Navigating the Structure of the Global Economy

By Michael Sposi

The Globalization and Monetary Policy Institute's primary focus is developing a better understanding of how the process of deepening economic integration among countries of the world, or globalization, alters the environment in which U.S. monetary policy decisions are made. In this article, I discuss how my research contributes to this mission. I emphasize the interaction between increased globalization and the changing structure of economic activity, and how these phenomena affect the ways economists evaluate key economic trade-offs.

Structural Changes in the Economy

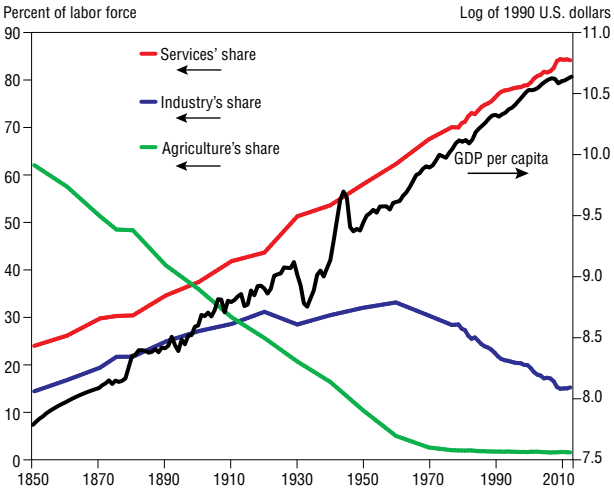
The composition of economic activity in the U.S. has changed markedly since the Industrial Revolution. In 1850, 62 percent of the workforce was engaged in agricultural activities, 14 percent in industry and 24 percent in services; see also Sposi and Grossman (2014). As the country developed, workers moved out of agriculture and into the industrial and service sectors. By 1965, the share of employment in industry peaked at 32 percent and has since declined to 15 percent. Agriculture's share has continued to fall from more than 60 percent and now accounts for less than 1 percent of the workforce; services' share has steadily increased from roughly 25 percent to its current 85 percent (*Chart 1*). This structural transformation is not unique to the U.S. and has been experienced by almost every advanced economy.

There are many reasons why economists would like to understand what drives structural change. To begin with, in spite of the massive shift in the composition of economic activity, U.S. real gross domestic product (GDP) per capita has consistently grown by roughly 2 percent per annum since 1850. Researchers taking a historical and international perspective may better understand the engines of economic growth based on the composition of economic activity.

Citizens and policymakers have expressed concern over the decline of the industrial sector as well. In absolute terms, the total number of U.S. workers engaged in manufacturing—the largest component of the industrial sector—has decreased 37 percent, from a peak of 19.4 million workers in 1979 to 12.2 million workers by the end of 2014. During the same period, U.S. nonfarm employment grew 54 percent. To date, the decline in manufacturing employment has been attributed to globalization, outsourcing and automation of routine production tasks. Some analysts also consider structural change to be closely linked to rising income inequality; as such, heated political debate

Chart 1

U.S. Composition of Employment Changes, Real GDP Per Capita Grows at Roughly Constant Rate



SOURCES: International Historical Statistics (2013); Organization for Economic Cooperation and Development; "Market Services Productivity Across Europe and the U.S. [with Discussion]" by Robert Inklaar, Marcel P. Timmer, Bart van Ark, Wendy Carlin and Jonathan Temple, *Economic Policy*, vol. 23, no. 53, 2008, pp. 139–94; "The First Update of the Maddison Project; Re-estimating Growth Before 1820," by Jutta Bolt and Jan Luiten van Zanden (2013), Maddison Project Working Paper no. 4 (The Maddison Project, Groningen, Netherlands, January); author's calculations.

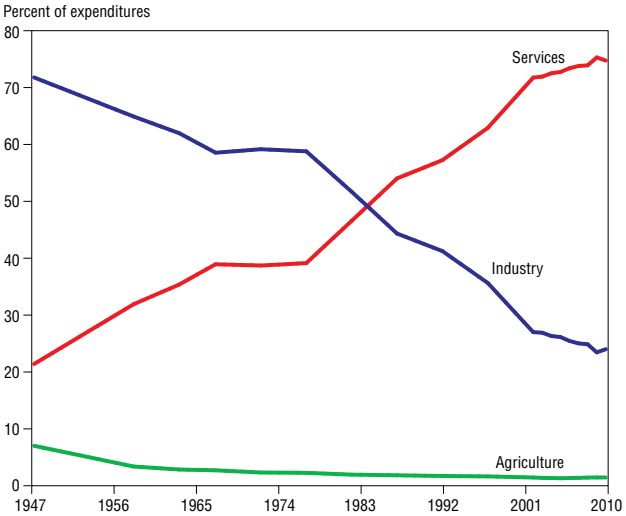
and arguments for trade protection have occurred. Nonetheless, manufacturing-labor productivity growth increased from 2 percent pre-1980 to 3.1 percent post-1980. In addition, value added in the manufacturing sector shifted more toward the production of high-tech equipment; the share of high tech was 40 percent in 2012 compared with 30 percent in 1977.

