June 14, 2012

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Testimony before the U.S.-China Economics and Security Review Commission
Hearing on the Evolving U.S.-China Trade and Investment Relationship

1. Motivation: What can go wrong with standard trade statistics?

When an American customer orders the next model of iPhone from Apple's online store, the phone will be shipped out of China by a Taiwanese-owned company called Foxconn. The official trade statistics will record an export by China to the United States on the order of $200 per smart phone (the retail price will be higher due to a fat sales margin charged by Apple). Of course, the product is designed in California and uses many components from Japan, Korea and other economies. In fact, the Chinese value added that is exported will be on the order of only $10, or about 5% of the recorded export value. At the same time, via the shipment of iPhone from China, Japan and Korea also export their value added to the United States, even though such exports do not show up in the US official customs data. In this example, the standard trade statistics exaggerate the true exports of value added from China to the United States, and miss the exports of value added from Japan and Korea to the United States. In other words, the standard trade statistics may provide a misleading picture of who produces for whom.

As we will see, the extent of imported inputs embedded in China's iPhone exports turns out to be extreme, not representative of most of China's exports. Nonetheless, the pattern that China's exports to the United States embed certain amount of inputs from other countries is relatively common. In contrast, the U.S. exports to China embed comparatively less foreign content. As a result, the true Chinese trade surplus against the United States in value added terms is smaller by about 40% than what is recorded in official trade statistics.

For a number of important questions, such as a country's true comparative advantage, bilateral trade balance, and consequences of trade policies, one has to go beyond standard trade data and make use of estimates on trade in value added.

Below, after briefly summarizing three approaches to estimating trade in value added, I will devote most space to discussing some main findings and implications for trade policies.

2. Corrective actions: How to estimate true value added in trade?

There are three approaches to extract exports of true value added: (a) case studies of individual products or industries, (b) decomposition of a country's gross exports into exports in value added and other "double counted" terms by using a combination of input-output data and official trade statistics, and (c) a survey of exporting firms on their use of domestically produced and imported inputs.

2.1 Case studies

Case studies on global value chains based on detailed micro data for a single product or a single sector in industries such as electronics, apparel, and motor vehicles have provided detailed examples of the discrepancy between gross and value-added trade. According to a commonly cited study of the Apple iPod (Dedrick, Kraemer, and Linden, 2008), while the Chinese factory gate price of an assembled iPod is $144, only $4 constitutes Chinese value added. Other case studies of specific products show similar discrepancies. Case studies, while enhance our intuitive understanding of global production chains in particular industries, cannot offer a comprehensive picture of the gap between value added and gross trade and an economy's participation in cross-border production chains.

2.2 Extracting domestic value added in trade from input-output tables and official trade statistics

A more systematic approach to decompose a country's exports into domestic and foreign value added has to use the country's input-output table together with official trade statistics. The input-output table provides information on how the production in any sector uses inputs from all other domestic sectors and from foreign sources. Instead of focusing on a single product or a single sector, one can obtain information for all sectors.

The first attempt to isolate foreign and domestic content via this way was by Hummels, Ishii, and Yi (2001) (HIY in subsequent discussion). They suggested that a country can participate in vertical specialization in two ways: (a). uses imported intermediate inputs to produce exports; (b) exports intermediate goods that are used as inputs by another country to produce goods for exports. However, a key assumption in the HIY approach is that the intensity in the use of imported inputs is the same between production for exports and production for domestic sales. This assumption doesn't hold in general. For many countries, for any given sector, more imported inputs tend to be used in the production for exports than that for domestic sales. Such a violation is particularly severe for countries like China, Mexico, and Vietnam, for which a significant portion of exports is done through what is called "processing exports." Firms that produce for "processing exports" can usually receive tariff exemptions on the imported inputs they use. Taking advantage of this favorable tariff treatment, they tend to use substantially more imported inputs than firms that produce the same or similar products but primarily for the domestic market.

