Implications and Interpretations of Value-Added Trade Balances

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Abstract

Recent academic work has suggested that China's exports to the United States contain a large portion of non-Chinese value added. This paper looks at what the findings of this work could suggest for U.S. and Chinese trade balances, provides some theoretical cautions in interpreting value-added trade findings, and applies those cautions to U.S. and Chinese trade balances.

The paper begins by showing that a country's reported trade balance with the world is always the same as its value-added trade balance with the world. Thus, to the extent that China's net exports to the United States are lower on a value-added than on a reported basis, China's net exports to some other countries must be correspondingly higher on a value-added basis than on a reported basis. China must also have a substantially smaller market for imported final goods than reported import data suggest. Additionally, the paper discusses data and theoretical issues in comparing Chinese value added to value added in other countries.\

Implications and Interpretations of
Value-Added Trade Balances

Recent academic work has suggested that China's exports to the United States contain a large portion of non-Chinese value added. This paper shows that these findings are subject to some arithmetic constraints that frame trade balance considerations within the context of China's changing trade relationship with the world. Additionally, this paper suggests several interpretive questions that merit further consideration.

I. Background

In GDP accounts, "value added" is gross output less intermediate inputs. From a trade standpoint, national value added is the value of national work performed (i.e., the contribution of all national factors of production) in a country's exports, thus excluding the contribution made by component production in other countries. For example, if a Chinese company imports $4 of inputs from Japan, assembles those parts in China, and exports the final product to the United States for $5, then Chinese output and reported exports are $5, but Chinese value-added exports are only $1. Thus, a country's value-added exports can be less than its total exports, as it may have imported some inputs, done some additional work, and then included those imported inputs in its own exports. There has always been the potential to misinterpret one country's exports as entirely the product of that country; recent economic work has suggested that because supply chains are more globalized than ever before, reported exports are a less useful proxy for value added performed in a country than ever before.[2]

As Charles McMillion points out,[3] some of these recent results have been used in popular media to make it sound as if China is not really performing much value

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[2] See, for example, Hammer, Koopman, and Martinez, "Overview of U.S.-China Trade in Advanced Technology Products," May 2011, on the issue of Chinese value added in Chinese exports of advanced technology products to the United States.

[3] McMillion, "China Trade Apologists Know a 'Reality' That is NOT True," October 21, 2011.

added, and therefore the U.S. trade deficit with China may not be a large concern.[4] For example, the *Wall Street Journal* reported that some researchers claimed that traditional trade balance measures "exaggerate" trade imbalances.[5] This paper discusses trade balances in the context of the new work being performed on value-added trade, and asks what conclusions about trade balances can be drawn from the recent work on value-added in trade.

II. The Constraint: Trade Balances With the World Must be the Same on Both the Reported and the Value-Added Basis

To understand the effect of using value-added trade balances rather than reported trade balances, one must recognize that at the level of trade with the entire world, any country's reported and value-added trade balances must be the same. For this discussion, a "reported trade balance" will refer to the common measures of a country's trade balance as currently used, i.e., reported exports[6] minus reported imports. A "value-added trade balance" will refer to the usually unmeasured trade balances of a country as the domestic value added in its own exports that stays in foreign markets minus the foreign value added in its imports that stays in the country.

As an example of the differences in these definitions, consider the following hypothetical transaction. China imports components from Japan and assembles them into a cellular phone that it exports to the United States. On a reported basis, China

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[4] McMillion also critiques the findings of Linden et al on the Apple iPod. Those findings alleged that roughly 4 percent of the value of an iPod is performed in China. The author of this paper notes that Linden et al attribute the Broadcom processor in an Apple iPod either to the United States or to Singapore and Taiwan, but that Broadcom's own website notes that it may produce processors in China as well. See Linden, Kraemer, and Dedrick, "Who Captures Value in a Global Innovation System?" 2007, and Broadcom, "Factsheet," 2011. Later work by Linden et al. acknowledges that the majority of the production jobs in the iPod production chain are in China (Linden, Kraemer, and Dedrick, "Innovation and Job Creation in a Global Economy," 2009).

[5] Batson, "Not Really 'Made in China,'" December 15, 2010. Other examples are cited by McMillion. Often articles on the subject may not overtly state that the recent value-added work shows that the China is not running a large trade surplus with the world. However, the articles will place the work in the context of critiquing those who have raised concerns about China's currency policies or trade surpluses. See, for example, Gang, "Behind China's Trade Deficit," April 30, 2010.

