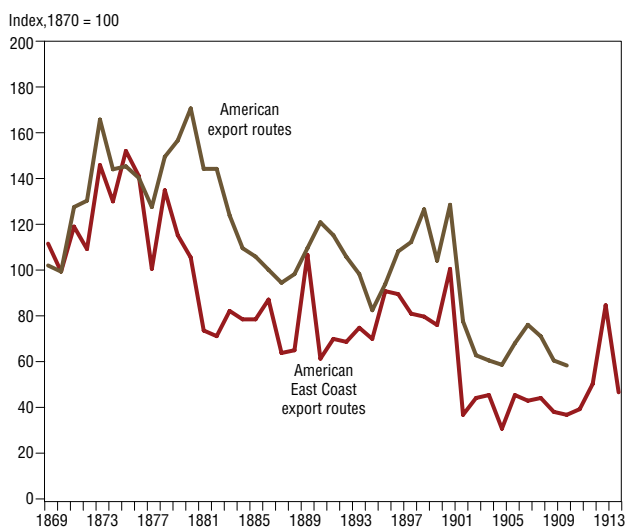
A thousand kilometers of railways operated in England, and more lines were quickly constructed in western Europe and North America. Railroads represented an inland transport system that was flexible in geographic coverage and could carry heavy loads. They were a significant improvement from the stagecoaches widely used in the 18th and early 19th centuries.⁷

Trains on the first railway networks traveled 20 to 30 mph, three times faster than stagecoaches. The journey between New York and Chicago (a 700-mile distance) was reduced to 72 hours in 1850 from three weeks by stagecoach in 1830. The 2,600-mile transcontinental line between New York and San Francisco, completed in 1869, was a remarkable achievement that reduced the cross-country journey to just one week from six months, aiding territorial integration and opening a vast pool of resources and new agricultural regions in the western United States.⁸

Maritime routes linking harbors, especially between Europe and North America, were established at the beginning of the 19th century and mostly serviced by sailing ships until 1850.

Chart 2

Freight Rates Decline in 19th Century



NOTE: The freight rate indexes are aggregate rates on American export routes as reported by Douglass C. North and are deflated by the U.S. Consumer Price Index.

SOURCE: "Late Nineteenth Century Anglo-American Factor-Price Convergence: Were Heckscher and Ohlin Right?" by Kevin O'Rourke and Jeffrey G. Williamson, *Journal of Economic History*, vol. 54, no. 4, 1994, Table 1.

Development of fast and reliable intercontinental shipping passage was aided by the creation of accurate navigational equipment and mapping of sea currents and winds.

By the end of the 19th century, improved steam-power technology revolutionized maritime trade. Shipbuilding advances increased 1914 ship capacity to more than 12 times the 1871 tonnage—from just 3,800 gross registered tons to 47,000 tons.⁹ The sailing ship’s commercial utility faded as trade shifted to the steamship.

Accordingly, ocean freight rates dropped by about 70 percent between 1840 and 1910.¹⁰ Douglass North, an economic historian, documented the revolutionary decline in transport costs in the 19th century. Chart 2 plots North’s aggregate freight-rate index among American export routes, which declined more than 41 percent between 1870 and 1910. His wheat-specific American East Coast freight factor—freight costs as a proportion of the overall value of shipments, including insurance and other charges—fell 53 percent between 1870 and 1913.¹¹ Cotton freight-rate data from three American ports—Charleston, New Orleans and New York—similarly declined from 1840 to 1850 (*Chart 3*).

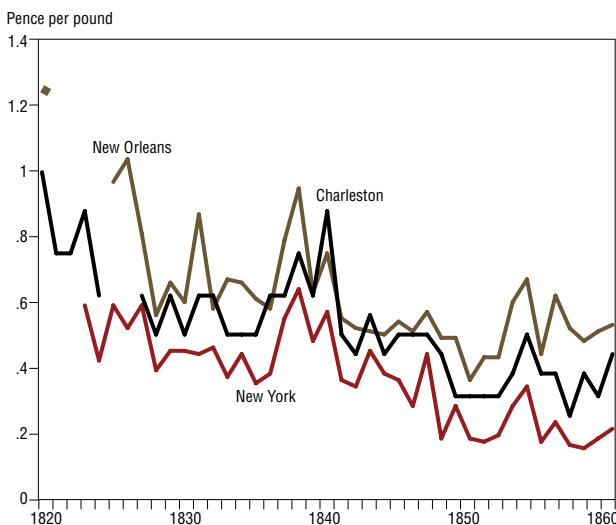
The Suez and Panama canals further shortened travel times and stimulated trade flows between East and West. The Suez, which opened in 1869, linked the Mediterranean Sea with the Red Sea and Indian Ocean. London to Bombay, India—separated by 6,274 nautical miles—was a 47 percent shorter journey via the Suez than around South Africa’s Cape of Good Hope.¹² The Panama Canal, completed in 1914, similarly reduced trip times between the Atlantic and Pacific oceans (*Chart 4*).

Commodity prices illustrate the impact of these advances. Mainly due to transport improvements, commodity prices in Britain and the U.S. tended to converge between 1870 and 1913.

Wheat prices in Liverpool exceeded prices in Chicago by 58 percent in 1870, by 18 percent in 1895 and by 16 percent in 1913.

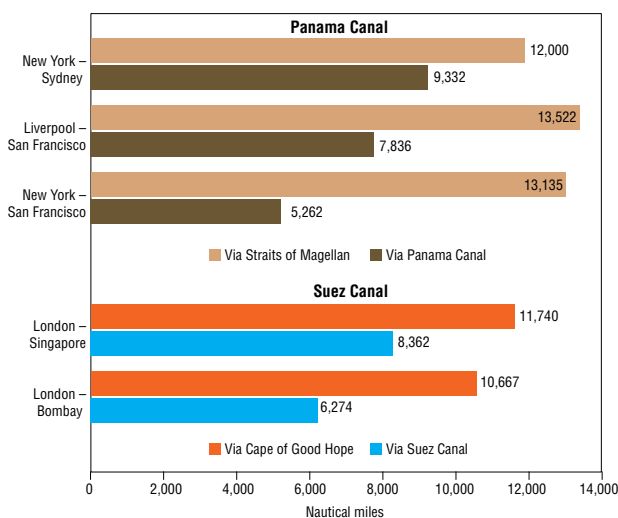
The Boston–Manchester cotton textile price gap fell from 14 percent in 1870 to almost zero

Chart 3
Cotton Freight Rates Steadily Fall in 1800s



NOTE: Cotton freight rate data are missing for New Orleans (1821-1824) and Charleston (1825-1826).
SOURCE: “Ocean Freight Rates and Productivity, 1740-1913: The Primacy of Mechanical Invention Reaffirmed,” by C. Knick Harley, *The Journal of Economic History*, vol. 48, no. 4, 1988, Table 10.

Chart 4
Suez and Panama Canals Shorten Maritime Distance



SOURCE: “Transport Shaping Space: Differential Collapse in Time-Space,” by Richard D. Knowles, *Journal of Transport Geography*, vol. 14, no. 6, 2006, Table 2.

in 1913; the Philadelphia–London iron bar price gap declined from 75 percent to 21 percent, according to historians O'Rourke and Williamson. The authors note that the “impressive increase in commodity market integration in the Atlantic economy [of] the late 19th century” was a consequence of “sharply declining transport costs.”



Similar trends can be documented for price gaps between London and Buenos Aires, Argentina, and between Montevideo, Uruguay, and Rio de Janeiro.¹³

However, even as such technological improvements as motorized shipping continued reducing transport costs through the first half of the 20th century, rising wartime protectionism and the Great Depression largely unraveled economic integration achieved in the 19th century. After World War II, governments around the world undertook the difficult task of rebuilding both physical infrastructure and international trade.

Global integration was slowly reestablished in the second half of the 20th century, and export shares of world output edged higher, into the double digits, as seen in Table 1. Development of propeller aircraft, flying at 300 to 400 mph by the 1950s, greatly reduced journey times, although the benefits were limited to a tiny sliver of the wealthy.

Beginning in the late 1950s, the introduction of jet engines increased aircraft speed by 50

percent, further shortening travel times. Airlines also used larger planes to reduce the cost per seat, accelerating adoption. Today, air transport is an important carrier of high-value, low-bulk cargoes. For a wide array of products, including fresh flowers, electronic components and airplane parts, air cargo is a cost-effective means of international delivery. International aviation moves about 40 percent of world trade by value, although far less in physical terms.¹⁴

International trade has expanded by unprecedented proportions in the past half-century. Even with goods moving by air and electronically, as in the case of high-value cargo such as software, ships still carry more than 90 percent of world trade by volume. Many commodities are transported in bulk, with specialized vessels developed to accommodate this trade. Giant tankers move petroleum products from producers to consumers, and other vessels carry such cargo as cement, coal, iron ore and grain.

Just about everything else that's not considered bulk—flat-screen TVs, clothing, shoes and boxes of cereal—travels across the sea from factory to market aboard fleets of containerships. These vessels have played a critical role in furthering the integration and interdependence of world economies. To be sure, technology has aided the process through expanded use of computers and telecommunications that manage and track the intermodal movement of containers.

Frustration Spurs Innovation

A trucker, Malcolm McLean, grew increasingly irritated by lengthy port waits as dockworkers offloaded bales of cotton from his truck to ships for export. He wondered whether the transfer could be expedited were he to drive his truck onto the ship and drive it off at the destination, without anyone dockside touching his cargo.

Before 1956, ocean transport of general cargo used break-bulk methods of loading cargo—pallets were moved, generally one at a time, from a truck or railcar that carried them from the factory to the

docks. There, each pallet was unloaded and hoisted by dockworkers (or by cargo net and crane for heavier loads). Once a pallet was in the ship's hold, it had to be positioned and braced to protect it from damage during sometimes rough ocean crossings. The process was slow, labor intensive and expensive. Cargo ships typically spent as much time in port loading and unloading as sailing.

McLean's big idea of handling cargo only twice, once at the shipper's location and again at the final destination—never while in transit—came to fruition on April 26, 1956, during the container ship *Ideal X's* five-day trip from New Jersey to Houston. There, cranes hoisted the containers from the ship onto 58 trucks that hauled the big boxes to their final destinations. The voyage marked the beginning of a maritime shipping revolution in the global movement of goods.

Cargo in that era typically took a week's worth of labor to load, and another week to unload, at a cost of about \$5.83 a ton. The *Ideal X's* loading costs were a tiny fraction of that, approximately 15.8 cents a ton.¹⁵ With containerization, the movement of general cargo became less labor intensive and more capital intensive, spelling the end of thousands of cargo handlers' jobs. Worldwide, about 70 percent of dockworkers lost their jobs with the adoption of containerization.¹⁶ Mechanization of ship loading and unloading reduced loss, damage and pilferage and, in the process, lowered insurance costs and greatly reduced ships' time in port.¹⁷

Containerization facilitated the integration of separate transport systems to allow the seamless shifting of cargoes between transport modes. The emergence of intermodal transportation was also hastened by improved technology and techniques for transferring freight. Today, containers filled with goods quickly move between warehouse, ship, train and truck.

What Was Revolutionary?

Container shipping has a dynamic history of little more than a half-century, an era that began with the *Ideal X's* voyage. In the early years,

vessel capacity remained limited in scale and in geographic deployment, and the ships used to carry containers were converted World War II tankers. McLean's initial design for a container was a box—8 feet tall, 8 feet wide and 10 feet long—constructed from 2.5 millimeter-thick corrugated steel. At the outset of the development of the container system in the late 1950s and early '60s, there was no standard for container size and construction.

Like many technological innovations, the container faced an initial period of experimentation. Shippers were unwilling to immediately adopt it, preferring to wait until they were sure containerization would prevail and an industry standard for containers and handling was established. In the mid-1960s, the adoption of standard container sizes—the now-universal 20 and 40 TEUs—hastened global acceptance.

The container itself was not new; railroad box cars were transported on ships as early as 1929 between New York and Cuba.¹⁸ What was revolution-

ary was the seamless transfer of cargo from one mode of transport to the next, including integrated inland transport with trucks, barges and trains—with the boxes never opened while in transit.

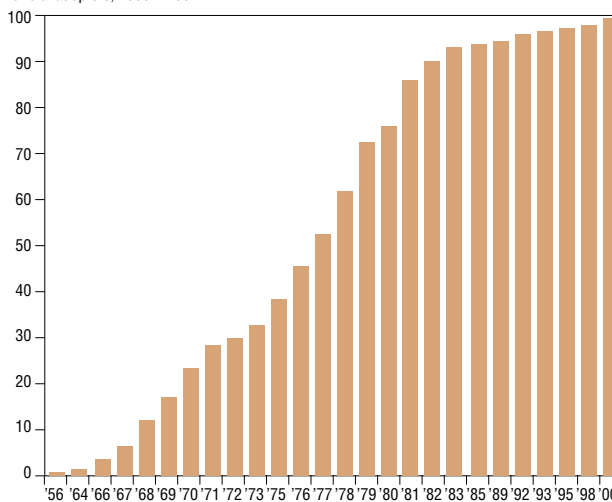
Standardization Increases Adoption

Following widespread adoption of containerization in the 1970s (*Chart 5*), construction began on the first cellular container ships, on which shipments were stacked in "cells."¹⁹ Economies of scale have driven construction of ever-larger container ships since 1980. The greater the number of containers carried, the lower the cost per unit of good being shipped.

