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OUTSOURCING AND TRADE IMBALANCES: THE UNITED STATES–CHINA CASE

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Abstract. Trade imbalances between the United States and China have become a major concern of international macroeconomics. This paper shows that the existence of outsourcing hides the true scale of the problem.

1. INTRODUCTION

In many circles China is increasingly seen as a threat or even menace to the global economic system. The source of this peril is China's very success in liberalizing its economy, achieving stupendous rates of GDP growth and becoming a very dynamic exporter of an ever increasing range of goods to an ever increasing number of markets. The criticism originated in the United States; the recent build-up of its trade deficit has been linked with an extremely rapid Chinese export expansion to the United States unaccompanied by a matching growth of imports from that region. A purely economic issue, or non-issue as we shall argue, has become a real political problem.

American politicians speak with rising frequency and force about the need to solve the United States–China trade deficit problem. *The Economist* reported on 19 May 2007 in an article entitled 'America's fear of China':

> The itch to get tough with Beijing is urgent in Congress. Brandishing China's growing bilateral trade surplus as proof, congressmen from both parties have denounced the country as a currency manipulator, an illegal export-subsidizer, a violator of rights to intellectual property and all-round trade scoff-law. China-bashers have introduced a dozen bills in the new Congress. Some are bound to languish, but others may be passed—though there would then be further hurdles to jump, not least the president's power of veto (George Bush has other conflicts on his mind). The most threatening include proposals that would declare China's cheap currency an illegal subsidy and allow American firms to seek compensatory tariffs.

Just four days later, Li Jin and Shan Li (2007) commented in *The Wall Street Journal* on a risk of the United States–China trade conflict:

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> Is there another international conflict on America's horizon? Tension is steadily mounting between the United States and China over trade issues. The US trade deficit with China accounted for almost one-third the record $765 billion US trade deficit in 2006. Both sides agree that this large imbalance is unsustainable, but negotiations to reduce it are making little progress – putting pressure on the negotiators in Washington at this week's Strategic Economic Dialogue meetings. If not managed properly, the trade imbalance could escalate into a trade war.

European countries are beginning to follow the US lead. Floyd Norris (2006) from the *New York Times* reported on 29 April 2006:

> A few years ago, as the United States discovered that its trade deficit with China was growing rapidly, there was more than a little smugness in Europe. Its deficit with China was very small, a sign that its residents were not like the profligate Americans who insisted on spending money they did not have on Chinese imports ... the euro zone's trade deficit with China, measured as a percentage of GDP, is growing at almost exactly the same rate the American deficit was growing five years ago. The difference may have been in timing, not in magnitude.

Not surprisingly, the language of European politicians has become quite similar to that of their North American colleagues. In fact, the European Union is taking concrete steps to slow down China's exports. The European Commission decided recently to impose a 19.4% tariff on imports of leather Chinese shoes.[1] Of course, the official explanation for this action is based on 'disguised subsidies' allegedly received by Chinese shoe manufacturers from the government thus allowing them to set export prices below costs.[2]

Bilateral trade deficits can clearly cause concerns among policy-makers and prompt them to take corrective measures, yet the economic profession would probably be unanimous in agreeing that bilateral trade deficits, or surpluses for that matter, should be of no concern at all. There seems to be a disconnect on this issue, not for the first time, between the economics profession on the one hand and the policy-makers and public opinion on the other hand. The latter fail, or do not wish to see, the wisdom and benefits stemming from trade. If the principle of balanced bilateral trade should have a general validity, then every country would have to balance its trade with every trading partner. It goes without saying that overall trade surpluses and deficits could never materialize if the logic of balanced bilateral trade was fully applied. Under these conditions, benefits from intertemporal trade could not be obtained.

Recent macroeconomic debates about current account imbalances of the United States, Japan, China, Germany and the oil-exporting countries show

[1] It is interesting to note that a large part of European exports to China takes the form of machinery needed to produce shoes, clothing and other products where European producers used to be competitive.

