Web Appendix B:

The Extent to Which Increased Imports from China Are Offset by Changes in Other Imports

To accompany the Congressional Budget Office paper
*How Changes in the Value of the Chinese Currency
Affect U.S. Imports*

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CONTENTS

APPENDIX B:
THE EXTENT TO WHICH INCREASED
IMPORTS FROM CHINA ARE OFFSET
BY CHANGES IN OTHER IMPORTS

Increases in U.S. imports from China are offset by changes in imports from other countries for two reasons. First, many Asian firms have moved the location of the final assembly of their products from other Asian countries to China in order to lower costs and, in some cases, to be nearer to the large Chinese market. The effect of the change in location is to increase Chinese exports to the United States and reduce the exports of the other Asian countries from which the final assembly was moved. Second, the lower costs may enable manufacturers in China to undercut the prices of exports of other countries and thereby displace them from the U.S. market. Many Chinese products are labor-intensive goods that the United States already imports significant amounts of from other countries. Increased U.S. imports of those products from China are likely to come to a considerable degree at the expense of imports from elsewhere rather than at the expense of U.S. manufacturers.

This appendix reviews several papers that have examined those phenomena and calculates an updated estimate of the degree of offset. On the basis of the analysis, the Congressional Budget Office (CBO) concludes that roughly one-third of the increase in Chinese market share in the United States from 1998 through 2005 came at the expense of the market share of imports from the rest of the world rather than that of U.S. manufacturers. Correspondingly, roughly two-thirds of the increase in Chinese market share came at the expense of U.S. manufacturers' shipments, although that does not necessarily mean that U.S. manufacturers' domestic sales declined by that much.

BACKGROUND: RESEARCH BY OTHERS

The general issue of the exports of other countries' declining in response to, or simultaneously with, the large increases in Chinese exports has been examined in a number of papers. All of them provide evidence of such a response, but only two of them directly examine the degree to which increasing U.S. imports from China have been offset by declines in imports from elsewhere.

Displacement of Other Countries' Exports

A June 2006 paper by Susana Iranzo and Alyson C. Ma uses a regression analysis of U.S. import data at the 10-digit level of the Harmonized Tariff System (HTS) of classification from 1989 through 2004 to examine the question of whether the benefits of the North American Free-Trade Agreement (NAFTA) to Mexican exporters have been negated by increased competition from Chinese exports to the United States resulting from China's joining the World Trade Organization (WTO).[1] That paper detects significant crowding out of existing Mexican exports

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[1] Susana Iranzo and Alyson C. Ma, *The Effect of China on Mexico-U.S. Trade: Undoing NAFTA?*, draft dated June 14, 2006. (The paper can be found at www.sandiego.edu/tbi/documents/iranzo_ma_TBI.pdf. It appears to have been presented at the Midwest Theory and Trade Meetings Spring 2007, which were held at the Twin Cities Campus of the University of Minnesota on April 20–22, 2007.)

to the United States by Chinese exports but also finds that Chinese exports of new product varieties complement Mexican exports to the United States. It concludes, "According to our estimates a 10% increase in Chinese exports to the U.S. would be displacing approximately 5% of Mexican exports in existing products with the negative impact increasing to 7.5% after China became a WTO member."

A September 2006 paper by Caroline Freund and Caglar Ozden uses a regression analysis of bilateral trade data among many countries at the 4-digit level of the Standard International Trade Classification system from 1985 to 2004 to examine the effects of Chinese exports on the exports of countries of Latin America and the Caribbean.[2] The paper's methodology can determine only the extent to which a country's exports are negatively affected by competition from Chinese exports to a greater degree than the average country's exports are affected. The paper finds a significant negative effect on Latin American exports that is concentrated primarily in exports from Mexico to other North America countries since 1995, with some negative effects for exports of countries of Central America and the Caribbean as well. Relating specifically to Mexico, the paper says, "The coefficient of -0.759 and an average market share of 13 percent in industrial products implies that 20 percent Chinese export growth has limited Mexican export growth by about 2 percentage points." The paper also finds that exports of industrial products, and especially electronics, have been affected the most.

A July 2007 paper by Gordon Hanson and Raymond Robertson uses a gravity model to assess the extent to which the increasing exports of China have reduced world demand for the exports of 10 medium-to-large developing countries whose export compositions are similar to that of China—Hungary, Malaysia, Mexico, Pakistan, the Philippines, Poland, Romania, Sri Lanka, Thailand, and Turkey.[3] (A gravity model is a statistical model that expresses trade as a function of such variables as the distance between the trading countries, the similarity of the two countries in terms of culture and language, and so on.) The paper concludes that if China's export capacity had remained constant from 1996 through 2003, demand for those countries' exports would have been 0.6 percent to 1.4 percent higher, depending on the country.

Movement of the Location of Final Assembly to
China from Other Asian Countries

An analysis by the staff of the U.S. International Trade Commission (ITC) in 2003 contains several figures illustrating the effects of the shift by many manufacturers of the location of their final assembly to China from other Asian countries.[4] The analysis notes that the increase in U.S.

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[2] Caroline Freund and Caglar Ozden, "The Effect of China's Exports on Latin American Trade with the World," Chapter 3 in Daniel Lederman, Marcelo Olarreaga, and Guillermo Perry, eds., *Latin America and the Caribbean's Response to the Growth of China and India: Overview of Research Findings and Policy Implications*, Office of the Chief Economist for the Latin American and Caribbean Region, The World Bank, September 2006.

[3] Gordon H. Hanson and Raymond Robertson, *China and the Manufacturing Exports of Other Developing Countries*, paper presented at a National Bureau of Economic Research conference on August 3–4, 2007, titled *China's Growing Role in World Trade*, draft paper dated July 2007. The paper will be published as a chapter in a forthcoming conference volume.

[4] Staff of the U.S. International Trade Commission, technical assistance provided to staff of the Subcommittee on Trade of the House Committee on Ways and Means on September 24, 2003, in response to a request to update an article titled "Why Is the U.S. Trade Deficit with China So Big?" (International Economic Review, U.S. International Trade Commission, September/October 2001) and to provide data concerning whether a shift to China from other Asian nations may have occurred over the years with respect to U.S. imports.

imports from China was offset by declines in imports from other Asian countries from 2000 through 2002 (see Figure B-1). Whereas imports from China rose by $26.0 billion over that period, imports from Japan declined by $25.4 billion, and imports from Taiwan, Singapore, Korea, the Philippines, Hong Kong, Thailand, and Malaysia all declined by a sum total of $26.8 billion.[5] The analysis says that the only country other than China for which imports did not decline—Vietnam, imports from which rose by $1.7 billion—could be explained by the fact that the United States and Vietnam signed a bilateral trade agreement in 2000.