Transport efficiencies captured the economic impact of containerization. Quicker handling and less time in storage meant faster transit from manufacturer to customer, reducing financing costs for inventories sitting unproductively on railway sidings or in dockside warehouses awaiting a ship. Containerization, combined with

Chart 5
Adoption of Containerization Increases Following Container Standardization

Percent of countries adopting relative to total adopters, 2000 = 100



NOTES: Containerization adoption is defined as the year when the first container port was constructed. The chart plots the cumulative share of countries engaged in international maritime trade that adopted containerization by a given date, relative to the total adopters at the beginning of the 21st century. Some years are not shown either because no container ports were constructed in those years or container adoption data were not available. SOURCE: Containerisation International Yearbooks, several editions.



telecommunications advances, made just-in-time manufacturing practices possible—producing goods as customers need them and shipping with the expectation that they will arrive at a specified time.

These efficiencies also became an essential driver in reshaping supply-chain practices and allowing multinational global sourcing strategies. As freight costs plummeted, manufacturers shifted production to the most cost-effective locations. Segmentation of production would have been unattainable without containerization and development of the intermodal transport network.

Closing Distances, Spurring Trade

The distance between countries has a negative impact on the volume of trade, according to the so-called gravity model of international trade (which is based on Newton's universal law of gravitation). This model explains trade flows between two countries as being directly proportional to the product of each country's "economic mass," as measured by GDP, and inversely proportional to the distance between the countries.²⁰

Ambitious public works projects in the late 19th and early 20th centuries significantly shortened the effective maritime distances between regions of the world. The Suez and Panama canals stimulated bilateral trade flows between East and West. The Suez Canal not only provided remarkable cost savings on distance, making the far reaches of Asia and Australia accessible, but it also provided impetus to the building of large, fast and economical steamships that eventually led to the decisive switch from sail power over the 1870 to 1880 period.²¹

Ship size grew dramatically, with the largest going from 3,800 gross registered tons in 1871 to 47,000 tons in 1914. With the advent of containerization, vessels have significantly increased to Triple E capacity of 18,000 TEUs—three times the size of ships in the 1990s. Port infrastructure has expanded to meet the needs of the increased vessel size.

A hundred years after the Panama Ca-

nal's completion, its latest expansion is nearly complete, with improvements made to allow the passage of larger ships—oil supertankers, military ships and larger containerships. The canal significantly shortens the trip between the U.S. East and West coasts.

Following the canal's expansion, ships double the size of current Panamax vessels—the largest that can ply the original canal—will be accommodated, dramatically increasing the volume of goods that can be carried.²² U.S. manufacturers may realize new opportunities to expand exports at considerably lower cost to new markets, such as between the U.S. West Coast and South America's eastern coast, particularly Brazil, an important emerging-market economy.

Inland Nations Less Able to Benefit

The trade benefits of broader market access from distance reduction contrast with the increased costs that landlocked countries incur to access world markets because of separation from maritime transport networks. These countries' transport costs average 50 percent more than those with readily available world market access, and they engage in about 60 percent less trade than their coastal counterparts.²³ Landlocked nations also must depend on neighbors' infrastructure while maintaining sound cross-border political relations and administrative practices.

The container has substantially contributed to the integration of various transport systems that link maritime and inland transport networks as goods move from producers to consumers. Containerization offers ship, rail and road networks greater ease of movement and standardization of loads, improving efficiency and reducing transportation costs. Conversely, poor infrastructure and connection of the various transport modes increases costs, which inhibits access to international markets and curtails global competitiveness.

The quality of infrastructure is even more important for countries that lack direct access to the sea. Their overall transport costs are affected

by the quality of other countries' infrastructure in addition to the distance to get goods to consumers. Transportation infrastructure improvements and the ease of transit between countries are significant factors facilitating trade and economic integration. Additionally, increased intraregional trade and collaboration can bolster economies of scale from the export of large quantities of products, improving cost competitiveness.

An Era of Greater Integration

Societies and economies around the world have generally become more integrated due to increases in the speed of trade, factor movements and communication of information. More recently, the pace of economic globalization has been particularly rapid and stands in contrast to the earlier period of integration halted by two world wars and the Great Depression in the 20th century.

Over the past 200 years, technology has transformed the scale of transport systems from small to large and improved transport speed from slow to fast, slashing costs and increasing trade flows and global interdependence.

Containerization, a technological improvement in shipping, has revolutionized the ocean transport of general cargo and simultaneously facilitated intermodal transportation, in which ocean, inland waterway, highway, railway and air transport form continuous interrelated networks, increasing efficiency and reliability. Production processes as a result have become more segmented—instead of producing goods in a single process at a single location, firms are increasingly breaking manufacturing processes into discrete steps and performing each at whatever location minimizes costs.

Notes

¹ TEU stands for 20-foot equivalent unit, which is used to measure a ship's cargo-carrying capacity. One TEU represents the cargo capacity of a standard intermodal container, 20 feet long and 8 feet wide. There is a lack of standardization with regard to height, which ranges between 4 feet and 9 feet.

² All containerizations are composed of cells that hold containers in stacks of different heights depending on ship capacity. Cellular containerizations also offer the advantage of using an entire ship, including below deck, to stack containers.

³ See *The Box: How the Shipping Container Made the World Smaller and the World Economy Bigger*, by Marc Levinson, Princeton, N.J.: Princeton University Press, 2006.

⁴ See *Globalization and History: The Evolution of a Nineteenth-Century Atlantic Economy*, Cambridge, Mass.: MIT Press, 1999, for details on the two globalization episodes.

⁵ See "Transport Shaping Space: Differential Collapse in Time-Space," by Richard D. Knowles, *Journal of Transport Geography*, vol. 14, no. 6, 2006, pp. 407–25.

⁶ See *An Economic History of Transport*, by Christopher I. Savage, London: Hutchinson University Library, 1966.

⁷ A stagecoach is a type of covered wagon, drawn by horses, for transporting passengers and goods. Stagecoaches were widely used before the introduction of railway transport.

⁸ See *The Geography of Transport Systems*, by Jean-Paul Rodrigue, Claude Comtois and Brian Slack, London and New York: Routledge, 2013.

⁹ See note 5.

¹⁰ See note 8.

¹¹ See "Late Nineteenth-Century Anglo-American Factor-Price Convergence: Were Heckscher and Ohlin Right?" by Kevin O'Rourke and Jeffrey G. Williamson, *Journal of Economic History*, vol. 54, no. 4, 1994, pp. 892–916.

¹² See note 5.

¹³ See "Real Wages, Inequality and Globalization in Latin America Before 1940," by Jeffrey G. Williamson, *Revista de Historia Económica*, vol. 17, no. S1, 1999, pp. 101–42.

¹⁴ See "International Air Transport: The Impact of Globalisation on Activity Levels," by Ken Button and Eric Pels, in *Globalisation, Transport and the Environment*, Paris: Organization for Economic Cooperation and Development (OECD) Publishing, 2010, pp. 81–120.

¹⁵ See note 3.

¹⁶ See *The Blackwell Companion to Maritime Economics*, by Wayne K. Talley, Oxford, U.K.: Wiley-Blackwell, 2012.

¹⁷ See note 16, chapter 1, for a description of the nature of work and activity of a container port.

¹⁸ See "Growing World Trade: Causes and Consequences," by Paul Krugman, *Brookings Papers on Economic Activity*, vol. 26, no. 1, 1995, pp. 327–77.

¹⁹ "Adoption of containerization period" refers to the year a country's first container port was constructed.

²⁰ See "The Gravity Equation in International Trade: Some Microeconomic Foundations and Empirical Evidence," by Jeffrey H. Bergstrand, *The Review of Economics and Statistics*, vol. 67, no. 3, 1985, pp. 474–81.

²¹ See "The Suez Canal and World Shipping, 1869–1914," by Max E. Fletcher, *The Journal of Economic History*, vol. 18, no. 4, 1958, pp. 556–73.

²² A class of ships known as Panamax was built to the maximum capacity of the Panama Canal and its locks.

²³ See "Infrastructure, Geographical Disadvantage, Transport Costs, and Trade," by Nuno Limao and Anthony J. Venables, *World Bank Economic Review*, vol. 15, no. 3, 2001, pp. 451–79.

Suggested Reading

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Measuring the External Value of the Dollar

By Mark Wynne



and Adrienne Mack



how much is a dollar worth? The value of a dollar is most generally defined in terms of its purchasing power over the goods and services that households and individuals consume on a regular basis. As goods and services become more expensive, the purchasing power—or value—of the dollar falls. Over long periods of time, the tendency has been for most goods and services to become more expensive in dollar terms. The result is that the purchasing power of a dollar in 2014 is a lot less than the purchasing power of a dollar in 1914.

One way to keep track of changes in the purchasing power of the dollar is by monitoring measures such as the Consumer Price Index or the deflator for Personal Consumption Expenditures. These measures attempt to summarize in a single statistic the changes in all of the prices confronted by consumers in the United States. To a first approximation, we might think of these indexes as tracking changes in the internal purchasing power of the dollar.¹

But we might also be interested in the external purchasing power of the dollar—the ability of a dollar to purchase a bundle of goods and services in another country. Since most countries use their own currencies rather than the dollar, an important determinant of the external purchasing power of the dollar will be the exchange rate of the dollar against other currencies. If the dollar depreciates against other currencies, goods and services produced overseas will become more expensive for American consumers. If the dollar appreciates against other currencies, goods and services produced overseas will become cheaper for American consumers.

How do we track the value of the dollar against other currencies over time? Each week the Federal Reserve's H.10 statistical release reports the daily noon New York City buying rates for some 23 currencies against the dollar. The *Wall Street Journal* reports the bilateral value of the dollar against 53 currencies every day. In combin-

ing these different exchange rates in a single measure that captures the movement in the value of the dollar against other currencies, we contrast the traditional approach to a new method that recognizes the extraordinary growth of financial globalization over the past two decades.

Dollar's Value Based on Trade Flows

There are approximately 200 states in the world, and almost all of them issue currency. Some currencies (such as the dollar and the euro) are used by more than one state, and some states (typically those that have experienced episodes of high inflation) use more than one currency. So there is a dollar exchange rate against a large number of currencies.

One option for combining the various bilateral exchange rates of the dollar is to construct a simple average value of the dollar's movements. For example, if the dollar appreciated by some amount against half the currencies (that is, it took fewer dollars to purchase them) and depreciated by the same amount against the other half, we might say that on average the value of the dollar was unchanged. However, some exchange rate movements are more important than others. For example, a 10 percent appreciation of the dollar against the Zambian kwacha might be regarded as less significant in terms of its implications for the U.S. economy than a 10 percent appreciation of the dollar against the euro. Zambia's economy is a lot smaller than that of the euro area, and U.S. trade and investment relations with Zambia are on a much smaller scale than those with the euro area.

Movements in the value of the dollar against other currencies are relevant because these shifts have implications for international trade flows and—through their impact on trade—domestic economic activity and employment. A decline in the dollar's value will in some circumstances make U.S. imports more expensive and U.S. exports less expensive. So, one approach to constructing a single measure of the dollar's value against differ-

ent currencies is to weight the currencies by the importance in U.S. international trade.

Since the 1970s, the Federal Reserve System Board of Governors has published a broad measure of the value of the dollar against a large number of currencies.² The weight each currency gets in the index (or rather, indexes, because there is more than one) is based on its importance in U.S. international trade. Importantly, the weights are allowed to change over time to capture changing trade patterns. The weights assigned to the currencies of different countries have evolved since the index was created in the 1970s (*Chart 1*). When the index first appeared, U.S. international trade was dominated by the countries that subsequently became the euro area, along with Canada and Japan. Since then, trade with emerging markets, such as Mexico and especially China, has grown in importance. As of today, the Chinese renminbi has the largest weight in the index, surpassing the euro in 2008.

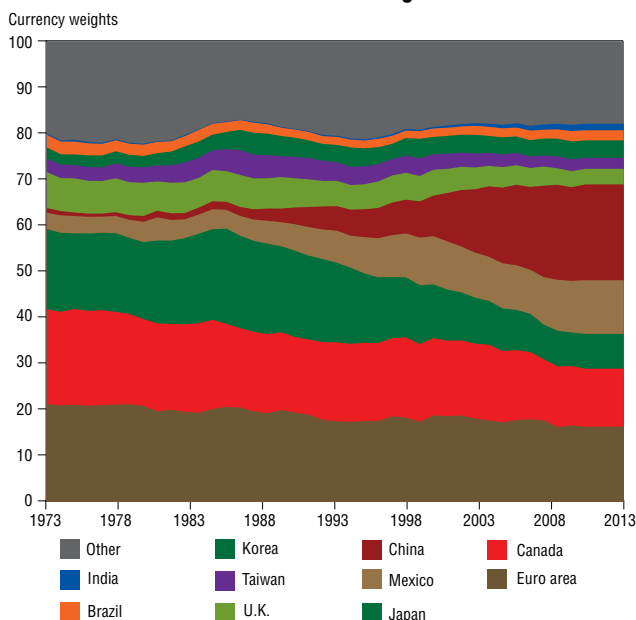
The Board of Governors reports both a nominal and a real trade-weighted measure of the dollar's value. The nominal trade-weighted value of the dollar is simply the trade-weighted average of the various bilateral exchange rates. The real trade-weighted value includes an adjustment for changes in the overall level of prices in each country as well and is arguably the more appropriate measure for assessing the importance of exchange rate movements for international trade. (Simply put, a decline in the value of the dollar that is accompanied by an equal-sized increase in U.S. prices might not give U.S. exporters much of an edge in overseas markets.)

