Working Paper Series

NUMBER WP 05-11 SEPTEMBER 2005

The US Trade Deficit: A Disaggregated Perspective

Catherine L. Mann and Katharina Plück

Catherine L. Mann has been a senior fellow at the Institute for International Economics since 1997. Previously, she served as assistant director of the International Finance Division at the Federal Reserve Board of Governors, senior international economist on the President's Council of Economic Advisers at the White House, and adviser to the chief economist at the World Bank. She is author or coauthor of *High Technology and Globalization in America* (forthcoming), *APEC and the New Economy* (2002), *Global Electronic Commerce: A Policy Primer* (2000), and *Is the US Trade Deficit Sustainable?* (1999). Katharina Plück is a research assistant at the Institute for International Economics.

Abstract

The paper prepares new estimates for the elasticity of US trade flows using bilateral, commodity-detailed trade data for 31 countries, using measures of expenditure and trade prices matched to commodity groups, and including a commodity-and-country specific proxy for global supply-cum-variety. Using the United Nations Commodity Trade Statistics Database (UN Comtrade) we construct bilateral trade flows for 31 countries in four categories of goods based on the Bureau of Economic Analysis's "end-use" classification system—autos, industrial supplies and materials–excluding energy, consumer goods, and capital goods. We find that using expenditure matched to commodity category yields more plausible values for the demand elasticities than does using GDP as the measure of demand that drives trade flows. Controlling for country and commodity fixed effects, we find that industrial and developing countries have demand elasticities that are statistically significant and that generally differ between development groups and across product categories. Relative prices for the industrial countries have plausible parameter values, are statistically significant and differ across product groups, but the relative prices for developing countries are poorly estimated. We find that variety is an important variable for the behavior of capital goods trade. Because the commodity composition of trade and of trading partners has changed dramatically, particularly for imports, we find that the demand elasticity for imports is not constant. Comparing the in-sample performance of the disaggregated model against a benchmark that uses aggregated data and GDP as the expenditure variable, our disaggregated model predicts exports better in-sample but does not predict imports as well as the benchmark model.

Note: This paper was prepared for the NBER Project "G-7 Current Accounts: Sustainability and Adjustment." The authors thank Jaime Marquez, Menzie Chinn, and David Roodman, who were invaluable in answering econometric questions, but are not responsible for errors.

JEL classification: F4, F1

Key words: US trade deficit, Goods, Trade, Commodity composition, Trade elasticities and sustainability

INSTITUTE FOR INTERNATIONAL ECONOMICS

1750 MASSACHUSETTS AVENUE, NW | WASHINGTON, DC 20036-1903
TEL: (202) 328-9000 | FAX: (202) 659-3225 | WWW.IIE.COM

I. INTRODUCTION

By early 2005, US net trade had been in deficit for more than 25 years and was on a trajectory for more than $700 billion for the year. In dollar terms, this was the largest deficit of any country ever; as a share of GDP, it was much larger than ever experienced by a large industrial country. Pundits, policymakers, financiers, and researchers want to know how the trade deficit got so large. They are even more interested in its future path.

Empirical modeling of the determinants of trade flows using the "elasticities" approach has a very long history in international economics and is used both to explain the past and to project the future. Key ingredients of this model are the elasticity of demand for exports and imports with respect to economic activity, the elasticity of exports and imports with respect to relative prices, and the influence of other factors, including global supply and increased variety.

Have there been any changes in the nature of US trade to warrant more analysis in this vein? An examination of US trade patterns over the last 25 years finds that the commodity and country composition of trade have changed, particularly on the import side. A changing country and commodity composition of trade may be particularly important to understand both the widening of the trade deficit and its future trajectory. Country composition may affect comparative advantage as new global supply comes on-line and new trading partners appear, and because differences in exchange rate regimes across countries may affect movements of relative prices. Commodity composition may matter because of differences in relative price elasticities on account of product heterogeneity. In addition, for both country and commodity composition, differences in growth rates of different categories of expenditure (particularly as reflected in long-time systematic deviation between production and absorption) in the United States compared with that of US trading partners could be particularly important in explaining the dynamics of US trade.

This paper considers whether measures of economic activity other than GDP better model observed trade flows. It investigates whether income and relative price elasticities of US trade differ by trading partner or commodity category. It asks whether new estimates of key parameters improve the forecast performance of the trade equations. Our strategy creates a database of bilateral trade data for 31 countries, aggregates these detailed flows into four categories of goods based on the Bureau of Economic Analysis's (BEA) "end-use" classification system—autos; industrial supplies and materials, excluding energy (ISM-ex); consumer goods; and capital goods. We employ trade prices and measures of expenditure that match these commodity categories and include a country-by-commodity proxy for global supply-cum-variety.

We find that using expenditure matched by commodity category is a superior measure of economic activity compared with using GDP and yields far more plausible values for the demand elasticities. We find that the demand and relative-price elasticities differ between industrial and developing countries and across the four commodity categories. Because the commodity composition of trade and of trading partners has changed, particularly for imports, we find that the demand elasticity for imports is not constant. We find that industrial and developing countries have different income and relative price elasticities for these four commodity categories. We find that variety is an important variable for the behavior of capital goods trade.

Comparing the in-sample performance of the model that disaggregates by product group, differentiates by income group, and uses matched expenditure and trade price against a benchmark model that uses aggregated data and GDP as the expenditure variable, our disaggregated model predicts exports better in-sample but does not predict imports as well as the benchmark. Within product groups, auto trade and consumer goods imports are least well explained in-sample by the disaggregated model. But, in-sample predictions of consumer goods exports, ISM-ex trade flows, and capital goods trade are better than the predictions of a model that uses GDP as the measure of economic activity.

The new elasticities yield insights into the sources of the widening of the US trade deficit and have implications going forward for policymakers' approach to demand management and global trade imbalances. Estimated demand elasticities across commodity categories and trading partners imply that if US consumers "saved more," this likely would be a more important factor in changing the trajectory of the trade deficit than if the other industrial economies "grew more," considering a common metric of a one-percentage point increase. The differences in estimated relative price elasticities across trading partners and commodities, in conjunction with complementary research on exchange rate pass-through undertaken by other authors (Campa and Goldberg 2004, Marazzi et al. 2005), imply that exchange rate valuations of developing countries need to lead to more trade-price variability to appreciably narrow the US trade deficit.

The next section of the paper briefly reviews the vast literature on modeling US international trade, focusing on the workhorse model of income and relative prices, including its more recent variations that include proxies for global supply and variety. Section III presents and discusses data on the US trade deficit that show changes in country and commodity composition of trade, which initiated this investigation. Section IV discusses our newly constructed data. Section V presents the econometric approach. Section VI discusses results and summarizes findings. Section VII presents some implications and notes areas for further work.

