Economic Growth in Foreign Regions and U.S. Export Growth

By Jun Nie and Lisa Taylor

Export growth is an important source of aggregate growth in the U.S. economy. Indeed the importance of exports in contributing to U.S. economic growth has risen steadily over the past three decades, with exports nearly doubling as a share of GDP. Export growth has been championed in recent years as a key driver for the country's ongoing economic recovery.

But exports of goods and services produced in the United States depend crucially on foreign demand. When foreign economic growth is low, foreign demand tends to be weak as people have less income to purchase U.S. goods and services. In this way, lower foreign growth may lead to less growth in U.S. exports.

Recently, some parts of the world, particularly Asia and Europe, have shown signs of slowing growth. The International Monetary Fund has revised downward its growth forecasts for both Asia and Europe for 2013 by about one percentage point each. A question arising from this slowdown overseas is how U.S. exports and overall U.S. real GDP growth will respond. Economists have shown empirically that decreases in aggregate foreign growth tend to coincide with decreases in U.S. export growth, but the disaggregated relationships between distinct

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foreign regions' growth and U.S. export growth have not been fully explored.

Using historical data, this article offers a framework for analyzing how U.S. export growth varies with changes in economic growth in different regions of the world. The greatest changes in U.S. export growth are associated with growth changes in Europe, followed by Canada and Asia. Europe is most relevant to U.S. export growth both because of its large size, as measured by its share of global GDP, and because of its large share of total U.S. exports. The analytical framework can also be used to identify the likely implications for future U.S. export growth of changes in foreign regions' prospective growth. For example, the framework indicates that the recent downward revisions in IMF forecasts for foreign regions—primarily for Europe and Asia—will be associated with a reduction in the contribution of U.S. export growth to overall U.S. real GDP growth by 0.4 percentage point over the two-year period from 2013 to 2014.

Section I presents key facts about U.S. exports over the past three decades. Section II quantifies the static relationship between U.S. export growth and foreign economic growth using regression models. Section III complements the previous section by providing a dynamic analysis of the relationship between U.S. export growth and foreign growth. Section IV illustrates how the preceding sections' findings can be applied to understand changes in recent U.S. export growth and to quantify the expected reduction in U.S. export growth related to the near-term slowdown in foreign growth.

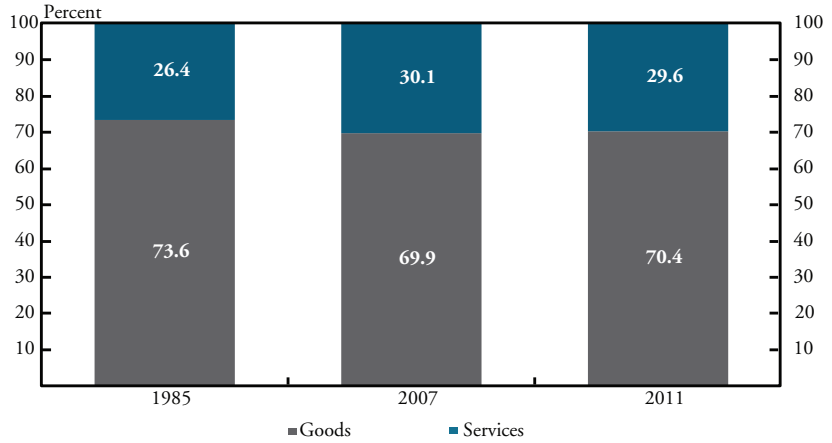
I. AN OVERVIEW OF U.S. EXPORTS

U.S. exports of goods and services have grown tremendously during the past three decades, with the level of real exports increasing fivefold from 1985 to 2012. This growth in U.S. exports and its relationship to economic growth in the rest of the world depends on the composition of U.S. exports, the major trading partners of the United States, and the variation in U.S. exports by destination and over time.

The United States exports both goods and services to countries throughout the world, with goods accounting for the majority of total U.S. exports. Chart 1 shows that the share of overall U.S. exports accounted for by goods as opposed to services has been relatively stable

Chart 1

SHARE OF GOODS AND SERVICES IN U.S. EXPORTS



Sources: Bureau of Economic Analysis and Haver Analytics.

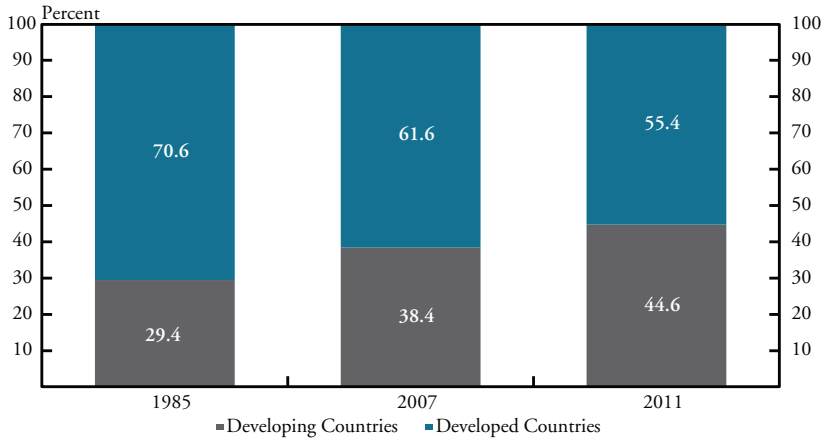
over the past 27 years, standing at about 74 percent in 1985 and declining only slightly to 70 percent by 2011.[1] Due to data limitations, and because the export shares of goods and services have been quite stable, the analysis throughout this article will use shares of U.S. export goods by destination as a proxy for the shares of total U.S. exports to each region.[2]

The bulk of U.S. export goods historically has been destined for developed countries, but the share of goods exported to developing countries has increased considerably since the 1980s (Chart 2).[3] In 1985, the share of goods exported to developing countries was only about 29 percent. This share increased to 38 percent in 2007 and rose further to almost 45 percent in 2011. The share of exports to Mexico, for example, increased by 7 percentage points over this period, while the combined share of exports to Canada and Europe decreased by a similar amount (Chart 3).[4]

The United States has four large export markets—Asia, Europe, Canada, and Mexico—and an increase in the share of U.S. export goods to any given region usually is associated with an increase in the real GDP growth rate in that region.[5] From 1985 to 2011, for example, a declining share of U.S. export goods to Canada was associated with slower real GDP growth in Canada. Similarly, from 1985 to 2011, the

Chart 2

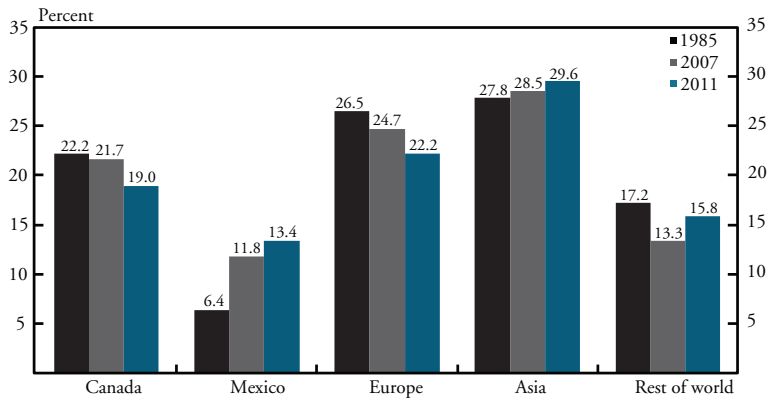
SHARE OF U.S. EXPORT GOODS BY DEVELOPMENT LEVEL OF DESTINATION



Sources: IMF and Haver Analytics.

