Understanding International Trade in an Era of Globalization: A Value-Added Approach

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Over the past two decades, trade in intermediate inputs (goods and services that are incorporated into other products) has been growing steadily, accounting for 56 percent of world trade in goods and 70 percent in services, and the share varies greatly by country (Figure 1). The fragmentation of the production chain across borders and the increasing importance among global manufacturers of outsourcing and foreign direct investment explain the growth of intermediate trade.

As more and more products are effectively “made in the world” and intermediate inputs cross national borders several times before being transformed into a final product, traditional customs-based trade statistics—which record the full value of trade flows at each border crossing (rather than the net value-added)—have become less reliable as a measure for understanding the importance of trade as a source of economic growth. With trade-related issues still a considerable cause of friction among major economies, relying on conventional trade statistics can lead to unsuitable decisions for trade policy and multilateral trade negotiations.

The limitations of the official trade statistics have long been recognized by researchers and policymakers. There is increasingly widespread agreement that focusing on the value-added part of trade flows can distinguish the foreign and domestic content in gross exports and better reflect the contribution of trade to economic growth and job creation. However, an accurate assessment of value-added in trade has remained a challenge since it requires cross-country cooperation in order to construct a consistent and systematic global input-output (IO) table. Truly global analysis of value-added in trade has become possible only in recent years with the development of a worldwide time series of multi-country IO tables, which are expected to be made public in 2012.

It is important to state that analyzing trade flows and reassigning the value-added contribution to different countries in the supply chain does not change the top-line U.S. trade deficit. The United States imported $1.77 trillion manufacturing goods and exported $1.09 trillion in 2011—incurring a $673 billion trade deficit in manufactured goods. Ultimately, the U.S. trade imbalance is the result of the larger macroeconomic imbalance that comes from low saving (particularly large federal budget deficits) relative to investment.

The economic adjustment process that would bring the trade deficit back into balance is impeded through currency manipulation, tariffs, import restriction, discriminatory standards-setting, and a host of other impediments to free trade by many countries. These larger issues are not within

4 The OECD and the WTO have been collaborating on this issue since early 2009 and have launched the Made in the World initiative and the Global Forum on Trade Statistics. An inter-country IO table covering 50 countries for three benchmark years (1995, 2000, and 2005) is under construction. A worldwide time series of multi-country IO tables called the World IO Database (WIOD) is expected in 2012 as well; it includes 27 EU members and 13 other major economies and runs from 1995 to 2009. Four international organizations (United Nations Statistics Division, Eurostat, WTO, and United Nations Conference on Trade and Development) set ambitious goals for 2020, including establishing a specialized satellite account of trade in value-added.

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the scope of this paper. Rather, the purpose of the analysis is to disentangle flows of trade and determine who really benefits from the globalization of the production network and by how much. The findings show that the usual suspect, China for example, has not benefited nearly as much as shown in the top-line trade data.

First, case studies on popular Apple products are used to illustrate the challenges in measuring international trade on a gross basis. The main feature, though, is to present a more comprehensive picture of global trade by showing how much various countries add value to trade and where global manufacturing output is distributed by region and by production factors. Related policy implications and the challenges that countries at different development stages have to face to prosper in a globalized environment are also discussed.

ISSUES WITH GROSS TRADE STATISTICS
In a globalized production network, various stages of production are regularly performed in different countries. At each stage, a producer purchases inputs and adds value that is included in the cost of the next stage of production. As intermediate inputs cross national borders for further processing, their values are implicitly counted multiple times in traditional trade statistics that record the full value of trade flows on a gross rather than net basis. This well-known “double counting” problem means that conventional export statistics overstate the domestic value-added content of exports, making it difficult to identify the real contribution that exports can make to economic growth and employment in a country (Figure 2). By assigning the total commercial value of an import to the last country of origin, import statistics (1) understate the degree to which the importing country’s own firms benefit from trade (because part of their output might be incorporated in the goods); and (2) overstate the degree of competition that comes from one’s trading partners, leading to miscalculations about the economic dimension of bilateral trade imbalances.