From the perspective of monetary policy, structural change matters as well. The Fed's dual mandate is price stability and maximum employment. To achieve this, the Fed currently targets an inflation rate of 2 percent in the personal consumption expenditures (PCE) index. From a pure measurement perspective, weights in the PCE are based on expenditure shares across many goods and services. To the extent that expenditure shares change over time, the dynamics of PCE inflation will respond very differently to otherwise similar underlying shocks. Since the Fed aims to stabilize long-term inflation, the long-run evolution of the composition of expenditures is worthy of consideration. Volatility in aggregate employment depends on the composition of employment. Manufacturing employment is more volatile over the business cycle than services employment.

Aside from measurement issues, the underlying economic causes and consequences of structural change are of central importance. In particular, prices and employment in the manufacturing sector may be more susceptible to conditions in foreign economies than those in other sectors since manufactured goods are highly traded. Moreover, understanding the forces behind the changes in the composition of economic activity is crucial to determining the effectiveness of policy and the shaping of price and employment dynamics. Changes in the composition of employment can be either growth reducing or growth enhancing, depending on whether resources shift toward sectors with higher or lower productivity. Finally, Stefanski (2014) argues that the size of the industrial sector in large economies plays a critical role in determining commodity prices; thus, structural change affects rates of inflation at the global level.

Chart 2

U.S. Consumption Expenditures Shift Toward Services



SOURCES: Bureau of Economic Analysis; "Two Perspectives on Preferences and Structural Transformation," by Berthold Herrendorf, Richard Rogerson and Ákos Valentinyi, *American Economic Review*, vol. 103, no. 7, 2013, pp. 2,752–89; author's calculations.

Uncovering the forces behind structural change requires the use of general equilibrium models. General equilibrium models are mathematical constructs that study the interaction between various economic agents, including firms, households and governments. They essentially act as mini-laboratories for studying how certain types of shocks affect market outcomes by accounting for how economic agents respond to the shocks. There has been a great deal of recent research along these lines. The literature has highlighted four key mechanisms: income effects, price effects, comparative advantage and sectoral linkages.[1]

Income Effects

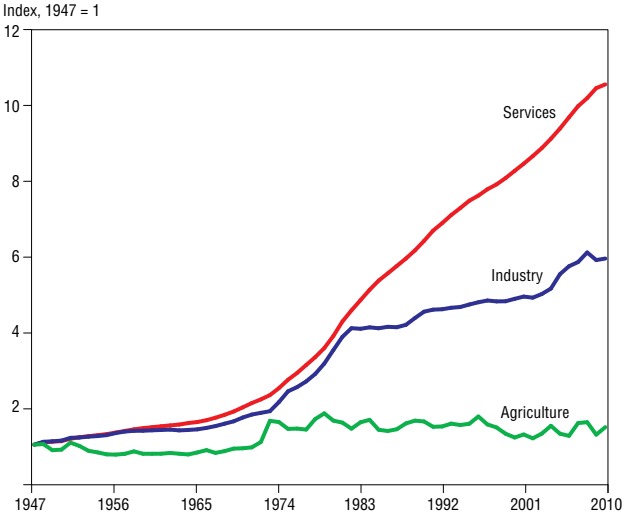
The first mechanism is income effects, first articulated by 19th-century economist Ernst Engel, in which income elasticities of demand for each good differ from one another (e.g., Laitner, 2000; Kongsamut, Rebelo and Xie, 2001). That is, as households become wealthier, a smaller share of income is allocated toward food and agricultural products. However, higher income and longer life expectancy are associated with increased demand for services such as health care, education and entertainment (*Chart 2*).