Chart 3

SHARE OF U.S. EXPORT GOODS BY REGION



Notes: Europe includes Albania, Andorra, Armenia, Austria, Azerbaijan, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Faroe Islands, Finland, France, Georgia, Germany, Gibraltar, Greece, Hungary, Iceland, Ireland, Italy, Kazakhstan, Kosovo, Kyrgyzstan, Latvia, Liechtenstein, Lithuania, Luxembourg, Macedonia, Malta, Moldova, Monaco, Montenegro, Netherlands, Norway, Poland, Portugal, Romania, Russia, San Marino, Serbia, Slovakia, Slovenia, Spain, Svalbard–Jan Mayen Island, Sweden, Switzerland, Tajikistan, Turkey, Turkmenistan, Ukraine, United Kingdom, Uzbekistan, and Vatican City. Asia includes Afghanistan, Bahrain, Bangladesh, Brunei, Cambodia, China, Gaza Strip, Hong Kong, India, Indonesia, Iran, Iraq, Israel, Japan, Jordan, Korea, Kuwait, Laos, Lebanon, Macao, Malaysia, Myanmar, Nepal, Oman, Pakistan, Philippines, Qatar, Saudi Arabia, Singapore, Sri Lanka, Syria, Taiwan, Thailand, United Arab Emirates, Vietnam, West Bank, and Yemen. Rest of world is defined as the residual of U.S. export goods after subtracting U.S. export goods to Canada, Mexico, Europe, and Asia.
Sources: Census Bureau, Haver Analytics, and authors' calculations.

share of U.S. export goods to developing countries correlated positively with real GDP growth in those countries.[6] Given that total U.S. export goods increased over this period, an increase in the share of U.S. export goods to a given region indicates that the total level of goods exported there also increased. This fact points to a positive relationship between U.S. export growth and foreign economic growth, meaning that as a region's growth increases, it will tend to purchase more goods from the United States.

II. THE STATIC RELATIONSHIP BETWEEN U.S. EXPORT GROWTH AND FOREIGN ECONOMIC GROWTH

Quantifying the relationship between U.S. export growth and foreign economic growth helps reveal what has driven U.S. export growth in the past and how U.S. export growth may evolve in the future. A static analysis captures the contemporaneous relationship between U.S. export growth and each foreign region's GDP growth by holding growth in other regions constant. The analysis shows that U.S. export growth exhibits a varied relationship with changes in growth in other regions. These differences can be explained by differences in each region's economic size, its share of U.S. exports, and other factors such as its distance from the United States.

While numerous studies have focused on understanding the relationship between U.S. export growth and overall foreign growth, this analysis investigates further whether the relationship differs across regions.[7] Such analysis requires a framework that jointly accounts for U.S. export growth and regional GDP growth. Following the literature (Cardarelli and Rebucci; Ahearne and others; and Senhadji and Montenegro), a regression model is used to uncover the contemporaneous relationship between U.S. export growth and the factors that may be correlated with this variable, including growth in several distinct regions and changes in exchange rates between the currencies of foreign countries and the United States.[8]

Consistent with the existing literature (Krugman; Houthakker and Magee; and Hooper, Johnson, and Marquez), the regression shows U.S. export growth increases with aggregate foreign growth and declines with an appreciation of the U.S. dollar.[9] A benchmark regression based

on aggregate foreign growth shows that a 1.0-percentage-point increase in growth in all regions is associated with an increase in U.S. export growth of 2.1 percentage points (Table 1, column 1). This figure, 2.1, may also be described as the "elasticity" of U.S. export growth with respect to foreign GDP growth. Additionally, each percentage point that the dollar appreciates against foreign currencies reduces U.S. export growth by 0.2 percentage point, holding foreign growth constant.[10]

However, considering only aggregate foreign growth in analyzing U.S. exports may mask important differences across regions. Even if two regions have the same growth rate, the relationships between their growth and U.S. export growth are unlikely to be the same. A regression that breaks down aggregate foreign growth into separate growth rates for individual regions can help determine how U.S. export growth is related differently to each distinct region's GDP growth.[11] An analysis of the relationships between regional growth and U.S. export growth suggests that changes in GDP growth in Europe are associated with the greatest changes in U.S. export growth. A 1.0-percentage-point increase in the European growth rate is associated with a 1.0-percentage-point increase in the growth rate of U.S. exports (Table 1, column 2). In comparison, the increase in U.S. export growth associated with an increase in growth of 1.0 percentage point in Canada, Asia, and Mexico is only, respectively, 0.5, 0.4, and 0.2 percentage point.[12]

These findings raise the question of why growth in some regions, such as Europe, is more relevant to U.S. export growth than growth in other regions, such as Mexico.[13] There are two possible explanations for these differences.

First, the size of a region's economy plays an important role in influencing the relationship between the region's growth and U.S. export growth. The elasticity of U.S. export growth with respect to each given region's GDP growth, after controlling for the size of the region's economy, indicates how U.S. export growth would vary with that region's growth if the region were the whole world (Table 1, column 3). The actual relationship between U.S. export growth and the given region's growth can then be calculated by multiplying the export growth elasticity associated with that region by the region's share of world GDP. For example, the elasticity of U.S. export growth associated with Canadian GDP growth is 19.8, and Canada's average share of world GDP is

Table 1

THE STATIC RELATIONSHIP BETWEEN U.S. EXPORT GROWTH AND REGIONAL GDP GROWTH

Dependent Variable: Growth of Real U.S. Exports of Goods and Services	Aggregate Foreign Growth (1)	Foreign Growth Disaggregated by Region (2)	Controlling for Share of World GDP (3)	Controlling for Share of U.S. Export Goods (4)
Foreign GDP growth	2.13***			
	(0.32)			
Canadian GDP growth		0.46*	19.83*	2.09*
		(0.27)	(10.99)	(1.20)
Mexican GDP growth		0.22*	15.98*	2.48*
		(0.12)	(9.33)	(1.27)
European GDP growth		1.03***	3.81***	4.45***
		(0.37)	(1.17)	(1.49)
Asian GDP growth		0.39*	2.18**	2.06**
		(0.21)	(1.06)	(1.00)
GDP growth of the rest of the world		0.25	0.91	1.99
		(0.26)	(4.40)	(3.89)
Exchange rate growth	–0.15**	–0.19**	–0.18**	–0.19**
	(0.08)	(0.08)	(0.08)	(0.08)
Constant	–0.08	–0.15	–0.07	–0.11
	(1.17)	(1.24)	(1.20)	(1.24)
F–test: Canada = Mexico = Europe = Asia		1.52	2.53	0.50
p–value		0.21	0.06	0.68
R–square	0.3815	0.4319	0.4404	0.4388
Observations	108	108	108	108
Time period	1985:Q1–2011:Q4	1985:Q1–2011:Q4	1985:Q1–2011:Q4	1985:Q1–2011:Q4

Standard errors given in parentheses.
*Indicates significant at 10% level.
**Indicates significant at 5% level.
***Indicates significant at 1% level.

Note: See Appendix B for a description of the regression models used to generate the results above.
Sources: Badan Pusat Statistik, Banco Central de Reserva del Perú, Bureau of Economic Analysis, Census Bureau, Central Statistics Office (India), European Commission, Federal Reserve Board, Haver Analytics, Instituto Brasileiro de Geografia e Estatística, IMF, National Bureau of Statistics of China, Russian Federation Federal State Statistics Service, Singapore Department of Statistics, Statistical Office of the European Communities, World Bank, and authors' calculations.