A generalization of the HIY approach that explicitly allows for potentially different input-output coefficients for production for exports versus production for domestic sales has been developed by Koopman, Wang, and Wei (2012). They then apply the new methodology to decompose China exports into China's value added and foreign value added in 1997, 2002, and 2007 – 2007 is the latest year for which a Chinese input-output table is available. This allows one to see both the level and the time trend in the share of domestic value added in China's exports. We will summarize some of the key findings later.

There are other attempts to extract information on trade in value added by first estimating an inter-country input-output table using data on a group of countries' individual input-output tables and their bilateral official trade statistics. Such an attempt include Daudin, Rifflart, and Schweisguth (2011), Johnson and Noguera (2012), and Koopman, Power, Wang and Wei (2010).

The approach by Koopman, Power, Wang, and Wei (2010) provides a systematic way to further decompose foreign value added in a country's exports into terms that can be attributed to individual foreign countries and sectors, rather than simply excluding foreign value added from

official trade statistics. (It also decomposes domestic value added into different domestic sectors.) The framework thus makes it possible to estimate at which stage "double counted" foreign value added terms enter into a country's production and official exports statistics. Relative to the other approaches, this additional information on the structure of the double counted items provides a way to quantify the extent to which a country's participation in the global production chain in a given sector is more likely to be at the upstream or the downstream. This will turn out to be useful to think (or re-think) about who will bear the ultimate burden of a given trade policy action by an importing country.

2.3 Firm-level information

Another approach is to directly work with firm-level information. The idea is simple. If one can ask all exporting firms which inputs they import and which inputs they source from domestic firms, one can compute the foreign content share in exports as the ratio of the imported input values to firm exports. A clear advantage of this approach is that one can avoid assuming that exporting firms have the same propensity to use imported inputs as firms that sell mainly in the home market.

However, this approach has its shortcomings. Many of the inputs purchased from domestic firms can contain imported content. In fact, most small and medium exporting firms buy inputs from domestic wholesalers, and do not have a reliable way to estimate the share of foreign content in the inputs they buy. On the other hand, some of the imported inputs can contain domestic value added. The latter is especially important for firms in a high-income country that specializes in the upstream of a global production chain.

3. Key insight: What do the new estimates say about trade patterns and trade policies?

3.1 Low but increasing domestic value added in China's total exports

Table 1 presents the results from Koopman, Wang, and Wei (2012) on the decomposition of China's aggregate exports into foreign and domestic value-added shares in 1997, 2002 and 2007. The estimated aggregate domestic value added share in China's merchandise exports was 54% in 1997, and 60.6% in 2007. In other words, in China's exports, the foreign content, or the indirect exports by other countries through China, is substantial (about 39.4% in 2007). Over time, however, the share of foreign value added in China declines.

Kee and Tang (2012) complement the above analysis by using firm-level data on exports and imports for Chinese processing exporters over 2000-2006. They find that the average share of domestic value added has risen from 52% in 2000 to 60% in 2006.

Whether the share of domestic content in China's exports should increase or decrease over time is not pre-ordained. There are conflicting forces at work. On the one hand, as domestic input suppliers increase their quality over time, and multinationals move more and more of their upstream production into China, exporting firms may decide to increase local sourcing of their inputs. On the other hand, reductions in the country's trade barriers especially since China's accession to the WTO a decade ago also encourage exporting firms to use more imported inputs. These two opposing forces partially offset each other. However, on net, the domestic content share in China's exports appears to be on the rise. Looking ahead, the share of imported content in exports could fall or rise, depending on the relative speed with which domestic input suppliers

and multinationals can step up their quality and variety versus the extent of additional reductions in the cost of using imported inputs.

3.2 Seemingly sophisticated sectors are more likely to have a high foreign content share

In Table 2, we can see the top 10 sectors in terms of the share of foreign content in China's exports. The table also reports the shares of processing and foreign invested enterprises exports in each sector's exports as they tend to drive the patterns on the relative use of imported inputs. These have a share of foreign value-added in their exports at 50 percent or more; they collectively account for about 32 percent of China's total merchandise exports. Interestingly, the high foreign content sectors are concentrated in high-tech sectors.