Price Effects

The second mechanism is price effects, in which the elasticity of substitution between goods is less than one (e.g., Baumol, 1967; Ngai and Pissarides, 2007). This means that if the relative price of one good increases

Chart 3

Services Prices in the U.S. Grow Faster than Agricultural and Industrial Prices



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by 1 percent, the reduction in the quantity demanded of that good is less than 1 percent. That is, total expenditures on the good increase after an increase in that good's price. This has far-reaching implications in the long run. Consider a technological improvement in manufacturing processes that reduces the relative cost of producing manufactured goods. Then the share of expenditures allocated toward manufacturing will fall, reducing the number of workers employed in that sector.

Chart 3 illustrates the long-run change in relative prices in the U.S. The real (inflation-adjusted) price of services has increased 12-fold since 1947, while the real price of industrial products has increased six-fold, and the real price of agricultural products, less than two-fold. This reflects asymmetries in productivity growth. Productivity grew fastest in agriculture via increased use of sophisticated equipment and improved fertilizing techniques. Industrial productivity growth was next; advancements came from automation software. Productivity growth was slowest in the services sector.

Comparative Advantage

The third mechanism is changes in comparative advantage in an open economy (Uy, Yi and Zhang, 2013). As emerging economies become increasingly integrated into the global economy, they often realize productivity gains in the manufacturing sector. Thus, the global allocation of manufacturing production shifts toward these countries. International trade has been particularly important for the economic growth and development of East Asian economies.

In 1950, Japan accounted for 1 percent of U.S. imports, primarily involving low-tech goods—textiles, rubber and plastic. By 1985, Japan accounted for 20 percent of U.S. imports. Japan's exports initially relied on cheap labor and access to industrial goods from more-advanced economies such as the U.S. The proportion of labor employed in the industrial sector in Japan increased from 29 percent in 1950 to 36 percent in 1985, while that share of labor in the U.S. fell from 32 percent to 29 percent.

As the Japanese economy grew, wages rose and its competitive edge in exporting low-tech goods diminished as other emerging Asian economies began to industrialize. During the 1980s, Japan focused its production and exports on more high-tech goods (semiconductors and computer chips) and investment goods (automobiles and medical equipment). Simultaneously, the share of labor in Japan's industrial sector fell from 36 percent to 26 percent. Japan's real GDP growth began to taper to rates more similar to those of the U.S.

As the Japanese economy slowed down, industrialization and rapid growth began to take off in the Asian Tiger economies (Hong Kong, Singapore, South Korea and Taiwan). These economies took on much of the low-tech production and exporting Japan previously performed. As a result, Japan accounted for a declining share of U.S. imports—from 20 percent in 1985 to 6 percent in 2013 (*Chart 4A*). The Tigers experienced a rise in industry's share of employment, which peaked in the mid-1990s and coincided with

a rise in the Tiger's share of world imports (*Chart 4B*). After the mid-1990s, these shares began to fall as did real GDP growth. During the decline, the Tigers reallocated production toward more high-tech goods including semiconductors and automobiles. China began absorbing the low-tech work. China industrialized quickly, and economic growth was very high. China's share of world imports picked up rapidly: Its share of U.S. imports increased from 6 percent in 1995 to 20 percent in 2013.

In recent years, real GDP growth in China fell from double-digit rates to less than 7 percent per annum. Whether the current slowdown in China should be perceived as a threat to growth in the U.S. is, of course, debatable. However, this is not the first case in which an important U.S. trading partner experienced a growth slowdown. Each of the previous Asian growth miracles grew at unprecedented rates as they industrialized. However, after peaking, these economies' growth rates slowed as the "low-hanging fruit had already been picked," and each country shifted from adapting foreign technology and producing low-tech goods to building a service sector and developing technologies for producing high-tech goods.

In the past, the U.S. and other advanced economies have altered their trade shares in response to structural change in the rest of the world. It is unclear whether the Chinese transition should be any different. However, China is substantially larger today than Japan was in 1990, and the U.S. is more integrated with the rest of the world today than it was 25 years ago. Therefore, it is important to ask how the slowdown in emerging economies today impacts economic conditions across the world. Sposi (2015a) explores how changes in foreign productivity propagate throughout the world and impact the composition of employment. He finds that foreign productivity shocks have relatively little impact on the share of employment in the industrial sector in advanced economies, and domestic productivity shocks are far more important for generating employment composition changes.