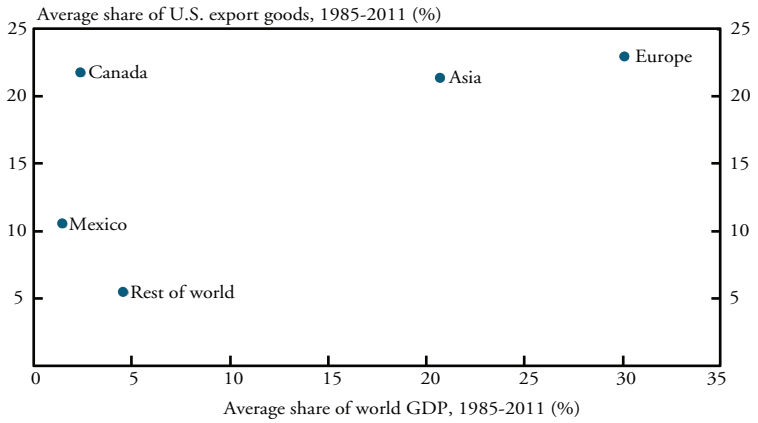
0.024. Thus, a measure of the sensitivity between movements in U.S. export growth and movements in Canadian GDP growth can be derived by multiplying 19.8 by 0.024 to obtain 0.5, meaning that U.S. export growth tends to increase by 0.5 percentage point when Canada's growth increases by 1.0 percentage point.[14] In comparison, the export growth elasticity for Europe is 3.8 and its share of world GDP is 0.301, which leads to an approximate overall sensitivity of 1.1 percentage points.[15]

Second, the strength of the trade relationship between the United States and a given region also influences the relationship between that region's growth and U.S. export growth. The elasticity of U.S. export growth with respect to each given region's GDP growth, after controlling in this case for the region's trade share with the United States (its share of U.S. export goods), indicates how U.S. export growth would vary with that region's growth if the region were to account for all of U.S. exports (Table 1, column 4).[16] The sensitivity between movements in U.S. export growth and movements in a given region's economic growth can thus be decomposed as the product of its trade share with the United States and the corresponding export growth elasticity. For example, the elasticity of U.S. export growth with respect to Mexican GDP growth is 2.5. Multiplying that figure by Mexico's trade share of 0.105 yields 0.3, meaning that U.S. export growth tends to increase by 0.3 percentage point when Mexican GDP growth rises by 1.0 percentage point.[17]

These decompositions show that both a region's economic size and its relative share of U.S. exports are important in determining the relationship between its economic growth and U.S. export growth. For example, because Europe accounts for both the largest share of world GDP and the largest share of U.S. export goods, changes in European economic growth are associated with the largest changes in U.S. export growth. Similarly, Mexico's and Canada's much smaller shares of world GDP make them much less relevant to U.S. export growth than Europe.[18] Also, regions with smaller GDP shares tend, predictably, to buy fewer goods from the United States, which is reflected in the positive relationship between GDP shares and export trade shares for different regions (Chart 4). However, both Mexico and Canada, despite the

Chart 4

SHARES OF WORLD GDP AND U.S. EXPORT GOODS



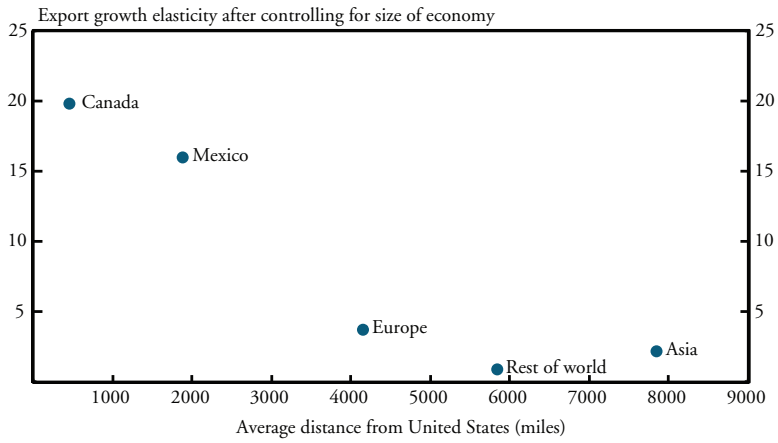
Sources: Badan Pusat Statistik, Banco Central de Reserva del Perú, Bureau of Economic Analysis, Census Bureau, Central Statistics Office (India), European Commission, Federal Reserve Board, Haver Analytics, Instituto Brasileiro de Geografia e Estatística, IMF, National Bureau of Statistics of China, Russian Federation Federal State Statistics Service, Singapore Department of Statistics, Statistical Office of the European Communities, World Bank, and authors' calculations.

relatively small sizes of their economies, nevertheless stand out as important trading partners of the United States because their trade shares with the United States are substantial.

In addition, factors other than economic size and trade share matter. Estimates of export growth elasticities differ across regions after controlling for the economic size of the regions, suggesting that growth in different regions is related to U.S. export growth in fundamentally different ways (Table 1, column 3).[19] One readily apparent explanation for this heterogeneity is the varying distance between the United States and the different regions. An examination of the export growth elasticity (controlling for the share of world GDP) for each region and that region's distance from the United States shows that the export growth elasticity declines with distance from the United States (Chart 5).[20] This possibly is because the goods imported by regions that are far away from the United States may be the goods that are more needed by those regions, and, therefore, are less sensitive to changes in growth of those regions.[21]

Chart 5

DISTANCE FROM THE UNITED STATES AND U.S. EXPORT GROWTH ELASTICITIES



Sources: Badan Pusat Statistik, Banco Central de Reserva del Perú, Bureau of Economic Analysis, Central Statistics Office (India), European Commission, Federal Reserve Board, Haver Analytics, Instituto Brasileiro de Geografia e Estatística, IMF, National Bureau of Statistics of China, Russian Federation Federal State Statistics Service, Singapore Department of Statistics, Statistical Office of the European Communities, World Bank, and authors' calculations.

III. THE DYNAMIC RELATIONSHIP BETWEEN U.S. EXPORT GROWTH AND FOREIGN ECONOMIC GROWTH

Although the analysis in the previous section provides a convenient way to characterize the static relationship between U.S. export growth and contemporaneous foreign GDP growth, it does not capture the dynamic perspective showing how U.S. export growth and foreign growth move together over a relatively longer period. Taking into account the interactions of these variables over time produces a richer picture of their relationships. These interactions are important because they include both the *direct* relationship (how a growth change in one region is directly related to U.S. export growth) and the *indirect* relationship (how each region's growth is related to other regions' growth and, therefore, is indirectly related to U.S. export growth). The analysis in this section shows that the relationship between various regions' growth and U.S. export growth differs both directly and indirectly, and both in the short term and in the long term.[22]

The reason for conducting such a dynamic analysis is to track how growth in different regions, exchange rates between foreign countries and the United States, and U.S. export growth interact with each other over time. In particular, such an analysis can show how an increase in one region's growth rate in a particular quarter is associated with growth in U.S. exports, growth in other regions, and exchange rate movements over the next few quarters.[23] This method separates U.S. export growth that is *directly* related to one region's growth from U.S. export growth that is *indirectly* related to that region through its interaction with growth in other regions. Movements in exchange rates are also taken into account in the model. The analysis is conducted through the use of a vector autoregression (VAR), a method that simultaneously estimates a set of regression equations relating current and past values of the key variables.[24]

This dynamic analysis yields three results regarding the relationship between GDP growth in different regions and U.S. export growth. First, U.S. export growth is most sensitive to a growth increase in Europe during the first four quarters following the initial growth increase in the region. Following a 1.0-percentage-point increase in the European growth rate, the U.S. export growth rate increases by 1.8 percentage points over the first four quarters (Table 2, column 1). Canada has the second-strongest correlation with U.S. export growth over the same period, followed by Asia and the rest of the world.[25] The order of these regions is the same as in the regressions in the static analysis (Table 1, column 2).