Over time, however, sectors with a relatively high domestic content tend to rise in relative importance. This is true for some capital intensive industries such as automobile, industrial machinery and rolling steel. This suggests that China's industrial upgrade is real. Multinational firms play an important role in this process as they move some of their upstream production to China.

3.3 The Chinese exports to USA contain a higher foreign content share

Not all destinations in the Chinese exports have the same domestic/foreign content, partly because exports to different countries vary by sector and by the relative importance of processing exports. Hong Kong, the United States, Singapore, Taiwan and Malaysia are the top 5 destinations in terms of the share of foreign value added in China's exports, with less than 60 percent of China's domestic value-added embodied in its exports in 2007 (Koopman, Wang, and Wei, 2012). The lower domestic value-added share in its exports to the U.S. may partially explain why Chinese exports have continued their rapid expansion in the U.S. market despite an appreciating RMB since July 2005.

3.4 Revealed comparative advantage needs to be based on trade in value added

The concept of revealed comparative advantage (RCA for short), proposed by Balassa (1965), is useful in many policy applications. In standard applications, it is defined as the share of a sector in a country's total gross exports relative to the world average of the same sector in world exports. When the RCA exceeds one, the country is said to have a revealed comparative advantage in that sector; when the RCA is below one, the country is said to have a revealed comparative disadvantage in that sector. The problem of multiple counting of certain value added components in the official trade statistics suggests that the traditional computation of RCA could be noisy and misleading.

Computing RCA based on trade in value added can change our views about comparative advantage in some instances. As an illustration, we select two sectors ("finished metal products" and "business services') (the detail can be found in Koopman, Power, Wang, and Wei, 2010). In Figure 1, we report the two sets of RCA indices for the finished metal products sector. Using gross exports data, both China and India show a strong revealed comparative advantage (ranked the first and fourth, respectively, among the set of countries in our database, and with the absolute values of RCA at 1.94 and 1.29, respectively). However, when looking at domestic value added in that sector's exports, both countries ranking in RCA drop precipitously to 7th and 15th place, respectively. In fact, for India, the sector has switched from being labeled as a comparative advantage sector to a comparative disadvantage sector. Unsurprisingly, the ranking for some other countries moves up. For example, for the United States, not only its RCA ranking

moves up from 10th place under the conventional calculation to the 3rd place under the new calculation, finished metal products industry also switches from being labeled as a comparative disadvantage sector to a comparative advantage sector.

For the "business services" sector, using official data on gross exports, India exhibits a strong revealed comparative advantage in that sector on the strength of its unusually high share of business services exports in its overall exports. However, once we compute RCA using domestic value added in exports, the same sector becomes a comparative disadvantage sector for India! One key reason for the change is that business services in advanced countries are often exported indirectly by being embedded in these countries manufacturing exports. Indeed, the RCA rankings for this sector in the United States, the European Union and Japan all move up using data on the domestic value added in exports. Therefore, compared to the share of this sector in other countries' exports (after taking into account indirect value added exports), the Indian share of the sector in its exports becomes much less impressive.

3.5 Bilateral trade balances from the standard trade data are misleading

Because a country's gross exports embeds value added from other countries, bilateral trade balance in value added terms can be very different from bilateral balance in gross trade terms. While this point is already well understood qualitatively, the exports decomposition results allow us to quantify the difference.

Figure 2 provides a scatter plot of the trade balance in value added terms against the trade balance in standard trade statistics for all bilateral country-pairs based on the calculations in Koopman, Power, Wang and Wei (2010). Without loss of generality, the two countries in any pair are always ordered in such a way that the trade balance in gross term is non-negative. A negative value-added to gross BOT ratio indicates there is a sign change between BOT measured in gross and value-added terms. All observations that lie below the 45 degree line have their bilateral trade imbalances smaller in value-added terms than those in gross terms, and vice visa for observations that lie above the 45 degree line.