Chart 2 plots the evolution of the trade-weighted value of the dollar since 1973, along with sub-indexes for major currencies and other important trading partners. This offers some perspective on recent concerns that extraordinary policy actions by the Fed have debased the currency.

There was a significant appreciation of the dollar in 2008, driven by safe-haven capital flows to the U.S. at the height of the financial crisis. These

Chart 1

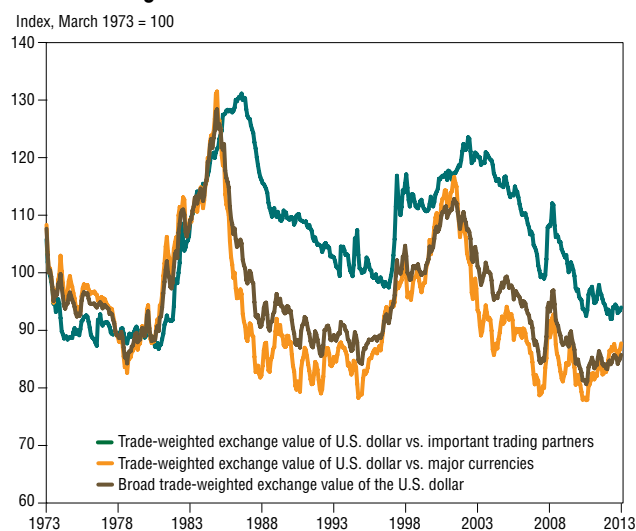
U.S. Trade Patterns Reflected in Trade-Weighted Value of the Dollar



SOURCE: Federal Reserve Board.

Chart 2

Real Trade-Weighted Value of the U.S. Dollar Since 1973



SOURCE: Federal Reserve Board.

Movements in the value of the dollar matter for more than international trade flows. The liberalization of capital accounts over the past three decades has produced a massive increase in international financial flows.

flows have now been largely reversed, and the real trade-weighted value of the dollar as of December 2013 was 84.91, compared with 86.69 in August 2008, immediately prior to the worst phase of the financial crisis and the launch of unconventional monetary policy. That is, between August 2008 and December 2013, the broadest measure of the value of the dollar declined about 2 percent.

These movements in the value of the dollar are dwarfed by what happened in the 1980s, when the dollar appreciated 31 percent between June 1980 and March 1985 before declining 42 percent between March 1985 and April 1988.³ During the 1990s, the dollar appreciated 7 percent, peaking at 112.82 in February 2002 and declining 34 percent between February 2002 and April 2008.

An Alternative Approach

But movements in the value of the dollar matter for more than international trade flows. The liberalization of capital accounts—investments—over the past three decades has produced a massive increase in international financial flows. The U.S. simultaneously borrows a lot from the rest of the world and invests a lot overseas. Changes in the value of the dollar against a foreign currency then create valuation effects depending on how important that currency is in U.S. international borrowing and lending. And the importance of a currency in international financial transactions may not be the same as its importance in international trade.

U.S.-owned assets overseas were valued at \$20.8 trillion at year-end 2012, while foreigners owned assets in the U.S. totaling \$25.2 trillion. The U.S. is a net debtor to the rest of the world by just less than \$5 trillion, and it has been a net debtor since 1986. Movements in the dollar's value against the currencies in which these assets and liabilities are denominated generate capital gains and losses that in turn affect the purchasing power of U.S. consumers.

Suppose, for example, that all U.S. international liabilities were denominated in dollars,

while all of our international assets were denominated in foreign currencies. An unanticipated appreciation of the dollar would generate a capital loss for the U.S.: We would still owe the same amount in dollars to our overseas creditors, but our foreign assets would now be worth less in dollar terms. Likewise, an unanticipated depreciation of the dollar would generate a capital gain. If the situation were reversed—that is, our liabilities were all denominated in foreign currencies, while our foreign assets were somehow denominated in dollars—an unanticipated appreciation of the dollar would generate a capital gain for the U.S.

It turns out that, in practice, almost all U.S. foreign liabilities are denominated in dollars, while about 70 percent of our foreign assets are denominated in foreign currencies.⁴ The currency composition of U.S. international assets and liabilities differs in important ways. Moreover, international financial relationships tend to be more complex than international trade relationships. For example, it seems reasonable to assume that U.S. foreign direct investment in the euro area will fluctuate in value with fluctuations in the dollar–euro exchange rate. More concretely, it seems reasonable to assume that fluctuations in the value of foreign direct investment positions in specific countries will be tied to fluctuations in the values of those countries' currencies against the U.S. dollar.⁵

However, the denomination of foreign debt held by U.S. investors may not be the same as the currency of the issuing country. For example, firms in the euro area may issue debt denominated in euros, dollars or pounds sterling. So the value of a bond issued by a French company but denominated in pounds sterling will be determined more by movements in the dollar–pound exchange rate than by movements in the dollar–euro exchange rate.

Chart 3 plots the currency composition of U.S. foreign assets over time. For purposes of constructing this chart, the countries depicted

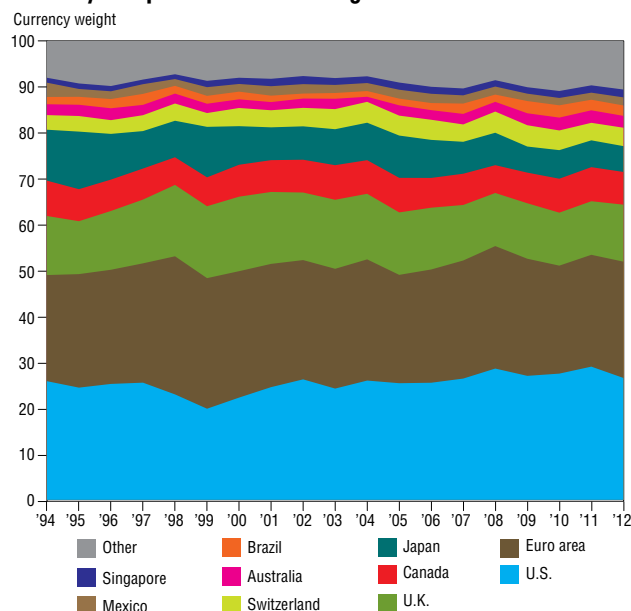
are limited to those also included in the trade-weighted value of the dollar index produced by the staff of the Fed Board. Note that about one-quarter of U.S. assets are denominated in U.S. dollars and, thus, unaffected by changes in the dollar's exchange rate. Second, note the prominent and relatively stable shares of the euro area, the U.K., Canada and Japan (or rather, the euro, the pound sterling, the Canadian dollar and the yen). The Chinese renminbi barely registers ("other"), in marked contrast to its importance in the U.S. trade relationship seen in Chart 1.

We can construct a similar chart showing the evolution of the currency composition of U.S. foreign liabilities over time (*Chart 4*). The bulk of U.S. foreign liabilities are denominated in U.S. dollars, with the euro the only other currency registering a significant share. Thus, fluctuations in the external value of the dollar have a minimal impact on the ability of the U.S. to service its external debt, in marked contrast to countries whose external liabilities are denominated in a foreign currency.⁶

Recently, researchers have proposed constructing financial exchange rates to complement the well-known trade-weighted measures shown in Chart 2.⁷ The idea behind these indexes is to weight currencies by their importance to the U.S. international investment position. To capture how exchange rates affect the net financial position, two separately weighted indexes are constructed: one weighted by the currency composition of international assets, the other by international liabilities. These two indexes are then used to create a third, net asset index that captures the currency composition of the U.S. net financial position.

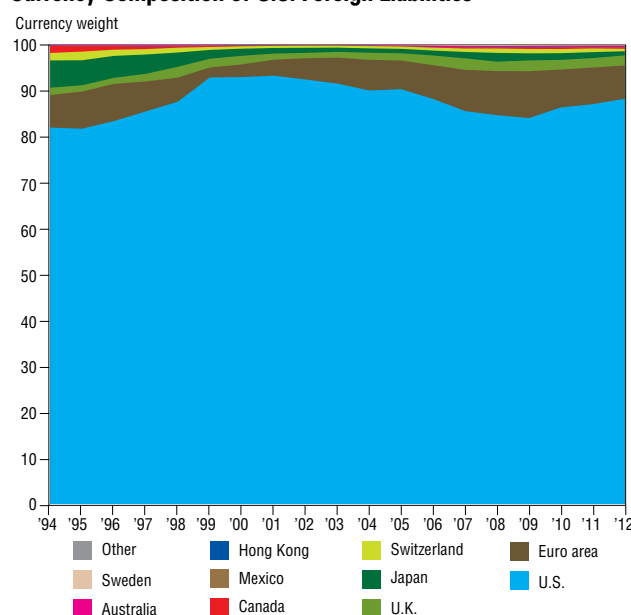
Chart 5 plots five different measures of the foreign exchange value of the U.S. dollar based on different weighting schemes.⁸ The four financial exchange rate indexes are based on asset weighting of currencies, liability weighting, total investment position (assets plus liabilities) and net liabilities (liabilities minus assets). For the sake of

Chart 3

Currency Composition of U.S. Foreign Assets

SOURCES: "Monthly Estimates of U.S. Cross-Border Securities Positions," by Carol C. Bertaut and Ralph W. Tryon, International Finance Discussion Paper no. 2007-910, Federal Reserve Board, 2007; Bureau of Economic Analysis; U.S. Treasury; Bank for International Settlements; authors' calculations.

Chart 4

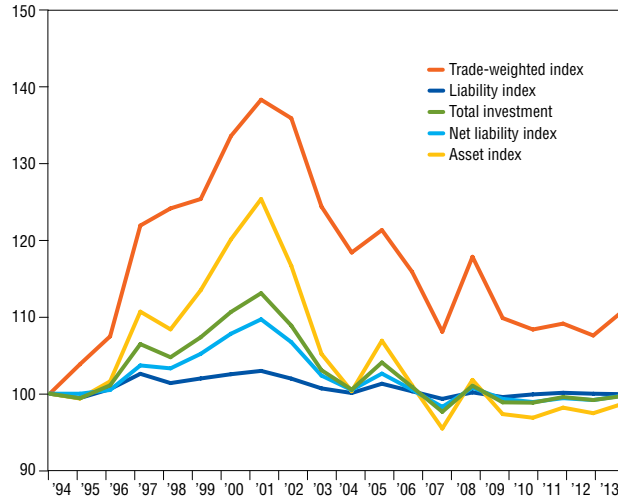
Currency Composition of U.S. Foreign Liabilities

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Chart 5

Five Measures of the International Value of the Dollar

Index, 1994 = 100



SOURCES: "Monthly Estimates of U.S. Cross-Border Securities Positions," by Carol C. Bertaut and Ralph W. Tryon, International Finance Discussion Paper no. 2007-910, Federal Reserve Board, 2007; Bureau of Economic Analysis; U.S. Treasury; Bank for International Settlements; authors' calculations.

On a financially weighted basis—whether by assets, liabilities, total investment position or net liabilities—the value of the dollar in 2013 was about the same as it was in 1994.

comparison, we also include the trade-weighted value of the dollar, recomputed to conform to the exchange rate convention used to calculate the financial indexes and rebased to equal 100 in 1994.

The chart shows that the largest movements in the external value of the dollar arise when different currencies are weighted based on their importance in U.S. international trade. The dollar cost of a unit of foreign currency declined more than 27 percent between 1994 and 2001 on a trade-weighted basis but only 21 percent on an asset-weighted basis. On a financial liability basis, the decline in cost was less than 3 percent over the same period because the bulk of U.S. international liabilities are denominated in dollars.

A second important point to note is that on a financially weighted basis—whether by assets, liabilities, total investment position or net liabilities—the value of the dollar in 2013 was about the same as it was in 1994. However on a trade-weighted basis, relative to 1994, the dollar

cost of foreign currency in 2013 was about 10 percent lower.

Properly Valuing the Dollar

There is no unique "right" way to combine different exchange rates into a single measure of the dollar's external value; it all depends on the question you want that measure to address. The value of the Chinese renminbi against the U.S. dollar has important implications for international trade given the importance of China as a trading nation. However, movements in the value of the renminbi against the U.S. dollar have limited implications for capital gains and losses on U.S. international investments. China holds a large amount of U.S. debt, but all of it is denominated in U.S. dollars. A change in the value of the dollar against the renminbi has no implications for the U.S. in terms of its international liabilities; it simply determines whether China experiences capital gains or losses on its U.S. debt holdings.⁹

Recent movements in the value of the dollar

(over the past five years) are remarkably small in comparison with some historical episodes, as seen in Chart 2. Switching the focus from international trade to international investments offers a different interpretation of exchange rate movements. If different currencies are weighted by their importance in U.S. assets and liabilities rather than their importance to U.S. international trade, the dollar is worth about as much in 2013 as it was in 1994. Financial globalization necessitates that new measures be added to the toolkit for tracking international developments.

More information about the methodology used in this article can be found online at www.dallasfed.org/institute/annual/index.cfm.

Notes

¹ We say to a first approximation because the basket of goods and services consumed by the typical U.S. household will usually include some imported products as a result of globalization, and the prices of these goods will be determined in part by changes in the value of the dollar against other currencies, or the external value of the dollar.

² The methodology behind the Board's indexes is described in "Indexes of the Foreign Exchange Value of the Dollar," by Mico Loretan, *Federal Reserve Bulletin*, Winter 2005, pp. 1–8.

³ The dramatic appreciation of the dollar in the first half of the 1980s took place against the background of Volcker disinflation.