[6] This definition is equivalent to the "gross exports" term used in Koopman et al., "Give Credit Where Credit is Due," 2010. This author prefers the term "reported" as "reported" makes clear that the reference is to the actual data as reported by countries' governments.

now runs a trade deficit with Japan (the value of the imported components) and a trade surplus with the United States (the value of the entire exported cellular phone, with both Chinese and Japanese content). However, on a value-added basis, China runs no trade deficit with Japan (Chinese imports do not stay in China but are instead exported to the United States), and a smaller trade surplus with the United States (only the value of the assembly work performed in China).

To understand how value-added analysis will affect trade balances, one must recognize a crucial constraint: *a country's reported trade balance with the world must be the same as its value-added trade balance with the world*. The following analysis will demonstrate this point.

A country's reported trade balance includes the trade in intermediate products that will go into final products that are in turn re-exported or re-imported, whereas its value-added trade balance does not.

Thus, a country's reported exports include three types of value added: domestic value added that stays overseas, domestic value added that will return home embedded in imports, and foreign value added embedded in the country's reported exports. Similarly, a country's reported imports include three types of value added: foreign value added that will stay in the country for consumption, domestic value added that was previously exported, and foreign value added that will be re-exported (and counted within reported exports).[7] The reported trade balance is the difference between these reported exports and reported imports.

On the other hand, a country's value-added trade balance with the world is the difference of only two items from above: its exports of domestic value added that stay overseas less imports of foreign value added that stay in the country.

Importantly, as shown in table 1, with regard to a country's trade balance with the entire world, the additional terms in the reported trade balance will always cancel out exactly, i.e., have no net effect. In the table, the terms marked (1) are equivalent and will net each other out, as will the terms marked (2). The (1) and (2) terms represent value added that must travel both as an import and as an export, and so will always cancel out exactly. Thus, at the level of trade with the entire world, a country's reported trade balance with the world must be the same as its value-added trade balance with the world.

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[7] This paragraph reflects the analytical framework in Koopman et al., "Give Credit Where Credit is Due," 2010.

As an example of (1), assume China exports steel to Korea. Korea takes the Chinese steel and makes auto parts that it exports to the United States. The United States takes those parts (containing Chinese-made steel) and uses them to make autos, which China then imports. The Chinese value-added in its steel is counted both as a Chinese export of value-added to Korea and as a Chinese import of value added from the United States (embedded in China's auto imports). Thus, from the standpoint of China's trade balance with the world, the exports and imports of steel will cancel each other out exactly.

TABLE 1 The equivalence of reported and value-added trade balances at the level of trade with the entire world

Item	Exports	Imports	Net
Reported trade balance with the world	Domestic value added that stays overseas	Foreign value added that stays home	Domestic value added that stays overseas minus foreign value-added that stays home
	+	**+**	
	(1) Domestic value added that will return home in imports	(1) Domestic value added that is embedded in imports	
	+	**+**	
	(2) Foreign value added that is embedded in exports	(2) Foreign value added that will be embedded in exports	
Value-added trade balance with the world	Domestic value added that stays overseas	Foreign value added that stays home	Domestic value added that stays overseas minus foreign value added that stays home

Source: Author, 2012.

Similarly, as an example of (2), assume China imports components from Japan and uses those components to make cellular phones, which it then exports to the United States. Considering China's trade balance with the world, the Japanese value added in the components will count both as a Chinese import from Japan and as a Chinese export to the United States (embedded in China's exports of the cellular phones), and thereby cancel out.

At the level of bilateral trade, the (1) and (2) terms do not necessarily cancel and so a bilateral value-added trade balance can be different from a reported bilateral trade balance, as discussed in the "background" section above. This potential difference between bilateral value added and reported trade balances is a key insight of most of the value-added literature. However, it is also important to remember the constraint that at the level of trade balances with the world, value-added and reported trade balances must be equal.

As a corollary to the constraint, *all of a country's bilateral value-added trade balances must sum to its reported trade balance with the world*. This is so because a country's value-added trade balance with the world is the sum of all of a country's bilateral value-added trade balances. Since the value-added and reported trade balances with the world are the same, then so too the sum of all of a country's bilateral value-added trade balances must sum to its reported trade balance with the world.[8]

This corollary means that, while any country's bilateral value-added trade balance with one country might be different than its reported bilateral trade balance with that country, the difference must be accounted for in its total trade balance with all other countries.