Figure B-1.
Change in U.S. Imports, 2000–2002
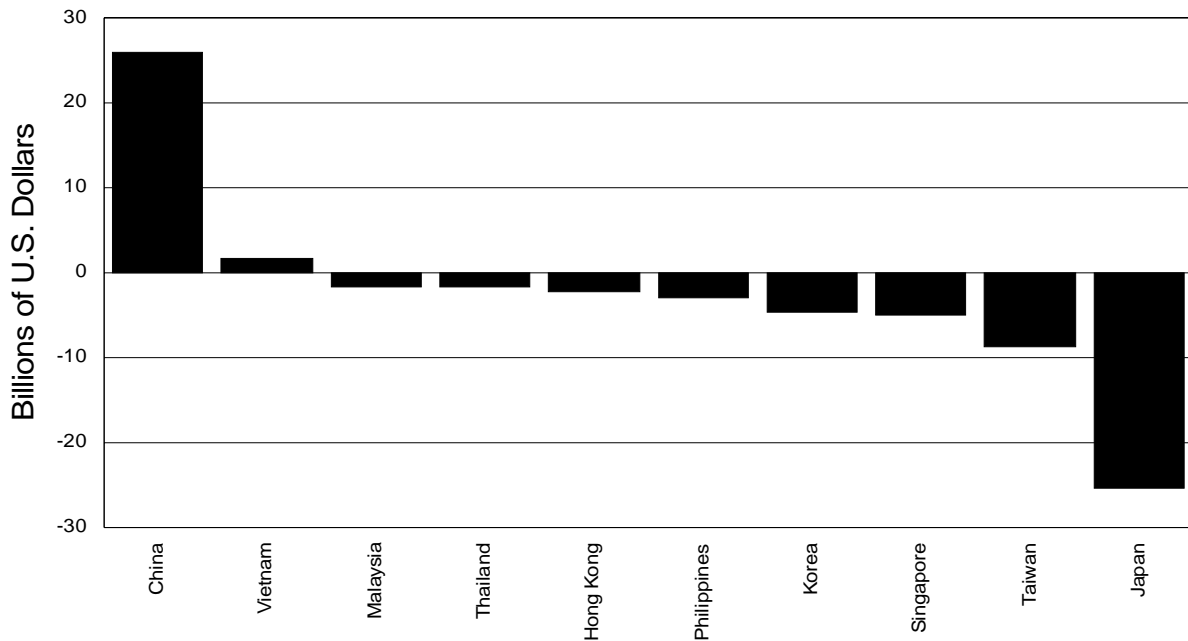
Source: Staff of the U.S. International Trade Commission, technical assistance provided to staff of the Subcommittee on Trade of the House Committee on Ways and Means on September 24, 2003, Figure 5.

Note: The values plotted are the c.i.f. (customs, insurance, freight) values of imports from the Bureau of the Census. (The figure in the source plotted customs values.)

The analysis notes that the same trend was especially evident for imports of electrical and nonelectrical machinery (see Figure B-2). It also notes that although the U.S. trade deficit with China rose throughout the period from 1996 through 2002 (broken only by a slight decline from 2000 to 2001), the deficit with the rest of Asia (defined as the eight countries in Figures B-1 and B-2 other than China and Japan) declined noticeably from 2000 through 2002 (see Figure B-3).

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[5] The numbers presented here are slightly different from those in the ITC staff analysis because that analysis used the customs values of imports whereas the numbers presented here are the c.i.f. (customs, insurance, freight) values.

Figure B-2.
Change in U.S. Imports of Electrical and
Nonelectrical Machinery, 2000–2002

Billions of U.S. Dollars

15
10
5
0
-5
-10
-15
-20
-25

China   Vietnam   Hong Kong   Thailand   Malaysia   Philippines   Singapore   Korea   Taiwan   Japan
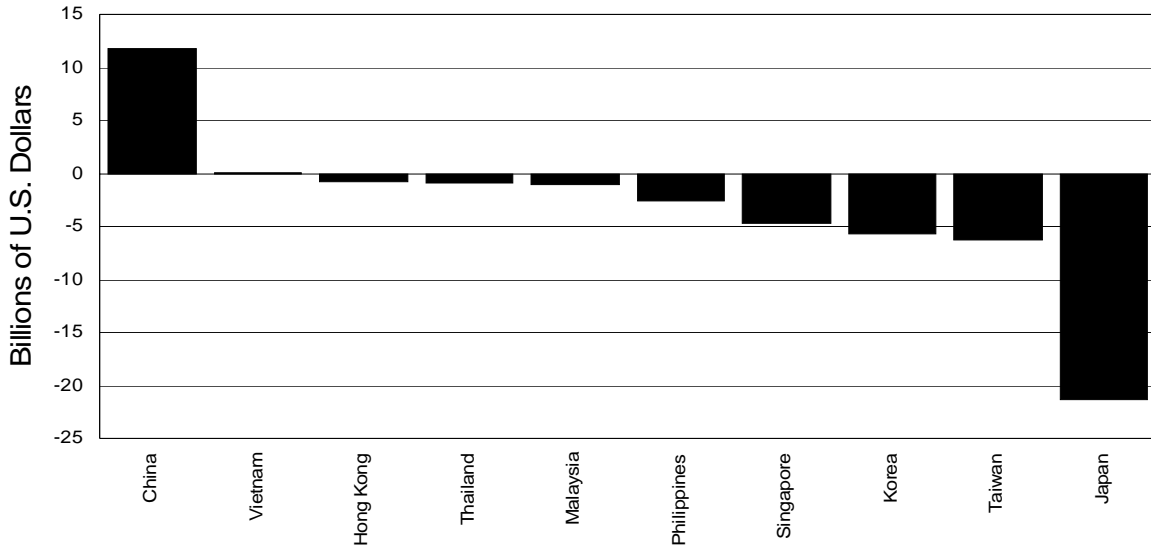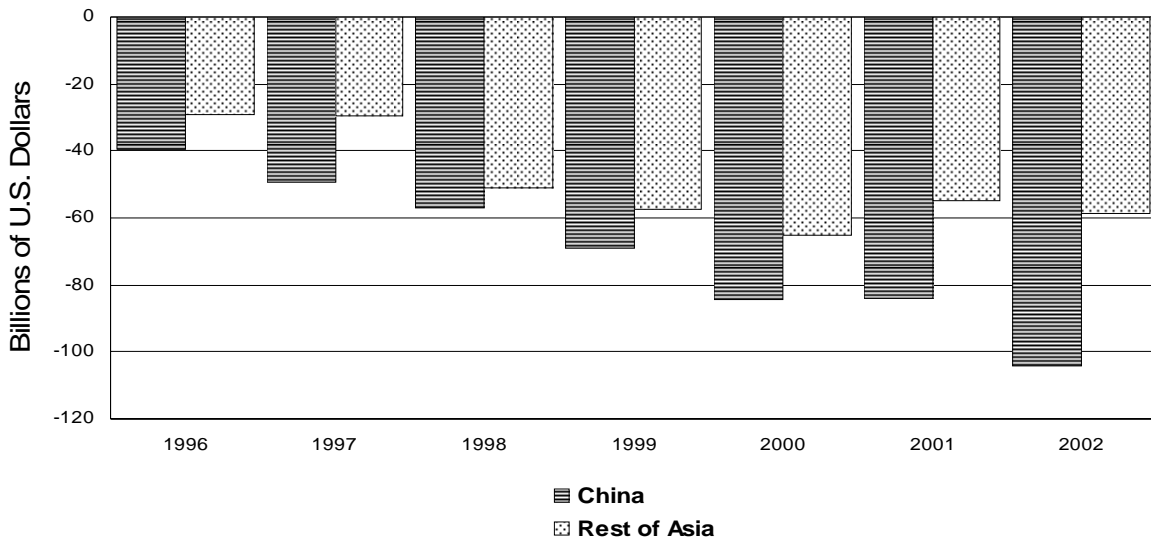
Source: Staff of the U.S. International Trade Commission, technical assistance provided to staff of the Subcommittee on Trade of the House Committee on Ways and Means on September 24, 2003, Figure 7.