An often-cited case study that clearly illustrates this issue relates to the iPhone, for which the production primarily takes place outside the U.S. though it is designed and marketed by Apple. The major producers and suppliers of iPhone parts and components include eight companies from Japan, Korea, Germany, and the U.S.; in 2009, they accounted for 70 percent of the $179 total manufacturing cost. All components were eventually shipped to mainland China for final assembly, where Chinese workers added only $6.50 to each iPhone, less than 4 percent of the total manufacturing cost. However, when a ready-to-use iPhone is exported from China to the U.S., the traditional method of measuring trade records all of the $179 as a U.S. import from China when most of the value should be attributed to parts and components from countries that precede the final assembly. Breaking down the value-added along the manufacturing value chain suggests that the contribution of the product to the bilateral trade imbalance between China and the U.S. has been significantly exaggerated (Table 1).5

Table 1 – 2009 U.S. Trade Balance in iPhones (Millions of USD)

<table>
<thead>
<tr>
<th></th>
<th>China</th>
<th>Japan</th>
<th>Korea</th>
<th>Germany</th>
<th>ROW</th>
<th>World</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross</td>
<td>-1901</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-1901</td>
</tr>
<tr>
<td>Value-Added</td>
<td>-73</td>
<td>-685</td>
<td>-259</td>
<td>-341</td>
<td>-543</td>
<td>-1901</td>
</tr>
</tbody>
</table>

*Rest of the world
Source(s): WTO, Global Forum on Trade Statistics, April 2011

Furthermore, because of the need to link and hold the global production chain together, the service content of manufactured goods has been rising over time. Conventional trade statistics, however, do not reflect the use of services as inputs for manufactured goods destined for overseas markets and thus underplay the role of services in trade. As a result, official trade data will not necessarily be able to reveal those sectors of the economy where value-added originates. This is especially troublesome for advanced industrial countries where the so-called “multiplier effect”—services generated by manufacturing, including marketing, transport, distribution, finance, and even intellectual property rights—are gaining importance in a product’s final price and can be a significant share of the domestic content of a manufactured product by the time it reaches the final user.

As for the iPod, another popular Apple device, the 2007 total manufacturing cost (including components and assembly) for a 30GB model was estimated at $144 while the U.S. retail price was $299. The $155 markup can be separated into $75 for distribution and retail in the U.S. and $80 for Apple’s design and R&D, the largest piece of value-added in the entire supply chain.\(^6\)

For many electronic products, if the value-added at each stage of the supply chain is plotted in a chart, it follows the shape of a “smile of value” curve, which was named after the U-shaped arc of a smiley face. It starts “high for branding and product concept, swoops down for manufacturing, and rises again in the retail and servicing stages.”\(^7\) It is typical that Western companies’ activities are at the two ends of the curve and capture the majority of the value in a globalized supply chain. As for the impact on employment, the iPod line supported 41,000 jobs worldwide in 2006, of which about one-third were located in the U.S. While the Asia-Pacific region accounted for almost all of the low-wage production jobs, the U.S. workers held more than 60 percent of the high-wage professional jobs in management, engineering, computer support, and retail, and earned about $750 million—three-quarters of the $1 billion total earnings for all iPod-related jobs.

Consumer electronics are relatively small, lightweight, valuable, and produced in high volume, making them amenable to a long global supply chain. Most manufactured products, however, are not so easily divisible, nor is it beneficial to lose assembly operations and the spinoff benefits that manufacturing activity has on an economy. A greater understanding of global sourcing of intermediate components and where value is added aids in understanding the severity of the problem.

GLOBAL VALUE-ADDED TRADE

Case studies of global value chains date back to the 1990s; well-known examples include products from the electronics, apparel, and automobile industries.\(^8\) Although they greatly enhance our intuitive understanding of the geographic spread of global value chains and have illustrated the discrepancy between gross and value-added trade, case studies are based on detailed microdata for a single product or sector and therefore do not provide a comprehensive picture with statistical representativeness. Truly global analysis of value-added in trade has become possible only in recent years with the development of international IO tables, which help unravel the long global supply chain and identify the origin and the use of intermediate inputs produced and traded among countries and industries. Although many statistical and methodological issues remain unresolved under this approach, various studies have already offered preliminary results to help better explain the global trade pattern and how a country fits into the integrated world economy.\(^9\)

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\(^9\) For more about the limitations of the international IO tables, see Andreas Maurer and Christophe Degain, “Globalization and trade flows: what you see is not what you get!” WTO Staff Working Paper ERSD-2010-12, June 2010, www.wto.org/english/res_e/reser_e/ersd201012_e.pdf. 

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GROSS VS. VALUE-ADDED EXPORTS BY COUNTRY

Empirical studies find that gross trade statistics significantly overstate the exchange of value-added around the world, and in 2004, value-added exports represented only 76 percent of world gross exports. The gap between the two types of exports, which is usually measured by the ratio of value-added exports to gross exports (VAX), varies greatly across regions. Countries with relatively high VAX ratios—mostly in the Americas (except for Mexico and Canada), the Middle East, and Africa, have smaller gaps between gross and value-added exports. Those with relatively low VAX ratios, mostly in Central and Eastern Europe as well as East and Southeast Asia (except for Japan, India, and Indonesia), have larger gaps (Figure 3).