[2] This charge might be true but in no way should it be connected with the EU trade deficit with China.

that macro-level trade disequilibrium can also be seen as a problem. With regard to overall trade imbalances, there is less agreement among economists, especially in reference to the size of trade deficits. Corden (2006) expresses the view of the majority that trade deficits and surpluses can be perfectly rational phenomena expressing saving propensities of different countries, their actual and potential GDP, their level of competitiveness at present and in the future, and even demographic conditions. Current account deficits and surpluses reflect intertemporal trade. Currently produced goods and services can be exchanged for financial claims. Surely, there must be room for this type of transaction in the world of different endowments, varying preferences, diverse growth prospects and dissimilar saving/spending trajectories followed by various countries. In principle, this type of trade should generate benefits to the participating countries. It is perhaps better understood that at the micro level an individual is not expected to spend exactly what he earns year in and year out.

The most far-reaching conclusion of Corden's analysis is that in the age of globalization the opportunities for intertemporal trade should only increase. Therefore, current account surpluses and deficits may well increase rather than subside in the future. It should signify the fact that globalization is working, not failing.

The present paper, honouring Professor Max Corden, will show that in the age of globalization bilateral trade surpluses can be expected to grow as well. A new type of trade, based on fragmentation of production and international outsourcing, has emerged in recent decades. A finer division of labour is being established as national borders become increasingly porous with regard to organization of the production process and the Internet, modern international banking and more and more efficient transportation shrink the distance between countries.

The principle contribution of the present paper, however, is to demonstrate on the basis of the United States–China trade that the available information about bilateral trade imbalances is highly distorted. International trade statistics had been designed for the world in which trade takes place in the form of final goods. Today, we live in an era when parts and components, rather than final goods, are exchanged frequently even over long distances and when trade in intermediate products is more important than trade in finished products. In this new world the expression 'Made in X' should really be replaced by a more appropriate term 'Made in X, Y and Z', or, better still, it should disappear altogether.

There are serious implications of the described paradigm change: international trade flows should be measured on the basis of value added in various participating countries. Here again, a connection to Max Corden's previous work is apparent. In the theory of effective protection the concept of value added plays the central role.[3]

[3] See Corden (1966, 1971).

2. FRAGMENTATION OF PRODUCTION AND OUTSOURCING

Theory fragmentation of production was put forward by Ronald W. Jones and Henryk Kierzkowski (1990) in a festschrift volume honouring Robert Baldwin.[4] The essential elements of the framework can readily be stated:

An alternative way of generating output is to divide the production process into two or more production blocs. Again, constant returns to scale are assumed at the level of individual segments. Production stages do not function independently; they are arranged in patterns determined to a large extent by engineers and existing technologies. An important feature of the fragmented technology is that services are called in to 'connect' individual blocs. These services range from transportation, quality control, R&D and insurance to telecommunications and various activities related to the Internet. It seems reasonable to assume that service links require inputs of various factors in quantities that are independent of the scale of output of a final good.[5]

The combination of constant returns to scale in the production of individual blocs and increasing returns to scale in service links encourages fragmentation and outsourcing.[6]

Fragmentation allows producers to lower the marginal cost of the final good.[7] Cost savings achieved this way must be compared with relatively fixed cost of service links. With a suitably large scale of output, fragmentation dominates integrated technology. The cost minimizing degree of fragmentation increases as the scale of production expands. As famously stated by Adam Smith, the size of the market determines the extent of the division of labour. It should be pointed out that lowering of the service costs links works in the same direction.[8]

Fragmentation and outsourcing are not purely international phenomena. They can occur within a domestic economy. Indeed, a better knowledge of cost-reducing opportunities, lower costs of service links and a better protection of the local legal system tend to spur domestic fragmentation and outsourcing first. However, international deregulation of service industries, unification of international legal systems, liberalization of trade in services, technological progress in the tertiary sector and increased awareness of production capabilities around the world all lead to international fragmentation and outsourcing.

[4] There has been an avalanche of papers on this subject in recent years and alternative theories have been put forward. Yi (2003), for instance, stresses that trade liberalization had a powerful effect on trade flows through fragmentation.

[5] For some empirical and theoretical support for this assumption, see Jones and Kierzkowski (2005 a,b).

[6] This implication stands in sharp contrast with one of the key result of the new geography and trade theory according where an increase in the market size leads to agglomeration. This issue is discussed in depth in Jones and Kierzkowski (2005 a,b).

[7] Note that under assumed fixed costs of service links, lower marginal production costs of production blocs are a necessary condition for fragmentation to became a viable method of production.