Sectoral Linkages

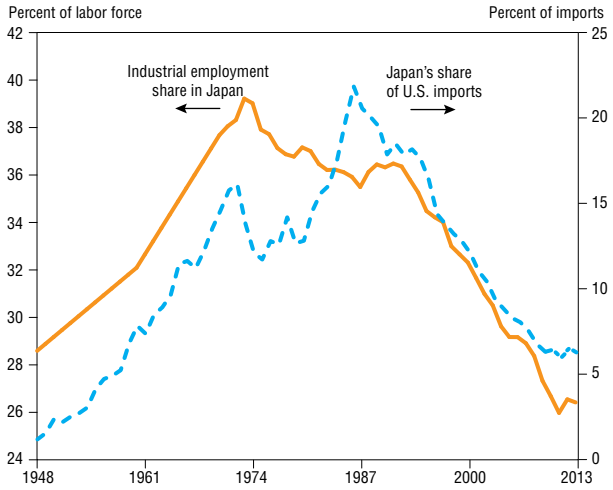
The fourth mechanism, which has received far less attention, is sectoral linkages in production. In the presence of sectoral linkages, 1) a productivity shock in one sector affects intermediate-goods prices and, hence, impacts relative prices of output across all

"Each of the previous Asian growth miracles grew at unprecedented rates as they industrialized."

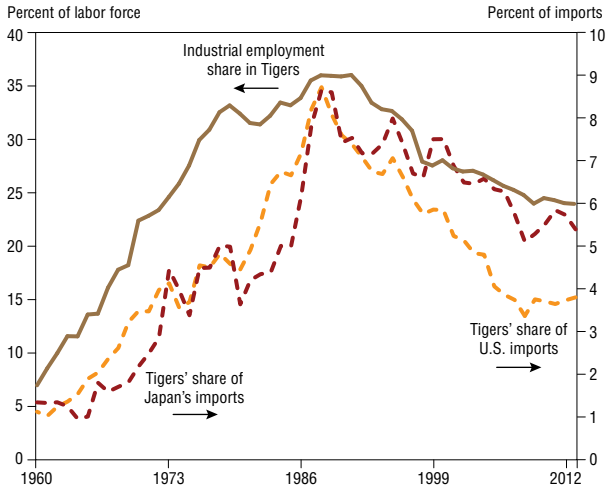
Chart 4

Import Expansion Reflects Industrial Cycles

A. Japan Employment Precedes Higher Import Share in U.S.



B. Tigers Industrial Growth Propels Greater Import Shares



SOURCES: Haver Analytics; International Historical Statistics, 2013; International Monetary Fund's Direction of Trade Statistics; "A Cross-Country Database for Sectoral Employment and Productivity in Asia and Latin America, 1950–2005," by Marcel P. Timmer and Gaaitzen J. de Vries, Groningen Growth and Development Center, Research Memorandum GD-98, 2007; author's calculations.

sectors by different proportions depending on the extent of the linkages, and 2) the extent that the composition of value added and employment responds to changes in the composition of final demand depends exclusively on the sectoral linkages. Using a partial equilibrium framework, Berlingieri (2014) shows that accounting for the intermediate use of "professional and business services" is important for explaining increased service sector employment in the U.S.

Chart 5 depicts the change in the composition of intermediate inputs employed by U.S. firms. In 1947, industrial inputs accounted for more than 50 percent of intermediate-input expenditures, and services amounted to less than 30 percent. By 2012, services accounted for more than 60 percent.

Sposi (2015b) argues that differences in sectoral linkages in production are crucial to accounting for the hump shape in industry's share of employment. Much of the decline in industry's share of employment at higher levels of development can be accounted for by changes in the structure of production. Services are increasingly more important in production in advanced economies. That is, as final demand grows, more and more resources are employed in the service sector in order to deliver the intermediate inputs necessary for final goods production, leading to a tapering of industrial employment.

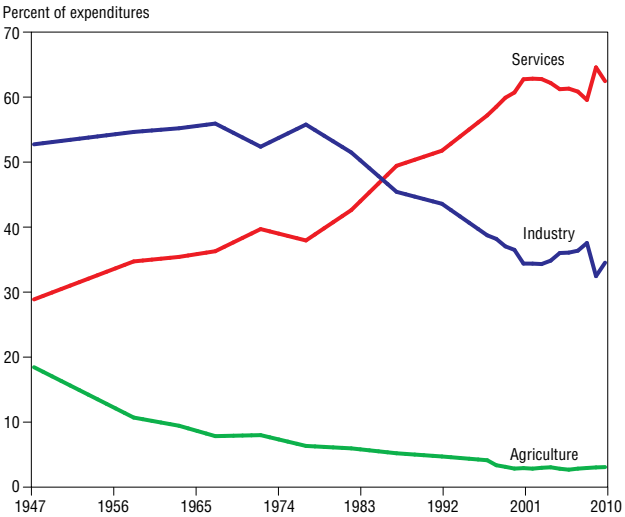
Sposi (2015b) also investigates the importance of sectoral linkages in explaining how prices respond to isolated productivity shocks. The nature of the global supply chains determines the channels through which shocks get transmitted. For example, consider technological advances in the manufacturing sector. If both the U.S. and emerging economies improve their technology, relative prices will adjust by different magnitudes. Specifically, the price of services will decrease by a larger magnitude in emerging economies than in the U.S., since in emerging economies, services production uses manufacturing inputs more intensively. The implication is that otherwise-identical shocks in various locations can have asymmetric impacts on aggregate price levels.