The cross-country variation in VAX ratios is mainly impacted by a country’s position in the global value chain (GVC). Countries lying upstream in the chain participate by providing raw materials (such as Russia and Middle Eastern countries) and/or manufactured intermediates (such as Japan, the U.S., and the UK); their exports tend to have relatively low foreign content and high domestic content. Countries lying downstream in the GVC tend to have exports with high foreign content and low domestic content since they must import a large portion of the intermediate inputs necessary to produce final goods; examples include China, Mexico, Thailand, the Philippines, Vietnam, and Eastern European countries.10

GROSS VS. VALUE-ADDED EXPORTS BY INDUSTRY

The sector composition of world value-added exports differs greatly from that of gross exports. Manufacturing industries have much smaller shares in global value-added exports than they have in gross exports; the opposite is true for the agricultural, natural resource, and services sectors (Table 2a, on the following page). This is not surprising considering that manufacturing industries purchase inputs from non-manufacturing sectors and therefore contain value-added originating elsewhere. Breaking the aggregate VAX ratios into different sectors for selected countries can also confirm this pattern (Table 2b, on the following page).11

This cross-sector variation in VAX ratios implies that the sector composition of trade can shape the aggregate VAX ratios across countries since richer countries, which tend to trade more manufactured goods, should have lower VAX ratios. However, empirical studies find no strong correlation between the VAX ratio and income per capita, mostly because richer countries also tend to export in manufacturing sectors with relatively high VAX ratios.

**GROSS VS. VALUE-ADDED BILATERAL TRADE**

By illustrating the VAX ratios for individual exporters across destinations, researchers conclude that global production-sharing significantly distorts bilateral trade patterns as well. Not only are the bilateral trade statistics scaled down in value-added terms relative to gross terms, but the scaling factors also differ greatly across trading partners. Most of the variation can be explained by the difference in the intensity of production-sharing, not by the composition of traded goods. When intermediates cross borders several times, this inflates gross trade and pushes down the VAX ratio. The more connected two countries are in production-sharing, the bigger the gap between gross and value-added trade.

Figures 4a and 4b (on the following page) present bilateral VAX ratios for the U.S. and Germany vis-à-vis selected trading partners. For the U.S., the VAX ratios with trading partners in East Asia (Korea, Singapore, and China) and NAFTA (Canada and Mexico) are relatively low since the bilateral value-added trade is usually 35-50 percent lower than gross trade. The VAX ratios with Japan and major Western European countries are much higher, as the bilateral trade is essentially identical in gross and value-added terms. In addition, its import VAX ratios from Poland, Slovakia, and Russia exceed 1.0; this largely reflects multilateral production-sharing in which these countries send intermediates to a third country for processing and their value-added is embodied in final goods that are delivered to the U.S. for consumption (Figure 4a).

For Germany, while its trade with the U.S. and Japan is less distorted, the bilateral value-added trade is scaled down substantially for the vast majority of its European partners (especially for the Czech Republic and Hungary), a result of the integrated production chain within Europe (Figure 4b).

One important policy implication of the variations in VAX ratios across trading partners is that bilateral balances can differ substantially when measured in gross versus value-added terms. Various studies find that the U.S. trade deficit with China is 20-40 percent smaller when measured on a value-added basis while its deficits with Japan and Korea are significantly underestimated.12 China imports intermediates from

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its neighbor countries in East Asia and mainly serves as a final assembly hub for triangular trade between the U.S. and the rest of Asia. As China exports more to the U.S., Japan’s and Korea’s shares of U.S. imports have declined. The U.S. trade imbalance with Mexico and Canada falls as well after adjusting for production-sharing (Figure 5).

VALUE-ADDED DISTRIBUTION OF GLOBAL MANUFACTURING OUTPUT
To show a complete picture of the development of global production networks and better understand a country’s competitiveness in the manufacturing industry, Figure 6 presents the value-added contribution of different regions to the global manufacturing output for final products, which are products used for consumption or investment. China’s share increased from 5 percent in 1995 to 11 percent in 2006 whereas the shares of the EU and NAFTA countries declined slightly. The major loss was in East Asia (Japan, Korea, and Taiwan); the share of Japan declined rapidly while the shares of Korea and Taiwan increased. More specifically, countries in East Asia and NAFTA lost significant shares to China in machinery and equipment while NAFTA countries gained shares in business materials at the expense of East Asia and the EU (Table 3, on the following page).13