The analysis can be applied to the current value-added trade literature. For example, the USITC estimated that in 2004, the U.S. value-added trade deficit with China was about $75 billion rather than the reported 2004 U.S. trade deficit with China of about $125 billion.[9]

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[8] The constraint and its corollary come from the definition of value added. At the firm level, value added is the firm's output less its inputs. While it may buy inputs from some supplier firms and sell outputs to other purchasing firms, the sum of all those relationships (all its outputs less all its inputs) is the same as its total value added. Similarly, while a country may be a net importer from some countries and a net exporter to others (including importing inputs from some countries that it assembles into exports to other countries), the sum of all of its bilateral value-added trade balances with individual countries is the same as its reported trade balance with the world.

[9] Figures are author's estimates based on box 3.4 from USITC, *Economic Effects of Significant Import Restraints*, 2011. Using a different aggregation of data, the U.S. Commerce Department reported a 2004 U.S. trade deficit with China of $162 billion.

However, China's 2004 reported and value-added trade surplus with the world is still the same. Thus, if China's trade surplus with the United States is $50 billion lower on a value-added basis, then China's trade surplus with all other countries (i.e., the rest of the world) must be $50 billion higher on a value-added basis.

Similarly, in 2011, economists Johnson and Noguera wrote, based on 2004 data, that "the US-China imbalance is approximately 40 percent smaller when measured on a value-added basis."[10] This magnitude is similar to the results reported by the USITC, and again suggests that China exported a substantial amount of value added to other countries in 2004.

As a general point, any claim that the Chinese trade surplus with the United States is substantially lower on a value-added basis than on a reported basis mandates a fascinating corollary—China is running a much higher value-added trade surplus with other countries than is currently known.

To which countries did $50 billion of 2004 Chinese net exports go? One possible answer is that China's value-added trade balance with certain countries, such as Japan, is more positive (or less negative) than its reported trade balance with those countries. That is, Chinese reported exports to Japan may have substantial Chinese value added, while its reported imports from Japan could be mostly exported again to third countries, meaning that they would not count as part of China's value-added trade balance. However, no matter which countries China's net exports end up being assigned to on a value-added basis, one should remember that the $50 billion cannot disappear from China's net exports.

III. China Has a Large Trade Surplus With the World; Therefore It Is Not Just a Final Assembly Point

Some have used the work done on value-added trade balances to suggest that China is mostly a final assembly point that adds little value to its exports. For example, in a December 2011 presentation, economists Kee and Tang postulated that "[d]omestic value added in Chinese exports may be far less than actual gross export[s]."[11] Similarly, in 2008, former U.S. Labor Secretary Robert Reich stated that if one were to "subtract

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[10]   Johnson and Noguera, "The Value-added Content of Trade," June 2011.
[11]   Kee and Tang, "Domestic Value-added in Chinese Exports," December 2011.

what's merely assembled in China" then "more than half of China's trade deficit [sic][12] disappears."[13] The Cato Institute's Daniel Griswold described China as "the final assembly operation in a global factory."[14]

These claims are not consistent with some of the work that has been performed so far. In 2011, the USITC estimated that in 2004, about 15 percent of Chinese value added imported into the United States went through third countries, and that Chinese imports had low Chinese value added.[15] In this report, the USITC did not make any claim that China is merely a final assembly platform for products produced elsewhere. Indeed, by dividing the USITC estimate of China's 2004 share of U.S. value-added imports (7.7 percent) by China's 2004 share of U.S. reported imports (11.1 percent), one can estimate that the 2004 U.S. imports of Chinese value added were equal to about 70 percent of the value of 2004 reported U.S. imports from China. This 2004 finding is not consistent with China being mostly a final assembly platform, at least for China's exports to the United States.

Moreover, the analysis in section II above (i.e., that trade balances with the world must be the same on a reported and value-added basis) provides some context and implications for these claims. The constraint shows that, if China's reported trade surplus with the world is large as a percentage of its reported imports, then it must be exporting substantial value-added somewhere. In such a situation, it cannot be mostly a final assembly point.[16]

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[12]   Reich may have intended to mean the U.S. trade deficit with China, but his misstatement is perhaps indicative of a wider problem of confusing the possibility that the U.S. value-added trade deficit with China is lower than the reported U.S. trade deficit with China with the impossibility of China's trade surplus with the world being lower on a value-added basis than on a reported basis.

[13]   Reich, "Don't Blame China for the Trade Deficit," January 2008.