Sectoral linkages are also important for understanding the sources of sectoral productivity growth. For instance, advances in manufacturing productivity were brought about by inputs from the service sector, such as research and development and information technology.

Bridgman, Duernecker and Herrendorf (2015) are currently exploring another channel. Their work examines factors that influence labor-force participation and the substitution from home-produced services to market-produced services.

Chart 5

U.S. Firms Increase Service-Based Intermediate Input Expenditures



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Economic Integration, Prices and Real Exchange Rates

The degree of economic integration determines how developments in foreign economies impact prices and production at home. It also determines how domestic conditions and domestic policy propagate throughout the economy. The first challenge in quantifying the effects of globalization is constructing measures of the extent of integration between countries.

I focus on goods market integration via

international trade.

To measure goods market integration, one may directly measure tariffs and transport costs. However, these account for only a small portion of the overall impediments to trade. Moreover, there are literally thousands of goods, and each good potentially has its own tariff schedule. Beyond tariffs, countries also impose quotas. One is then confronted with the challenge of summarizing very different policies—that is, tariffs and quotas—into a single statistic, as attempted by Anderson and Neary (1994). Aside from trade policy barriers, there are geographical and economic barriers to trade.

Most international trade is in intermediate goods and, therefore, requires coordination for production processes and quality control to ensure components coming from various sources can be assembled correctly in a timely manner into the final good. Whether firms in different countries are able or willing to adhere to such standards poses one type of barrier. Another type of barrier, particularly in less-developed countries, is corruption and noncompetitive behavior among government officials and businesses. Such behavior can deter foreigners from selling output in a country. Yet another factor is cultural similarities: Goods that U.S. firms produce and sell in the U.S. may possess characteristics that U.S. consumers desire. The same characteristics may be less desirable in other countries, so U.S. firms may not export their products to such locations. In addition, different countries have different standards for goods, such as automobile emissions, health standards for processed foods and safety features of manufactured devices, making it costly for firms to tailor their products specifically to each location. These constitute just some of the potential barriers to trade that limit the extent of economic integration. Each is extremely difficult, if not impossible, to directly measure with any reasonable degree of accuracy.

To circumvent the complexities in measuring trade barriers, many economists use price differentials to gauge the extent to which economies are integrated. One of the oldest theories in international economics is purchasing power parity (PPP). It states that if there are no costs to trading goods, then the price index constructed with similar goods should be the same everywhere when quoted in a common currency, usually U.S. dollars—that is, the real exchange rate should be one. If prices are different across borders, entrepreneurial individuals can arbitrage these opportunities for profit, eventually pushing prices toward parity. Economists have applied the reverse of this logic to infer trade barriers from prices. For instance, in the literature on economic development, observed dispersion in aggregate prices has been used to study differences in cross-country income and investment rates (see Restuccia and Urrutia, 2001; Hsieh and Klenow, 2007; Armenter and Lahiri, 2012). In the international trade literature, the dispersion in prices is used to measure departures from "one world price," and these departures are presumed to reflect trade barriers (see, for instance, Anderson and van Wincoop, 2004). Hence, price equalization across countries has led to the inference that trade barriers are absent. Mutreja, Ravikumar, Riezman and Sposi (2014) and Mutreja, Ravikumar, Riezman and Sposi (2015) show that such an inference may not be correct in the context of aggregate prices.

In particular, Mutreja, Ravikumar, Riezman and Sposi (2015) employ a model to argue that price equalization does not imply free trade. They show that there are many equilibria with price index equalization, even if there is not free trade. That is, multiple combinations of trade barriers exist that are consistent with equal prices; however, each combination has a different implication for trade flows. Hence, price equalization by itself does not guarantee zero trade barriers. Instead, information on trade flows is necessary to determine whether there are no barriers to trade.