⁴ Data found in "From World Banker to World Venture Capitalist: U.S. External Adjustment and the Exorbitant Privilege," by Pierre-Olivier Gourinchas and Hélène Rey, in *G7 Current Account Imbalances: Sustainability and Adjustment*, Richard H. Clarida, ed., Chicago: University of Chicago Press, 2007.

⁵ This is not to imply that there is a unique causal relationship from exchange rate movements to the value of foreign direct investment positions. Capital flows (of all types) also affect exchange rates.

⁶ The debt crises experienced by many Latin American countries during the 1980s were due in no small part to the fact that essentially all of their external debt was denominated in dollars rather than pesos, *reals*, etc.

⁷ See "Financial Exchange Rates and International Currency Exposure," by Philip R. Lane and Jay C. Shambaugh,

American Economic Review, vol. 100, no. 1, 2010, pp. 518–40.

⁸ To compute the financial weighted exchange rates, we follow Lane and Shambaugh (2010) and measure all of the exchange rate series in units of dollars per unit of foreign currency. Thus, a decline in one of the exchange rate indexes corresponds to an increase in the value of the dollar—fewer dollars are needed to purchase a unit of foreign currency. This convention is followed rather than the alternative convention of measuring exchange rates in units of foreign currency per dollar so as to facilitate the calculation of the financial exchange rates. By measuring exchange rates this way, a rapidly depreciating foreign currency converges toward zero rather than infinity. We then invert them to make them comparable to the trade-weighted value of the dollar.

⁹ Of course, financial linkages and trade linkages are not independent. For example, the value of foreign direct investment by U.S. firms in China will be affected by changes in the U.S. dollar–renminbi exchange rate: A depreciation of the renminbi will make those investments less valuable. But if the U.S. firm is producing in China for export to the U.S., a cheaper renminbi will also make the goods produced at the Chinese facilities cheaper in the U.S., which will give the firm a competitive edge and potentially raise its value.

Financial globalization necessitates that new measures be added to the toolkit for tracking international developments.

Summary of Activities 2013

In terms of policy work, the institute launched a series of initiatives in 2013 to support President Richard Fisher in his Federal Open Market Committee duties.

One of the core business products of the Globalization and Monetary Policy Institute since its creation in 2007 has been policy-relevant research that is circulated through the institute's dedicated working paper series.

As of the end of 2013, the institute had circulated 166 working papers, with 32 of those appearing in 2013.

A reasonable proxy for the impact of these working papers is the frequency with which papers are downloaded from the Bank's website. (The ultimate measure of impact is the frequency with which the papers—whether in working paper or published form—are cited.) Total downloads of institute working papers increased from 1,963 in 2012 to 2,207 in 2013. Abstract views were also up, from 4,563 to 7,840.

In terms of policy work, the institute launched a series of initiatives in 2013 to support President Richard Fisher in his Federal Open Market Committee duties.

The first of these initiatives was to develop a database of global economic indicators that will allow for standardization across briefings, international economic updates and speeches. The second was to develop a “nowcasting” model to allow for more accurate forecasting of global economic activity in real time. And the third was to develop a multicountry model that can be used for scenario analysis as part of the briefing process.

The institute made significant progress on all three initiatives, and a description of the database is provided in institute working paper no. 166. And Jian Wang independently published a book titled 还原真实的美联储 (*Demystifying the Fed*, Hangzhou, China: Zhejiang University Press).

Staff made progress on other fronts as well, presenting their work at a variety of research forums, moving papers through the publication process and initiating new projects. The institute also deepened its global network of research associates.

Academic Research

Journal acceptances in 2013 were down from 2012. Alexander Chudik's paper, “How Have Global Shocks Impacted the Real Effective Exchange Rates of Individual Euro Area Countries Since the Euro's Creation?” was accepted for publication in the *B.E. Journal of Macroeconomics*, and Anthony Landry's “Borders and Big Macs” was accepted for publication in *Economics Letters*.

At year-end, staff had papers under review at the *Journal of International Economics*, *Journal of Econometrics*, *Review of Economics and Statistics*, *Journal of Monetary Economics*, *Journal of Applied Econometrics*, *Journal of Economic Interaction and Coordination*, *Journal of Urban Economics* and *European Economic Review*.¹

Conferences

The institute organized three conferences during the year, the first with Shanghai's Fudan University, the London-based Center for Economic Policy Research and the Geneva-based Graduate Institute of International and Development Studies, and the other two with the Swiss National Bank.

“International Conference on Capital Flows and Safe Assets” was held in Shanghai in May as part of the Shanghai Forum and featured presentations on financial globalization, the role of safe assets in the global financial system and the global business cycle.

“The Effect of Globalization on Market Structure, Industry Evolution and Pricing,” cosponsored with the Swiss National Bank in May, was a sequel to an earlier joint conference and further explored the impact of economic integration in firms' pricing decisions. “Inflation Dynamics in a Post-Crisis Globalized Economy,” also cosponsored with the Swiss National Bank and held in Zurich in August, explored the macro dimensions of globalization on the evolution of prices. Summaries of papers presented at all three conferences by Jian Wang, Michael Sposi and Mark Wynne are included in this report.

As in previous years, institute staff in 2013 presented their work at external forums. Among them were the:

- Annual Meeting of the American Economic Association
- Annual Meeting of the Southern Economic Association
- Annual Meeting of the Western Economic Association International
- Barcelona Graduate School of Economics Summer Workshop
- Conference on Structural Change, Dynamics and Economic Growth
- Federal Reserve Bank of Atlanta/New York University Stern School of Business Workshop on International Economics
- International Conference on Computing in Economics and Finance
- International Panel Data Conference, University of Texas at Dallas
- North American Summer Meeting of the Econometric Society
- Shanghai Macroeconomics Workshop
- Society for Economic Dynamics
- System Committee on International Economic Analysis
- System Committee on Macroeconomics

Staff also presented their work at central banks and universities, including the Bank of Mexico, Board of Governors of the Federal Reserve System, Chinese University of Hong Kong, Durham University, Federal Reserve Bank of Philadelphia, Fudan University, International Monetary Fund, Shanghai University of Economics and Finance, Swiss National Bank, Tsinghua University, University of Alicante and University of Arkansas.

Bank Publications

Staff contributed to several Bank publications, including the institute annual report and *Economic Letter*, which are intended to disseminate research to a broader audience than technical experts in economics. They produced six *Economic Letters* in 2013:

- “Technological Progress Is Key to Improving World Living Standards,” by Enrique Martínez-García
- “Value-Added Data Recast the U.S.–China Trade Deficit,” by Michael Sposi and Janet Koech
- “Economic Shocks Reverberate in World of Interconnected Trade Ties,” by Matthieu Bussière, Alexander Chudik and Giulia Sestieri
- “A Short History of FOMC Communication,” by Mark Wynne
- “Asia Recalls 1997 Crisis as Investors Await Fed Tapering,” by Janet Koech, Helena Shi and Jian Wang
- “The Euro and Global Turbulence: Member Countries Gain Stability,” by Matthieu Bussière, Alexander Chudik and Arnaud Mehl

Scott Davis and Adrienne Mack’s paper, “Cross-Country Variation in the Anchoring of Inflation Expectations,” was published in the Bank’s *Staff Papers* series.

People

One staff member spent the spring semester on leave at the University of Pennsylvania’s Wharton School and subsequently resigned to stay at Wharton.

The institute recruited 13 new research associates: Matthieu Bussière (Bank of France), Matteo Cacciatore (HEC Montreal), Richard Dennis (Australian National University), Gee Hee Hong (Bank of Canada), Arnaud Mehl (European Central Bank), Daniel Murphy (University of Virginia), Giulia Sestieri (Bank of France), Vanessa Smith (University of Cambridge), Jeff Thurk (University of Notre Dame), Ben Tomlin (Bank of Canada), Eric van Wincoop (University of Virginia), Yong Wang (Hong Kong University of Science and Technology) and Zhi Yu (Shanghai University of Finance and Economics).

Note

¹ Specifically, institute working papers nos. 64, 89, 103, 107, 119, 129, 137, 139, 146, 162 and 165.

International Conference on Capital Flows and Safe Assets

By Jian Wang



2013 Conference Summary

When: May 26–27

Where: Fudan University, Shanghai, China

Sponsors: Federal Reserve Bank of Dallas Globalization and Monetary Policy Institute, Finance Research Center of Fudan University, Center for Economic Policy Research and Graduate Institute of International and Development Studies



From just after the Great Depression until the beginning of the 2007–09 financial crisis, the global financial system was relatively quiet, with no major calamity afflicting advanced economies. Although emerging markets periodically confronted crises, these events were usually limited to a small set of countries that tended to recover quickly. The devastating consequences of the financial crisis caught most policymakers and economists off guard.

Policymakers and researchers from the U.S., China and Europe who studied triggers of the crisis gathered to discuss global financial industry stability and implications for monetary policy at the “International Conference on Capital Flows and Safe Assets” in Shanghai, China. Presenters explored the role of capital flows and the scarcity of global safe assets in financial markets and exchanged ideas about crucial global economic issues such as monetary policy in the U.S. and China, the euro-area debt crisis and flaws in the global monetary system.

Two keynote speeches, nine paper presentations and three panel discussions examined the “puzzle” of insufficient safe assets—liquid debt claims with negligible default risk—as well as other economic concerns such as global liquidity and exchange rates and the unconventional monetary policies adopted worldwide as a result of the crisis.

Keynote Speeches

Richard Portes, an economics professor at the London Business School and president of the Center for Economic Policy Research (CEPR), opened the conference with his keynote speech, “The Safe Asset Meme.”

Safe assets are crucial for modern finan-

cial systems. For instance, they serve as reliable stores of value, as collateral in financial transactions and as assets to meet prudential institutional requirements. A global shortage of safe assets and its impact on the global financial system have been significant themes in recent policy debates. A safe-asset shortage can lead to financial instability, Portes said, noting that such scarcity had depressed real interest rates, forcing investors into excessively risky assets. A lack of safe assets, attributable to high savings rates in emerging markets, is believed to be a cause of global imbalances and asset bubbles before 2007.

Depending on the definition of “safe assets,” there are conflicting indicators of a shortage, Portes said. U.S. dollar- and euro-denominated safe assets declined relative to emerging market foreign exchange reserves, especially after 2008. However, if safe assets include government debt of all Organization for Economic Cooperation and Development (OECD) countries rated AA and higher, there is no evidence of a safe-asset shortage. Such scarcity also isn’t obvious based on the prices (interest rates) of safe assets.

Downward-trending long-term real interest rates in the U.S. and the U.K. after the 1990s have been cited as evidence of a safe-asset shortage. But similarly low interest rates with no shortage of safe assets occurred in those same countries in the 1950s and 1970s. Therefore, Portes argued, we should be cautious when using safe-asset shortages to explain recent financial market instability. More theoretical and empirical studies are needed to further examine this issue.

Maurice Obstfeld, an economics professor at the University of California, Berkeley, gave the second keynote, “Finance at Center Stage: Some Lessons of the Euro Crisis.” Obstfeld reviewed the roots of the euro crisis and praised the euro

area for quickly correcting some of the currency union's design flaws. For instance, the euro area's decision to reform its financial sector and initiate centralized financial supervision will improve future financial stability.

However, Obstfeld also highlighted a financial/fiscal “trilemma”: Euro-area countries cannot simultaneously enjoy financial integration among member states, financial stability and fiscal independence. He argued that with those countries' financial integration, the cost of banking rescues may now exceed national fiscal capacity. Therefore, it is necessary to establish centralized fiscal backstops to finance deposit insurance and bank resolution on top of the centralized financial supervision. This argument provides additional support for fiscal constraints in a monetary union.

Session One: Safe Assets and Shadow Banking

The first session, chaired by Hans Genberg of the International Monetary Fund (IMF),

featured three papers on the consequences of increased demand for global safe assets—the shortage of such assets, the dollar's safe-haven effect and shadow banking.

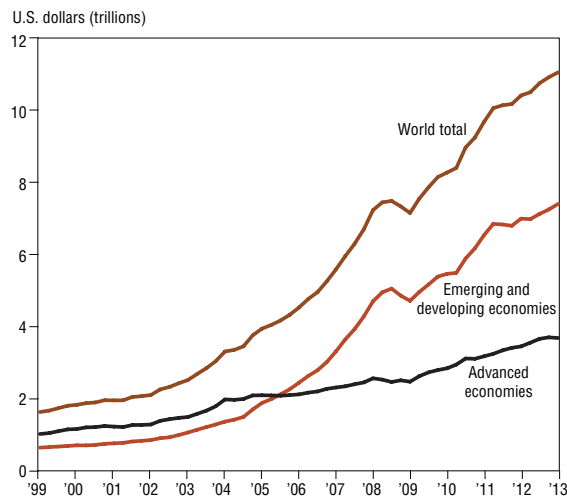
Pierre-Olivier Gourinchas, an economics professor at the University of California, Berkeley, presented “Global Safe Assets,” coauthored with Olivier Jeanne, an economics professor at Johns Hopkins University. They demonstrated in a model of stores of value that supplying public safe assets is a natural way to eliminate the financial instability associated with a safe-asset shortage. The crucial issue in creating safe assets is how to make them truly safe, which usually requires a monetary backstop. Sufficiently safe assets can immunize the economy against bubbles by eliminating private-label, supposedly safe assets, Gourinchas and Jeanne's model shows.

“The definition of safe assets has a key impact on the financial sector and so should not be left entirely to the private sector,” they argued. “The authorities should commit themselves to a

Presenters and discussants at the “International Conference on Capital Flows and Safe Assets.”