II. LITERATURE REVIEW

The classic workhorse model for estimating trade elasticities has been used since at least the 1940s (Adler 1945 and 1946, Chang 1945–46). It relates the volume of exports or imports to real foreign and domestic income and relative prices (in log form):

$$\ln trade = \alpha + \beta_1 \ln income + \beta_2 \ln rel.price \, .$$

The model assumes that domestic and foreign tradable goods are imperfect substitutes, that price homogeneity holds (e.g., that an estimated coefficient on the trade price and domestic price are equal, thus allowing for a single relative price term), and that the elasticities with respect to economic activity (e.g., income) and relative prices are constant over time (see Hooper, Johnson, and Marquez 2000 for a concise summary of the model).

All studies find—as expected—that an increase in domestic economic activity ("income") will raise the domestic demand for imports and that an increase in foreign economic activity ("income") will raise the foreign demand for domestic exports. A rise in the relative price of imports to the domestic substitute will reduce demand for imports and a rise in the relative price of a country's export good to the foreign competing good will dampen the demand for exports.

The sizes of the coefficients on income and relative price vary greatly by study, time period, countries analyzed, coverage of commodity groups, and as to whether different or additional explanatory variables are in the model. Most studies estimate that the income elasticity for US exports is smaller than the income elasticity for US imports and in this regard replicate the earliest and most well-known finding by H.S. Houthakker and Stephen Magee. Subsequent studies often estimate higher export and import elasticities than the original findings but surprisingly find that the *ratio* of the import to export elasticity varies relatively little from the 1.7 found by Houthakker and Magee in 1969.[1]

Despite the empirical persistence of this asymmetry, and its concomitant value for intermediate-term projections of US trade flows, it is not consistent with a global long-run equilibrium. The estimates imply that if the United States and the rest of the world grow at the same pace (long-run convergence), the US trade deficit would worsen, absent a trend change in relative prices.[2] Researchers continue to investigate US trade flows and the Houthakker-Magee puzzle by examining different data samples, considering more precise measures for certain variables, employing different estimation techniques, and adding new independent variables to the basic Houthakker and Magee specification.

One approach to the Houthakker-Magee puzzle is to take on directly the changes in the commodity composition of US trade over the past 25 years by estimating import and export equations for different categories of goods and services and/or different groups of trading partners. If the country-and-commodity composition of a country's trade has changed significantly over time, one might expect that trade elasticities, specifically for the United States, are not constant. For example, researchers have found different income and price elasticities for different product categories (see Stone 1979 and Marquez 2002 for different goods

[1]Houthakker and Magee estimated the US income elasticity for total imports of 1.7 (auto-correlation corrected estimate in the appendix) and the foreign income elasticity for US exports at around 1. In their survey of import and export demand elasticities for the United States, Sawyer and Sprinkle (1996) find income elasticities for total merchandise imports ranging from 0.1322 (Welsch 1987) to 4.028 (Wilson and Takacs 1979). Estimates for foreign income elasticities for US exports do not vary quite as much; still they range from 0.374 (Stern, Baum, and Greene 1979) to 2.151 (Wilson and Takacs 1979). The median (mean) estimate of the 24 studies on total US imports referenced in Sawyer and Sprinkle is 2.02 (2.14). The median (mean) estimate of the 17 studies on total US merchandise exports referenced in Sawyer and Sprinkle is 1.12 (1.02). In one of the more recent studies, Hooper, Johnson, and Marquez (2000) find that the long-run income elasticities for US exports and imports are 0.8 and 1.8, respectively, and are stable over time.
[2] Krugman and Baldwin (1987), among others, make this observation and discuss implications.

categories; see Sawyer and Sprinkle 1996 for a survey; see Deardorff et al. 2001 and Mann 2004 for services). Hooper, Johnson, and Marquez (2000) cannot reject the hypothesis that the US trade elasticities are constant over time, but they hold the country composition of trade fixed at the 1995 shares and because of data availability and the objective of the study, focus on industrial-country trade. Using a century of data, Marquez (1999) finds that the elasticity with respect to income for US imports varies over time as trade openness affects the share of imports in expenditure.

Researchers have also focused on "the notorious inadequacies of import and export price indexes" (Houthakker and Magee 1969, 112). Relative price measures used most often to proxy for domestic substitutes for the traded product—the GDP deflator and the wholesale price index—introduce bias because both include a considerable share of nontraded goods (Goldstein and Khan 1985). Moreover, conventional price indexes for traded goods are too aggregated to reflect new product introductions and may not take account of the effect of changes in global supply on prices and therefore on demand, which apparently have been important features of current data.[3] Incorporating different price indexes changes the estimated income elasticities in the workhorse model. In particular, Feenstra's (1994) detailed work on prices of six narrowly defined manufacturing goods substantially reduced the estimated income elasticity of US import demand for these six products.[4] And Marquez's (2002) variable constructed using both Feenstra's price-index methodology and a variant on the relative capital stock term originally used in Helkie and Hooper (1988) reduced income elasticities for US imports of producer goods but not of services or consumer goods.

As an alternative to constructing new price indexes, researchers have put auxiliary variables in the standard regression—focusing almost exclusively on the US import equation even though the theory should be equally relevant for the US export equation—to account for changes to both the supply and demand sides.[5] The theoretical backdrop in conjunction with the empirical research to date gives conflicting hypotheses for the sign and size of any supply-cum-variety variable. In the global supply shift story, new trading countries increase global supply, which reduces prices, and thus increases demand for their exports.

[3] Broda and Weinstein (2004) show that between 1972 and 2002 the number of "varieties" imported by the United States increased by 252 percent (p. 15), with an important source of the new varieties being the entry into global trade of dynamic emerging-market economies including China, Taiwan, Korea, India, and Mexico. Hummels and Klenow (2004) find that as countries industrialize and grow, not only do their exports increase in nominal value but also the breadth of variety these countries offer to the world widens. Schott (2004) shows that varieties within a product set differ systematically across countries, with higher unit-value varieties coming from countries with higher productivity.

[4] Feenstra considers imports of men's leather athletic shoes, men's and boys' cotton knit shirts, stainless steel bars, carbon steel sheets, color television receivers, and portable typewriters, and for comparison purposes gold and silver bullion, between 1967 and 1987. He treats as variety a good from a particular country (often termed the Armington assumption) and calculates each variety's share in actual US expenditure and the US elasticity of substitution between those different varieties. This method takes account of the new varieties produced (in this case, equivalently new trading partners) and exported in ever greater quantities by developing countries, for example.

[5] Gagnon (2003a) estimates regressions for US exports using a supply variable; but his results for US exports are less robust and less stable across samples than his results for US imports (pp. 13 and 16).

According to Paul Krugman's (1989) "45-degree rule,"[6] fast-growing countries will not experience a deterioration of their trade balance (and therefore face steady depreciation of their currency) because as they grow, they produce more varieties with increasing returns to scale. Since consumers love varieties, given income, the apparent demand curve for the varieties shifts out and there is no deterioration in the terms of trade. Peter Schott (2004) finds that fast-growing countries with high productivity growth produce varieties that are high unit-value, so for them the demand curve is not only shifting out but also tilting in their favor.