[8] Jones *et al.* (2005) test the propositions that the size of output has a positive impact on fragmentation, outsourcing and, consequently, on the size of trade in parts and components. There is also empirical support for the thesis that lowering of the service links costs works in the same direction. Golub *et al.* (2007) also find evidence that service links encourage trade in general and trade in parts and components (as well as flows of international direct investments).

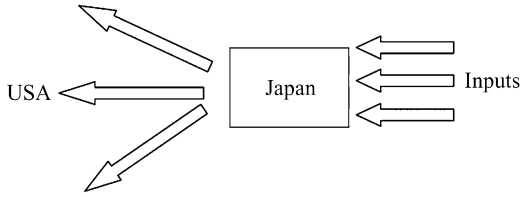

Figure 1. Integrated production

International differences in production costs at the level of individual blocs may have different origins.[9] The Ricardian model can be most helpful in explaining the phenomenon of outsourcing. However, the Heckscher–Ohlin model can also shed some light on this problem. It should be pointed out that fragmentation and outsourcing can take place within a single firm or be done at arms length in market transactions.[10]

The basic insight of the fragmentation theory is shown in Figure 1. In order to set the stage for the next section of the paper we use a hypothetical example of an industry that is initially located in Japan with its output directed to the United States. The process of production is fully integrated. Suppose now that the Japanese producers find out that production can be divided into blocs and that the initial stage of production can be beneficially relocated to China, leading to a reduction in the marginal cost. Exactly the same final product will be produced but cheaper. Of course, there will now be a need to establish a service link between producers of components in Japan and China. Figure 2 shows this simple example of fragmentation and outsourcing. It also shows a more complex production arrangement, with Korea and the United States joining the production network. Although service links become more intense and costly, the higher degree of fragmentation may dominate integrated technology or a two-bloc production set-up.

What are the trade balance implications of fragmentation? Even the simple partial equilibrium analysis presented in Figures 1 and 2 shows that there can be an impact on imports undertaken by the United States and, especially, on bilateral trade. Because fragmentation and outsourcing help to bring production costs down, one would expect that, ceteris paribus, the United States will import a greater quantity of the good in question.

The important aspect of outsourcing is that Japan may disappear from the US statistical radar screen, and be completely replaced by China. The more complex production arrangement depicted in Figure 2 suggests that what passes as Chinese exports to the United States hides exports of parts and components by Japan, Korea and indeed the United States itself. Winston Churchill once said that statistics are not always reliable. (Actually, it was stated much more bluntly.)

[9] The idea of heterogeneous firms is becoming more and more accepted.

[10] Cheng and Kierzkowski (2001) contains some evidence on this point with regard to East Asia.

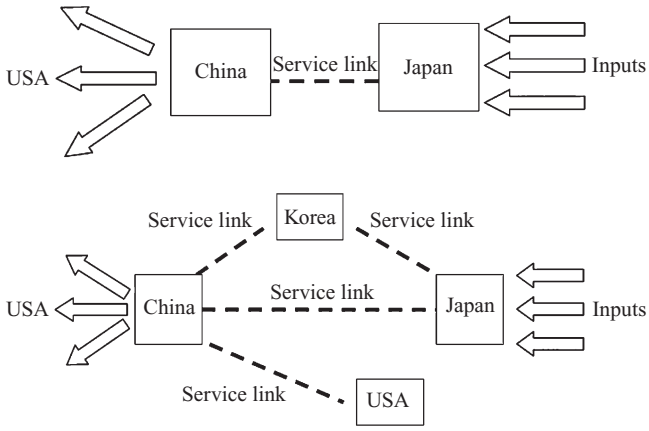

Figure 2. Fragmented production

The statistical distortion resulting from outsourcing works in the opposite direction as well. The US exports to China are likely to contain imports of parts and components from various countries, possibly including China itself.

It goes without saying that distorted values of exports and imports lead to a falsification of the current account balance. The degree of the misrepresentation is likely to increase with globalization as more complex production networks are created with an ever increasing number of interacting countries. In addition, the range of industries practicing international fragmentation of production seems to increase with globalization.

Once again, the proper trade statistics should be based on the domestic value-added content at different stages of production. This would require a major overhaul of the international system of collecting trade data.