Second, in the short term, U.S. export growth is more sensitive through indirect channels to growth in Canada and Europe than other regions (Table 2, column 1). These two regions exhibit a strong positive correlation with growth in other regions, implying that a growth increase in these regions is associated with a relatively larger increase in growth in other regions and thus a larger increase in U.S. export growth. In contrast, the simulation results show that Mexico's growth usually is negatively correlated with growth in other regions.[26] Therefore, increased growth in Mexico typically is associated with reduced growth in other regions and thus is associated with a decline in U.S. export growth. This negative indirect relationship is not offset by a positive direct relationship, explaining the overall negative relationship

Table 2

DECOMPOSITION OF U.S. EXPORT GROWTH THROUGH DYNAMIC ANALYSIS

1.0–Percentage–Point Change at Time 0 in a Given Region's Real GDP Growth or in Exchange Rate Growth	The Corresponding Percentage–Point Change in U.S. Real Export Growth	In the First 4 Quarters	In the Second 4 Quarters
Canadian GDP growth	Related directly to Canadian GDP growth	0.4	–0.3
	Related indirectly through other variables	1.2	0.0
	Aggregate	**1.6**	**–0.2**
Mexican GDP growth	Related directly to Mexican GDP growth	0.0	0.0
	Related indirectly through other variables	–0.4	0.0
	Aggregate	**–0.4**	**0.0**
European GDP growth	Related directly to European GDP growth	1.1	–0.5
	Related indirectly through other variables	0.8	–0.8
	Aggregate	**1.8**	**–1.2**
Asian GDP growth	Related directly to Asian GDP growth	0.5	–0.2
	Related indirectly through other variables	0.5	–0.2
	Aggregate	**1.0**	**–0.4**
GDP growth of the rest of the world	Related directly to GDP growth of the rest of the world	0.2	0.1
	Related indirectly through other variables	0.1	0.3
	Aggregate	**0.2**	**0.3**
Exchange rate growth	Related directly to exchange rate growth	–0.3	0.0
	Related indirectly through other variables	0.0	–0.1
	Aggregate	**–0.3**	**–0.1**

Notes: Each panel represents a separate simulation. In each simulation, the variable listed in the left column was increased 1.0 percentage point at time 0. The cumulative percentage-point change in real export growth in quarters 1-4 and quarters 5-8 is shown in the right two columns, decomposed as the change related directly to the variable itself, the change related indirectly through the other six variables in the model (including real export growth), and the aggregate change. Note the decompositions may not sum because of rounding.

Sources: Badan Pusat Statistik, Banco Central de Reserva del Perú, Bureau of Economic Analysis, Central Statistics Office (India), European Commission, Federal Reserve Board, Haver Analytics, Instituto Brasileiro de Geografia e Estatística, IMF, National Bureau of Statistics of China, Russian Federation Federal State Statistics Service, Singapore Department of Statistics, Statistical Office of the European Communities, and authors' calculations.

between growth in Mexico and U.S. export growth in the first four quarters (Table 2, column 1).

Third, for most regions, the positive relationship between their growth and U.S. export growth over the first year is subsequently offset—but only partially—by a correction over the course of the following year. On net, the relationship over the first two years is still positive, however. In other words, following a positive relationship in the first four quarters, most regions have a negative relationship with U.S.

export growth in the next four quarters (Table 2, column 2).[27] The negative relationship does not mean that U.S. export growth turns negative, but only that U.S. exports grow at a rate below their historical average.[28] Thus, following an increase in growth in a foreign region, U.S. exports initially grow at a faster-than-average pace in the first four quarters and then at a slower-than-average pace in the next four quarters (though the deviation below average in the latter quarters is less than the initial deviation above average).

The slower pace in the second four quarters is primarily because a growth increase in one region usually is followed by some decline in its future growth, which also may be correlated with declines in other regions' growth in the second four quarters. This pattern is especially pronounced for Europe and Asia. In contrast, Canada's growth decline in the second four quarters is not correlated with a growth decline in other regions, leading Canada to have the strongest positive correlation with export growth in the first eight quarters.

IV. PROSPECTS FOR U.S. EXPORT GROWTH

The framework associating foreign growth and U.S. export growth can be applied to explain the historical patterns of U.S. export growth as well as future prospects for U.S. export growth. Both U.S. export growth and growth in different foreign regions have varied considerably in the past. Therefore, a decomposition of aggregate U.S. export growth into growth attributable to each foreign region helps better explain why U.S. export growth has changed over time.

Similarly, various foreign regions are expected to grow at different rates in the future. And recent projections of a global growth slowdown pertain differently to different regions. For example, more substantial growth slowdowns are forecast in Europe and Asia than in Canada and Mexico. The framework relating U.S. export growth and each foreign region's economic growth can help predict changes in future U.S. export growth.

Decomposition of past U.S. export growth

The performance of U.S. exports was markedly different during the recent expansion, recession, and recovery periods. U.S. exports grew at an average annual rate of 8.4 percent during the expansion prior to the

Table 3
DECOMPOSITION OF PAST U.S. EXPORT GROWTH (PERCENTAGE POINTS)

	Expansion (2004:Q1–2007:Q3)	Recession (2007:Q4–2009:Q2)	Recovery (2009:Q3–2011:Q4)
Canadian GDP growth	1.3	–0.8	1.3
Mexican GDP growth	0.9	–0.8	1.2
European GDP growth	3.2	–2.6	2.4
Asian GDP growth	2.2	1.1	2.5
GDP growth of the rest of the world	1.2	0.4	1.1
Exchange rate growth	0.5	–0.4	0.6
Predicted export growth (percent)	9.1	–3.3	9.0
Actual export growth (percent)	8.4	–3.3	9.0

Note: The sum of export growth attributable to each region's growth and to exchange rate growth will not equal predicted export growth in each period because the constant is not shown and because of rounding.

Sources: Badan Pusat Statistik, Banco Central de Reserva del Perú, Bureau of Economic Analysis, Central Statistics Office (India), European Commission, Federal Reserve Board, Haver Analytics, Instituto Brasileiro de Geografia e Estatística, IMF, National Bureau of Statistics of China, Russian Federation Federal State Statistics Service, Singapore Department of Statistics, Statistical Office of the European Communities, and authors' calculations.

recent recession (from the first quarter of 2004 through the third quarter of 2007). Exports then declined at an average annual rate of 3.3 percent during the recession (from the fourth quarter of 2007 through the second quarter of 2009) and subsequently increased at an average annual rate of 9.0 percent during the recovery (from the third quarter of 2009 through the fourth quarter of 2011; Table 3, bottom row). The static model in Section II slightly overestimated average annual U.S. export growth during the 2004-2007 expansion at 9.1 percent but accurately predicted average export growth in both the recession and recovery.

A decomposition of U.S. export growth based on the static analysis shows variation in the importance of different regions to U.S. export growth over the past several years. During the 2004-2007 expansion, the framework shows 3.2 percentage points—or 35 percent—of the predicted 9.1 percent average growth in U.S. exports were attributable to growth in Europe (Table 3, column 1).[29] Another 2.2 percentage points of average U.S. export growth were attributable to Asia, while the share of U.S. export growth attributable to other regions was smaller but still positive.