Note: The values plotted are the c.i.f. (customs, insurance, freight) values of imports from the Bureau of the Census. (The figure in the source plotted customs values.)

Figure B-3.
U.S. Trade Deficit with China and with the Rest of Asia, 1996–2002

Billions of U.S. Dollars

0
-20
-40
-60
-80
-100
-120

1996   1997   1998   1999   2000   2001   2002

▤ **China**
⊠ **Rest of Asia**

Source: Staff of the U.S. International Trade Commission, technical assistance provided to staff of the Subcommittee on Trade of the House Committee on Ways and Means on September 24, 2003, Figure 6.

Notes: Rest of Asia = Hong Kong, Korea, Malaysia, the Philippines, Singapore, Taiwan, Thailand, and Vietnam.

Trade balances are calculated as the difference between the f.a.s. (free alongside ship) values of exports and the c.i.f. (customs, insurance, freight) values of imports from the Bureau of the Census.

Those figures and facts are suggestive and illustrative of the expected result (at least for 2000 through 2002) of manufacturers moving the location of their final assembly from the other Asian countries to China. However, they do not prove such movement to be the cause, as can be seen by what happens when the figures are updated. A dominating influence in the period covered by the ITC staff figure was a recession, a result of which was that U.S. merchandise imports from the world as a whole declined very slightly—from $1.21 trillion to $1.15 trillion. From 2004 through 2006, however, the U.S. economy grew, and U.S. merchandise imports from the world as a whole increased by 26.4 percent—from $1.46 trillion to $1.85 trillion. The only countries with trade depicted in Figure B-1 from which U.S. imports declined over that period were Korea and Hong Kong (see Figure B-4). Moreover, the increase in imports from China dwarfed the changes in imports from the other countries.

Figure B-4.
Change in U.S. Imports, 2004–2006
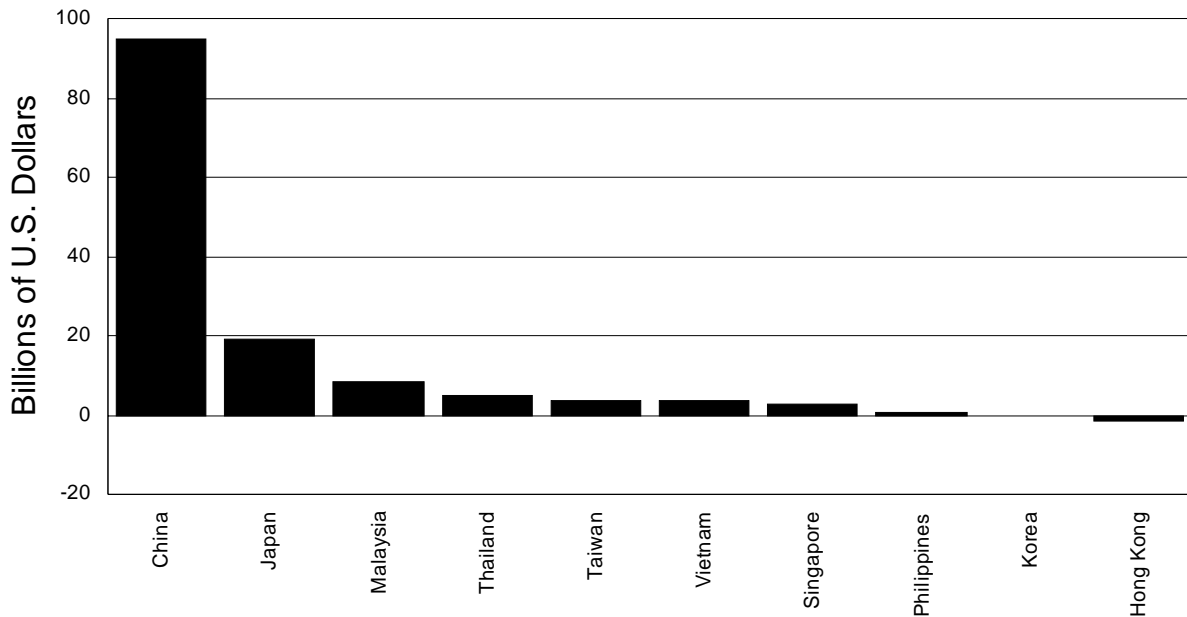
Source: Congressional Budget Office based on based on c.i.f. (customs, insurance, freight) import data from the Bureau of the Census.

Note: The values plotted are the c.i.f. (customs, insurance, freight) values of imports.