The distortive effects of fragmentation have already been noticed by several authors with reference to rules of origin and the imposition of tariffs[11]. Lloyd (2001) points out that applying rules of origin is a straightforward matter only in an unrealistic world where all production processes are completely integrated. He calls for a replacement of present tariffs by a system based on value added.

Other authors have begun to draw implications of international outsourcing for trade flows and the way we measure them. Voon and Kueh (2000, p. 124) focus on the Hong Kong–China connection and point out that: 'Owing to the SCO rules, goods initially dispatched from Hong Kong to China for "outward processing" (OP) or assembling, and then either directly or indirectly exported from China to the United States (the U.S.) have been consistently counted by the United Sates entirely as imports from China rather than Hong Kong'.[12] Lau

[11] Of course, Max Corden's entire work on effective protection deals with the world of fragmentation, outsourcing and international production networks without ever using those terms!

[12] SCO (single country of origin).

(2003) also argues that global outsourcing and division of labour have falsified the true Chinese surplus vis-à-vis the United States.

3. AN EMPIRICAL STUDY

This section attempts to measure the impact of outsourcing on the United States–China trade flows and, consequently, the trade balance between the two countries.

To proceed with an empirical analysis, a statistical equivalent of 'a production bloc' has to be identified. Fortunately, trade in parts and components can now be extracted from the UN COMTRADE database. Bilateral trade flows of final products used in the present paper come from the same source. All GDP series have been obtained from the World Bank WDI database.

Let's start with US imports from China. Our discussion of theoretical foundations of fragmentation suggested that the phenomenon can occur within any of the well-established trade models. We have decided to use gravity-styled equations. The standard gravity equation would explain US imports from China as follows:

$$Imports_{USA,China,t} = GDP_{USA}^{\alpha 1} \cdot GDP_{China}^{\alpha 2} \cdot K_{USA}^{\alpha 3} \cdot K_{China}^{\alpha 4} \cdot Dist_{USA,China}^{\alpha 5}, \quad (1)$$

where $Imports_{USA,China,t}$ denotes the US aggregate imports from China in year t, $GDP_{USA,t}$ and $GDP_{China,t}$ denote the United States' and China's GDP, and $K_{USA,t}$ and $K_{China,t}$ stand for United States' and China's GDP per capita. *Dist* denotes the geographic distance between the two countries.

We postulate that bilateral United States–China trade is affected by imports of parts and components and expand equation 1 to include such intermediate inputs as the additional determinants of Chinese exports to the United States:

$$Imports_{USA,China,t} = GDP_{USA}^{\alpha 1} \cdot GDP_{China}^{\alpha 2} \cdot K_{USA}^{\alpha 3} \cdot K_{China}^{\alpha 4} \cdot Dist_{USA,China}^{\alpha 5} \cdot \sum_{i \neq USA} PC_{China,i,t}^{\gamma i}, \quad (2)$$

where $\sum_{i \neq USA} PC_{China,i,t}^{\gamma i}$ represents Chinese imports of parts and components from other countries.

Moreover, Chinese imports of parts and components from the United States may also influence its exports of final goods to the United States. It is possible that the United States first exports intermediate inputs that are relatively technological and capital intensive to China to perform some labour intensive sub-stage production there, and then imports the final goods to meet the demand from the domestic market. Such a trade flow from the United States to China can also be expressed by the gravity model, as equation 3 shows:

$$PC_{China,USA,t} = GDP_{China}^{\beta 1} \cdot GDP_{USA}^{\beta 2} \cdot K_{China}^{\beta 3} \cdot K_{USA}^{\beta 4} \cdot Dist_{USA,China}^{\beta 5}. \quad (3)$$

Substituting equation 3 into equation 2, we have:

$$Imports_{USA,China,t} = GDP_{USA}^{\chi 1} \cdot GDP_{China}^{\chi 2} \cdot K_{USA}^{\chi 3} \cdot K_{China}^{\chi 4} \cdot PC_{China,USA,t}^{\gamma 0} \cdot \sum_{i \neq USA} PC_{China,i,t}^{\gamma i}. \quad (4)$$

In equation 4, we assume $\alpha_5 = \gamma_0 \cdot \beta_5$. That is, the influence of the geographic distance on China's exports of final goods to the United States is contained in the term $PC_{China,USA,t}$, the estimated Chinese imports of parts and components from the United States using the model expressed by equation 3. Accordingly, the coefficients of variables GDP_{USA}, GDP_{China}, K_{USA} and K_{China} should be interpreted as their effects on bilateral trade (from China to the United States) in addition to the marginal effects that have been shown on bilateral trade in parts and components (from the United States to China).