However, the framework implies that the changes in U.S. export growth attributable to Europe and Asia differed both in magnitude and

in direction during the 2007-2009 recession. In particular, 2.6 percentage points of the 3.3 percent average decline in U.S. exports were attributable to economic contraction in Europe (Table 3, column 2). An additional 1.6 percentage points of the reduction in average export growth were attributable to negative growth in Canada and Mexico. On the other hand, Asia maintained positive average growth during the period, partially offsetting the negative U.S. export growth attributable to other regions by 1.1 percentage points.[30]

The slow economic recovery in Europe was associated with a smaller increase in U.S. export growth during the post-2009 recovery than during the 2004-2007 expansion that preceded the recession. Indeed, 2.4 percentage points of average U.S. export growth were attributable to European growth during the recovery, which was less than the comparable 3.2 percentage points during the expansion. It also was slightly less than the 2.5 percentage points attributable to growth in Asia during the recovery. Average growth in U.S. exports attributable to growth in Canada, Mexico, and the rest of the world, taken together, totaled 3.6 percentage points (Table 3, column 3).

In addition to growth in different regions, depreciation of the U.S. dollar against foreign currencies increased the pace of U.S. export growth. During the expansion and recovery, the U.S. dollar depreciated against foreign currencies, increasing foreign demand for U.S. goods and services and thus adding to U.S. export growth (Table 3, row 6). In contrast, during the recession, the U.S. dollar appreciated, most likely due to an increase in demand for safe-haven assets.[31] The appreciation of the dollar was associated with a decline in demand for U.S. exports and thus a reduction in U.S. export growth.

The global growth slowdown and future U.S. export growth

The analysis presented in this article has distinct implications regarding the prospects for both future U.S. real export growth and, in turn, future U.S. real GDP growth. In the past two years, the IMF has consistently revised downward its estimates for growth prospects across different regions. These downward revisions are illustrated in a comparison of IMF growth forecasts in successive years. From September 2011 to October 2012, the IMF forecast for average, annual, global growth over the 2013-2016 period was lowered by 0.5 percentage point (Table

Table 4
REVISIONS IN EXPECTED FOREIGN GROWTH

		2013	2014	2015	2016
Canada	Sept. 2011 (percent)	2.5	2.5	2.4	2.2
	Oct. 2012 (percent)	2.0	2.4	2.4	2.4
	Change (percentage points)	*–0.5*	*–0.1*	*0.1*	*0.2*
Mexico	Sept. 2011 (percent)	3.7	3.8	3.4	3.2
	Oct. 2012 (percent)	3.5	3.5	3.3	3.3
	Change (percentage points)	*–0.2*	*–0.3*	*–0.1*	*0.1*
Europe	Sept. 2011 (percent)	2.2	2.3	2.3	2.3
	Oct. 2012 (percent)	1.1	1.9	2.2	2.3
	Change (percentage points)	*–1.0*	*–0.3*	*–0.1*	*0.0*
Asia	Sept. 2011 (percent)	7.3	7.3	7.4	7.4
	Oct. 2012 (percent)	6.0	6.3	6.5	6.6
	Change (percentage points)	*–1.3*	*–1.0*	*–0.8*	*–0.8*
Rest of world	Sept. 2011 (percent)	4.1	4.1	4.1	4.1
	Oct. 2012 (percent)	3.7	4.1	4.1	4.1
	Change (percentage points)	*–0.4*	*0.0*	*0.1*	*0.0*
World	Sept. 2011 (percent)	4.5	4.7	4.8	4.9
	Oct. 2012 (percent)	3.6	4.1	4.4	4.5
	Change (percentage points)	*–0.8*	*–0.5*	*–0.4*	*–0.3*

Notes: Projections are year-over-year growth rates. Changes may not sum because of rounding.
Sources: IMF and authors' calculations.

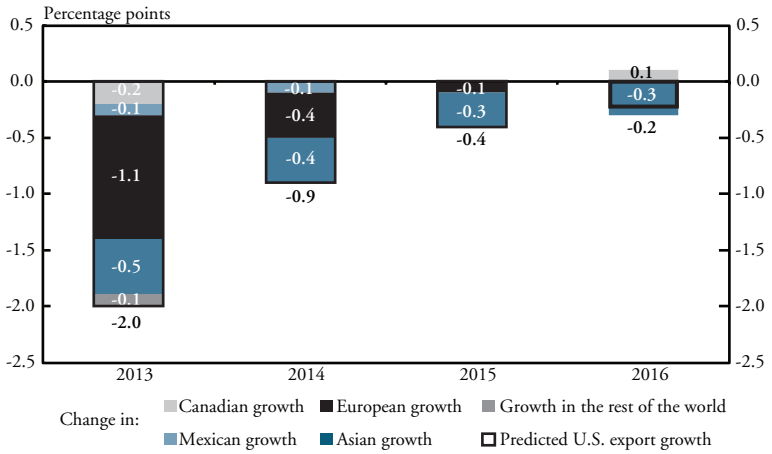
4).[32] Of particular note are Asia and Europe, for which average growth was revised down by 1.0 percentage point and 0.4 percentage point, respectively. In contrast, the expected growth in Canada and Mexico essentially has been unchanged. Based on the framework of analysis presented in this article, three conclusions may be drawn.

First, the overall effect on U.S. exports of the projected growth slowdown across different regions is most noticeable in the near term. Specifically, U.S. export growth is projected to be 2.0 percentage points lower in 2013 and 0.9 percentage point lower in 2014 than previously estimated. The expected reduction in U.S. export growth diminishes to 0.4 percentage point and 0.2 percentage point in 2015 and 2016, respectively (Chart 6).[33]

Second, the reduction in U.S. export growth from 2013 to 2016 is primarily attributable to the growth slowdowns in Europe and Asia (Chart 6). In particular, a 1.1-percentage-point reduction in U.S.

Chart 6

DECOMPOSITION OF THE CHANGE IN PREDICTED U.S. EXPORT GROWTH



Note: Regions not shown in some years were not associated with any significant downward revision in U.S. export growth in those years.
Sources: Badan Pusat Statistik, Banco Central de Reserva del Perú, Bureau of Economic Analysis, Central Statistics Office (India), European Commission, Federal Reserve Board, Haver Analytics, Instituto Brasileiro de Geografia e Estatística, IMF, National Bureau of Statistics of China, Russian Federation Federal State Statistics Service, Singapore Department of Statistics, Statistical Office of the European Communities, and authors' calculations.

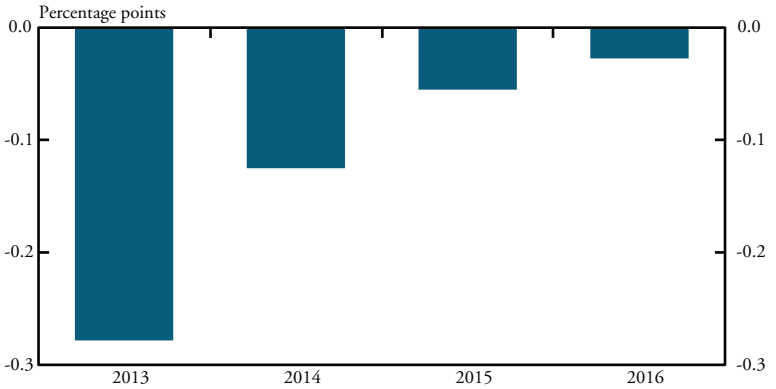
export growth is attributable to weaker growth in Europe in 2013. The reduction attributable to Asia's growth slowdown in 2013 is smaller at 0.5 percentage point. However, because Asia's growth slowdown is expected to persist, the associated reduction in U.S. export growth continues through 2016, while growth reductions attributable to Europe dissipate beyond 2013. The large change in future U.S. export growth attributable to European growth stems from a combination of two facts: U.S. export growth is most sensitive to growth in Europe (Table 1, column 2), and growth in Europe is expected to be significantly slower over the next few years (Table 4).