Similarly, for the longer period of 1996 through 2006, the recession was not a dominating influence, and U.S. merchandise imports from the world as a whole doubled in value—from $0.91 trillion to $1.85 trillion. The only countries of the Pacific Rim from which U.S. imports declined were Hong Kong and Singapore (see Figure B-5). Again, the increase in imports from China dwarfed the changes in imports from the other countries. Further, the same patterns hold for imports of electrical and nonelectrical machinery (see Figures B-6 and B-7).
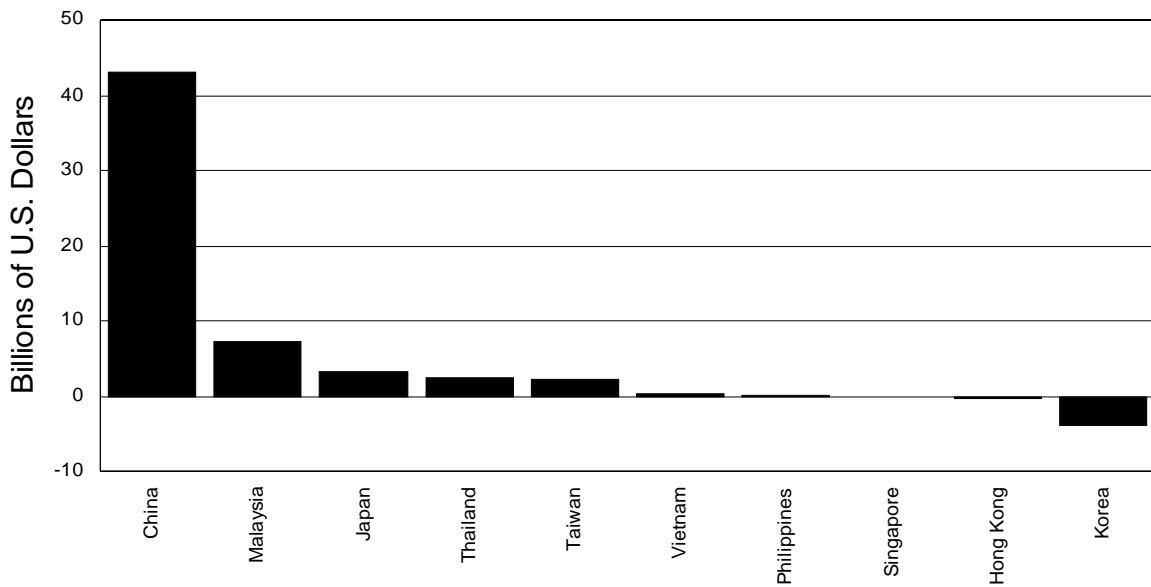
Figure B-5.
Change in U.S. Imports, 1996–2006

Figure B-6.
Change in U.S. Imports of Electrical and
Nonelectrical Machinery, 2004–2006

Figure B-7.
Change in U.S. Imports of Electrical and
Nonelectrical Machinery, 1996-2006

Although Figures B-4 through B-7 are consistent with the contention that the source of some U.S. imports shifted from Korea, Hong Kong, Singapore, and perhaps other countries of the Pacific Rim to China, that contention is not the only possible interpretation of the figures. The large increases in imports from China could reflect, at least in part, currency manipulation by China, and the much smaller increases from the other countries could be the normal changes to be expected for imports from countries that do not manipulate their currencies. More analysis would be necessary to prove that argument wrong.

Similarly, an update of Figure B-3 can be interpreted in both ways (see Figure B-8). The U.S. trade deficits with China and with the rest of Asia both rose from 1996 through 2000. Thereafter, the deficit with China continued to rise while that with the rest of Asia leveled off and remained roughly constant. That fact could be interpreted as the U.S. trade deficit with Asia as a whole's continuing to rise but after 2000 the location of final assembly's shifting to China. In that case, the consequent continued growth of U.S. imports from China would have been offset by reduced growth or (in some cases) even reductions in U.S. imports from the rest of Asia. Alternatively, it could be argued that only the deficit with China has continued to rise because only China has followed a policy of an artificially low exchange rate, and that the growth of imports from China was largely at the expense of U.S. manufacturers. Further analysis is required to determine which argument is more nearly correct.

Figure B-8.
U.S. Trade Deficit with China and with the Rest of Asia, 1996–2006
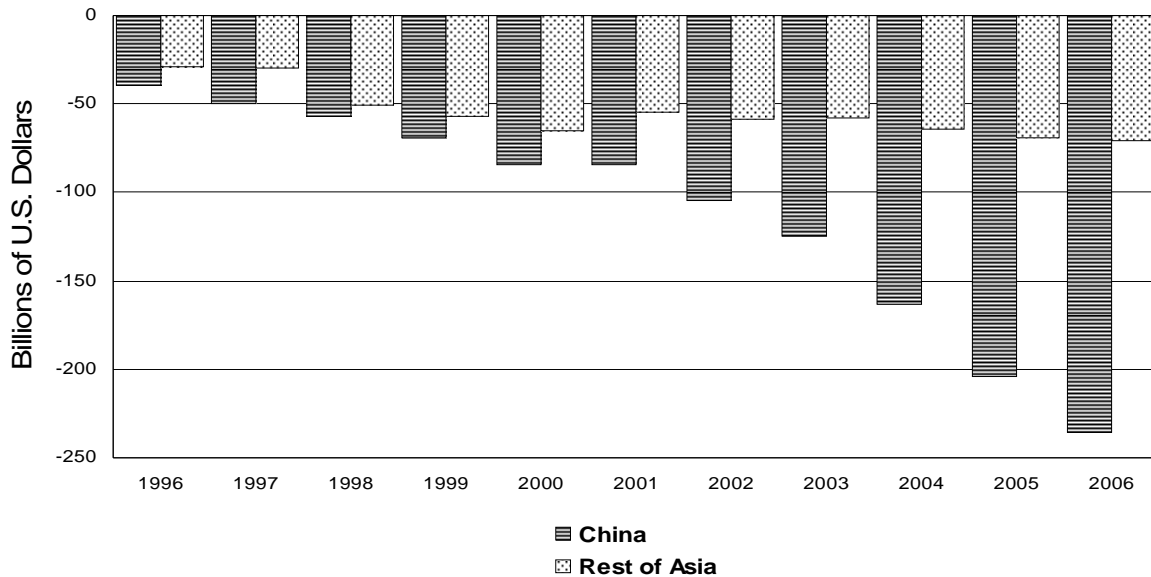
Source: Congressional Budget Office based on trade data from the Bureau of the Census.

Notes: Rest of Asia = Hong Kong, Korea, Malaysia, the Philippines, Singapore, Taiwan, Thailand, and Vietnam.
            Trade balances are calculated as the difference between the f.a.s. (free alongside ship) values of exports and the c.i.f. (customs,
            insurance, freight) values of imports.

Calculating the Degree of Offset

One way to estimate the degree to which increased imports from China have been offset by
reduced imports from the rest of the world is to look at the market shares of imports in the
United States on a product-by-product basis. For example, it would be reasonable to conclude
that the rise in market share of imports from China has been offset to some extent by the decline
in market share of imports from other countries if the shares of imports from other countries in
U.S. markets have tended to decline for those products for which the market shares of imports
from China have risen but not for those products for which imports from China have not risen.