China imports parts and components from, literally, dozens of countries. A priori there is no way of telling which of these imports, and to what extent, will end up disguised as exports to the United States and which will be re-exported somewhere else. It could happen that some of imported parts and components will not be re-exported at all but rather used domestically as consumption or investment goods. They would need some local transformation and processing, just like the final goods that will be exported. The degree of transformation of imported parts and components may vary depending on whether the final destination of a good will be the domestic market or export.

China imports parts and components primarily from Japan, China Hong Kong SAR, the United States, EU15, Korea, Oceania countries and the ASEAN countries. We have estimated equation 4 with different country composition of the term $\sum_{i \neq USA} PC_{China,i,t}^{\gamma i}$. Because the estimators of $GDP_{China,t}$, $K_{USA,t}$ and $K_{China,t}$ turned out to be not significant, the marginal effects of these three factors on the bilateral trade of final goods could be considered roughly equal to that on the bilateral trade in parts and components.[13] It also shows that besides imports of parts and components from the United States, the intermediate inputs from Japan, China Hong Kong SAR and Korea play an important role in determining Chinese exports to the United States. In the end, the final function specification under estimation involves the following variables: GDP_{USA}, $PC_{China,USA,t}$, $PC_{China,Japan,t}$, $PC_{China,HongKong,t}$ and $PC_{China,Korea,t}$. The estimation is based on the annual trade data from 1990 to 2003:

$$\begin{aligned} \log(Imports_{USA,China,t}) = {} & C + \chi_1 \cdot \log(GDP_{USA}) + \gamma_0 \cdot \log(PC_{China,USA,t}) \\ & + \gamma_1 \cdot \log(PC_{China,Japan,t}) \gamma_2 \cdot \log(PC_{China,HongKong,t}) \\ & + \gamma_3 \cdot \log(PC_{China,Korea,t}) + \mu \end{aligned} \quad (5)$$

Before estimating the above function, however, we have to face the non-stationary issue brought about by running regressions on time-series variables.

[13] It is striking that, on the basis of our results, China's GDP does not seem to have any significant effect on its total exports to the United States. One would expect a rather different result. It can be readily imagined that China's rapid economic growth favours export-oriented industries. Indeed, the creation of the special export zones back in the late 1970s and through the 1980s was said to serve this purpose, yet the flows of exports to the US are driven by the demand factor represented by the US GDP.

Table 1. Regressions of US total imports from China

	OLS	Maximum likelihood	General least squares
Constant	–25.82	–26.15	–26.14
	(1.65)	(1.48)	(0.71)
$\log(GDP_{USA,t})$	3.23***	3.27***	3.27***
	(0.20)	(0.17)	(0.09)
$\log(PC_{China,USA,t})$	–0.37***	–0.39***	–0.38***
	(0.08)	(0.08)	(0.04)
$\log(PC_{China,Japan,t})$	0.23***	0.25***	0.22***
	(0.07)	(0.06)	(0.04)
$\log(PC_{China,HongKong,t})$	0.35***	0.33***	0.36***
	(0.08)	(0.07)	(0.04)
$\mathrm{Log}(PC_{China,Korea,t})$	–0.25***	–0.26***	–0.26***
	(0.04)	(0.03)	(0.02)
R^2	0.99	0.99	0.99

Note: *** represents significance at the 1% level.

We find that time series have unit roots and, therefore, conclude that the stochastic process is non-stationary. The trends of the variables are stochastic.

In our empirical work reported here, we do not try to generate stationary time series via differentiation of the variables. However, we test for possible cointegration. Following the Engle–Granger test, we obtain a τ-value of –5.61, which is in absolute terms larger than the 1% critical value computed by Davidson and MacKinnon (1993).[14] Therefore, we treat the variables as cointegrated time series and run the regression. The long-run correlation is reflected by the estimators listed in Table 1. Theoretically, one could also apply the error correction mechanism to show the short-term dynamics.[15] The coefficient of the error correction term is negative and highly significant. Loosely speaking, China's imports of parts and components affect its exports to the United States in both the short run and the long run.