Value-added flows give a much different picture of the contributions of China and Japan to the U.S. and Western EU countries' trade deficits. Because China is the final assembler in a large number of global supply chains, and it uses components from many other countries, especially East Asian countries, its trade surplus with US and Western EU countries measured in value-added term is 41% and 49% less than that measured in gross terms. In contrast, Japan's trade surplus with the U.S. and Western EU countries are 40% and 31% larger measured in value-added terms, because Japan exports parts and components to countries throughout Asia that are eventually assembled into final products and exported to the United States and Western EU countries. The true trade pattern for Korea is similar to that for Japan.

Zooming in near the origin shows that the trade balances of a number of country pairs even have opposite signs measured in value-added and gross terms. For example, Japan's trade balance vis-à-vis China is switched from surplus to deficit in value added terms. This is because some of Japan's exports of components to China are actually indirect exports to the United States and the European Union. Once these component exports are excluded, Japan runs a deficit against China.

It is important to point out that the calculations of trade in value added do not alter a country's multilateral or overall trade balance; it simply redistributes the multilateral balance among the trading partners. Therefore, neither China's, nor America's overall trade balance is affected by the computation of trade in value added.

3.6 Be Aware of self-inflicted injuries from trade policies

Because the United States and many other high-income countries tend to specialize in the upstream of the global production chains, their imports from developing countries often contain a relatively high share of their own value added (and those from other high-income countries). For example, for imports by the United States, 8.3% of the value reflects its own value added (which are embedded in US exports of intermediate goods to other countries that, in turn, returned home in other countries' exports). In comparison, for imports by China, only 0.9% of the import value reflects its own value added (Koopman, Power, Wang, and Wei, 2010).

This structure of value added implies that an increase in trade barriers in a typical high-income country tends to hurt domestic upstream firms and firms in other high-income countries as collateral damage. The self-inflicted injuries are more likely to take place for trade policies in a high-income country that specializes in the upstream of a global production chain than a developing country that specializes in the downstream.

Because China's production factors, skill sets, and wage rates are more similar to other developing countries in Asia and elsewhere than to the United States, if a US trade policy change were successful in reducing the Chinese exports, the same production that used to be done in China is more likely to move to other developing countries than to come to the United States. In this sense, a part of the US deficit against China can be replaced by a higher deficit against other developing countries.

To the extent that other developing countries are higher-cost producers than China, their exports increase may not be as big as the reduction in China's exports. The US exports of business services, equipment, and other upstream inputs to the relevant global production chains would also fall in proportion.

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Table 1 Shares of domestic and foreign value added in China's total exports (%)

	1997	2002	2007
Total Foreign value-added	46.0	46.1	39.4
Total Domestic Value-added	54.0	53.9	60.6

Source: Estimation by Koopman, Wang, and Wei (2012).

Table 2: Top 10 Sectors with the Highest Imported Value Added in China's Exports, 2007

IO Industry description	Decomposition		processing exports as % of total exports	Share of exports by foreign-invested firms
	Foreign value added as % of exports	Domestic value added as % of exports		
Electronic Components	67.7	32.3	83.1	89.8
Household Audiovisual Apparatus	67.4	32.6	93.4	79.1
Electronic computers	66.2	33.9	97.9	93.3
Cultural and office equipment	63.5	36.5	91.7	86.4
Other electronic and communication equipment	60.3	39.7	84.8	81.6
Telecommunication equipment	56.4	43.6	79.3	83.6
Shipbuilding	56.2	43.8	89.4	16.5
Petroleum feline and Nuclear Fuel	55.6	44.4	50.1	27.3
Measuring Instruments	54.2	45.8	81.2	73.3
Synthetic Materials	52.4	47.7	67.7	66.1
Average over all exports	39.4	60.6	50.1	55.7

Source: Koopman, Wang, and Wei (2012).