Chart 1
Foreign Exchange Reserves Increase After 2000



SOURCE: International Monetary Fund.

clear definition of safe assets and back it with a policy regime that makes those assets credibly safe.”

Gourinchas and Jeanne document that the increased demand for U.S. safe assets comes mainly from the U.S. financial sector and the rest of the world, while U.S. private nonfinancial sector demand remains remarkably stable. Increased financial system demand reflects destruction of internal liquidity during the global financial crisis. Rest-of-the-world demand is mainly driven by precautionary accumulation of foreign reserves by the foreign official sector (*Chart 1*).

Following the 1997–98 Asian crisis, foreign reserves in emerging economies (especially emerging Asian countries) skyrocketed, reflecting these countries’ fear that no international lender of last resort would provide them liquidity if there were an international investor run on their financial markets. Economic frictions and inefficiencies are responsible for both instances of increased demand for safe assets. Therefore, it remains an open question whether the priority of solving the safe-asset shortage should be given to reducing demand by addressing these underlying inefficiencies or to increasing the supply of safe assets.

Matteo Maggiori, an assistant professor at New York University, presented “The U.S. Dollar Safety Premium.” The U.S. dollar acts as the reserve currency for the international monetary system and thus becomes a safe haven during global financial crises when international investors chase safe assets in the market. Because of this flight to quality, investors are willing to hold dollars despite a lower return than on other currencies. Maggiori quantified the U.S. dollar safety premium and found that during the period of the modern floating exchange rate (1973–2010), the annual return on dollars was 1 percent lower than on a basket of foreign currencies. The return differential is much higher in financial crises. For instance, in October 2008, it was as large as 52 percent following the collapse of Lehman Brothers.

“Velocity of Pledged Collateral” was presented by Manmohan Singh, a senior economist at the IMF. One explanation of the recent global financial crisis suggests that a safe-asset shortage led to the private sector’s creation of assets such as mortgage-backed securities. These private safe assets are used as collateral in short-term financing, Singh showed. The use and reuse of pledged financial collateral contributes significantly to the supply of credit to the real economy and has become a key source for short-term financing in the U.S. and many other advanced economies. The process is analogous to the traditional money-creation process, in which collateral acts like high-powered money.

Singh detailed the shadow banking system’s use of private safe assets as pledged collateral and how there are systemic risks to global financial markets if the collateral turns out to be less safe than labeled.

Session Two: Capital Flows and Portfolio Choice

Paul Luk, an economist at the Hong Kong Institute for Monetary Research (HKIMR) presented “A Micro-Founded Model of Chinese

Capital Account Liberalization” during the second session, chaired by Enrique Martínez-García of the Dallas Fed. Luk and coauthor Dong He, director of HKIMR, examined China’s capital account liberalization in a general equilibrium model with endogenous portfolio choice. Their model predicts that Chinese households will increase their holdings of U.S. equity but decrease U.S. bond positions after China removes capital account restrictions. Indeed, China will short U.S. bonds to offset excess real exchange rate exposure to holding U.S. equity.

Yanliang Miao, an economist at the IMF, presented “Coincident Indicators of Capital Flows,” coauthored with IMF colleague Malika Pant. Capital-flows data become available with a lag of three to six months, which substantially constrains timely policy analysis of important capital-flow issues. To address this difficulty, Miao and Pant proposed two coincident composite indicators for capital flows. The first provides a timely proxy for net capital inflows and is based on the difference between the trade balance and the change in international reserves, augmented with other regional and global coincident correlates of capital flows. The second indicator augments data from Emerging Portfolio Fund Research with regional and global correlates of capital flows in an error-correction model and provides a real-time proxy for gross bond and equity inflows.

Miao and Pant showed that their indicators predict one- or two-quarter-ahead actual capital flows considerably better than standard measures used in the literature. At the same time, their indicators are simple enough to be easily constructed and used in policy analysis.

Shu Lin, an economics professor at Fudan University, presented the session’s last paper, “Monetary Policy, Credit Constraints and International Trade,” jointly authored with Jiandong Ju, an economics professor at Tsinghua University and the University of Oklahoma, and Shang-Jin Wei, a professor of finance and economics

at Columbia University. Previous empirical evidence shows that external credit is important in facilitating firm export activities, and credit market conditions generally worsen during monetary policy tightening. Thus, monetary policy may have an important impact on exports by affecting firms’ access to external financing. Lin, Ju and Wei tested this hypothesis, studying the effect of monetary policy on international trade through the credit channel. Employing a gravity-model approach and a large bilateral trade dataset, the authors found that exports fall much more following monetary policy tightening in sectors that are more financially constrained. This supports the credit channel transmission of monetary policy on exports.

Session Three: Global Assets and Prices

Lin chaired the third session, which featured three papers on international asset returns and exchange rates. Hélène Rey, an economics professor at the London Business School, presented “World Asset Markets and Global Liquidity,” coauthored with Silvia Miranda Agrippino, a postdoctoral researcher at the London Business School.

Rey and Agrippino decomposed a panel of world risky-asset prices into three components: global, regional and idiosyncratic asset-specific factors. They found that one global factor—global banks’ time-varying degree of risk aversion—explains most of the variance of world risky-asset prices. U.S. monetary policy is found to negatively affect the risk aversion of global banks; following a positive shock to the federal funds rate, global banks reduce their risk appetite. At the same time, U.S. monetary policy is also found to respond to global risk aversion (loosening when risk aversion increases).

Yi Huang, an assistant professor at the Graduate Institute of International and Development Studies (IHEID) presented the second paper, “The External Balance Sheets of China and Returns Differentials.” As a result of China’s huge current-account surplus in the past 10 years, it

Singh detailed the shadow banking system’s use of private safe assets as pledged collateral and how there are systemic risks to global financial markets if the collateral turns out to be less safe than labeled.

Wang and Nam show that anticipated technology improvement in the U.S. will appreciate the dollar, but an unanticipated development will depreciate the currency.

accumulated a large amount of foreign assets. Yi, seeking to learn how those holdings performed, calculated excess returns on China's net foreign assets. The task was challenging because of data issues, including unavailability of some crucial information.

Yi found that China's net foreign assets incurred a substantial loss—as much as 6.6 percent annually. The asymmetric structure of China's foreign assets is an important reason: China holds a short position in equity and a long position in debt. The return on debt is lower than the return on equity—especially government debt, which accounts for a large portion of China's foreign reserves.

Jian Wang, a senior economist and advisor at the Dallas Fed, presented “The Effects of Surprise and Anticipated Technology Changes on International Relative Prices and Trade,” coauthored with Deokwoo Nam, an assistant professor of economics at the City University of Hong Kong. Exchange rate movement is an important consideration for international capital flows and trade.

How does the exchange rate respond to a U.S. productivity increase? Previous empirical findings are mixed: The U.S. dollar is found to appreciate in some studies but depreciate in others. Wang and Nam argue that the response of the dollar depends on the nature of productivity increases.

The authors decomposed changes in U.S. technology into two components: anticipated changes and unanticipated ones. An example of anticipated technology improvement is a new invention in a firm's pipeline. It is expected to increase the firm's future productivity, but has no impact on today's technology. Wang and Nam show that anticipated technology improvement in the U.S. will appreciate the dollar, but an unanticipated development will depreciate the currency. Additionally, these two types of technology changes induce different dynamics for international trade, as well as for macroeconomic variables such as consumption and investment.

Thus, Wang and Nam argue that the nature of technology change should be carefully investigated when evaluating cross-country transmission of technology change.

Policy Panel Discussions

The first policy panel discussion, “Unconventional Monetary Policies in U.S. and Euro Zone and Monetary Policy in China,” was chaired by Mark Wynne, director of the Globalization and Monetary Policy Institute. Xiaoling Wu, former deputy governor of the People's Bank of China; John Rogers, a Federal Reserve Board of Governors senior advisor; Lars Oxelheim, chair of international business and finance at the Lund Institute of Economic Research, Lund University; and Lijian Sun, director of the Financial Research Center at Fudan University, discussed monetary policies during the global financial crisis.

Rey from the London Business School chaired the second policy panel, “Safe Assets and Capital Flows.” Panelists were Yongding Yu, director of the Institute of World Economics and Politics, Chinese Academy of Social Sciences; Steven Kamin, director, division of international finance, Federal Reserve Board; Hans Genberg, assistant director, independence evaluation office at the IMF; and Gourinchas from the University of California, Berkeley. Speakers discussed the shortage of global safe assets and the impact on advanced and emerging markets.

Portes from the London Business School and CEPR chaired the last policy discussion panel, “China and Global Financial Crisis: Implications and Future Perspective.” Benhua Wei, former vice chair of State Administration of Foreign Exchange of China; Chun Chang, a professor of finance and executive director of the Shanghai Advanced Institute of Finance; and Alexandre Swoboda, an emeritus professor of economics at the IHEID, discussed China's role in global financial systems and lessons learned from the recent global crisis.

Conclusion

The two-day conference shed light on important lessons of the recent crisis and also prompted questions that may inspire additional research.

First, global banks and shadow banking represent a crucial channel for global economic linkages and policy transmissions. As Rey and coauthor Agrippino found, a global factor highly related to the risk appetite of global banks explains most of the variation in risky-asset prices in many countries. Singh showed that shadow banking system participants—global investment banks and bank holding companies—contributed significantly to the short-term credit supply across the world. Economies are more inter-linked than ever through financial markets. The understanding of such ties is increasingly crucial for conducting monetary policy.

Another important issue discussed was the shortage of global safe assets. The insufficient supply of (or, alternatively, excess demand for) safe assets depressed interest rates after the 1990s and is believed to be one of the main factors that led to the recent financial crisis. Low rates forced investors to put money into risky assets (for example, real estate) for higher returns and created asset price bubbles that burst around 2007. The safe-asset shortage also motivated the private sector to create “safe” assets that were far riskier than labeled. It is important to examine the source of the safe-asset shortage—was it a decline in supply or an increase in demand? Or was there really a shortage of safe assets at all? Additional study can clarify the issue.

Conference participants also examined flaws within the global financial system that are believed to be the underlying cause of the global financial crisis. Emerging-market demand for foreign-exchange reserves accounts for some of the heightened global demand for safe assets. Asian countries learned a difficult lesson regarding the lack or insufficiency of an international lender of last resort during the 1997–98 Asian financial

crisis. As a result, these countries accumulated a large amount of foreign reserves following that crisis to defend their economies from bank runs by international investors.

With emerging markets’ share of world GDP growing bigger, it becomes increasingly difficult for the U.S. to provide enough safe assets to meet emerging-market foreign exchange reserve demand. In the long run, a more sustainable solution may rely on developing a global monetary system in which the U.S. dollar is no longer the only major reserve currency.

The insufficient supply of (or, alternatively, excess demand for) safe assets depressed interest rates after the 1990s and is believed to be one of the main reasons that led to the recent financial crisis.

The Effect of Globalization on Market Structure, Industry Evolution and Pricing

By Michael Sposi



The Globalization and Monetary Policy Institute and Swiss National Bank enlisted researchers from both sides of the Atlantic for a conference

focused on the determinants and dynamics of prices in a globalized economy. Increased globalization has heightened research and policy interest in external factors as drivers of inflation. Firms' pricing decisions are at the core of the analysis.

When firms sell in multiple markets, they face greater competition and experience additional complexities in their choice of a currency in which to set prices. Globalization has fundamentally altered the pricing power of many firms as markets become more competitive.

All papers considered various aspects of prices. One section focused on cross-country price differences and attempted to outline the sources of cross-country variation: from currency invoicing to market power as well as pricing to market and quality differentiation. Another section focused on how external factors affect price dynamics. It examined the role of currency invoicing, industrial composition and firm heterogeneity. Yet another section examined and quantified how responsive quantities are to changes in external factors, such as exchange rate movement and trade liberalization.

Significance of Cross-Country Prices

There is substantial variation in prices of goods across countries, even for goods that are traded. For instance, Chart 1 shows a histogram representing the distribution of prices of consumption goods across 19 developed countries in 2010. The key challenges are to, first, carefully measure where the deviations from the law of one price (LOP) exist, and second, to identify the sources of deviations from LOP. The underlying mechanism that drives differences in prices across

countries is crucial to the way we think about the dynamics of prices. Does industrial composition matter? Do developments in foreign economies have any impact on domestic prices? Does the currency in which goods are invoiced matter? If so, how much?

Roberto Rigobon from the Massachusetts Institute of Technology (MIT) and National Bureau of Economic Research (NBER) opened with his paper, "Product Introductions, Currency Unions and the Real Exchange Rate" (coauthored with Alberto Cavallo of MIT and Brent Neiman of the University of Chicago and NBER). This research uses novel data from the Billion Prices Project, an academic initiative at MIT. The dataset contains weekly prices for about 90,000 goods in 81 countries from 2008 to 2012 that are "scraped" from web pages of online retailers. First, the detailed nature of the data avoids issues of noncommon baskets encountered in price indexes. Second, by comparing the same product and retailer combination, researchers eliminate the issue of differences in quality of similar goods. Third, given that the data are from online retailers, as opposed to brick-and-mortar stores, there is no issue of price variability within a country that could arise from local-distribution cost differences.

A key finding is that the LOP holds almost perfectly within currency unions for thousands of goods. That is, the real exchange rate at a good level for many tradable goods equals 1 within currency unions. However, prices of the same goods deviate from LOP in countries outside of currency unions even when the nominal exchange rate is pegged. Rigobon and his coauthors argue this evidence suggests that it is the common currency per se, and not a lack of nominal volatility, that results in the lack of price deviations across countries within a currency union.