The results shown in column (1) of Table 1 are based on OLS regression. In columns (2) and (3) of Table 1, the basic equation is re-estimated using maximum likelihood and general least squares, respectively.

The positive values of coefficients of $PC_{China,Japan,t}$ and $PC_{China,HongKong,t}$ support our presumption that China's imports of parts and components from Japan and Hong Kong serve as intermediate goods to be combined with Chinese labour, capital and other factors of production for exports to the market of the United States. An increase in China's imports of parts and components from Japan by 1% will increase US aggregate imports from China by approximately 0.25%. The elasticity of total US imports from China is even larger in the case of Japan–China flows of parts and components between 1990 and 2003.

[14] $\Delta\hat{u}_t = -1.46 \cdot u_{t-1}$
$t = (-5.61)$
$R^2 = 0.72$.

[15] Error correction mechanism estimation: $R^2 = 0.95$.

The results presented in Table 1 suggest a negative relationship between China's imports of parts and component from the United States and Korea and China's aggregate exports to the United States. To explain this finding, one may wish to think of a multitude of foreign markets where Chinese exports of final goods can be placed. With exports capabilities fully utilized, simultaneous expansion in all the markets for final goods may not be possible. Therefore, imports of parts and components from the United States and Korea could be undertaken to export final goods to, say, the European Union. Trade diversion could take place as some Chinese factors of production have to be moved from 'the US desk' to 'the EU desk'.

An alternative scenario could be advanced in which US multinationals change to a more complex system of global production *and* distribution. Instead of importing a final good from China to the United States market (possibly for further distribution throughout the world) they switch to outsourcing, supply Chinese subcontractors with some components and ship the final good directly from China to various foreign destinations.

At the bilateral trade level, one may expect that a country's bilateral imports of intermediate inputs have either 'trade creation' or 'trade diversion' effects on its aggregate exports. We observe that in the United States–China case, the estimated coefficients of $PC_{China,Japan,t}$ and $PC_{China,HongKong,t}$ are positive, while coefficients of $PC_{China,USA,t}$ and $PC_{China,Korea,t}$ are negative. The positive coefficient means imports of parts and components from Japan and China Hong Kong SAR could create more exports from China to the United States. In this case, intermediate inputs directly improve China's capability of supplying to the US market. The negative coefficient, however, means the increasing imports of parts and components from the United States and from Korea would reduce China's exports to the United States. One possibility is that intermediate inputs from these two countries are components for products that are demanded by either the domestic market of China or some other markets. In this situation, imports of parts and components reduce China's exports to the United States by diverting parts of resources that were originally located in producing goods for the US market.

Is it possible that the combined effect of outsourcing reduces the total flow of goods from China to the United States? It will be shown shortly that in aggregate China's imports of parts and components do have a significantly positive impact on its exports to the United States.

Turning to the question of an overall impact of outsourcing on trade flows, the following exercise is proposed: set China's imports of parts and components equal to zero and calculate the implied value of US total imports from China. Table 2 shows what US imports from China would be like under 'no-fragmentation'.

Table 2 shows a spectacular growth of the United State's imports from China. However, already in 1990 as much as 47.4% of those imports were parts and components that China had imported herself. The share of foreign parts and components in China's exports to the United States had risen to 58.2% by 2003. Clearly, China and the United States know a thing or two about fragmentation and outsourcing.

Table 2. Estimated US imports from China assuming China's imports of parts and components are equal to zero

Year	US aggregate imports from China (US$bn)	Estimated imports from China assuming no Chinese imports of parts and components (US$bn)	US imports from China related to Chinese imports of parts and components (US$bn)	The share of US imports from China related to China's imports of parts and components (%)
1990	16.3	8.6	7.7	47.4
1991	20.3	9.5	10.8	53.2
1992	27.5	11.4	16.1	58.6
1993	33.7	13.3	20.3	60.4
1994	41.4	16.2	25.1	60.8
1995	48.5	18.8	29.8	61.3
1995	54.4	22.4	32.0	58.7
1997	65.8	27.3	38.5	58.5
1998	75.1	32.4	42.7	56.9
1999	87.8	39.1	48.7	55.5
2000	107.6	47.1	60.5	56.2
2001	109.4	51.7	57.7	52.7
2002	133.5	58.3	75.2	56.3
2003	163.3	68.2	95.1	58.2