[14]   Griswold, "U.S.-China Trade a Collaborative Effort," April 2010.

[15]   USITC, *Economic Effects of Significant Import Restraints*, 2011.

[16]   The reverse is not necessarily true. That is, a small reported trade surplus is not necessarily a sign that a country is a final assembly point. Instead, the country could be importing and exporting completely unrelated products in roughly the same volumes.

IV. When China has Lower Value-Added Exports Than Reported Exports, Then It Must Also Have a Smaller Final Import Market Than the Reported Data Show

It is also important to note that if China's value-added exports are lower than its reported exports, then its final consumption of imports is also lower than its reported imports. In other words, if China is importing a lot of products for processing into further exports, then China's imports of products for final consumption are that much lower than its reported imports.

China's imports of goods include both (1) imports that stay in China (i.e., are not re-exported) and (2) imports of foreign value added that will be re-exported after further Chinese processing. China's market for goods that stay in China will consist of (1), but not (2). That is, China's imports of goods that stay in China and are not re-exported are equal to its reported imports minus the non-Chinese value-added in China's exports.[17]

Using a simple numerical example, assume that only 60 percent of China's reported exports to the world consisted of Chinese value added. (This assumption closely matches the 60.6 percent estimate from China's National Bureau of Statistics, and used in Koopman et al. (2010)).[18] If so, then we must subtract the other 40 percent of China's reported exports from China's reported imports to understand how much of China's imports are actually intended for Chinese final consumption, and not for re-export as part of another product.

Using this assumed ratio (60 percent of China's reported exports are China's value added) on China's 2010 exports of $1.6 trillion yields an estimate that $630 billion of China's 2010 reported exports were actually value added from other countries. In turn, however, such an estimate also means that of China's 2010 reported imports of $1.4 trillion, only $760 billion[19] was actually for Chinese final consumption. Thus, when China is not adding much value to its exports, then it must be true that the size

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[17] Here, for ease of analysis, "goods that stay in China and are not re-exported" include imports of Chinese value added previously exported and now embedded in imports. If such imports exist, then Chinese imports of foreign value added will be less than reported imports minus the non-Chinese value added in Chinese exports, by the amount of imported Chinese value added.

[18]   Koopman, et al., "Give Credit Where Credit is Due," 2010.

[19] That is, China's reported imports of $1.4 trillion less the foreign value added in China's exports of $630 billion.

of the Chinese market for imported final goods is also substantially smaller than might be assumed from the reported import data or press reports.

It is common in the press to see descriptions of China's market for imports as potentially "vast."[20] However, if China's exports consist of a large portion of foreign value added, then its market for imports for consumption must be less vast than reported import data may suggest.

V. Chinese Data and Value Added

Another important reason for recognizing the constraint (i.e., that a country's reported trade balance with the world must be the same as its value-added trade balance with the world) is that the constraint can act as a way to examine the likely growth of Chinese value-added over time. Economic data may not always keep up with rapid changes in the Chinese economy. The analysis in Koopman, Wang, and Wei (2008)[21] was based on a 2002 domestic value-added multiplier, and resulted in China adding only 50 percent of the value added in its exports, and a much lower percentage in high-tech products. Koopman eta al. (2010)[22] uses a higher 2007 domestic value-added multiplier of 60 percent of Chinese value-added in Chinese exports. This increase is consistent with economic literature showing that China is moving up the value chain.[23]

Data for some broad categories covering China's trade in machinery and electronics illustrate the difference in the nature of China's trade from 2002 to now. In the Harmonized System (HS) of tariff classifications, HS 84 covers machinery and HS 85 covers electronics products, two broad categories that account for a large portion of China's trade with the world. Table 2 shows the change in China's trade balances from 2002 to 2011 in these categories. Irrespective of the reasons for this change, it will

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[20] See, for example, Hepker, "US to Meet China in Washington to Tackle Thorny Issues," May 2011, and Xinhua, "A Billion Buyers," January 2011.

[21] Koopman, Wang, and Wei, "How Much of Chinese Exports is Really Made in China?" 2008.

[22] Koopman, et al., "Give Credit Where Credit is Due," 2010.