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Rigobon then argues that cross-sectional variation in real exchange rates at the level of individual goods reflects differences in prices at the time a product is introduced in various locations. International relative prices measured at the time of introduction move together with the nominal exchange rate. This is important because it implies that differences in prices across countries are not a result of price changes during the life of a good. The implications for measuring differences in real exchange rates stretch far. For instance, LOP deviations are best understood by measuring relative price levels at the time a product is introduced. Moreover, the evidence suggests that there is a limit on how much change among external factors can pass through into domestic prices of existing goods.

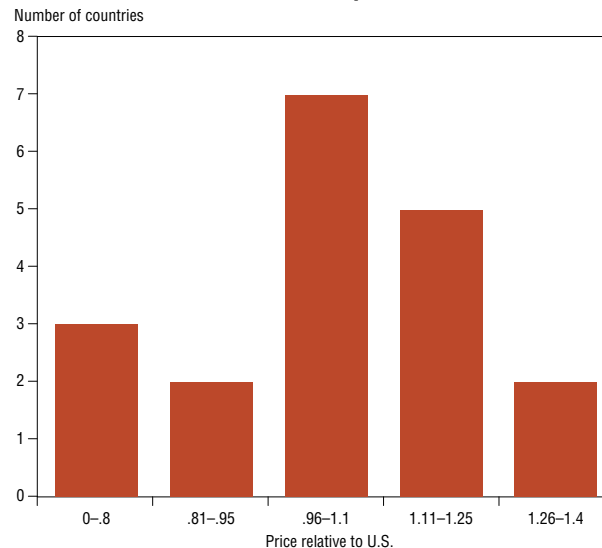
Economists often face complications when using cross-country price data arising from aggregation of nonidentical baskets of goods, differences in distribution costs and quality differences. Moreover, in the presence of imperfect competition, firms can charge different markups for the same good across different locations. Thus, there is still much room in decomposing price differences that stem from these other sources.

Benjamin Mandel of the Federal Reserve Bank of New York provides a new method to decompose prices of imports into a cost component and a markup component in his paper, “Chinese Exports and U.S. Import Prices.” He uses this methodology to study how competition from Chinese imports affects U.S. prices and found that increased competition from China leads other foreign producers (and domestic ones as well) to decrease their markup. In addition, increased competition also leads to higher marginal costs, which he argues could be the result of producers changing their output composition to higher-quality varieties or of increased demand for industry-specific factors. So, pricing to market as well as quality differentiation appear to be important features of pricing behavior and are dependent on industrial structure.

In “Export Destinations and Input Prices: Evidence from Portugal,” Paulo Bastos of the World

Bank (with World Bank colleague Joana Silva and Eric Verhoogen of Columbia University) argue that cross-country price differences reflect, at least in part, differences in the quality of goods. Country-specific prices of similar goods are positively correlated with income. Two strands of literature have attempted to reconcile why. One focuses on pricing to market. This theory requires some degree of pricing power. Another theory hinges on the fact that the quality of the goods is higher in rich countries, and thus, rich countries pay higher prices. The quality argument has been difficult to test empirically because measuring and quantifying quality are extremely challenging tasks. This paper provides new evidence in line with the quality theory using a novel idea. Producing higher-quality output requires higher-quality inputs. This paper looks at firm-level data for Portuguese exporters and finds that firms that export to richer destinations pay higher prices for imported inputs. This fits the notion that firms produce different quality for different destinations and also pay a higher price

Chart 1

Distribution of the Price of Consumption Across Countries

NOTE: Chart depicts the price of consumption relative to the U.S. for the 17 euro-area countries, the U.K. and Japan.
SOURCE: Penn World Tables, version 7.1, 2010.

This fits the notion that firms produce different quality for different destinations and also pay a higher price for higher-quality inputs. This evidence suggests that pricing to market is not the full story.

for higher-quality inputs. This evidence suggests that pricing to market is not the full story. If the export prices were purely due to pricing to market, the firms would not pay more for inputs.

The paper's focus on differences in relative prices offers important insight regarding the origination of variation in real exchange rates. This insight is key to how economists think about pass-throughs, on which a large portion of the conference was focused.

Understanding Pass-Through

It is widely accepted that prices respond less than fully to exchange rate and cost changes. An implication is that the nominal exchange rate tracks movements in the real exchange rate very closely, as shown in Chart 2. If prices responded fully to nominal exchange rates, the real exchange rate would be constant over time because the prices in each country would adjust to offset any changes in the nominal exchange rate.

Chart 2 plots the real and nominal exchange

rates of the dollar and the euro from January 2000 to July 2013. The fact that the real exchange rate moves closely with the nominal exchange rate suggests that factors such as distribution costs or pricing to market influence prices after a good is produced and even after it is shipped.

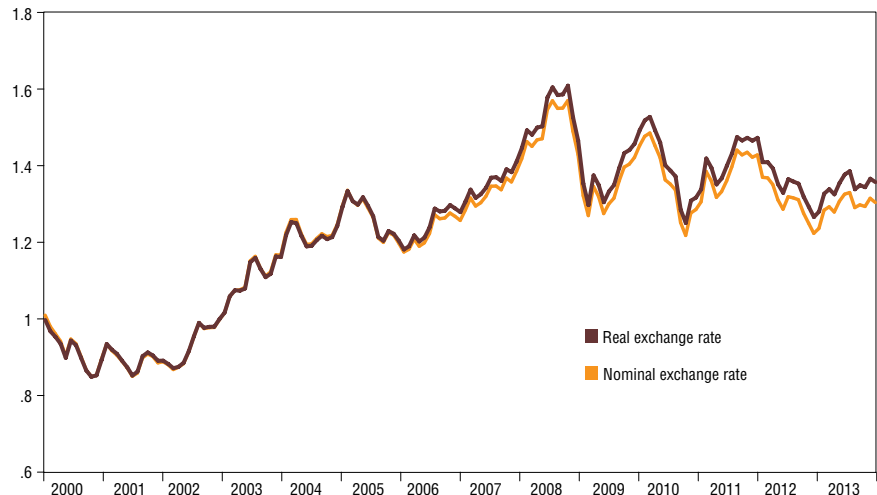
Understanding exchange rate pass-through is crucial to understanding the dynamics of real exchange rates, which depend on the nominal exchange rate and the relative price levels across countries. Understanding cost pass-through is equally important because models of price dynamics must be able to identify the source of price shocks, particularly to understand the effects of monetary policy and its implications for inflation. Additionally, the extent that firms can absorb cost shocks carries implications for how much prices respond to external shocks affecting productivity and wages, for example.

As Rigobon's paper suggests, currency invoicing helps determine whether any two countries have similar pricing. A follow-up question might

Chart 2

Dynamics of Real and Nominal Exchange Rates

Exchange rate, dollar/euro



NOTE: The real exchange rate is computed as the ratio of consumer prices in the U.S. relative to consumer prices in the euro area times the nominal exchange rate. The real exchange rate is normalized to be equal to the nominal exchange rate in 2005. SOURCES: Organization for Economic Cooperation and Development; Haver Analytics; Federal Reserve Board.

probe whether currency invoicing affects how much prices respond to exchange rate movements. Ben Tomlin from the Bank of Canada addressed this in his presentation, “Exchange Rate Pass-Through, Currency Invoicing and Trade Patterns.” The paper (coauthored with Michael Devereux of the University of British Columbia and Wei Dong of the Bank of Canada) constructs a novel dataset and documents that the invoicing currency of imported goods affects pass-through arising from exchange rate and import price changes. The dataset focuses on Canadian-apparel imports and separates these imports into two groups: goods invoiced in U.S. dollars and those invoiced in Canadian dollars.

There were two key findings. First, the authors found that exchange rate pass-through is much higher for U.S. dollar-invoiced goods than for Canadian dollar-invoiced goods. Second, the pass-through coefficient for goods shipped directly from China or India to Canada is higher than the pass-through coefficient for the same goods that have a “layover” in the U.S. during shipment, even if in both cases the goods are invoiced in U.S. dollars. Thus, a key challenge for economists is to understand why the currency in which goods are invoiced matters.

In “Market Structure and Cost Pass-Through in Retail,” Nicholas Li of the University of Toronto (with Gee Hee Hong of the Bank of Canada) focuses on how vertical and horizontal market structures affect cost pass-through to retail prices. Previous literature has looked at each structure individually but has not combined them. The authors focus on three types of goods: national brands, private-label goods that are not produced by the retailer and private-label goods that are retailer-manufactured. The paper employs scanner transaction data for thousands of UPC barcodes that contain both prices and quantities.

The authors estimate pass-through from commodity to wholesale price, and from wholesale to retail price. They find that firms and goods with a large market share tend to have lower cost



Participants (from left) Michael Devereux of the University of British Columbia, Mario Crucini of Vanderbilt University and Roberto Rigobon of the Massachusetts Institute of Technology.

pass-through because these goods/firms have more pricing power and are thus able to absorb cost shocks. In terms of vertical market structure, they find that intrafirm prices exhibit greater pass-through. One explanation is that vertical integration leads to goods priced closer to marginal cost, which eliminates variable markups that may serve as a buffer between costs and prices. The authors then argue that vertical and horizontal market structures are not independent of one another. For instance, increased vertical specialization can increase market share. Since these both have opposite effects on the extent of pass-through, the authors develop a framework that decomposes these two effects. Their main finding: When controlling for increased market share, increased vertical integration still increases pass-through but by a lesser degree than when market share is not controlled for.

Another aspect of exchange rate pass-through is heterogeneity among firms. Oleg Itskhoki of Princeton University presented “Importers, Exporters and Exchange Rate Disconnect,” cowritten with Mary Amiti of the Federal Reserve Bank



Conference attendees examined how globalization has altered the pricing power of firms as markets become more competitive.

Firms appear to take actions that affect their current and future revenue in response to past tariff reductions. These findings are consistent with the fact that exports respond very little to movements in the exchange rate and more to tariff reductions.

of New York and Jozef Konings of the University of Leuven, which provides a novel perspective on the behavior of aggregate exchange rate pass-through by exploiting heterogeneity in pass-through across different firms. Small exporters that import none of their intermediate inputs exhibit almost full pass-through. Exporters with large market shares that import a large share of their intermediate inputs exhibit substantially lower pass-through rates: An increase in the exchange rate may make marginal costs higher, but it will also reduce the price of exports. Because large exporters are also large importers, these firms account for a bulk of total trade, and hence, we observe low levels of pass-through at the aggregate level.

These implications shed light on a large puzzle in international economics: why large movements in nominal exchange rates have small effects on prices of traded goods. That is, the real exchange rate does not move closely with the nominal exchange rate.

Assessing Elasticities

The values assumed for certain structural parameters, such as elasticities of substitution between different types of goods, are key to determining price sensitivity through modeling. Elasticities of substitution have important implications for the degree of market power each firm has and, thus, are crucial in understanding the pricing decisions firms make. In turn, the degrees of both

exchange rate pass-through and external adjustment depend critically on the size of elasticities.

Raphael Auer of the Swiss National Bank presented “The Mode of Competition Between Foreign and Domestic Goods, Pass-Through and External Adjustment,” a paper cowritten with Raphael Schoenle of Brandeis University, which focuses on how “origin differentiation” affects exchange rate pass-through and external adjustment.

First, the authors estimate that the elasticity of substitution between different goods of the same origin and within the same sector is more than twice as large as the elasticity between domestic and foreign goods within the same sector. The small elasticity between foreign and domestic goods implies that foreign goods and domestic goods are relatively differentiated, and thus, the quantity of imported goods does not change very much in response to changes in the relative price of imports.

But there are also key implications for pricing behavior on which the authors shed light. Foreign firms, even if relatively small, can employ substantial price discrimination. In addition, domestic firms will not alter their price by a substantial amount in response to changes in import prices. As a result, both external adjustment and exchange rate pass-through are limited by the large degree of origin differentiation—that is, the relatively small elasticity of substitution between foreign and domestic goods.

The elasticity of substitution is clearly an important parameter. However, depending on the type of models being used, there is disagreement as to what value should be assigned. For instance, calibrated open-economy macro models such as the classic international real business cycle require a small elasticity of substitution between home and foreign goods to match comovements between relative prices (real exchange rates) and relative quantities. Trade models require substantially larger elasticities of substitution between home and foreign goods to account for how trade changes in response to changes in trade

costs. Leading explanations in the literature are tied to sunk costs of entry into export markets. In particular, if business-cycle shocks that lead to exchange rate movement are less persistent or more volatile than trade liberalization shocks, sunk costs of entry imply that the extensive margin of trade will react more to trade liberalization than to real exchange rate movements.

Doireann Fitzgerald from Stanford University presented “Exporters and Shocks,” cowritten with Stefanie Haller of University College Dublin, which provides evidence of how firms respond to both exchange rate shocks and to trade liberalization shocks.

The authors find that the sales of existing exporters (intensive margin) are more responsive to tariff reductions than they are to movements in the real exchange rate, and the estimated elasticities at the firm level are close to the aggregate elasticity. Also, they find that export participation (extensive margin) is also more sensitive to tariffs than to exchange rate movements and supports the sunk-cost story. However, the magnitudes are small and the sizes of entering/exiting firms are small and, thus, the extensive margin of trade cannot fully account for the elasticity puzzle.