In the mid-to-late 1990s, Marcus Noland at the Institute for International Economics (now called
the Peterson Institute for International Economics) used market shares to produce two estimates
of the degree of offset. The first estimate was contained in one section of a more general 1996
paper on economic relations between the United States and China.[6] In that section, he derived an
equation relating production, exports, imports, and market share and applied it to data on U.S.
production, exports, and imports for the years 1988 through 1994. The data distinguished 460
product categories at the 4-digit level of the Standard Industrial Classification system.

Noland concluded that from 1988 to 1994, U.S. imports from China rose by $10.9 billion more
than they would have if they had merely maintained constant shares in U.S. markets. Moreover,

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[6]   Marcus Noland, *U.S.-China Economic Relations*, Working Paper 96-6, Peterson Institute for International Economics, 1996, later
            published as Chapter 4, "U.S.-China Economic Relations," pages 107–147 in Robert S. Ross, ed., *After the Cold War: Domestic
            Factors and U.S.-China Relations*, M.E. Sharp, New York, 1998.

he concluded that $10 billion of that gain above constant market share was at the expense of imports from other countries and only $900 million was at the expense of U.S. production bound for domestic consumption. Thus, 91.7 percent of the increase above constant market share was offset by reduced imports from elsewhere. After factoring in exports to China, Noland concluded that changes in trade with China over the period had reduced U.S. industrial production by $200 million compared with what would have occurred if the United States and China had maintained their relative competitiveness, and that that reduction caused a loss of fewer than 1,000 jobs.

In 1999, Noland updated his estimate using data for 1993 through 1997 for a paper written by Daniel H. Rosen.[7] That paper concluded that U.S. imports from China over the period rose by $10.1 billion beyond the amount required to maintain constant market share, and that of that amount, $7.6 billion displaced imports from the rest of the world and $2.5 billion displaced U.S. production. Thus, 75.2 percent of the increase above constant market share was offset by reduced imports from elsewhere. The paper then said that "[t]he conservative $3.1 billion estimate for increased U.S. exports following implementation of China's WTO commitments more than offsets this marginal Chinese displacement of U.S. production."

CBO'S ANALYSIS

To update Noland's estimates, CBO used U.S. trade data from the Bureau of the Census and manufacturers' shipments data from the Bureau of Economic Analysis (BEA), both by industry/product at the 6-digit level of the North American Industry Classification System (NAICS) for 1998 through 2005.[8] The share of imports from China in the U.S. market was calculated for each industry/product as the ratio of those imports to apparent consumption, where apparent consumption is defined as U.S. manufacturers' shipments plus imports minus exports. The share of imports from the rest of the world was calculated analogously. The share of U.S. manufacturers' shipments was calculated as the ratio to apparent consumption of the difference between U.S. manufacturers' shipments and exports.

Correction of Problems with the Data

Before calculating the market shares, it was necessary to process the data to address problems relating to differences in the classification of the trade data and the shipments data. Specifically, some NAICS codes were merged with others, and a few codes were deleted from the data set. After the processing, the data set included 344 manufacturing industries/products in which the United States had imports from China, and those sectors represented 99.4 percent of such imports.

Isolated Aggregation Differences. In several cases, two or more NAICS codes were merged together in the original BEA shipments data. CBO made matching mergers in the trade data set.

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[7]   Daniel H. Rosen, *China and the World Trade Organization: An Economic Balance Sheet*, Policy Brief 99-6, Peterson Institute for International Economics, June 1999.

[8]   The shipments data from the BEA Web site consist of the shipments data collected and published by the Bureau of the Census in its Census of Manufactures and Annual Survey of Manufactures. BEA has put the data in convenient spreadsheet form and made only very minor changes for compatibility with its input-output accounts.

Problems from the HTS–NAICS Conversion. The conversion between the different classification systems used in the collection of the trade data and the collection of the shipments data introduces a number of oddities when those data sets are merged. For example, for a number of the NAICS codes, U.S. exports are apparently greater than U.S. manufacturers' shipments, with the result that the calculated U.S. manufacturers' market shares, or in some cases even the calculated market sizes, are negative. Moreover, after the mergers discussed above, 70 NAICS codes in the manufacturing data set were found to be missing from the trade data set.

The shipments data are collected and published in accordance with NAICS, but the trade data are collected and published in accordance with the Harmonized Tariff System. Thus, the trade data had to be converted from HTS to NAICS for use with the shipments data, and problems arise in the conversion from HTS to NAICS. NAICS makes distinctions that HTS does not. For illustration, NAICS code 311320, is for "chocolate and confectionery manufacturing from cacao beans," and NAICS code 311330, is for "confectionery manufacturing from purchased chocolate." HTS does not distinguish whether confectioneries are made from purchased chocolate or directly from cacao beans, however. Undoubtedly, some imports under the relevant HTS codes belong under NAICS code 311320 and others belong under 311330. However, because the only thing known about the characteristics of an import is its HTS classification and HTS does not note the characteristic that distinguishes between the two NAICS codes, there is no obvious rule to split the imports in the HTS code between the NAICS product codes.

In practice, the Bureau of the Census decides for each HTS code which 6-digit NAICS code represents the best description of the product in question, and all imports under that HTS code are included in the chosen NAICS code. In the chocolate/cacao beans example, all imports are included in NAICS code 311320, which is recharacterized as being for "chocolate and confectionary products." No trade is left for NAICS code 311330, which is excluded from the data set.

In general, the result of this problem is that the conversion process produces too little trade for a number of NAICS codes (no trade at all for many of them) and too much trade for a number of other codes, and that fact is the cause of many of the negative calculated market shares and market sizes. Effectively, the conversion process in many cases has merged two or more NAICS codes together, so for this analysis, CBO addressed the problem by performing the same mergers on the manufacturers' shipment data. Specifically, CBO obtained information from the Bureau of the Census regarding what kinds of imports were missing from each NAICS code after an HTS–NAICS conversion and into which NAICS codes those imports were placed by the conversion. That information allowed CBO to judge which industries to merge in order to ameliorate the most serious problems. Those mergers eliminated most, but not all, of the negative calculated market sizes and shares. Moreover, after the mergers, only seven 6-digit NAICS codes and portions of three other codes (that is, 7-digit codes that made up part of three 6-digit codes) remained in the shipments data set that were absent from the trade data set. The Census Bureau information indicated that two of the 6-digit codes are mapped by the conversion into codes outside the manufacturing sector. The other five codes and several of the 7-digit codes are mapped into "N/A." That fact and the descriptions of the products covered by the codes suggest that the products are probably not traded internationally.