Third, downward revisions in U.S. export growth attributable to Canada, Mexico, and the rest of the world are small in 2014 through 2016. This is primarily because of the relatively small revisions in these regions' forecasted growth over the medium term.

To summarize, the overall reduction in future U.S. export growth associated with expected slowdowns in foreign countries' economic growth is significant and varies widely across regions. Most of the growth reduction in U.S. exports is attributable to slower growth

Chart 7

CHANGE IN U.S. REAL GDP GROWTH RELATED TO THE GLOBAL GROWTH SLOWDOWN



Sources: Badan Pusat Statistik, Banco Central de Reserva del Perú, Bureau of Economic Analysis, Central Statistics Office (India), European Commission, Federal Reserve Board, Haver Analytics, Instituto Brasileiro de Geografia e Estatística, IMF, National Bureau of Statistics of China, Russian Federation Federal State Statistics Service, Singapore Department of Statistics, Statistical Office of the European Communities, and authors' calculations.

in Europe and Asia, while the parts of the reduction attributable to Canada and Mexico are much smaller. Because U.S. exports account for about 14 percent of total U.S. GDP, the expected slowdown in foreign growth suggests lower U.S. real GDP growth both in the near term and in the medium term. In particular, weaker export growth is expected to reduce the contribution of exports to U.S. real GDP growth over the next four years. The contribution of exports to U.S. real GDP growth is projected to be reduced by 0.4 percentage point in the 2013-2014 period and by 0.1 percentage point in the 2015-2016 period (Chart 7).

V. CONCLUSION

U.S. export growth and economic growth across regions of the world are closely related. Numerous studies have documented that when *aggregate* foreign economic growth declines, U.S. export growth tends to decline as well. But the relationship between U.S. export growth and *different regions'* economic growth has been a somewhat neglected area of research.

This article fills the gap by examining how U.S. export growth is related to real GDP growth in different regions and what leads to the differences in these relationships. Two approaches, one emphasizing

the static relationships (a regression analysis) and another incorporating dynamic interactions (a vector autoregression), provide analysis of twenty-seven years of data on U.S. export growth, real GDP growth in different regions, and exchange rates.

The analysis shows U.S. export growth is most closely associated with growth changes in Europe, followed by growth changes in Canada and Asia. The close relationship between U.S. export growth and European growth results from Europe having the largest share of world GDP and the largest share of U.S. export goods.

The analysis can be applied not only to assess U.S. export growth in the past but also to forecast future U.S. export growth. Based on projections of slower economic growth in foreign regions, particularly in Europe and Asia, a 0.4-percentage-point reduction in the contribution of annual U.S. real export growth to U.S. real GDP growth is projected in the 2013-2014 period.

APPENDIX A
DATA DESCRIPTION

The analysis in the article was based on data from the first quarter of 1985 to the fourth quarter of 2011. All data were obtained and seasonally adjusted (as needed) using Haver Analytics. All variables were expressed as growth rates, specifically the annualized percent change from the previous quarter.

Real exports of goods and services data were reported by the Bureau of Economic Analysis at a quarterly frequency and were seasonally adjusted at an annual rate (SAAR).

The real broad trade-weighted exchange rate index, published by the Federal Reserve Board, was converted to a quarterly series by averaging the three monthly means in each quarter.

The countries in the analysis were included because they had the greatest data coverage over the analyzed period and accounted for the majority of U.S. export goods (82 percent) and of world GDP (87 percent) on average from 1985 to 2011. Europe was defined to include Austria, Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Norway, Portugal, Russia, Spain, Sweden, Switzerland, Turkey, and the United Kingdom. Asia was defined to include China (mainland), Hong Kong SAR, India, Indonesia, Israel, Japan, Korea, the Philippines, and Singapore. Argentina, Australia, Brazil, Chile, Colombia, New Zealand, Peru, and South Africa were categorized as "the rest of the world." Foreign growth was a weighted average of growth in Canada, Mexico, Europe, Asia, and the rest of the world.

Aggregate foreign real GDP growth and real GDP growth in Europe, Asia, and the rest of the world were defined as a weighted average of the quarter-over-quarter annualized real GDP growth of countries in that region:

$$Real\ GDP\ growth_{i,t} = \sum_{j} \alpha_{j,t} \cdot Real\ GDP\ growth_{j,t}$$

where j represents each country in region i and $\alpha_{j,t}$ is country j's share of GDP in region i at time t:

$$\alpha_{j,t} = \frac{Nominal\ GDP_{j,t}}{Nominal\ GDP_{i,t}}$$

The GDP weight for each region i at time t ($w_{i,t}$) was defined as:

$$w_{i,t} = \frac{\textit{nominal GDP of region } i}{\textit{nominal GDP of total sample}} \cdot \frac{\textit{annual nominal GDP of total sample}}{\textit{annual nominal world GDP}}$$

where the ratio in the first term was based on the quarterly data (sources listed in Table A1) and the second (annual) term was based on data from the World Bank, with the ratio repeated in each quarter of a given year as an approximation. More simply,

$$w_{i,t} \approx \frac{\textit{nominal GDP of region } i}{\textit{nominal world GDP}}$$

Using quarterly Census Bureau data, the trade weight for each region i at time t ($\delta_{i,t}$) was defined as:

$$\delta_{i,t} = \frac{\textit{nominal U.S. export goods to region } i}{\textit{total nominal U.S. export goods}}$$

Table A1

DATA SOURCES BY COUNTRY

Country	Real and Nominal GDP	Exchange Rate(s) (Local Currency/US$)	Period Included in Sample
United States	Bureau of Economic Analysis	——	1985:Q1–2011:Q4
Canada	IMF	IMF	1985:Q1–2011:Q4
Mexico	IMF	IMF	1985:Q1–2011:Q4
Europe			
Austria	IMF	Federal Reserve Board/Haver Analytics, European Commission	1985:Q1–2011:Q4
Belgium	IMF	Federal Reserve Board/Haver Analytics, European Commission	1985:Q1–2010:Q4
Denmark	IMF	IMF	1985:Q1–2011:Q4
Finland	IMF	Federal Reserve Board/Haver Analytics, European Commission	1985:Q1–2011:Q4
France	IMF	Federal Reserve Board/Haver Analytics, European Commission	1985:Q1–2011:Q4
Germany	Statistical Office of the European Communities	Federal Reserve Board/Haver Analytics, European Commission	1985:Q1–2011:Q4
Italy	IMF	Federal Reserve Board/Haver Analytics, European Commission	1985:Q1–2011:Q4
Netherlands	IMF	Federal Reserve Board/Haver Analytics, European Commission	1985:Q1–2010:Q4
Norway	IMF	IMF	1985:Q1–2011:Q4
Portugal	IMF	Federal Reserve Board/Haver Analytics, European Commission	1985:Q1–2010:Q4
Russia	Russian Federation Federal State Statistics Service	IMF	1995:Q3–2011:Q4
Spain	IMF	Federal Reserve Board/Haver Analytics, European Commission	1985:Q1–2011:Q4
Sweden	IMF	IMF	1985:Q1–2011:Q4
Switzerland	IMF	IMF	1985:Q1–2011:Q4
Turkey	IMF	IMF	1987:Q2–2011:Q4
United Kingdom	IMF	IMF	1985:Q1–2011:Q4
Asia			
China	National Bureau of Statistics of China	IMF	1992:Q2–2011:Q4
Hong Kong	IMF	IMF	1985:Q1–2011:Q4
India	Central Statistics Office (India)	IMF	1996:Q3–2011:Q4
Indonesia	Badan Pusat Statistik	IMF	1985:Q1–2011:Q4
Israel	IMF	IMF	1985:Q1–2011:Q4
Japan	IMF	IMF	1985:Q1–2011:Q4
Korea	IMF	IMF	1985:Q1–2011:Q4
Philippines	IMF	IMF	1985:Q1–2011:Q4
Singapore	Singapore Department of Statistics	IMF	1985:Q1–2011:Q4