All told, the "classic" workhorse model (of equation 1 above) using the standard complement of income and relative prices may not take account of the effect that trading partners' supply or variety of exports have had on US import prices and/or import demand. The US import elasticity would tend to be overestimated to the extent that some of the explanation for the rising share of imports in US GDP lies with increased foreign supply (and thus lower prices and thus more demand for imports); and some of the explanation comes from increased domestic taste for variety, holding income constant. Researchers have implemented the global supply-cum-variety measure using several variables.

- Helkie and Hooper (1988) use the ratio of home to foreign productive capital stocks to represent exporters' increased capacity to supply more new products to the US market. Their new variable significantly reduces the inequality between income elasticities for US imports and exports for the time period of their estimation but later declines in significance tests.

- Bayoumi (1999) includes exporters' GDP in a panel estimation for trade flows between 21 industrial countries. He finds that this supply effect is significant and increases in the longer run,[7] whereas the importer's income elasticity decreases over time.

- Marquez (2002) considers "immigration" as a proxy for American consumers' tastes for varieties from abroad. With a growing share of immigrants in the population, he posits, US demand for imports from immigrants' home countries must be higher, with other things held equal. Including the immigration variable does reduce the US income elasticities for services and consumer goods imports.

- Gagnon, in three recent papers (2003a, 2003b, 2004), finds a significant supply effect (defined as potential output growth or relative GDP of the exporting country). Omitting this variety variable leads him to overestimate the coefficient on income in a US import regression.

[6] It is called the "45-degree rule" because the growth rates and the ratio of export to import income elasticities for countries can be plotted as a 45-degree line between two axes.
[7] The fact that the coefficient on exporters' output increases with increasing lags shows that it is the exporting countries' potential growth that determines its capacity to supply variety, not short-run fluctuations in growth rates.

- Cline (2005) puts the trading-partner GDP into the workhorse model and finds that it reduces the income elasticities in US trade equations for both exports and imports.

To summarize, closer attention to changes in trading partners and commodity composition of trade, using more disaggregated trade prices, and taking better account of global supply and/or demand for variety are the predominant directions of the research undertakings to date. We will continue in these directions and also investigate the "income" variable itself, collecting data that better matches this variable to the disaggregated commodity and country composition of trade. So, there are five dimensions for our analysis: trading partner, composition of trade, variety-cum-global supply, measures of economic activity, and trade prices.

III. GRAPHICAL EVIDENCE TO SUPPORT A DISAGGREGATED APPROACH

Figure 1 is a key spur to this investigation. It shows the US trade deficit disaggregated into BEA's end-use categories of capital goods, ISM-ex, consumer goods, and autos and auto parts. (For completeness, the figure also shows net trade in two categories of services and in "other"—petroleum and agricultural products.) The deterioration of the US trade balance has been trending by end-use categories, with the bulk of the deterioration in the trade deficit due to a widening deficit in autos, consumer goods, and oil. If the commodity shares of trade are unchanged, if the country composition of trade is unchanged, and if the income elasticities of trade are unchanged, then we should not see this differential widening of the trade deficit across product groups. Hence our investigation into the changing commodity-and-country composition of trade.

Table 1 (detail in appendix figures A1.1 and A1.2) decomposes the trade deficit into BEA's *commodity composition of trade* for imports and exports. The largest categories of both imports and exports are capital goods and ISM-ex. From 1980 to 2004, the share of capital goods rose and that of ISM-ex fell. Capital goods is a particularly interesting category because of the potential importance of changing global supply and variety. Moreover, from a macroeconomic perspective, global investment cycles may differ from global GDP cycles, with consequences for US capital goods exports and imports. Consumer goods is a large category with a dramatic increase in the share of US imports, rising from 14 to 25 percent in 25 years. The share of consumer goods in total merchandise exports rose only modestly and accounts for only 13 percent of exports. Consumer goods constitute a particularly interesting category because of the potential role of changes in country source of supply. Moreover, from a macroeconomic perspective, differential growth in personal consumption expenditures in the United States versus in trading partners may be an important factor in the widening of the US trade deficit. Finally, table 1 also indicates that trade overall, more on the import side, has been rising as a share of GDP.

Table 2 (detail in appendix figures A2.1 and A2.2) shows that the *country composition of trade*, particularly of imports, has changed dramatically. Trade with the industrial countries in general has stayed relatively stable, with the share of imports remaining at about 50 percent and that of exports falling from 60 to 54 percent (1980–2004). Within the industrial-country group, exports to Europe and Japan have fallen. The share of imports from certain countries and regions has changed dramatically, with the share of imports from China increasing from 1 to 13 percent over the period, the share of exports to non-China and non-Japan Asia doubling to 11 percent, and the share of trade with Latin America (less Mexico) contracting.

Putting commodity and country together, the large size of the capital goods trade, the large increase in the consumer goods share of imports and of the trade deficit, and the changing shares of trade with countries in Asia, as well as with the North American Free Trade Agreement (NAFTA) partners, suggests that closer inspection of trade flows by country and commodity is warranted. However, BEA does not publish bilateral trade data by merchandise categories. The Census Bureau's published trade data by category and trade partner does not extend further back than 1995, and the United States International Trade Commission (USITC) database covers bilateral trade by product only from 1989. Hence we turn to another comprehensive source of a long time-series of data to analyze the changing commodity-and-country composition of US trade.

IV. OUR DATABASE ON US TRADE COMMODITY-BY-COUNTRY

Our database includes (1) a 31-country sample of bilateral trade with the United States aggregated into proxy end-use categories; (2) expenditure data matched by country and proxy end-use category; (3) trade prices matched by end use and relative prices matched by country and end use; and (4) "variety" in each proxy end-use category.

Constructing Bilateral Trade Data

To approximate our initial observations from BEA data, and because we use their trade price indexes, we re-create BEA's end-use categories using the Standard International Trade Classification (SITC, Revision 2-, 4-, and 5-digit), which in the United Nations Comtrade database spans the longest time period.

To match BEA's end-use commodity groups, we use Comtrade's raw materials and intermediate goods for our "ISM-ex" category; "capital goods" encompasses most of SITC chapter 7 and some categories in chapter 8; "autos" includes passenger vehicles and their parts from chapter 7; and "consumer goods" is made up almost entirely of the categories comprising chapter 8. We excluded all of chapter 3 (energy) and all of chapter 1 (food) as these are also excluded from BEA's end-use categories that are the focus of our graphical evidence. Table A1 in the appendix shows the complete list.