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To address concerns about the uneven distribution of benefits from global production-sharing across different groups, researchers broke down global manufacturing output into income for capital and income for labor, and found that between 1995 and 2006, total capital income increased 28 percent while total labor income increased 9 percent (among which the income for low-skilled workers went up 24 percent). The EU and NAFTA countries continued to capture the majority of labor income for high- and medium-skilled workers but lost shares for low-skilled workers to China and the rest of the world (ROW). In East Asia—especially Japan—the labor income declined for all skill types. In China, the labor income for low- and medium-skilled workers more than doubled while the income for high-skilled workers almost tripled (Figures 7a-7c, on the following page). The capital income increase in China and the ROW was very impressive as well; this might reflect the fact that China was still abundant with low-skilled labor and continued to lack capital, and some countries contributed to global manufacturing mainly through the delivery of natural resources that are highly capital-intensive in production (Figure 7d, on the following page).

**POLICY IMPLICATIONS**

The insights we have gained from measuring international trade on a value-added basis have important policy implications. On the one hand, recognizing the discrepancies between gross and value-added exports can help avoid overestimating the importance of exports as a driver of short-term demand and underestimating the importance of trade and specialization as sources of increased efficiency in the longer term. This is especially the case for emerging markets, which tend to be downstream in the global supply chain and have large shares of imported content in their exports (Figure 8, on the following page).

Take China as an example. While gross exports accounted for more than 40 percent of its GDP growth since the 1990s, only half of its exports represented domestic value-added, which contributed to 19 percent of total GDP growth in 2008.15

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14 A high-skilled worker is defined as one with a college degree or greater; medium- and low-skilled workers are divided by whether they have secondary schooling, including professional qualifications.

Figure 7a – Value-Added Contribution to Global Mfg. Output by High-Skilled Workers

Source(s): Erumban, Los, Sterher, Timmer, and Vries (2011)

Figure 7b – Value-Added Contribution to Global Mfg. Output by Medium-Skilled Workers

Source(s): Erumban, Los, Sterher, Timmer, and Vries (2011)

Figure 7c – Value-Added Contribution to Global Mfg. Output by Low-Skilled Workers

Source(s): Erumban, Los, Sterher, Timmer, and Vries (2011)

Figure 7d – Value-Added Contribution to Global Mfg. Output by Capital

Source(s): Erumban, Los, Sterher, Timmer, and Vries (2011)

Figure 8 – Gross vs. Value-Added Exports to GDP Ratio, 2004

Source(s): Daudin, Rifflart, and Schweisguth (2011)
On the other hand, with the role of trade in intermediates rising, bilateral trade balances become less meaningful. From a macroeconomic standpoint, most economists believe that it is a country’s overall trade balance with all trading partners that matters. Acting on bilateral imbalances without addressing the underlying causes of the aggregate imbalance, which is widely believed to be directly linked with a nation’s saving-investment gap, simply redistributes that imbalance across trading partners.

In addition, while the globalization of production chains helps firms in industrial countries to enormously improve efficiency and gain access to new emerging markets, and provides a new option for developing countries to quickly participate in global trade and enter global markets, it raises many important challenges for all countries that are engaged in the global production chain. For developing countries that are nearly at the end of the value chain and mainly engaged in low-skilled labor-intensive activities in most industries (including the high-tech industries such as electronics and telecommunications), the gains from the labor division on the global value chain are gradually falling and the profit space of their enterprises continues to dwindle when labor and land get more expensive and pollution and other environmental damage can no longer be overlooked. To move up the value chain, it will be necessary for these countries to develop their own technological capabilities, which requires not only increasing spending on R&D but also creating a supportive environment for innovation, including stronger intellectual property rights protection and improved compliance with international standards.

It is increasingly difficult for developed countries to compete with developing countries in products that are labor-intensive but do not require cutting-edge technology. Advanced economies have to rely more on a high-skilled and knowledge-based workforce, incorporate more technology into their products, and bring intangible assets that are not easily replicated in other countries to make their manufacturing sector competitive. The primary benefit to trade for a nation is that the expanded competition forces domestic industries to continuously reinvent themselves, employ new technology, create innovative products and processes, design new management methods, and increase productivity in order to lower costs. Superior productivity growth in manufacturing is ultimately passed on to the consumer in the form of less inflation in manufactured goods and thus a higher standard of living.

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16 Empirical studies have found evidence that China’s exports in high-tech industries, including machinery and telecommunications, have high foreign content that is sourced from Japan, Korea, the U.S., and the EU. For details, see Judith M. Dean and K.C. Fung, “Explaining China’s Position in the Global Supply Chain,” prepared for the Joint Symposium on U.S.-China Advanced Technology Trade and Industrial Development, October 2009, Tsinghua University, [http://bit.ly/wQ7Y2n](http://bit.ly/wQ7Y2n).