As a result, the authors argue that much of the answer to the elasticity puzzle lies in better understanding the intensive margin. In particular, the authors argue that market-specific costs of adjustments for continuing exporters may significantly explain the elasticity puzzle. Such adjustment costs may include changing the currency in which goods are invoiced after a trade-agreement episode.

To support this hypothesis, they find that a firm’s probability of exit is negatively related to its attachment to that market. They also find that the growth rate of a firm’s sales in a particular market is negatively related to tenure in that market and that the growth rate responds to lagged tariff changes but not to lagged real exchange rate movements. That is, firms appear to take actions that affect their current and future revenue in

response to past tariff reductions. These findings are consistent with the fact that exports respond very little to movements in the exchange rate and more to tariff reductions.

Globalization and Pass-Throughs

In recent years we have experienced increasing globalization. Firms sell output in more markets than ever, while supply chains have become increasingly fragmented across multiple locations. This has led to increased competition, changes in the market structure in which firms operate and altered pricing strategies.

Conference papers can be classified into three broad sections: 1) cross-country differences in price levels, 2) channels through which changes in external factors pass through to price changes and 3) the sensitivity of both prices and quantities to changes in external factors.

These three elements are, however, intimately linked. For instance, we learned that the currency of invoicing matters for differences in price levels across countries, as well as how prices in one country respond to external factors.

We also learned that market structure matters for price-level differences as well as how prices respond to external factors. Competitive changes alter the landscape of markets through vertical and horizontal integration—both of which affect firm costs, the markups that firms apply to their prices and the quality of output produced. Quality differences are reflected in price levels and can explain why prices are higher in rich countries than in poorer ones. Firm heterogeneity also plays a key role in determining how external factors pass through into prices.

Finally, modeling the extent to which prices respond to various external factors requires carefully measuring elasticities of substitution. The degree to which goods from various sources are differentiated affects the price-setting environment as well as how quantities respond to prices. Recognizing adjustment costs of existing firms is an important channel for understanding why trade flows are so sensitive to tariff changes.

Competitive changes alter the landscape of markets through vertical and horizontal integration—both of which affect firm costs, the markups that firms apply to their prices and the quality of output produced.

Inflation Dynamics in a Post-Crisis Globalized Economy

By Mark Wynne



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he Great Recession that accompanied the global financial crisis—from which many advanced economies are still struggling to recover—

prompted extraordinary policy responses from central banks around the world. Some of these responses were coordinated, but all were directed at fulfilling purely domestic mandates for price stability and, in some cases, maximum employment. Fears that the dramatic expansion of central bank balance sheets would lead to higher inflation at the consumer level have so far proven unfounded, whether due to still-abundant slack in many countries or well-anchored inflation expectations.

But some have argued that an extended period of ultra-easy monetary policy is manifesting itself in excessive risk taking, bubbles in certain asset classes and price pressures in countries that are recipients of capital flows in search of yield, which will ultimately lead to higher inflation globally. At the same time, the debate has increasingly focused on the rapidly growing emerging and developing economies as their share of global output keeps rising. The disinflationary impact of the integration of these (generally) low-wage economies into the global trading system has challenged our understanding of the price-setting process at the national and international level and our understanding of exchange rate pass-through.

This forum discussing these and other aspects of inflation and price-setting follows two other joint Dallas Fed–Swiss National Bank conferences, “Microeconomic Aspects of The Globalization of Inflation” in 2011 and, more recently, “The Effect of Globalization on Market Structure, Industry Evolution and Pricing” (*see page 24*).

Globalization and Inflation Dynamics

The first two papers considered how globalization has affected inflation dynamics. This sub-

ject has been at the core of the institute’s research since the program was launched in 2007.¹ A key question is whether the greater integration of the global economy now means that measures of global, rather than domestic, resource utilization matter when assessing inflation pressures. Chart 1 shows measures of output gaps, one for the U.S., the other for the rest of the world excluding the U.S.

In “What Helps Forecast U.S. Inflation? Mind the Gap!” Enrique Martínez-García of the Dallas Fed and Ayse Kabukcuoglu of Koç University address this question from a forecasting perspective. A widely cited study by Andrew Atkeson and Lee Ohanian (2001) raised doubts about the ability of measures of resource utilization, or slack, to improve simple time-series-based forecasts of inflation.² Other studies have since documented a decline in the relationship between measures of domestic resource utilization and subsequent inflation. This decline coincides with the integration of large, emerging-market economies into the global trading system. So on the surface, it is plausible that global rather than domestic slack is the relevant driving force for inflation.

Martínez-García and Kabukcuoglu find that measures of global slack have limited predictive power for U.S. inflation. However, they also find that the terms of trade (or rather, the deviation of the terms of trade from trend) help forecast inflation in the U.S. Moreover, this seems to be a relatively robust result because the terms of trade work well for different measures of inflation and over different time periods. In some sense, this result is not too surprising. In an earlier paper, Martínez-García and Mark Wynne (2010) had shown that the open-economy Phillips curve can be written either as a relationship between inflation and domestic and foreign slack, or as a

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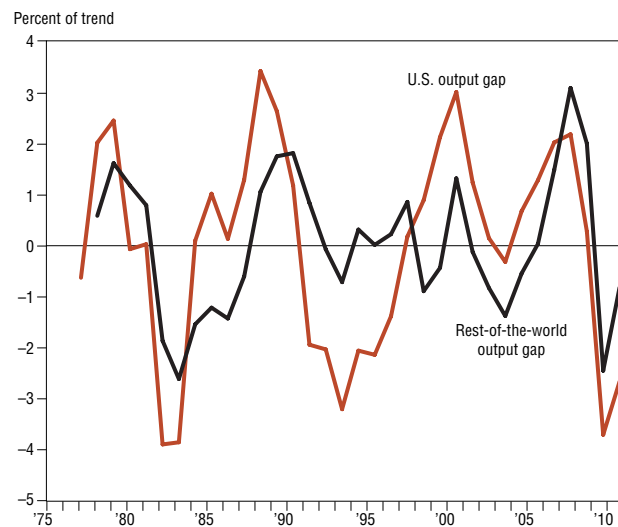
When: Aug. 22–23

Where: Swiss National Bank, Zurich

Sponsors: Federal Reserve Bank of Dallas

Globalization and Monetary Policy Institute, Swiss National Bank, Bank for International Settlements, Center for Economic Policy Research

Chart 1
U.S. and Foreign Output Gaps



SOURCE: Author's calculations.

relationship between inflation, domestic slack and the terms-of-trade gap.³

Measuring resource utilization is challenging in the best of times; measuring resource utilization in rapidly growing emerging-market economies undergoing structural change is even more challenging. But measuring the terms of trade—the relative price of imports in terms of exports—is a lot easier because data on the prices of imports and exports are more readily available. Martínez-García and Kabukçuoglu go a step further in their paper and try to understand the reasons for their forecast results by simulating a workhorse New Keynesian open-economy model and investigating what factors might account for their findings. They conclude that a run of good luck (in the period prior to the financial crisis) in conjunction with better monetary policy can best account for their findings, with globalization playing an important complementary role.

In “Globalization and Inflation: Structural Evidence from a Time Varying VAR Approach,” Francesco Bianchi of Duke University and An-

drea Civelli of the University of Arkansas evaluate the global slack hypothesis using data from 18 countries. Instead of focusing on whether measures of global slack can help forecast domestic inflation in the group of Organization for Economic Cooperation and Development (OECD) countries they include in their study, they ask whether there is any evidence that globalization has altered inflation dynamics in these countries in a manner consistent with the global slack hypothesis. Importantly, they use a methodology (time-varying coefficient vector autoregressions) that allows the impact of global factors to change over the sample period (1971 to 2006; they end their study before the onset of the recent global financial crisis).

They find that—consistent with the global slack hypothesis—global slack affects the dynamics of inflation in many countries, but, contrary to the global slack hypothesis, the effects of global slack do not get stronger over time as these countries become more integrated into the global economy. This puzzling finding is similar to the

A key question is whether the greater integration of the global economy now means that measures of global, rather than domestic, resource utilization matter when assessing inflation pressures.

results reported by Martínez-García and Wynne (2012) for the U.S.⁴

In discussing the paper, conference participants noted that the global slack hypothesis matters more for movements of inflation around trend because movements in trend inflation are largely determined by the actions of central banks. Others questioned the inclusion of measures of foreign slack and terms of trade in the specifications of the open-economy Phillips curve given that both variables capture the same thing. (This point is also made in some detail in Martínez-García and Wynne 2012.)

Small open economies provide a natural laboratory in which to study the role of global forces in inflation dynamics. Such economies are more exposed to external shocks, and inflation may be more responsive to global resource utilization. Poland is a classic example of a small open economy. In the third paper in the session, “Does Domestic Output Gap Matter for Inflation in a Small Open Economy?” Aleksandra Halka and

Jacek Kotłowski of the National Bank of Poland examine the drivers of inflation in Poland.

The authors’ empirical strategy is to estimate a series of Phillips curves at the sectoral level. They use data from the Polish consumer price index at the four-digit COICOP (classification of individual consumption by purpose) level, which gives them 110 price series. Their sample period runs from 1999 through second quarter 2012.

Halka and Kotłowski find that more than half of the components of the Polish consumer price index (CPI) are sensitive to changes in domestic activity in Poland as measured by the Polish output gap. This is somewhat surprising given the highly open nature of Poland’s economy. They also report that the category of goods whose prices are most sensitive to changes in the exchange rate is durable goods.

Finally, Halka and Kotłowski construct a new Index of the Demand for Sensitive Goods (IDSG); that is, an index of the prices of those goods that seem to be most sensitive to the domestic business cycle in Poland. They find that while the new series tends to track the headline CPI reasonably well, the two series diverge significantly in 2007 to 2009. Specifically, headline CPI inflation was significantly lower than IDSG inflation during these years, possibly because the global financial crisis was associated with an increase in global slack that restrained the headline number. Poland came through the recent financial crisis in better shape than most other European countries. It experienced only one quarter of negative growth, fourth quarter 2008.

During the discussion, a question was posed: Why isn’t there more deflation in the euro area given the paper’s findings? If domestic inflation is as sensitive to domestic economic activity as the paper claims, we might expect to see a lot more deflation in some euro-area countries where there is clearly a large negative output gap (for example, Spain and Greece). It may be that the measures of the output gap used in this (and the previous papers in this session) are poor proxies for the pri-

Participants (from left) Andreas Fischer and Raphael Auer of the Swiss National Bank and Mark Wynne of the Dallas Fed.



mary driver of inflation in New Keynesian models, namely marginal costs. Conference participants also asked about the degree to which the domestic output gap in Poland can be differentiated from the output gap in, say, Germany given the high degree of integration between the two economies.

Price Setting

A key element in modern international macroeconomic models is how firms set prices in foreign and domestic markets. Selling internationally means that a firm has to decide whether to set its prices in the currency of the country where a good is produced (producer currency pricing) or in the currency of the country where the good is sold (local currency pricing). The option chosen will determine how much of a change in the exchange rate between the two currencies shows up in the prices of the final good.

Under local currency pricing, exchange rate pass-through should be zero; under producer currency pricing, the pass-through should be 1. A 10 percent depreciation of the dollar against the euro, for example, should be reflected in a 10 percent increase in the price of U.S. imports from the euro area. However, in practice, estimates of the degree of exchange rate pass-through fall outside the theoretical range of zero to 1, or, in the case of export prices, zero to minus 1. Empirical estimates range from -2.26 to 2.55.

In “Exchange Rate Pass-Through and Market Structure in a Multi-Country World,” Kanda Naknoi of the University of Connecticut proposes a simple solution to this puzzle. Naknoi argues that the key to understanding the discrepancy is that exporting firms typically do not compete against firms from just one country (or, more specifically, against firms pricing in just one other currency) but rather against firms from many countries. Thus, when the dollar appreciates against, say, the euro, U.S. exporters also need to factor into their pricing decisions what is happening to the value of the dollar against the yen, the pound sterling and so on. She presents a simple static partial-equilibrium model

of a firm’s pricing problem in a multicountry world that can generate estimates of exchange rate pass-through greater than zero. That is, in response to a depreciation of the euro against the dollar, a U.S. exporter might raise rather than lower the dollar price of exports.

Naknoi’s model is related to earlier work by Paul Bergin and Robert Feenstra (2009) that examines pricing decisions in a simple three-country environment.⁵ Whereas Naknoi works from a quadratic specification of preferences over differentiated goods (to generate variable elasticities of demand), Bergin and Feenstra start with a translog specification of the consumer expenditure function. Bergin and Feenstra use their model to account for changes in measured exchange rate pass-through to U.S. import prices. Naknoi reports simulations showing that her model can in principle account for the variation in estimates of exchange rate pass-through to export prices reported in the existing literature. An important open question is how her framework would perform in a general-equilibrium setting.

The second paper in this session addressed an important puzzle in international economics: Why are prices of tradable consumption goods higher in rich countries than in poor countries? It has been long known that there are large differences in the prices of nontradable goods across countries, with nontradables a lot cheaper in poor than in rich countries. Often this is attributed to differences in productivity between the traded and nontraded sectors in these countries, but recent research has shown that differences in productivity levels between traded and nontraded sectors is not large enough to account for the observed price differences. Tradable price differences are even more puzzling because they imply significant deviations from the law of one price (goods have one price in various locations after giving effect for exchange rate differences).

Ina Simonovska (2010) proposes that consumers in rich countries pay more for tradable goods because they have a lower price elasticity of

Simonovska proposes that consumers in rich countries pay more for tradable goods because they have a lower price elasticity of demand for such goods, which arises from the fact that consumers in these countries typically import a wider variety of goods.