For our econometric technique, we need a uniform panel with the same set of countries for each of the proxy end-use groups for both imports and exports. To select countries to include in the database, we start with bilateral trade between the United States and partner countries by each 4-digit or 5-digit SITC category. For each country reporting trade data to the United Nations, we calculated its share in US total merchandise imports and total merchandise exports and its share in trade in each of our four proxy end-use commodity groups. Of all countries in the database, we selected those that represented the first 90 percent of trade in each category. We excluded most of the Middle East because of the suspicion that trade with these countries might not be well-estimated with the standard workhorse model. We excluded the countries of the former Soviet Union because there are insufficient data on expenditure and prices. We also excluded South Africa. Hence, our sample of bilateral trade pairs includes 31 countries from Asia and the Pacific, North America, Latin America, and Western Europe.[8]

Because of our intended econometric approach, some variation in country composition across the commodity groups is ignored. For example, Bangladesh, Honduras, and Sri Lanka are excluded; even though they are in the first 90 percent of US imports of consumer goods, they were not important trading partners in the other end-use categories. At the other extreme, we included 31 countries in US auto imports and exports even though the United States trades autos and parts overwhelmingly with Canada, Mexico, Japan, and Germany.[9]

Figure 2 shows one example—imports of capital goods—of how significant is the change over time in the country-by-commodity shares. Appendix figures A4.1 to A4.8 show the evolution of commodity-by-country shares for the complete set of four commodity groups in trade.

To employ the workhorse model of trade, we need real exports and real imports. We deflate all nominal values by the corresponding end-use export and import price indexes from the Bureau of Labor Statistics (BLS) International Price Program. [10]

Constructing Matched Expenditure Variables and Relative Prices

A key part of the analysis is whether the elasticities estimated in the workhorse model differ by the measure of economic activity employed. The standard measure of economic activity used in trade equations is real

[8] Trade data on 30 countries are from the UN Comtrade database. Data on a comparable basis for Taiwan come from that country's statistical office.
[9] Since we find, in this paper, that the commodity-and-country composition of trade is important for estimated coefficients, in a subsequent analysis we will allow the country composition of the commodity groups to vary.
[10] The end-use import and export prices do not differentiate by trading partner. Inspection of some country-specific time-series data from BLS rejects the assumption that prices do not vary by trading partner. However, country-specific trade-price data are unavailable at sufficient time-series length and are not disaggregated on an end-use basis.

GDP. Although this makes sense in aggregated trade equations, given the commodity focus of this paper, superior elasticity estimates may be generated by better matching the activity variable to the traded commodity.

We construct country-specific measures of real consumption expenditure, investment, and GDP from the Penn World Tables.[11] On the import side, US real GDP, real consumption expenditure, and real investment are all from the National Income and Product Accounts (NIPA) tables. In the estimation, we use real consumption expenditures in the trade equations for consumer goods and autos and real investment expenditures in the trade equations for ISM-ex and capital goods. (Appendix figure A3.1 compares export-weighted foreign activity variables with US activity variables.)

There is another rationale for using a different measure of economic activity than GDP. The systematic deterioration of the US current account deficit and the comparable rise in current account surpluses around the world (as documented in Truman 2005 and Mann 2005) suggest a systematic bias in GDP as a measure of economic activity. For chronic surplus countries, GDP growth as a measure of activity generating demand for US exports may be "too high" since domestic demand growth is less than GDP growth by the share of net exports in those countries' GDPs. For the chronic US deficit, GDP growth as a measure of activity generating demand for US imports may be "too low" since domestic demand growth is greater than GDP growth by the share of net imports in US GDP. A key econometric exercise is to compare the estimated demand elasticities across these alternative measures of economic activity, controlling for country and commodity–specific effects.

In our analysis, we take the relative price variable of the workhorse model (trade price relative to domestic competing substitute) as given rather than estimate a system of trade and price equations.[12] We construct relative prices for US imports as the ratio of the end-use specific import price index and the corresponding US "domestic" price index from the BLS: The producer price index (PPI) is used for ISM-ex and capital goods. The consumer price index (CPI), excluding energy and food prices, is used for consumer goods and autos. To construct relative export prices, we converted the dollar-based end-use–specific export price index into foreign currency using current market exchange rates and divided by the respective trading partner's price index (using CPI or PPI depending on the commodity group). Appendix figures A3.2 and A3.3 display the movement of selected relative price variables.

[11] We generate real measures of expenditure by multiplying the real per capita values by population. Since the Penn data only extend through 2000 we use the growth of these expenditure categories from the IMF's *International Financial Statistics* (IFS) deflated by domestic producer price or consumer price indexes to complete the time-series to 2003. For a discussion of purchasing power parity (PPP)–adjusted data versus market exchange rate–adjusted data when undertaking comparative country analysis, see Castles and Henderson (2005).

[12] Most recent studies estimate prices as part of a set of simultaneous equations (Hooper, Johnson, and Marquez 2000). While researchers have always warned of the bias that may be introduced by treating relative prices as exogenous, several recent studies could not confirm that the coefficient on economic activity changed when including different formulations of this price variable or when allowing for simultaneity.

Constructing Variety

Recent literature has focused on adding variables to the workhorse model, in part to address issues that have not been embodied in official price indexes. A global supply variable could account for entry of dynamic emerging-market economies into global trade and proxy for an outward shift of the global supply curve, which enables the United States to buy more imports at lower prices. A variety variable could account for differences in quality of goods within a commodity category and how variety in imports (exports) available to US consumers (foreign buyers) has grown. Such quality or variety shifts and changes in taste may not be incorporated into the price indexes we use, hence biasing the overall regression.

Following Broda and Weinstein (2004) as well as Gagnon (2003a, revised 2004), we construct a variety proxy by counting the number of SITC 4-digit categories that are included in each proxy end-use group for a given country in each year. To compare the growth in variety across countries and categories, we set the number of categories equal to 100 in the first year of our panel. Similar to Broda and Weinstein, we find that the growth in "variety" was modest for the industrial countries; emerging-market economies on the other hand substantially increased their supply of variety to the United States.

The growth in variety was especially great for capital goods imports—with the number of SITC categories provided by China having grown by more than 250 percent.[13] In 1980, China provided only 46 categories under the capital goods heading, "metalworking machine tools" being the biggest in nominal dollar terms ($18 million); in 2003, China supplied 125 goods out of 136 4-digit categories in capital goods, with $9 billion worth of "peripheral automatic data processing units" as the largest and $6 billion of office-machine accessories as the second largest category. Varieties from other developing countries have also risen: Capital goods variety from non-Japan Asia increased by 76 percent; varieties in consumer goods from the Western Hemisphere and Asia increased by 39 and 30 percent, respectively. The United States' supply to its different trading partners behaved similar to that of other industrial countries: Between 1980 and 2003, US exports in capital and consumer goods to its export markets grew on average by 10 percent.

V. ECONOMETRIC IMPLEMENTATION

Our panel thus comprises import and export data, activity variables, and relative prices for 31 US partner countries, 24 years, and four commodity groups (2,976 observations in all). Each commodity group panel contains 31 time-series of country data. The whole panel consists of the four commodity panels stacked on top of each other.

[13] Broda and Weinstein's findings are similar.