One of the predictions put forward in Jones and Kierzkowski (1990) is that international fragmentation of production creates a unique opportunity for developing countries and new players in the global economy to reach the markets of developed countries through the back doors, so to speak.[16] When Nike, Toys 'R' Us or Walmart placed China in their global production networks these actions opened Chinese producers' access to markets that are not quite competitive. Huge advertising and R&D expenses would have to be incurred by newcomers wishing to establish presence in markets for sports footwear, toys, clothing or electronics. China recognized and took advantage of a unique opportunity of integrating itself into the global economy. Outsourcing to China must have been beneficial also to US producers or otherwise they would not have been doing it.

Let's turn to US exports to China and how they are influenced by US imports of parts and components from its main trading partners. Table 3 contains the regression results. The GDP of both countries appear now relevant, suggesting that demand and supply factors are in operation. Imports of parts and components from China, Japan and Korea lead to expansion of American exports to the most populous country in the world. It is worth pointing out that Japan is the biggest exporter of parts and components in the world and it affects the United States–China trade in both directions.

The data suggest that a trade diversion effect operates in the case of Canada. Again, one can imagine an integrated production process under which a good is

[16] At the time of writing the article we had no clue that the new players would also include countries of Eastern Europe and former republics of the Soviet Union. Indeed, some of those countries have perused the option with great success.

Table 3. Regressions of US exports to China

	OLS	Maximum likelihood	General least squares
Constant	–13.73	–11.49	–14.44
	(2.80)	(1.45)	(2.69)
$\log(GDP_{USA})$	1.51***	1.23***	1.59***
	(0.37)	(0.19)	(0.36)
$\log(GDP_{China})$	0.40***	0.42***	0.38***
	(0.11)	(0.06)	(0.11)
$\log(1–PC_{USA,Japan,t}))$	0.86***	0.80***	0.90***
	(0.13)	(0.06)	(0.11)
$\log(1–PC_{USA,Canada,t})$	–0.93***	–0.86***	–0.94***
	(0.11)	(0.06)	(0.10)
$\log(1–PC_{USA,Korea,t})$	0.21**	0.27***	0.19**
	(0.08)	(0.04)	(0.18)
R^2	0.99	0.99	0.99

Note: *** and ** represent significance at the 1 and 5% level, respectively.

produced in the United States and partly or wholly exported to China. Suppose now that the original producer switches to a fragmented production process, imports some parts from Canada, takes it through another production stage, and sends it back to Canada for final finishing, packaging and export to various markets, including Chinese.[17]

Table 4 contains the value of implied US exports to China without outsourcing. Those exports would be 18.4% smaller in 1990 then the actual figures and 27.5% smaller in 2003. Fragmentation is a global process. One would expect that most market economies would respond to new opportunities and rearrange their production patterns. It is of course a two-way street. If China is practicing outsourcing, the United States and/or some other countries engage in it as well.

Going beyond the information contained in Tables 2 and 4, it could be speculated that developing countries could in general get a boost to their exports through fragmentation and outsourcing. This is very good news for the developing nations. The dominant trade paradigm in the 19th century placed the South at the centre of international commerce. This role was marginalized in the second part of the 20th century when North–North flows became dominant through an expansion of intra-industry trade between developed countries. The 21st century trade paradigm is based on a finer division of labour and offers a chance for developing countries to get into the game in a big way. Tables 2 and 4 show that this is indeed happening. However, China's experience can not be automatically replicated by other developing countries. As stressed and documented in Golub *et al.* (2007), national service links constitute entry membership fees to the 21st century global trading club.

As stressed in the Introduction to this paper, international fragmentation of production leads to misrepresentation of bilateral trade deficits. Without importing parts and components, US aggregate exports to China would

[17] This line of reasoning suggests that a multi-country framework should be used to evaluate the impact of fragmentation on bilateral trade flows.