[23] In 2007, economists Li Cui and Murtaza Syed ("The Shifting Structure of China's Trade and Production," 2007) described the processing trade story as a "caricature." Their analysis suggests that by 2006 and 2007, China's production profile had shifted its emphasis away from export processing and toward more sophisticated production. See also Preeg, "U.S. and Chinese Trade Imbalances in Manufactures Surge," 2011, which discusses China's success at moving up the value chain of exports.

affect any work based on the older data. As can be seen from the tables, China's global trade in these categories changes dramatically from 2002 to 2011. In 2002, China's trade flows are consistent with the profile of a country that imports a large amount of parts from other countries and assembles them for export to the United States. By 2010, that profile is no longer accurate, because China is a large net exporter of machinery and electronics to both the United States and the rest of the world.

TABLE 2 China's trade balance in HS 84 and HS 85, selected years between 2002 and 2011

	2002	2004	2007	2010	2011
Category	Trade balance *(billions of dollars)*				
HS 84 with the United States	6.5	22.2	41.0	58.1	66.5
HS 84 with the rest of the world	-7.9	4.6	63.3	79.5	87.9
HS 85 with the United States	8.5	19.1	43.2	46.1	54.1
HS 85 with the rest of the world	-16.7	-31.4	-0.4	28.4	40.8

Source: Global Trade Atlas data for China, February 2012.

Indeed, for electronics products (HS 85), even the difference between 2007 and 2010 is stark. China goes from running a trade deficit in these products with the rest of the world to running a trade surplus, even as its trade surplus in these products with the United States grows steadily.

While trade data are available within a few months of the events they represent, domestic value-added data are not so quickly available. This gap may indicate a need for caution in applying results from past years, even relatively recent past years, to the current time period.

VI. What Do the Measurements Actually Mean?

Another cause for exercising caution in the interpretation of value-added trade lies in how to interpret the value-added in a country's exports, and is best illustrated with a hypothetical example. Imagine a three-country world consisting of the United States, China, and Taiwan. At first, Taiwan manufactures widgets and exports them to the United States at a cost of $100 per widget. Widget production consists of producing widget inputs (which cost $50) and assembling them (which also costs $50 in Taiwan).

Then, Taiwan offshores the second stage, manufacturing widget inputs with a value of $50 and exporting them to China. China assembles the inputs for only $25 per unit. Finally, China exports the $75 finished widget to the United States.

Caution is recommended in claiming now that China only adds one-third ($25) of the value added of the finished widget ($75). Using Taiwan production costs as the metric, China is adding half the value ($50). From a Taiwan cost basis, $50 does not buy as much production as $50 in China does.

There are two possible reasons why China is able to perform the second step of the production process at lower cost than Taiwan: a market reason and a policy reason. Each reason would affect the analysis of China's lower value-added differently.

The first possibility, the market reason, is that China is able to perform the assembly less expensively because free trade has allowed the use of less-expensive Chinese labor in a global market. If so, then it may be accurate to describe China as adding $25 of value, or one-third of the value of its export. In this case, the less-expensive widget is the result of a gain from trade.

The second possibility is that Chinese Government policies have allowed Chinese firms to perform the second step at a lower cost. These policies (as with those of any country) could include labor regulations, currency policy, and sectoral support policies. To the extent one believes Chinese Government policies are the explanation for lower value added in China, then interpreting China's value-added as only $25, or otherwise suggesting that this final stage of production is economically less important than the first stage may not be correct.[24]

As a general point, if any government provides support to its industry, that industry may appear to be adding little value if the government support is not counted in the data on its value-added. Similarly, if two countries have very different labor regulations that reflect different political systems or preferences, those different regulations could lead to different labor costs and thus different value-added for similar work. Depending on the larger issue being examined, interpreting value-added trade flows between countries may require more consideration of these kinds of potential policy differences.

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[24] In such a circumstance, if one measures trade flows using reported exports rather than value added, one may actually end up with a more accurate measure of real work being performed, albeit for the wrong reasons. However, the point here is not necessarily to advocate using reported exports with this interpretation, but to note that value-added trade still does not account for the issues described above.

VII. Conclusion

There is no question that investigation of the value added in countries' reported trade flows will allow a much greater understanding of value-added trade flows between countries, as the work to date already has. However, it is important to remember the constraint that any country's value-added trade balance with the world must equal its reported trade balance with the world. The implications of that constraint for China's trade include that, if China has high foreign value added in its exports, then its market for imported products that stay in China is also smaller. Additionally, while China runs a large trade surplus with the world, so it cannot be mostly a final assembly point. Keeping the constraint in mind may also help interpretation of recent value-added work in light of some potential data issues. Finally, the theoretical question of why one country is able to produce one stage of production less expensively than another remains important in interpreting any results.

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