We use a dynamic panel specification to model bilateral trade flows. Our model allows us to estimate both short-term and long-term effects of changes in the explanatory variables—similar to an error correction model (ECM) common in time-series estimations:

$$\begin{aligned}
\ln \Delta trade_{ij,t} &= \beta_0 + \beta_1 \Delta \ln trade_{ij,t-1} + \beta_2 \Delta \ln activity_{ij,t} + \beta_3 \Delta \ln activity_{ij,t-1} \\
&+ \beta_4 \Delta \ln rel.price_{ij,t} + \beta_5 \Delta \ln rel.price_{ij,t-1} + \beta_6 \ln trade_{ij,t-1} + \beta_7 \ln activity_{ij,t-1} \\
&+ \beta_8 \ln rel.price_{ij,t-1} + \alpha_{ij} + u_{ij,t},
\end{aligned}$$

where i denotes the ith trading partner, j denotes the jth commodity group, and t=1980–2003 are the years in our sample; the a_{ij}'s are the unobserved fixed effects and the $u_{ij,t}$ denotes the idiosyncratic error.

For the short-run effects, the coefficient on the differenced natural logarithms of economic activity shows the short-run effect of a 1 percent point change in GDP, investment, or personal consumption expenditure on real exports or imports.

For the long-run relationships, the coefficients on the level logs divided by the coefficient on the lagged dependent variable represent long-run effects; as in the long run, we can set the differenced terms equal to zero:

$$\ln trade_{ij,t-1} = -\frac{\beta_0}{\beta_6} - \frac{\beta_7}{\beta_6} \ln activity_{ij,t-1} - \frac{\beta_8}{\beta_6} \ln rel.price_{ij,t-1} - \frac{1}{\beta_6}(\alpha_{ij} + u_{ij,t}).$$

The calculated coefficient on economic activity in this equation shows the effect of a 1 percent increase in GDP, investment, or personal consumption expenditure on real trade flows.

Using a dynamic formulation in a fixed-effects or first-difference context is problematic. The random error terms are correlated both with the differences and the level of the lagged dependent variable, thus biasing the results for the coefficients. Arellano and Bond (1991) and Blundell and Bond (1998) propose an estimation method that instruments the lagged levels of the dependent variable with the lagged differences of this variable and the differences of the dependent variable with its lagged levels. Our results using this instrumental variable technique were poor—mostly likely because the instruments as implemented in this technique (lagged change instrumenting for lagged level and lagged level for instrumenting lagged change) were poor. Ideally, one might try to estimate this panel using a vector error correction model (VECM) suited for dynamic panel data estimation—these techniques go beyond the scope of this paper (see, for example, Beck 2001, Schich and Pelgrin 2002, and Smith 2000 for estimation of long and wide panels). In future work, we may generate the cointegrating vector explicitly using panel dynamic ordinary least squares (OLS) (Mark and Sul 2002; Mark, Ogaki, and Sul 2003) and implement the result in a panel ECM.

The challenge of choosing an econometric technique in the context of dynamic panel data estimation is acknowledged in econometric texts. Wooldridge (2002, chapter 11) and Kennedy (2003, 313) discuss the bias, yet greater precision, of fixed-effects estimators, as opposed to general least squares or instrumental variable regressions; studies indicate that the bias induced by fixed effects is offset when the time variable exceeds 30 observations. Our time-series is 24 years, and we proceed without corrective action.

VI. RESULTS AND DISCUSSION

This section discusses the findings of the econometric exercise. We wish to compare estimated coefficients for whole panel versus commodity decomposition, over alternative activity variables, consider the role for variety and other proxies for global supply, investigate whether industrial and developing countries are different in US trade, and examine China in particular.

Benchmark Regression and Matched Expenditure Versus GDP

For the first comparison to previous research, we use the 31-country and four-commodity whole panel with country-and-commodity fixed effects to run a benchmark regression for US imports and US exports. An F-test of the constrained whole panel against the unconstrained country-and-commodity fixed effects panel rejects the null hypothesis that the constrained and unconstrained regressions are the same. Table 3 presents short-run and long-run estimates for the elasticity estimates for income and for relative prices from representative previous work. Wald tests (see footnote to table 3) test the null hypothesis that the short-run and the long-run coefficients are the same. Generally, the null is rejected for the activity variable. For relative prices, the null is rejected for exports but not for imports.

The first question is how our elasticities estimated using our 31-country and four-commodity panel and using *GDP as the measure of economic activity* compares with previous research. Our income elasticities for both exports and imports are higher in the short run but are similar to the long-run estimates that come from regressions run over sample periods starting from the 1980s, such as Wren-Lewis and Driver (1998). Our price elasticities are generally lower than comparable studies, particularly on the export side and often are not significant. This may be a result of the construction of our relative price index using the GDP deflator for all the categories of trade. (Note that this is not the deflator we construct for subsequent regressions, where we instead use matched trade price and deflators.)

Changing from GDP to *matched expenditure as the measure of economic activity and matched prices* makes a large difference to the estimated income elasticities. Both the short-run and long-run elasticities are much lower (with the short-run coefficients almost too low) and the long-run coefficients close to the theoretical priors based on constant share of trade in expenditure of about 1.0. This suggests that the GDP variable may not be the correct measure of economic activity that drives trade flows. The Houthakker-Magee asymmetry with respect to economic activity still persists, both in the short and long runs, but the magnitude of the asymmetry is dramatically smaller.

With respect to relative prices, although the regressions with matched expenditure also incorporate greater richness with regard to the relative prices (as discussed in the data section), the significance level of relative prices does not improve in this panel specification of the four-commodity model.

Finally, to be further discussed below, we find that the variety variable is statistically significant in the regressions for imports and exports implemented with matched expenditure and matched prices but not for the export regression using GDP as the measure of activity and the GDP deflators in the measure of relative prices.

Disaggregating by Product Categories

Given that the commodity-by-country composition of trade has changed, sometimes dramatically, over time, do the coefficients on economic activity, relative prices, and variety vary across product categories? Table 4 presents regressions by commodity group with country fixed effects and the whole panel estimates with country-and-commodity fixed effects, which constrains the nonintercept coefficients across the commodities. An F-test of the constrained whole panel with country fixed effects versus the unconstrained split panel with country fixed effects rejects the null hypothesis that the constrained and unconstrained regressions are the same. Wald tests in general reject the null hypothesis that the short-run and long-run coefficients are the same on the matched expenditure variable but do not reject the null hypothesis that the short-run and long-run relative price coefficients are the same (excepting that the null is rejected at the 5 percent level for auto exports).

Comparing the elasticities on matched expenditure and variety across the commodity panels: On the export side, the short-run elasticities of autos, capital goods, and consumer goods are more than twice that for ISM-ex and are greater than the elasticity estimated for the whole panel with country-and-commodity fixed effects. The long-run elasticities of consumer goods and autos are greater than the panel estimate. On the import side, differences in estimated expenditure elasticities are substantial across the disaggregated commodities groups. Comparing the short-run and the long-run estimates, there is evidence of substantial cyclical response in excess of the long-run relationship for US imports of consumer goods and autos and auto parts. Whereas most of the estimates make sense and are of plausible magnitudes, those for autos seem unreasonable, particularly the short-run estimate. Among the estimates throughout this analysis, the auto category seems poorly estimated. Based on this analysis that disaggregation of product categories is statistically relevant for understanding the drivers of trade flows, our future program of work may allow the countries included in each product category to vary, since we will no longer require the uniform panel.