Figure 1: Value-added-adjusted Revealed Comparative Advantage Indicators
Source: Koopman, Power, Wang, and Wei (2010)

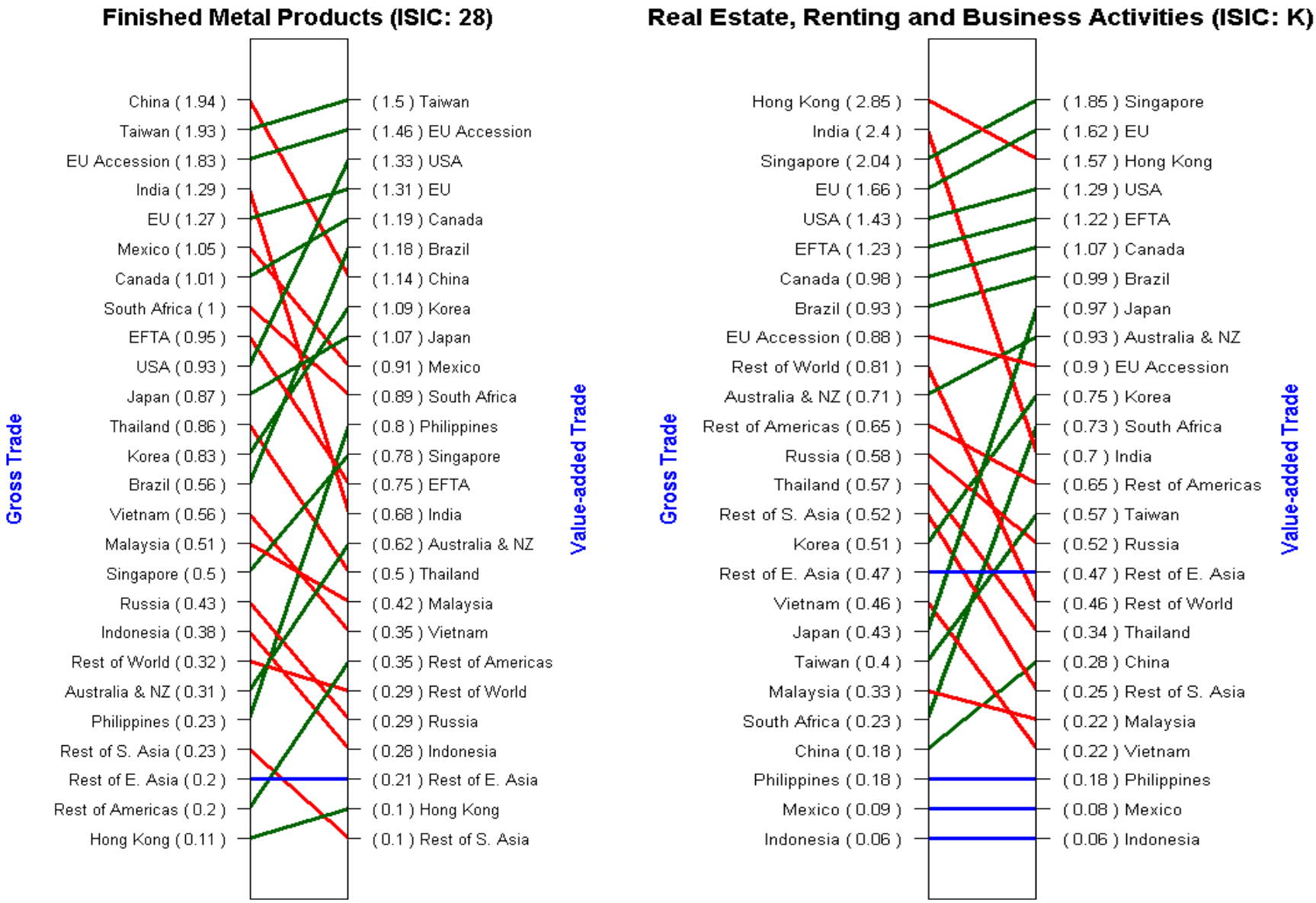
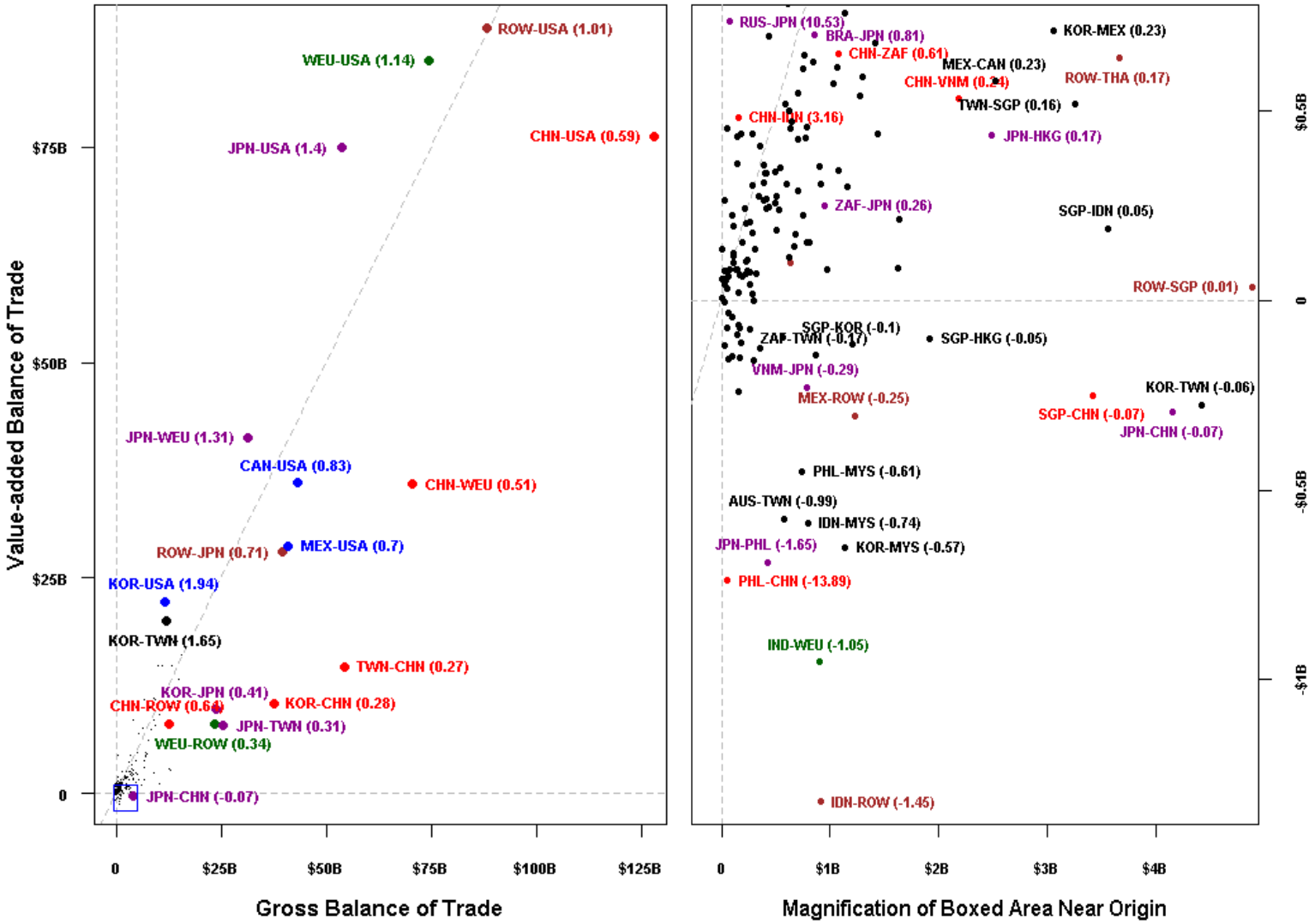


Figure 2: Bilateral Balances of Trade in Official Data versus in Value Added Terms, 2004

Source: Koopman, Power, Wang, and Wei (2010)



Note: The first country labeled in each pair is the surplus country while the second runs a deficit. Numbers in parentheses are the ratio of value-added to gross surplus.