Table 4. Estimated US exports to China assuming no imports of parts and components

Year	US aggregate exports to China (billion US dollars)	Estimated exports to China assuming no US imports of parts and components (billion US dollars)	US exports to China related to the US import of parts and components (billion US dollars)	The share of US exports to China related to the US import of parts and components (%)
1990	6.6	5.4	1.2	18.4
1991	8.0	5.8	2.2	27.9
1992	8.9	6.5	2.4	26.5
1993	10.7	7.1	3.6	33.3
1994	13.9	8.6	5.3	38.3
1995	16.1	10.2	6.0	37.0
1996	16.2	11.8	4.4	27.3
1997	16.3	13.4	2.9	17.9
1998	16.9	14.8	2.1	12.4
1999	19.5	16.5	3.0	15.6
2000	22.4	18.6	3.8	16.9
2001	26.2	20.1	6.1	23.4
2002	27.3	21.9	5.4	19.6
2003	33.9	24.6	9.3	27.5

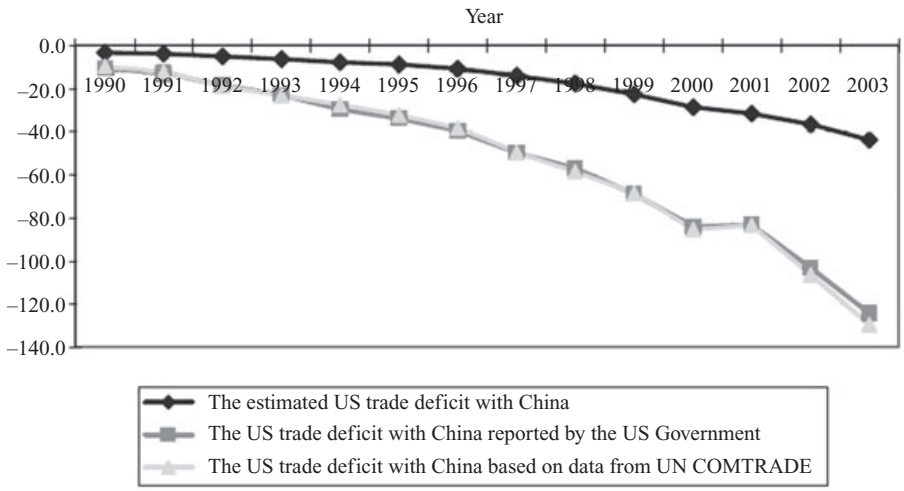

Figure 3. The US trade balance with China assuming no trade flows of parts and components to the two countries

decrease by approximately 20–30%. Similarly, Chinese exports to the US would shrink by approximately 50–60% with no outsourcing. The 'no outsourcing' scenario alters the trade balance picture in a major way, as shown in Figure 3. The United States–China trade deficit is shown based on the UN COMTRADE data as well as using the US government statistics. Approximately two-thirds of the deficit would disappear in 2003 in the absence of imports of parts and

components by both countries. Would this make the United States better off? Clearly not, although the negative press would likely subside.

The exercise reported in Figure 3 may be useful but it should be supplemented by another question: Given that outsourcing is a fact of life, how big is the US trade deficit based on value added in China and the United States? To answer this question one requires some information about the extent of processing undergone by imported intermediate goods in both countries. Lau (2003, p. 4) suggests that '... the domestic value-added content of Chinese exports to the US is low – it may be estimated at 20%.' However, the US domestic value added of US exports to China easily surpasses this figure: it is assumed by Lawrence Lau to be approximately 60%.

Applying these numbers to 2003 trade figures would suggest that exports from China to the United States amounted to US$87.2bn in domestic value-added terms while 'purified' trade flows in the opposite direction reached US$30.2bn. The United States–China 'true' trade deficit in that year equalled $57.0bn, approximately half of what is reported. It is a simple matter to redo the calculations for the entire period under analysis.

4. CONCLUSIONS

Fragmentation of production has taken international trade into a new realm. The decisions of how much to produce and for which markets have to be combined with decisions of where to produce and with what degree of intra-product specialization.

In this new world the concept of domestic value added re-emerges as being appropriate for calculating international trade flows and trade deficits. The designation 'Made in ...' should disappear as statistical reporting systems catch-up with the new world.

The above considerations have been applied to United States–China trade and the hotly debated trade deficit between the two countries. Taking into account imports of parts and components by both courtiers reduces this deficit by approximately half. It would be worthwhile repeating the analysis of this paper for other countries and trading blocs: Japan and the European Union are natural candidates.

The main idea advanced in this paper has a wider application. In fact, it has long been recognized in domestic taxation and statistical reporting. There is no reason why we should stop at national borders as they become less well-defined.

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