Disaggregating Industrial and Developing Countries by Product Group

Not only has the commodity composition of trade changed but there has also been a significant change, particularly evident for imports, in the composition of US trade with the industrial versus developing countries. Moreover, apropos our implementation using matched expenditure and trade prices, exchange rate regimes and sources of economic growth may differ between industrial and developing countries. Are differences observed in the estimated activity and relative price coefficients between industrial and developing countries and across product groups? (tables 5a and 5b).

F-tests of regressions including country fixed effects reject the null hypotheses that the industrial and developing countries regressions are the same, across all product groups and for each of the four product groups. Wald tests of the null hypothesis that short-run and long-run coefficients are the same are as noted.

Summarizing key aspects of the tables:

- **with respect to relative prices**: The relative price coefficient is of the correct sign and significant for imports of consumer goods and capital goods from industrial countries; it is significant and of the correct sign for all product categories of exports. This is in contrast to the estimates that constrained the relative price coefficient to be the same for industrial and developing countries and that resulted in poorly estimated coefficients.

- **with respect to activity**: The elasticity for US capital goods exports to industrial countries does not differ significantly from that to developing countries; but US capital goods imports from industrial countries is more responsive in the short run and less responsive in the long run to US activity than imports from developing countries. US consumer goods exports to industrial countries respond differently to foreign activity in those high-income countries as compared with the response to activity in the developing countries. On the other hand, there is no difference in elasticity of US consumer goods imports with respect to source country.

What does all this add up to in the context of the recent evolution of the US trade deficit? First, with respect to ***capital goods*** imports and exports, changing *relative prices* in industrial countries, and net trade, these coefficients are consistent with a story that dollar appreciation has, ceteris paribus, dampened capital goods exports and encouraged capital goods imports from the industrial countries. The depreciation of the dollar against these same currencies since 2002, and the somewhat higher pass-through of that exchange rate change vis-à-vis at least the euro[14] may, ceteris paribus, turn around the net trade deficit in capital goods, which was described earlier in this paper. But, to the extent that an increasing share of these goods come from developing economies, any dollar depreciation may have less of an effect to reduce capital goods imports or expand capital goods exports to developing countries, given the lack of significance in the estimated coefficient for relative prices of capital goods for developing countries.[15]

Second, with respect to changing *investment activity*, these coefficients are consistent with a story that robust US investment demand has encouraged imports of capital goods with a relatively higher elasticity, whereas slower investment growth abroad (both in the industrial and the developing world) has tended to yield slower growth in capital goods exports. Put together, the deterioration of net trade in capital goods comes from robust US investment, dollar appreciation, and the relatively slower investment growth abroad that is spread across both the industrial and the developing world.

Third, the fact that the *variety* effect is smaller for imports than for exports suggests that variety importantly underpins US capital goods export growth, which is consistent with Schott's (2004).

For ***consumer goods***, the story is somewhat different not only because the estimated US consumer demand elasticity is so high but also because relative prices are significant and relatively high for products from the industrial countries.

First, with respect to changing *relative prices* in industrial countries and net trade in consumer goods, these coefficients are consistent with a story that dollar appreciation has, ceteris paribus, hurt consumer goods exports to industrial countries and, particularly given the higher relative price elasticity, encouraged consumer goods imports from industrial countries. The depreciation of the dollar against these same currencies since 2002, and the somewhat higher pass-through of that exchange rate change vis-à-vis at least the euro may, ceteris paribus, reduce the net trade deficit in consumer goods, which was described earlier in this paper. But, to the extent that an increasing share of these goods come from developing economies, any dollar depreciation may have less of an effect to reduce consumer goods imports, given the lack of significance in the estimated coefficient for relative prices of consumer goods from developing countries. [16]

Second, with respect to *consumer demand growth* and net trade, the coefficients are consistent with a story that robust US consumer demand along with a very high cyclical demand elasticity has encouraged imports of consumer goods and autos from all trading partners. Slower consumption growth abroad and that lower elasticity have tended to dampen exports of consumer goods. Put together, the deterioration of net

---

[14] US import prices from the European Union have risen about 14 percent since the peak of the dollar in February 2002. This represents more than a 25 percent pass-through of the euro appreciation into US import prices. Import prices from Japan on the other hand have stayed stable since early 2002, in spite of a more than 25 percent appreciation of the yen against the dollar (Bureau of Labor Statistics).

[15] The large positive and significant long-run coefficient for relative price of capital goods imports from developing countries suggests another missing variable or that the variety variable needs additional work.

[16] The large positive and significant long-run coefficient for relative price of consumer goods imports from developing countries suggests another missing variable or that the variety variable needs additional work.

trade in consumer goods comes from very strong US consumer demand growth, as well as dollar appreciation (with greater imports of luxury, price-sensitive goods from industrial countries and reduced exports of similarly price-sensitive goods to industrial countries).

Is China Different?

For a number of reasons, we might expect China to be different from other countries in this specification of US dynamic trade. China's trade shares changed the most. Its net trade deficit is on the steepest trajectory. Its variety increased the most. Its exchange rates have changed the least. Table 6 reports regression results investigating whether China is appreciably different from the rest of the world in the consumer goods and capital goods categories. The bottom line is that the picture is mixed in terms of short-run versus long-run effects. The very large long-run estimates on US economic activity are consistent with the graphical evidence but arguably could not persist.

Summary of Findings

The paper prepared new estimates of the elasticity of US trade flows using bilateral trade data for 31 countries, using different measures of expenditure, and including alternative measures of global supply and variety. We examine four categories of goods based on BEA's end-use classification system—autos, ISM-ex, consumer goods, and capital goods. We consider whether industrial and developing countries differ in their elasticities and whether China is different.

1. Using expenditure by category group rather than GDP as the measure of "income" significantly reduces the Houthakker-Magee asymmetry and yields far more plausible values for these "income" elasticities.

2. The four product categories behave differently from an aggregated panel.

3. Variety is a significant variable, particularly for capital goods. Constructing this variable using 10-digit level trade from the Harmonized System may bear additional fruit.

4. Industrial and developing countries have different income and relative price elasticities for these four product groups. In particular, when industrial countries are distinguished from developing countries, the relative prices for industrial countries are the correct sign, significant, and of plausible values.

5. China evidences some difference in behavior relative to the rest of the sample in terms of US imports of capital goods and US exports of capital and consumer goods.

VII. IMPLICATIONS AND DIRECTION FOR FURTHER WORK

Do Changing Trade Shares Change Trade Elasticities?

The results indicate that industrial and developing countries differ in their elasticities of activity and relative price. The shares of these two groups in trade have changed over time, in particular within product categories for imports. Figure 3 shows elasticities for economic activity from the regression that splits the panel into four product categories and allows the elasticities to vary across the industrial and developing countries (tables 5a and 5b). These estimated elasticities are reaggregated using the time-varying trade weights of these two groups and four product categories in US trade. The figure also shows the constant elasticities generated from the benchmark model—GDP as income from table 3 and the matched expenditure model with variety from table 4.