At the peak of the crisis, firms with weaker balance sheets tended to increase prices, while those with stronger balance sheets lowered their prices.

demand for such goods, which arises from the fact that consumers in these countries typically import a wider variety of goods.⁶ In his presentation, “Why are Goods and Services More Expensive in Rich Countries? Demand Complementarities and Cross-Country Price Differences,” Daniel Murphy from the University of Virginia proposes an alternative explanation.

Murphy centers on the existence of complementary catalyst goods in rich countries. For example, consumers in rich countries are willing to pay more for cars because of the existence of good roads in these countries. Likewise, consumers in these countries are willing to pay more for electrical goods because of the presence of a reliable supply of electricity. Murphy tests his theory using data on Chinese and U.S. export prices and finds support for the core idea in the data. For example, a percentage-point increase in the fraction of roads that are paved is associated with a (statistically significant) 0.6 percent increase in the price of new cars. Likewise, a megawatt-hour increase in per capita electricity consumption (a proxy for access to electricity) is associated with an increase in the prices of electrical goods of between 2 and 6 percent (depending on whether we look at the prices of U.S. or Chinese exports of electrical goods). An important open consideration for future research is quantifying the role of demand complementarities in a more precise manner.

Monetary Policy Impact

Ultimately, of course, we are interested in how economic integration might impact the conduct of monetary policy. The benchmark for monetary policy in most countries is a variant of the rule first proposed by John Taylor (1993), which states that the policy rate should respond to deviations of inflation from target and deviations of output from potential.⁷ There is no role for external factors (such as the terms of trade or foreign slack) in such a rule. The final three papers address this question from different angles.

Raphael Schoenle of Brandeis University pre-

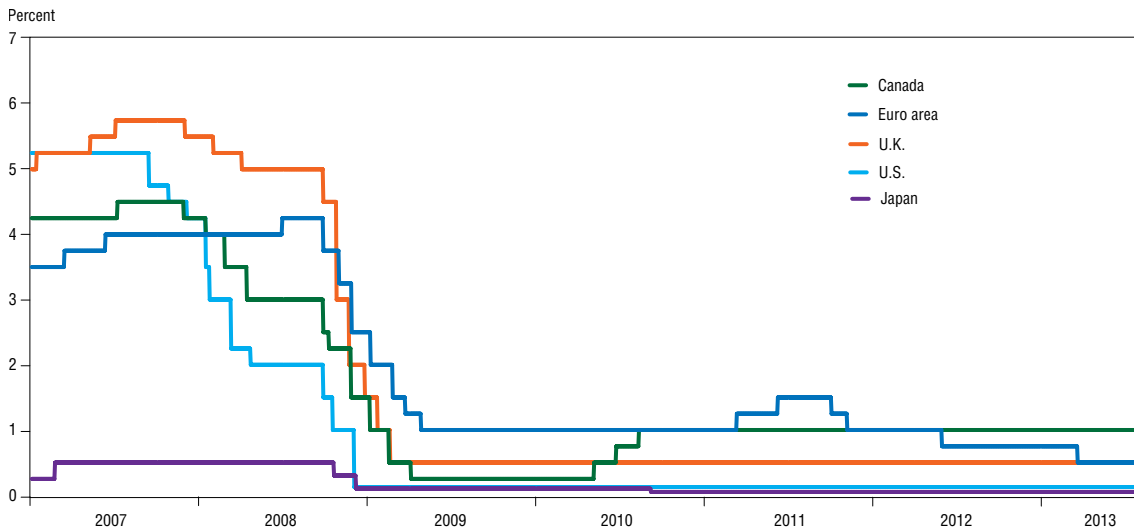
sented his joint paper with Simon Gilchrist of Boston University and Jae Sim and Egon Zakrajsek of the Federal Reserve Board on “Inflation Dynamics During the Financial Crisis.” The recent financial crisis was the most severe since the Great Depression, and Schoenle et al. ask whether firms’ pricing decisions during the crisis depended on the strength of their balance sheets. A major contribution of the paper is to match data on firms’ pricing from the Bureau of Labor Statistics’ producer price program with data on firms’ financial conditions from Compustat.

They find that at the peak of the crisis, firms with weaker balance sheets tended to increase prices, while those with stronger balance sheets lowered their prices. Specifically, in fourth quarter 2008, firms with relatively weak balance sheets (as measured by the ratio of a firm’s cash and other liquid assets to total assets) set prices in such a way as to produce a 20 percentage-point differential in factory gate inflation relative to firms with stronger balance sheets. Having documented these facts, the authors propose a theory of price setting that incorporates a financial constraint (in the form of a need to raise external finance to cover production costs through equity issuance). Their model is capable of generating widely differing inflation responses to various shocks depending on whether the financial friction is assumed binding or not.

The zero lower bound on policy rates—the inability to set interest rates below zero due to the existence of cash as an alternative store of value—was once thought to be a pathology of interest only to scholars of the Great Depression or of Japan following the bursting of its twin real estate and stock market bubbles in the late 1980s and early 1990s. However the policy response to the global financial crisis pushed interest rates to historic lows by early 2009, where they have remained (*Chart 2*).

Analyses of how economies respond to shocks now routinely take explicit account of the existence of the zero lower bound (see, for example,

Chart 2

Policy Rates in the Advanced Economies

SOURCES: National central banks; Haver Analytics.

the paper by Schoenle et al.). A paper by Gregor Bäurle and Daniel Kaufmann of the Swiss National Bank, “Exchange Rate and Price Dynamics at the Zero Lower Bound,” examines Switzerland’s experience with policy rates at the zero bound to see how the response of the economy differs in such circumstances. (Switzerland experienced two such episodes: the first from March 2003 to June 2004, and the second from January 2009 through May 2012.)⁸ A key determinant of the response to shocks in such an environment is how the central bank sets policy. If the central bank is engaged in inflation targeting, and long-run inflation expectations are anchored, a temporary shock may have permanent effects on the exchange rate and the price level (the idea of letting bygones be bygones). By contrast, if the central bank targets the price level rather than the inflation rate, these permanent effects of temporary shocks at the zero lower bound can be avoided.

How trade integration might impact the conduct of monetary policy is addressed explicitly in Matteo Cacciatore and Fabio Ghironi’s paper, “Trade, Unemployment and Monetary Policy.”

Cacciatore of HEC Montreal and Ghironi of Boston College examine how the optimal conduct of policy changes as trade linkages grow, developing a rich two-country model with multiple distortions (due to sticky prices and wages, firm monopoly power, labor market search and incomplete financial markets) that can potentially be offset by monetary policy. They report three major findings. First, when trade linkages between countries are weak, optimal monetary policy is inward-looking and gives little weight to foreign developments. Optimal monetary policy in this situation calls for a low but positive rate of inflation to offset some of the distortions in the economy. Second, as international trade increases and more productive firms gain market share, there is less need to use inflation to offset these distortions. And third, as trade becomes more integrated, business cycles become more synchronized across countries and there is less to be gained from conducting monetary policy in a cooperative versus noncooperative manner.

At a minimum, globalization changes the sources of the shocks to which monetary policy makers must respond in fulfilling their mandate for price stability.

Conclusions and Future Directions

As with most research conferences, this conference raised as many questions as it answered. The key question driving the research agenda of the globalization institute is how the increased integration of the global economy through trade and financial channels affects the conduct of monetary policy in the U.S. At a minimum, globalization changes the sources of the shocks to which monetary policy makers must respond in fulfilling their mandate for price stability (and, as in the case of the U.S., maximum sustainable employment). But it could potentially alter the nature of optimal monetary policy and the design of policy rules.

An ongoing challenge is accurate measurement of the output gap. The basic New Keynesian Phillips curve is usually written as a relationship between inflation, expected inflation and real marginal costs. The relationship can also be written in terms of the output gap if one is willing to make certain assumptions about the structure of the labor market. However, the concept of the output gap that is consistent with New Keynesian theory is very different from the concept commonly employed in empirical exercises such as those reported in the Martínez-García and Kabukçuoglu, Bianchi and Civelli, and Halka and Kotłowski papers presented at the conference.

This point has been known for some time (see, for example, Neiss and Nelson 2003).⁹ Indeed, Martínez-García and Kabukçuoglu mention it in their paper and report some figures showing that, depending on how a model is parameterized, there may be a positive, a negative or no relationship between the theory-consistent measure of the output gap and a measure constructed using a Hodrick–Prescott filter. Of course, one option would be to rely on measures of real marginal costs instead as the driving variable, but finding the data necessary to construct such measures for emerging-market economies that play such an important role in global inflation dynamics is an enormous challenge.

A second theme that emerged in conference

discussions dealt with the behavior of inflation during the recent financial crisis. Given the enormous amount of slack that emerged during the crisis, it is perhaps surprising that inflation did not fall by more than it did, or that more countries did not experience outright deflation. Some have attributed this to strong anchoring of inflation expectations.

However, as the discussion of the Halka and Kotłowski paper showed, if domestic factors truly are as important in driving price developments at the sectoral level, we should have seen more deflation. One possible resolution to this puzzle is suggested by the Schoenle et al. paper that draws attention to the importance of firms' financial conditions in setting prices. Of course, Schoenle et al. are only able to study price developments at the producer level. Central banks are more interested in price developments as measured by consumer price indexes, but the pricing decisions of retailers and the factors influencing them involve many more margins that are only imperfectly understood. Bäurle and Kaufmann's paper also provided evidence based on the Swiss experience that the transmission of shocks may differ when a central bank sets its policy rate at the zero lower bound, suggesting that the response to the financial recession may have also played a role in changing the transmission mechanism for monetary policy.

And, finally, there is the question of how monetary policy ought to be conducted in a highly integrated global economy. The paper by Cacciatore and Ghironi seems to suggest that inward-looking policies continue to deliver good outcomes even as the world becomes more integrated. But such findings tend to be sensitive to the details of the model environment used to study monetary policy and, in particular, to the degree of business-cycle synchronization that the economies attain under a given policy framework. Robust policy rules and guidelines for monetary policy are still some way off.

Cacciatore and Ghironi model trade integration as coming about through trade in final goods.

However, trade in intermediate goods is a defining feature of the modern era of globalization, and it would be useful to know how robust the Cacciatore and Ghironi results are to such an extension.

In light of the Naknoi results—how going from a two-country to a multicountry setting can help explain certain results in the exchange rate pass-through literature—it might also be useful to see an extension of the Cacciatore and Ghironi framework that allows for foreign trade partners that adopt different exchange regimes vis-à-vis the home country, specifically fixed and floating.

Notes

¹ See, for example: “Openness and Inflation,” by Mark A. Wynne and Erasmus Kersting, Federal Reserve Bank of Dallas *Staff Papers*, no. 2, April 2007; “Obstacles to Measuring Global Output Gaps,” by Wynne and Genevieve R. Solomon, Federal Reserve Bank of Dallas *Economic Letter*, vol. 2, no. 3, 2007; “The Global Slack Hypothesis,” by Enrique Martínez-García and Wynne, Federal Reserve Bank of Dallas *Staff Papers*, no. 10, September 2010; and “Global Slack as a Determinant of U.S. Inflation,” by Martínez-García and Wynne, Federal Reserve Bank of Dallas, Globalization and Monetary Policy Institute Working Paper no. 105, August 2012.

Also see: “Global Slack and Domestic Inflation Rates: A Structural Investigation for G-7 Countries,” by Fabio Milani, *Journal of Macroeconomics*, vol. 32, 2010, pp. 968–81; “Has Globalization Transformed U.S. Macroeconomic Dynamics?” by Milani, *Macroeconomic Dynamics*, vol. 16, no. 2, 2012, pp. 204–29; “Globalization, Domestic Inflation and Global Output Gaps: Evidence from the Euro Area,” by Alessandro Calza, Federal Reserve Bank of Dallas, Globalization and Monetary Policy Institute Working Paper no. 13, May 2008; and “Some Preliminary Evidence on the Globalization–Inflation Nexus,” by Sophie Guilloux and Enisse Kharoubi, Federal Reserve Bank of Dallas, Globalization and Monetary Policy Institute Working Paper no. 18, July 2008.

² “Are Phillips Curves Useful for Forecasting Inflation?” by Andrew Atkeson and Lee Ohanian, Federal Reserve Bank of Minneapolis *Quarterly Review*, Winter 2001, pp. 2–11.

³ See note 1, Martínez-García and Wynne (2010).

⁴ See note 1, Martínez-García and Wynne (2012).

⁵ See “Pass-Through of Exchange Rates and Competition Between Floaters and Fixers,” by Paul R. Bergin and Robert C. Feenstra, *Journal of Money, Credit and Banking*, vol. 41, no. s1, 2009, pp. 35–70.

⁶ See “Income Differences and Prices of Tradables,” by Ina



Conference participants considered how the increased integration of the global economy through trade and financial channels affects monetary policy.

Simonovska, Federal Reserve Bank of Dallas, Globalization and Monetary Policy Institute Working Paper no. 55, July 2010.

⁷ See “Discretion Versus Policy Rules in Practice,” by John B. Taylor, *Carnegie Rochester Conference Series on Public Policy*, vol. 39, no. 1, 1993, pp. 195–214.

⁸ Switzerland also experienced episodes of zero interest rates (as measured by the call money rate) in the 1970s, from 1977 through 1979.

⁹ See “The Real-Interest-Rate Gap as an Inflation Indicator,” by Katharine Neiss and Edward S. Nelson, *Macroeconomic Dynamics*, vol. 7, no. 2, 2003, pp. 239–62.

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