CBO did not use the Census Bureau information to check the remaining NAICS codes for which the HTS–NAICS conversion produced nonzero amounts of trade and for which the calculated market sizes and shares were positive. Some of those codes undoubtedly have too much or too little trade. However, in most cases, those problems are likely to be less serious than the ones that CBO corrected, since by definition they are not serious enough to cause negative calculated market sizes or shares or no trade data for the codes in question.

Product Data Versus Industry Data. Another problem that could cause the calculation of negative market sizes and shares is that in the data set for U.S. manufacturers' shipments, the value given for each NAICS code is not the value of shipments of all products defined by the code—what is called the "value of product shipments"—but is instead the value of shipments of all products produced by industries defined by the code—what is called the "value of industry shipments." The industry defined by the code is all establishments (not firms—a given firm might have several establishments at different locations) whose major product is the product defined by the code. Any given establishment might have more than one product, and the products might not all be classified by the same NAICS code. However, all of the product shipments of a given establishment are counted as shipments of the NAICS code by which the establishment is classified in the data set.

In most cases, the value of industry shipments is very close to the value of product shipments, so that the use of the value of industry shipments does not introduce significant error into the calculation of market sizes and shares. In a few cases, however, the value of industry shipments is significantly larger or smaller than the value of product shipments. In cases for which it is significantly smaller, the result could be negative calculated market sizes or shares.

For each of the remaining codes with negative calculated market sizes or shares after the correction for HTS–NAICS conversion problems, CBO obtained value-of-product-shipments data from the Bureau of the Census and determined whether substitution of those data for the value-of-industry-shipments data would correct the problem. In several cases, it did. In those cases, CBO made the substitution.

Deletion of NAICS Codes. After the corrections described here, one code remained for which the calculated market size was negative (333132, for oil and gas field machinery and equipment) and two other codes for which the calculated U.S. manufacturers' market shares were still negative (333314, for optical instruments and lenses, and 339913, for jewelers' material and lapidary work). Together, those three codes covered less than 0.5 percent of U.S. imports from China. Because negative market sizes and shares are impossible and thus indicate that something is wrong with the data and because the codes covered an insignificant portion of U.S. imports from China, CBO deleted those codes from the data set.

Preliminary Summary Statistics

From 1998 through 2005, the total value of U.S. imports from China in the 344 industries rose by $179.6 billion, or 248 percent.[9] If imports from China had maintained constant market shares in

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[9]   For comparison, total imports of manufactured goods from China, including those in the deleted industry/product codes, increased by $180.2 billion.

all industry/product sectors, the increase would have been $15.5 billion, or 21.5 percent (8.7 percent of the increase that actually occurred). Thus, the value of imports from China rose by $164.1 billion beyond what was necessary to maintain constant market shares in all product markets.

Over the same period, the share of imports from China in the U.S. market increased in 327 of the 344 industries. Among those 327 industries, the share of imports from the rest of the world increased in 255 and declined in only 72. Moreover, total imports from the rest of the world in the 327 industries taken together increased more than was required to maintain constant market shares in the industries. Thus, in the aggregate statistics, the increasing size of the U.S. trade deficit with the world relative to the size of the U.S. economy overwhelms any tendency for increases in imports from China to be offset by reductions in the market share of the rest of the world, and a simple updating of the calculation by Noland does not appear to show any offset.

That result does not mean, however, that the increases in the market shares of imports from China have not come partially at the expense of the market shares of imports from the rest of the world. The increases in the market shares of imports from the rest of the world would have been larger if the Chinese market shares had not increased so much. As a result, imports from the rest of the world would have caused greater displacement of U.S. manufacturers' market shares in U.S. markets than actually occurred. Therefore, for determining the net displacement of U.S. manufacturers' market shares in U.S. markets resulting from the increased shares of imports from China, the critical issue is not how much the market shares of imports from the rest of the world declined in absolute terms, but rather how much they declined relative to what they would have been in the absence of the increased shares of imports from China. That relative decline represents an offset of the increased market shares of imports from China by changes in imports from the rest of the world.

Estimating the Offset

To detect and estimate the magnitude of the offset, CBO fit the following simple equation to the data:

(1) $\Delta S_{ROW,i} = a_1 \cdot [S_{ROW,i,o} /(S_{ROW,i,o}+S_{US,i,o})] \cdot \Delta S_{China,i}$

$+ a_2 \cdot [S_{ROW,i,o} /(S_{ROW,i,o}+S_{China,i,o})] \cdot \min \{S_{ROW,i,o}+S_{China,i,o} , 1 - (S_{ROW,i,o}+S_{China,i,o})\}$,

where S_{China}, S_{ROW}, and S_{US}, are the shares of imports from China, imports from the rest of the world (ROW), and U.S. manufacturers' shipments, respectively, in the U.S. market for product i; Δ indicates the change in the value of the variable that follows it over the period in question; subscript o indicates a state variable equal to the value of the variable in question at some time during the interval over which the Δ is performed; and a_1 and a_2 are constant parameters estimated statistically to make the model fit the data as closely as possible.[10] The first term on the right-hand side of the equation represents the displacement of ROW market share by imports

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[10]   Usually when linear equations are estimated, a constant term is included. In equation (1) that would mean including an additional term of $+ a_3$. However, theoretically one would not expect such a term in equation (1). Moreover, CBO tried estimating equation (1) with such a term, and the result was that the estimated value of the term was very small and statistically insignificant.

from China. The second term represents general growth of market share in reflection of the increasing size of the U.S. current-account deficit, which is more a function of domestic macroeconomic conditions in the United States—in particular, domestic saving and investment—than of trade policies of the United States and other countries.

Explanation of First Term. The entire increase in Chinese market share for each product must displace some combination of ROW market share and U.S. manufacturers' market share. $[S_{ROW,i,o}/(S_{ROW,i,o}+S_{US,i,o})]$ is included in the first term because a greater share of the total displacement is likely to fall on imports from the rest of the world in industries in which those imports have a large share of the U.S. market than in industries in which those imports have a small share of the U.S. market. Thus, if imports from the rest of the world have 90 percent of the non-Chinese share of the U.S. market for a particular product and U.S. manufacturers have the other 10 percent, then an increase in the share of imports from China is likely to displace mostly imports from the rest of the world. Conversely, if imports from the rest of the world have only 1 percent of the non-Chinese share of the U.S. market in another product and U.S. manufacturers have the other 99 percent, then mainly U.S. manufacturers' shipments will be displaced.