For imports, there is a rising long-run expenditure elasticity of US imports and a somewhat time-varying short-run elasticity. The time-varying short-run elasticity lies between the constant elasticity as estimated using the benchmark model with GDP and with the matched expenditure model. These results imply that the assumption of a constant elasticity of US imports with respect to US economic activity may have to be rejected and that projections of US imports based on the constant elasticity assumption may be flawed.

For exports, country shares have changed less, hence there is little time-varying impact on the elasticity of US exports with respect to foreign activity either in the short or the long run. However, projecting exports using foreign GDP as the driver may overestimate exports, since both the matched expenditure and the time-varying estimate are lower than the elasticity of exports with respect to foreign GDP (benchmark model).

Do These New Elasticities Predict Better?

Research using the workhorse model often addresses the tension between the theoretical plausibility of the estimated elasticities, specifically the Houthakker-Magee asymmetry, and the affirmed excellence of these simple equations to predict US exports and imports in the short and medium terms. By using matched expenditure and trade prices and by disaggregating product groups and income class (industrial versus developing country), we "improve" on the Houthakker-Magee asymmetry, but do we "do better" at predictions?

We will examine this question by comparing in-sample predictive performance of three alternative models, running the model forward from 1998 to 2003 using the estimated coefficients for both the short- and long-run values from a panel spanning the years 1980 to 1997 and the actual values from the right-hand-side variables. We compare the actual with the predicted values in each year (table 7). The horse race is between the benchmark model that uses GDP and aggregated trade (table 3)—a formulation that many forecasters would use because they are interested in aggregate exports and imports; the matched expenditure model, with variety, with four separate product groups, and with industrial country dummies (tables 5a and 5b); and finally a model that uses GDP as the measure of economic activity but uses the coefficients generated from the four product groups. The latter model acknowledges that often forecasters have access to GDP forecasts and research-based elasticities in the literature and care about a disaggregated product group; for example, a company selling capital goods to Europe or facing consumer goods import competition from China.

In terms of the "bottom line," measured as the sum of the in-sample predictive errors, for exports, our disaggregated estimates "do better" at predicting exports than does either of the other two models. For imports, even though we obtain more plausible values for the elasticities, our predictions are poor compared with the benchmark model that uses US GDP as the measure of expenditure. So, our findings address the puzzle that surprised Houthakker and Magee in their original study: the very low income elasticities for US exports. Our estimations suggest that these elasticities might in fact be closer to those of other industrial countries. But, we have more work to do on the import side to find elasticities that meet theoretical norms and also predict well. We suspect that missing variables on the import side would help to better predict imports.

To determine where our matched expenditure model might be predicting the worst, we examined each of the four product groups comparing the model results for the matched expenditure, variety, and industrial-country dummies with the simple model that used the disaggregated coefficients and GDP as the driver of trade. Appendix tables A5.1 to A5.4 report the results. Within product groups, auto trade and consumer goods imports are least well explained in-sample by the new disaggregated model. But, in-sample prediction of consumer goods exports, industrial supplies and materials–excluding oil trade flows, and capital goods trade flows are better predicted in-sample by the matched expenditure and variety model than when GDP is used as the measure of economic activity. Hence, future work will focus on narrowing the country group for autos and reconsidering the composition of the consumer goods category, particularly the variety variable.

"What If" US Spending Had Been Slower and Foreign Spending Had Been Greater?

In recent policymaker confabs such as the G-8, it has been common to call for increased US savings and greater foreign growth, as well as more flexibility in exchange rates. Suppose the United States had saved more and growth abroad had been faster, say between 1997 and 2003. How much would the US trade deficit have been different from the actual outcome?

We use our model to "forecast" US trade to 2003 with the estimates obtained from regressions run on a panel spanning 1980 to 2003. As shown in figure 4, our model performs well through 2001. Yet it substantially underpredicts the size of the US trade deficit for 2002 and 2003, hinting at missing variables that have gained in importance in the determination of US trade recently. The same exercise also allows us to test which determinants of US trade have the greatest effect on the US trade balance.

Given that the Houthakker-Magee asymmetry persists in our estimation, albeit somewhat smaller, lower assumed values for US investment and consumption (e.g., more US saving) have a greater effect in dampening the trade deficit than an assumed rise in foreign investment and consumption of the same percentage point magnitude.

Conclusions and Further Work

These new elasticities yield insights into the sources of the widening of the US trade deficit and help to understand the nature of global competition and how it is impacting broad sectors of the US economy.

The differences in demand elasticities for consumer goods versus for other product categories—with consumer goods more responsive to consumption patterns in the United States—yields insights into how robust US consumer demand through trending lower household saving rates, as augmented by higher stock-market valuation in the 1990s and residential housing values and tax cuts in the 2000s, contributes to widening the consumer goods share of the trade deficit.

The differences in relative price elasticities between the industrial and developing countries—with relative prices significant and of correct sign for industrial countries but not for developing countries—yields insights into how certain exchange rate regimes, pricing-to-market behavior, or other factors more prevalent to developing country exporters mute the price signal, which is consistent with recent work on disaggregate pass-through (Campa and Goldberg 2004, Marazzi et al. 2005).

The evidence from this analysis suggests that the matched-expenditure model for exports, disaggregated across commodity groups and income class (industrial versus developing), is worth continued investigation. Not only do the elasticities have more plausible values but also the equation performs better in-sample than the benchmark model for exports. Simultaneous specification with an equation for relative prices warrants consideration.

On the import side, the matched-expenditure disaggregated model yields more plausible values for trade elasticities. However, the in-sample predictive performance is much worse than for the benchmark model. To understand the factors underpinning robust US imports of consumer goods and autos, in particular, requires additional work. Future work will focus on narrowing the country set for trade in autos and investigating a more detailed variable for variety.

Going forward, these new elasticities have implications for demand management and exchange rate policies. In particular, slack US exports appear importantly related to slack consumption and investment abroad, which has been masked by measures of GDP that incorporate net exports to the United States. On the other hand, factors beyond strong US consumer demand or love of variety are bolstering US imports of consumer goods. Different relative price elasticities between the industrial and developing countries suggest long-run implications for US trade of certain exchange rate regimes.

REFERENCES

Adler, J. Hans. 1945. United States Import Demand During the Interwar Period. *The American Economic Review* 35: 418–30.

Adler, J. Hans. 1946. The Postwar Demand for United States Exports. *Review of Economic Statistics* 28: 23–33.

Arellano, M., and S. Bond. 1991. Some Tests of Specification for Panel Data. *The Review of Economic Studies* 58: 277–97.

Bayoumi, Tamim. 1999. *Estimating Trade Equations from Aggregate Bilateral Data*. IMF Working Paper WP/99/74. Washington: International Monetary Fund.

Beck, Nathaniel. 2001. Time Series Cross-Section Data. *Statistica Neerlandica* 55: 111–33.

Blundell, R., and S. Bond. 1998. Initial Conditions and Moment Restrictions in Dynamic Panel Data Models. *Journal of Econometrics* 87: 115–43.