Table A1 Continued

Country	Real and Nominal GDP	Exchange Rate(s) (Local Currency/US$)	Period Included in Sample
Rest of world			
Argentina	IMF	IMF	1995:Q3–2011:Q4
Australia	IMF	IMF	1985:Q3–2011:Q4
Brazil	Instituto Brasileiro de Geografia e Estatística/Haver Analytics	IMF	1994:Q1–2011:Q4
Chile	IMF	IMF	1996:Q1–2011:Q4
Colombia	IMF	IMF	1994:Q2–2011:Q1
New Zealand	IMF	IMF	1987:Q3–2011:Q4
Peru	Banco Central de Reserva del Perú	IMF	1991:Q1–2011:Q4
South Africa	IMF	IMF	1985:Q1–2011:Q4

APPENDIX B
REGRESSION MODEL

The static analysis is based on the results from several regression models that quantify the contemporaneous relationship between foreign real GDP growth and U.S. real export growth. The results of these regressions are reported in Table 1.

The simplest model (column 1) relates U.S. real export growth to aggregate foreign real GDP growth:

$$\textit{Real Export Growth}_t = \alpha + \beta \cdot \textit{Foreign Real GDP Growth}_t + \rho \cdot \textit{Exchange Rate Growth}_t + \in_t. \quad (1)$$

In this model, β is the elasticity of U.S. real export growth with respect to foreign real GDP growth, and ρ is the elasticity of U.S. real export growth with respect to exchange rate growth. A 1.0-percentage-point change in foreign real GDP growth is associated with a β-percentage-point change in the growth rate of real exports of U.S. goods and services in the same period. Similarly, a 1.0-percentage-point change in exchange rate growth is associated with a ρ-percentage-point change in the growth rate of real exports of U.S. goods and services in the same period.

The second model allows the relationship between U.S. real export growth and growth in each region *i* (Canada, Mexico, Europe, Asia, and the rest of the world) to vary (column 2):

$$\textit{Real Export Growth}_t = \alpha + \Sigma_i \beta_i \cdot \textit{Real GDP Growth}_{i,t} + \rho \cdot \textit{Exchange Rate Growth}_t + \in_t. \quad (2)$$

In this model, β_i is the elasticity of U.S. real export growth with respect to real GDP growth in region *i*. A 1.0-percentage-point change in real GDP growth in region *i* is associated with a β_i-percentage-point change in the growth rate of real exports of U.S. goods and services in the same period.

The third model identifies the elasticity of U.S. real export growth with respect to real GDP growth in region *i* (γ_i) after controlling for each region's share of world GDP ($w_{i,t}$, column 3):

$$\textit{Real Export Growth}_t = \alpha + \Sigma_i \gamma_i \cdot w_{i,t} \cdot \textit{Real GDP Growth}_{i,t} + \rho \cdot \textit{Exchange Rate Growth}_t + \in_t. \quad (3)$$

In this model, a 1.0-percentage-point change in real GDP growth in region i is associated with approximately a $(\gamma_i \cdot \overline{w}_i)$-percentage-point change in the contemporaneous growth rate of real exports of U.S. goods and services, where $\overline{w}_i$ is region i's average share of world GDP over the sample period.

Similarly, the fourth model estimates the elasticity of U.S. real export growth with respect to real GDP growth in region i (θ_i) after controlling for each region's share of U.S. export goods ($\delta_{i,t}$, column 4):

$$\textit{Real Export Growth}_t = \alpha + \Sigma_i \theta_i \cdot \delta_{i,t} \cdot \textit{Real GDP Growth}_{i,t} + \rho \cdot \textit{Exchange Rate Growth}_t + \in_t. \quad (4)$$

A 1.0-percentage-point change in real GDP growth in region i is associated with approximately a $(\theta_i \cdot \overline{\delta}_i)$-percentage-point change in the U.S. export growth rate in the same period, where $\overline{\delta}_i$ is region i's average share of U.S. export goods over the sample period.

APPENDIX C
VAR MODEL

The vector autoregression (VAR) model has the following form:

$$y_t = A_0 + A_1 \cdot y_{t-1} + A_2 \cdot y_{t-2} + A_3 \cdot y_{t-3} + A_4 \cdot y_{t-4} + \in_t,$$

where

$$y_t = \begin{bmatrix} \textit{Real Export Growth}_t \\ \textit{Canadian Real GDP Growth}_t \\ \textit{Mexican Real GDP Growth}_t \\ \textit{European Real GDP Growth}_t \\ \textit{Asian Real GDP Growth}_t \\ \textit{Real GDP Growth of the Rest of the World}_t \\ \textit{Exchange Rate Growth}_t \end{bmatrix}$$

and A_i is a 7x1 vector for $i = 0$ and a 7x7 matrix for $i = \{1,2,3,4\}$. The optimal number of lags (four) was chosen based on a likelihood ratio test.

The VAR simulation, summarized in Table 2, is implemented using the following procedure:

Step 1: Estimate the VAR model, which generates coefficient matrices A_i for $i = \{0,1,2,3,4\}$.

Step 2: Assume all variables are at their steady-state levels at time 0. To start one simulation, assume there is 1.0-percentage-point increase in one variable at time 0 while all other variables are unchanged at time 0.

Step 3: Iterate the estimated system equations (i.e., the estimated VAR model) for N periods, which generates seven series—one for each of the seven variables: U.S. real export growth, Canadian real GDP growth, Mexican real GDP growth, European real GDP growth, Asian real GDP growth, real GDP growth of the rest of the world, and the growth in the exchange rate. Each of the series has the same length of N periods.[34]

Although the U.S. export growth series is of primary interest, all seven series are generated simultaneously. Therefore, in each period, each variable is influenced by all other variables, which captures the

dynamic interactions among different variables. Following the same logic, the relationship between each variable and U.S. export growth in each period can be separated.

For instance, in the first panel of Table 2, the simulation is conducted by assuming there is a 1.0-percentage-point increase in Canadian real GDP growth. The aggregate change captures the overall relationship between the seven variables and U.S. export growth. The first row shows the percentage-point change in real export growth related directly to growth changes in Canada only, while the second row shows the percentage-point change in real export growth related indirectly to Canada through the other six variables (including U.S. export growth).

ENDNOTES

[1]The shares of export goods and GDP growth rates in this section are calculated using annual data, while in later sections, the data used in the analysis are quarterly. The use of annual data in place of quarterly data does not significantly change the statistics in this section.

[2]Data on export services by destination are limited before 1992.

[3]Developed countries are those classified as "advanced economies" by the IMF, while developing countries are those categorized as "emerging and developing economies" by the IMF.

[4]See Constessi and Li for a similar comparison of U.S. export shares by destination in 2000 and 2011. Earlier studies include Schmidt.