Explanation of Second Term. CBO assumed that for industries/products for which the share of imports from the entire world (China and the rest of the world) is small, the increase in that share resulting from the increasing U.S. trade deficit would be proportional to the share, which is $S_{ROW,i,o}+S_{China,i,o}$. However, because the total share cannot exceed one, that assumption cannot hold if $S_{ROW,i,o}+S_{China,i,o}$ is equal to or close to one. Therefore, CBO assumed that the increase would be proportional to either $S_{ROW,i,o}+S_{China,i,o}$ or $1 - (S_{ROW,i,o}+S_{China,i,o})$, whichever was smaller—that is, that the increase would be proportional to $\min\{S_{ROW,i,o}+S_{China,i,o} , 1 - (S_{ROW,i,o}+S_{China,i,o})\}$, where $\min\{.,.\}$ was the minimum of the two arguments in the brackets. CBO then assumed that the increase in the share of imports from the world calculated in that fashion would be allocated between China and the rest of the world in proportion to their respective shares of U.S. imports, thus requiring that the $\min\{.,.\}$ function be multiplied by $S_{ROW,i,o}/(S_{ROW,i,o}+S_{China,i,o})$.

Statistical Methodology. Equation (1) was estimated for the period 1998 to 2005 using the least squares technique. Several variants of the equation were estimated. First, the equation was estimated exactly as written, with a_2 required to be the same for all industries/products. Second, because one might expect that the general growth of market shares in reflection of the increasing U.S. trade deficit would be greater for some industries than for others, the equation was estimated with a_2 being allowed to take different values for NAICS codes 31, 32, and 33. Third, in a further move in that direction, the equation was estimated with a_2 allowed to take different values for 10 different groups of 3-digit NAICS codes. The groups were chosen in part on the basis of similarity of the industries/products included in each group and in part on the basis of the need to have a sufficient number of 6-digit industries/products in each group to get a statistically significant estimate of a_2 (see Table B-1). Fourth, the equation was estimated separately for each of the 10 groups of industries. Finally, the equation was estimated using other more-flexible functional forms for the second term, including a quadratic function of $S_{ROW,i,o}+S_{China,i,o}$, to determine whether the estimate for the offset coefficient a_1 in the first term was sensitive to the functional form of the second term. For the first three variants, both unweighted and weighted regressions were performed—the latter using the market sizes as weights—to determine the sensitivity of the estimates to weighting.

For $\Delta S_{ROW,i}$ and $\Delta S_{China,i}$, CBO used the cumulative changes in $S_{ROW,i}$ and $S_{China,i}$ from 1998 to 2005. For $S_{China,i,o}$, $S_{ROW,i,o}$, and $S_{US,i,o}$, CBO used the values those variables had at the midpoint between 1998 and 2005, calculated as the harmonic averages of the values in 2001 and 2002.

CBO also estimated the equations using the values that $S_{China,i}$, $S_{ROW,i}$, and $S_{US,i}$ had in 1998. The resulting estimates of the offset were slightly higher than those presented here. From the standpoint of economic theory, the estimates using the share values at the midpoint between 1998 and 2005 would seem to be superior. Moreover, they are superior for a statistical reason as well. Because of the previously discussed data problems, it is likely that there remain some errors in the data for the market shares. Any such errors in the shares for 1998, which would appear in the independent variables on the right-hand side of the equation, would be correlated with consequent errors in the data for the dependent variable $\Delta S_{ROW,i}$ on the left-hand side of the equation. Correlation of data errors between dependent and independent variables can lead to estimates that are statistically inconsistent, which means that the estimate does not get closer and closer to the correct value as the number of data points gets larger and larger but instead zeros in on a value different from the correct one. The severity of that problem should be less for the estimates using the share values at the midpoint between 1998 and 2005.

Analysis of Results

The estimates from the unweighted regressions for the first three variants are presented in Table B-2. For each coefficient, the table presents the estimate, the standard error, and the p value. The standard error is a measure of the statistical uncertainty in the estimate. The probability that the true value of the coefficient is within one standard error (plus or minus) of the coefficient estimate is roughly two-thirds. The p value is the probability that one would obtain a coefficient estimate as large as or larger than (in terms of absolute value) the coefficient estimate actually obtained if the true value of the coefficient were zero. The adjusted R-squared is the fraction of the variation in $\Delta S_{ROW,i}$ that is explained by the estimated equation.

All of the coefficient estimates have the correct expected sign. That is, all three estimates of a_1 are negative, indicating that larger increases in the market share of imports from China are correlated with smaller increases or even decreases in the market share of imports from the rest of the world and that therefore there is some degree of offset; and all of the estimates of a_2 are positive, indicating that in the absence of increased market shares for imports from China, the market shares of imports from the rest of the world would all have grown in accordance with the increasing U.S. trade deficit.

Examination of the p values indicates that all of the estimates for a_1 are extremely significant, meaning that there is little doubt that there is some degree of offset. Almost all of the estimates for a_2 are extremely significant as well; the only one that is marginally significant is that for industry/product group 10, and even that estimate is significant at the 10 percent level.

Table B-1

Industry/Commodity Groups Used In CBO's Analysis

Industry/ Commodity Group	3-Digit NAICS Codes	Industry/Commodity Description	Number of Industries/ Products
1	311	Food and kindred products	32
	312	Beverages and tobacco products	8
2	313	Textiles and fabrics	8
	314	Textile mill products (Carpet, rugs, curtains, bags, rope, and so on)	7
	315	Apparel and accessories	3
	316	Leather and allied products	10
3	321	Wood products	12
	322	Paper	12
	323	Printed matter and related products, NESOI	5
4	324	Petroleum and coal products	3
	325	Chemicals	28
	326	Plastics and rubber products	11
5	327	Nonmetallic mineral products (Brick, porcelain, ceramic, glass, stone)	21
	331	Primary metal manufacturing	15
	332	Fabricated metal products, NESOI	27
6	333	Machinery, except electrical	41
7	334	Computer and electronic products	27
8	335	Electrical equipment, appliances, and components	21
9	336	Transportation equipment	25
10	337	Furniture and fixtures	10
	339	Miscellaneous manufactured commodities	19
All groups	311 – 339	All manufacturing	345

Source: Congressional Budget Office.

Note: NAICS = North American Industry Classification System; NESOI = not elsewhere specified or included.