Mutreja, Ravikumar, Riezman and Sposi (2014) show that the result is more than a theoretical one. The authors use data

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"The extent of economic integration has direct implications for relative prices, aggregate productivity and capital accumulation."

on capital goods prices and capital goods trade across 88 countries. Prices of capital goods are roughly similar across countries, which has led Hsieh and Klenow (2007) and Armenter and Lahiri (2012) to infer small barriers in capital goods trade. Using a general equilibrium model, Mutreja, Ravikumar, Riezman and Sposi (2014) find that trade barriers in capital goods must be substantial to reconcile the observed volume of trade; yet, their model predicts prices that are quantitatively consistent with the data.

There is one more popular metric for measuring integration: the ratio of total trade (imports plus exports) to GDP. Interpreting this measure requires care. For one, the composition of trade is different from that of GDP. Services are traded very little, yet account for the lion's share of GDP in advanced countries. Second, imports and exports are measured in gross terms, while GDP is a value-added concept. Global supply chains have become ever more prevalent, and intermediate goods may cross many borders before being assembled into a final good. In the past couple of years, substantial progress has been made in getting around the second issue. It is even more crucial to distinguish between these concepts when one evaluates bilateral trade linkages. Sposi and Koech (2013) argue that the trade deficit between the U.S. and China is up to 50 percent larger when measured in gross terms than when measured in value-added terms.

Relative Prices, Investment Rates and Productivity

The extent of economic integration has direct implications for relative prices, aggregate productivity and capital accumulation.

Sposi (2015c) argues that productivity in the tradable-goods sector depends crucially on the magnitude of trade barriers. Specifically, trade barriers result in a misallocation of resources in which countries end up producing goods for which they are comparatively inefficient. This reduces aggregate wages and also leads to a lower price of nontraded services. The article argues that trade barriers affect the prices of nontradable services more than the prices of tradable goods. This conclusion may appear counterintuitive at first.

The effect of trade barriers on relative prices has immediate implications for investment rates since trade barriers distort the trade-off between investment and consumption. Most consumption goods are nontradable services, while a large share of investment is in traded durable goods. Hsieh and Klenow (2007) and Restuccia and Urrutia (2001) show that almost all of the variation in real investment rates can be accounted for by variation in the relative prices of investment goods.

Mutreja, Ravikumar and Sposi (2014) study the effects of trade distortions in the investment-goods sector and in the noninvestment-goods sector. While the U.S. runs an aggregate trade deficit, the U.S. has a large comparative advantage in producing investment goods. Reducing trade barriers further would allow the U.S. to further specialize in producing investment goods. The increased capital stock would account for about 80 percent of the overall gains in terms of per capita income, while increases in productivity from improved specialization would account for the remaining 20 percent.

Future Directions

Given the surge in available data on international trade and the structure of production across countries and industries, many new facts about the nature of structural change and the factors driving it have been documented and explored empirically. However, there is still a lot to learn about what the driving forces are and the quantitative importance of various underlying mechanisms with regard to understanding economic growth and development. Much of the challenge of answering complex questions involving economic growth involves a lack of mathematical tools. Specifically, researchers confront the "curse of dimensionality" when exploring economic questions that involve both spatial and dynamic aspects—essen-

tially, the economic models are "too large" for existing software. As a result, researchers are working on developing new algorithms that can reduce the models' dimensionality.

One area of particular interest is linking international trade across countries to the dynamics of capital accumulation and growth. Until now, two-country models have been the limit. It is well known that two-country models can yield misleading results since there is no possibility of trade diversion.

Aside from trade linkages, another very important feature of globalization is financial linkages. The two are not independent. For instance, trade imbalances account for almost all of the current account deficit in the U.S. Any deficit in the current account must be offset by an equal surplus in the capital account—the U.S. must borrow resources to consume more than it produces, e.g., to finance its trade deficit. Citizens and the media often view the trade deficit in a negative light. However, there is no reason to assume, ex ante, that it is detrimental to the economy. Going forward, developing new tools to study the connection between international trade and the dynamics of the current account can offer quantitative insight to such debates. Monetary policy also has a strong influence on the directions of capital flows and the terms of trade. Therefore, economists need models that can untangle the forces that drive changes in the current account in order to prescribe appropriate policy.

Note

[1]There is a strand of literature that attempts to decompose the relative importance of each of the above mechanisms including Sposi (2012); Teignier (2012); Betts, Giri and Verma (2013); Herrendorf, Rogerson and Valentinyi (2013); Uy, Yi and Zhang (2013); Boppart (2014); Swiecki (2014); Comin, Lashkari and Mestieri (2015).

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