[5]On average across the 1985-2011 period, Asia, Europe, Canada, and Mexico together accounted for 87 percent of all U.S. export goods. Since 1992, the shares of export services to Canada, Mexico, and Asia have declined while the shares to Europe and the rest of the world have increased.

[6]The simple correlation between the share of U.S. export goods to developing countries and the real GDP growth rate for developing countries from 1985 to 2011 was 0.58.

[7]A handful of studies focus on the income elasticity of exports for different countries or for particular export sectors. Houthakker and Magee estimate the income elasticity of U.S. exports separately for different destinations as well as for various commodity classes, while Shane, Roe, and Somwaru focus on identifying the effects of changes in exchange rates and foreign income on U.S. exports of agricultural goods and their subcomponents.

[8]Appendix A provides a detailed description of the data sources and the definition of each variable used in the regressions. Appendix B provides more details on the regression models considered in this section. In a check of the robustness of the analysis, factors such as lags of U.S. real GDP growth and oil prices were added to the regression model. Including these variables did not change the main results, however, and most of the regression coefficients on these variables were not statistically significant.

[9]In theory, U.S. export growth also can be related to factors other than relative prices and incomes, such as trade policies and technological advancements. However, these factors are hard to measure, and because these factors change infrequently, including them in the model is unlikely to significantly alter the results. For more studies on U.S. export growth, relative prices, and foreign incomes, see Crane, Crowley, and Quayyum; Chinn; Goldstein and Khan (1978); Marquez; and Bussière, Chudik, and Sestieri. In this literature, both relative prices (measured as ratios of price indices in different countries) and real exchange rates are used (see Cardarelli and Rebucci; and Crane, Crowley, and Quayyum).

[10]These estimates are consistent with the income and exchange rate elasticities found in the existing literature. For a summary of previous estimates, see Crane, Crowley, and Quayyum; Goldstein and Khan (1985); and Marquez.

[11]Aggregate foreign real GDP growth and real GDP growth in Europe, Asia, and the rest of the world are defined as a weighted average of the quarter-over-quarter annualized real GDP growth of countries in the region. The weights are based on GDP. For more details, see Appendix A. An analysis using trade weights in place of GDP weights generates qualitatively similar results, but the significance of some estimates changes.

[12]The sum of the five regions' coefficients need not match the foreign GDP growth coefficient in column 1 (Table 1) because foreign growth has been disaggregated, changing the regression model.

[13]The F-test cannot reject the joint hypothesis that the coefficients are the same for Canada, Mexico, Europe, and Asia. However, as will be shown later, after controlling for the economic size of each region, significant differences have been found in the relationships between regions' GDP growth and U.S. export growth (Table 1, column 3).

[14]The overall sensitivity needs not equal the coefficient in column 2 because including the time-varying share of world GDP changes the regression model.

[15]From 1985 to 2011, Mexico's average share of world GDP was 0.015, Asia's share was 0.207, and the rest of the world's share was 0.046. Mexico's overall sensitivity is 0.2 percentage point, Asia's is 0.5 percentage point, and the rest of the world's is 0.04 percentage point.

[16]Again, data on U.S. service exports to different regions generally are not available at quarterly frequency since 1985 for all countries in the sample. The shares of U.S. export goods to different regions are used as an approximation to the shares of total U.S. exports to different regions. Crane, Crowley, and Quayyum study the relationship between foreign growth and U.S. exports of goods and of services separately.

[17]From 1985 to 2011, Canada's average share of U.S. export goods was 0.218, Europe's share was 0.230, Asia's share was 0.214, and the rest of the world's share was 0.054. Canada's overall sensitivity is 0.5 percentage point, Europe's is 1.0 percentage points, Asia's is 0.4 percentage point, and the rest of the world's is 0.1 percentage point.

[18]In fact, the export growth elasticities of Mexico and Canada after controlling for their shares of world GDP are much larger than the corresponding export growth elasticity for Europe. However, Mexico's and Canada's large elasticities are offset by their small shares of world GDP, weakening their overall importance to U.S. export growth.

[19]A joint hypothesis test based on the F-statistic rejects the hypothesis that export growth elasticity with respect to a region's economic growth after controlling for the share of world GDP is the same across Canada, Mexico, Europe, and Asia at the 10-percent significance level.

[20]The distance from the United States for each region is defined as the average distance, in miles, from Washington, D.C., to the capital of each country included in the region. See Appendix A for a list of countries included in each region.

[21]Transportation costs tend to increase with distance. For recent studies on transportation costs and U.S. export growth, see Alessandria and Choi; and Hummels. Note that the export growth elasticities controlling for the share of U.S. export goods are similar for Canada, Mexico, Europe, and Asia. Formally, the hypothesis that the elasticities for Canada, Mexico, Europe, and Asia are the same cannot be rejected by the F-test (Table 1, column 4). This is expected because trade shares are correlated with distance from the United States and thus (at least partially) controlled for in the model.

[22]As will be made clear, the short term means the first four quarters following a growth change, while the long term refers to the fifth through eighth quarters following a growth change.

[23]In practice, when using a VAR with four lags as in this analysis, the effect of an initial growth increase will dissipate after about 10 periods (or quarters).

[24]The VAR approach has not been used widely in this literature. Ahearne and others apply this approach to study exports of Asian emerging economies. The estimation of the simple VAR and details of the implementation of the simulation are described in Appendix C.

[25]Mexican GDP growth has a negative correlation with U.S. export growth in the first four quarters.

[26]This negative correlation is most likely related to the fact that Mexican GDP growth changed at a slightly different pace than other regions' GDP growth in the sample period.

[27]Consistent with this result, Hooper, Johnson, and Marquez find that the income elasticity of exports is smaller in the long run than in the short run.

[28]In this simulation, the U.S. export growth rate is compared with its historical average. See Appendix C for further details.

[29]This share is based on the predicted average annual export growth reported in Table 3, not the actual average annual export growth. That is, 35 percent is the result of dividing growth attributable to European growth, 3.2 percentage points, by the predicted average annual export growth rate in the expansion, 9.1 percent.

[30]Compared with Europe during the same period, Asia experienced a less severe and shorter period of negative growth that was offset by positive growth.

[31]During the downturn, international investors increased their demand for U.S. dollars, either because they preferred the high liquidity of the dollar in general or because they needed dollars to purchase other U.S. assets that were considered less risky than foreign assets.

[32]The IMF publishes annual real GDP forecasts in its World Economic Outlook. The growth forecasts for Canada and Mexico were taken directly from the IMF's database, while the regional forecasts for Europe, Asia, and the rest of the

world were based on the countries included in the sample as listed in Appendix A. The regional forecasts were constructed by weighting each country's growth rate by its share of the region's GDP, based on purchasing-power-parity valuation. The World Bank also forecasts global and regional growth. These forecasts are similar to those of the IMF, although more pessimistic in the near term. IMF forecasts were used for the purposes of this study to make possible forecasting growth for the regions as defined in the analysis over the forecast period through 2016 (further than the World Bank's forecast horizon).

[33]These results are similar to the revisions made by the IMF to their forecasts of real U.S. export growth in 2013 through 2016. On average, the revisions implied by this analysis are slightly larger than those of the IMF (-0.9 percentage point versus -0.7 percentage point, respectively). The IMF had smaller downward revisions in 2013, 2014, and 2016 and the same downward revision in 2015. In addition, it is also interesting to study why a growth slowdown is expected to take place in the next few years and whether it is related to a growth slowdown in the United States. Such questions are not in the scope of this analysis.

[34]In practice, the simulation length, N, is set to be eight periods (quarters).

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