The substantial improvement in *R*-squared in conjunction with the variation in the estimates of a_2 and the continued high significance of those estimates indicates that the suspicion that market shares of different industry groups would increase by different amounts in response to the increasing U.S. trade deficit was correct, that the second equation variant is probably a better model than the first, and that the third variant is probably a better model than the second. However, the three variants result in similar estimates for the offset—34.2 percent for the first variant, 35.4 percent for the second, and 36.1 percent for the third. The differences among the three estimates are even less significant when one looks at the 90-percent confidence intervals— 27.4 percent to 41.0 percent for the first variant, 28.6 percent to 42.1 percent for the second, and 29.3 percent to 42.8 percent for the third.

The results from the separate estimation of the equation for each of the 10 groups in Table B-1 suggest that the offset may vary considerably from group to group. However, confidence intervals around most of the estimates are sufficiently large as to make the estimates essentially useless beyond their support for that conclusion, so they are not presented here. The overall average offset for the 10 groups is within the 90 percent confidence intervals of all three variants listed in Table B-2. Thus, the assumption implicit in those variants—that the offset is the same for all industries—does not significantly affect CBO's estimate of the offset.

Estimating the equation with other more-flexible functional forms for the second term made little difference in the resulting estimate for a_1 in the first term. Weighting the regressions by the sizes of the markets for the various industries/products resulted in lower offset estimates. Such weighting of the regressions would be called for only if there were reason to think that the error term in the equation is smaller for larger industries, which is not the case. Nevertheless, the sensitivity of the results to the weights used suggests greater uncertainty about the true value of the offset than is captured in the standard errors. Hence, it is probably best to consider the offset to be roughly one-third rather than the more precise 36 percent.

Implications for Competing U.S.-Based Manufacturers. The implication that roughly two-thirds of the increase in market share of imports from China came at the expense of U.S. manufacturers' market share does not mean that the output of U.S. manufacturers fell or even did not increase by some amount. Such implications depend on what happened to the sizes of the relevant U.S. markets and to labor productivity. If the U.S. market for a given product increased by an amount almost equal in dollar value to the increase in imports from China of that product, then most of any increase in Chinese market share would have been taken up by the growth in market size rather than reductions in demand for U.S. manufactured products even with no offsetting reductions in the market share of the rest of the world. Conversely, if the size of the U.S. market for a given product declined, then larger market share for imports from China would have caused greater decreases in the demand for U.S. manufacturers' output than the increase minus the offsetting decline in the share of imports from the rest of the world would indicate.

It is possible to determine, however, that the actual reduction in domestic demand for U.S. manufacturers' shipments—that is, the absolute decline, not the decline relative to what they might have been—resulting from increasing Chinese competition from 1998 through 2005 was no more than, and probably significantly less than, $79 billion. Imports from China could have caused a decline in domestic demand for U.S. manufacturers' shipments only in industries for which both imports from China grew and U.S. manufacturers' domestic shipments declined. Of the 344 industries CBO analyzed, 144 fit that description. In each of those 144 industries, the maximum possible decline in demand for U.S. manufacturers' domestic shipments caused by the increase in imports from China is either the actual decline in such shipments or the increase in imports from China, whichever is less. Summing that maximum over all 144 industries gives the $79 billion figure, which is 70 percent of the $114 billion increase in imports from China in the 144 industries and 44 percent of the $180 billion increase in imports from China in all 330 industries in which imports from China increased. In reality, some of the decline attributed to

Table B-2

Equation Estimates

Variable	Variant 1			Variant 2			Variant 3		
	Coef. Est.	Stand. Err.	p value	Coef. Est.	Stand. Err.	p value	Coef. Est.	Stand. Err.	p value
a_1	-0.8535	0.1029	< 0.0001	-0.8820	0.1028	< 0.0001	-0.8999	0.1021	< 0.0001
a_2									
All Mfg.	0.3129	0.0190	< 0.0001						
2-digit NAICS									
31				0.4350	0.0494	< 0.0001			
32				0.3013	0.0448	< 0.0001			
33				0.2952	0.0218	< 0.0001			
3-digit NAICS									
Group 1							0.2164	0.0763	0.0048
Group 2							0.5652	0.0606	< 0.0001
Group 3							0.2338	0.0924	0.0119
Group 4							0.3928	0.0620	< 0.0001
Group 5							0.2642	0.0400	< 0.0001
Group 6							0.3821	0.0397	< 0.0001
Group 7							0.2837	0.0450	< 0.0001
Group 8							0.3730	0.0637	< 0.0001
Group 9							0.2601	0.0540	< 0.0001
Group 10							0.1067	0.0630	0.0914
Adjusted R-squared	0.4450			0.4532			0.4921		
Implied offset									
Point estimate	0.3422			0.3536			0.3608		
90-percent confidence interval	0.2743 – 0.4101			0.2858 – 0.4215			0.2935 – 0.4281		

Source: Congressional Budget Office.

Note: NAICS = North American Industry Classification System.

imports from China by that calculation actually resulted from increases in imports from the rest of the world rather than increases in imports from China. It follows that the decline actually resulting from the increase in imports from China was significantly less than $79 billion.

Implications for the *Perceptions* of Competing U.S.-Based Manufacturers. The general growth in market share of imports that is reflected in the second term of equation (1) has implications for imports from China as well. That is, even if China's economy were not growing more rapidly than that of the rest of the world and China had an appropriately valued exchange rate, China's market share in the United States would have increased along with the market share of imports from the rest of the world. A comparison of that case with what actually happened is of interest

because it reveals that the effect of the offset on the perceptions of U.S. manufacturers may be more significant than is readily apparent from the size of the offset.

The value of aggregate imports from China increased by $164.1 billion beyond what was required to maintain constant market share in the 344 product markets under examination. Imports from the rest of the world in those same sectors increased by $221.0 billion beyond what was required to maintain constant market share.[11] Thus, imports from the entire world increased by $385.1 billion beyond what was required to maintain constant market share. The entire $385.1 billion represents lost market share for U.S. manufacturers, and they see imports from China taking 42.6 percent of their lost market share and imports from the rest of the world taking 57.4 percent of it.

Under the assumption that the offset is equal to the estimate of 36 percent obtained from variant 3, however, it is straightforward to calculate that if imports from China had not increased so rapidly but instead had increased at only the same rate as imports from the rest of the world, then imports from China would have increased by $28.1 billion beyond what was required to maintain constant market share in the 344 product markets, and imports from the rest of the world would have increased by $270.0 billion beyond what was required to maintain constant market share in those markets. Thus, imports from the entire world would have increased by $298.1 billion beyond what was required to maintain constant market share—77.4 percent of the increase over constant market share that actually occurred. However, U.S. manufacturers would have seen imports from China taking only 9.4 percent of their lost market share and imports from the rest of the world taking 90.6 percent of it.

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[11] The number given here does not count imports from the rest of the world in sectors for which there were no imports from China.