Broda, Christian, and David E. Weinstein. 2004. *Globalization and the Gains from Variety*. NBER Working Paper 10314. Cambridge, MA: National Bureau of Economic Research.

Campa, José Mauel, and Linda S. Goldberg. 2004. Exchange Rate Pass-through into Import Prices. New York, Federal Reserve Bank of New York. Photocopy (September 28).

Castles, Ian, and David Henderson. 2005. International Comparisons of GDP: Issues of Theory and Practice. *World Economics* 6, no. 1: 55–84.

Chang, Tse Chun. 1945–46. International Comparison of Demand for Imports. *The Review of Economic Studies* 13: 53–67.

Cline, William R. 2005 (forthcoming). *The United States as a Debtor Nation*. Washington: Institute for International Economics.

Deardorff, Alan S., Saul H. Humans, Robert M. Stern, and Chong Xiang. 2001. Forecasting U.S. Trade in Services. In *Services in the International Economy,* ed. Robert M. Stern. Ann Arbor, MI: University of Michigan Press.

Feenstra, Robert C. 1994. New Product Varieties and the Measurement of International Prices. *The American Economic Review* 84: 157–77.

Funke, Michael, and Ralf Ruhwedel. 2001. Product Variety and Economic Growth: Empirical Evidence for the OECD Countries. *IMF Staff Papers* 48: 225–42. Washington: International Monetary Fund.

Gagnon, Joseph E. 2003a, revised 2004. *Productive Capacity, Product Varieties, and the Elasticities Approach to the Trade Balance*. International Finance Discussion Papers 781. Washington: Board of Governors of the Federal Reserve System.

Gagnon, Joseph E. 2003b. *Long-Run Supply Effects and the Elasticities Approach to Trade*. International Finance Discussion Papers 754. Washington: Board of Governors of the Federal Reserve System.

Gagnon, Joseph E. 2004. *Growth-Led Exports: Is Variety the Spice of Trade?* International Finance Discussion Papers 822. Washington: Board of Governors of the Federal Reserve System.

Goldstein, Morris, and Mohsin S. Khan. 1985. Income and Price Effects in Foreign Trade. In *Handbook of International Economics* II, eds. R.W. Jones and P.B. Kenen. Amsterdam: Elsevier Science Publishers.

Helkie, William L., and Peter Hooper. 1988. An Empirical Analysis of the External Deficit, 1980-86. In *External Deficits and The Dollar, The Pit, and the Pendulum*, eds. Ralph C. Bryant, Gerald Holtham, and Peter Hooper. Washington: Brookings Institution.

Hooper, Peter, Karen Johnson, and Jaime Marquez. 2000. *Trade Elasticities for the G-7 Countries*. Princeton, NJ: International Economics Section, Department of Economics, Princeton University.

Houthakker, H.S., and Stephen P. Magee. 1969. Income and Price Elasticities in World Trade. *Review of Economics and Statistics* 51: 111–23.

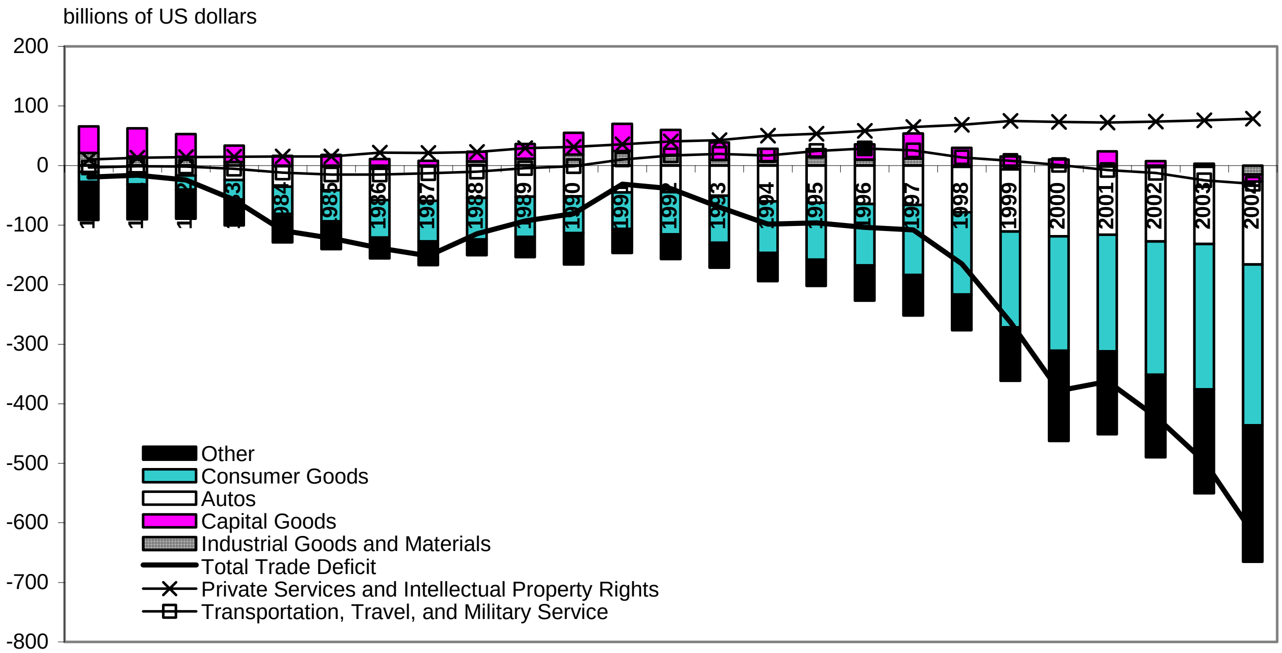
Hummels, David, and Peter Klenow. 2004. The Variety and Quality of a Nation's Exports. *The American Economic Review* (forthcoming). www.klenow.com.

Kennedy, Peter. 2003. *A Guide to Econometrics, 5th ed.* Cambridge, MA: MIT Press.

Krugman, Paul. 1989. Differences in Income Elasticities and Trends in Real Exchange Rates. *European Economic Review* 33: 1031–54.

Krugman, Paul R., and Richard E. Baldwin. 1987. The Persistence of the U.S. Trade Deficit. *Brookings Papers on Economic Activity*: 1–55.
Mann, Catherine L. 1999. *Is the U.S. Trade Deficit Sustainable?* Washington: Institute for International Economics.
Mann, Catherine L. 2004. The US Current Account, New Economy Services, and Implications for Sustainability. *Review of International Economics* 12: 262–76.
Mann, Catherine L. 2005. Breaking Up Is Hard to Do: Global Co-Dependency, Collective Action, and the Challenges of Global Adjustment. *CESifo Forum* 1/2005: 16–23.
Marazzi, Mario, Nathan Sheets, Robert Vigfusson et al. 2005. *Exchange Rate Pass-through to U.S. Import Prices: Some New Evidence.* International Finance Discussion Papers 833. Washington: Board of Governors of the Federal Reserve System.
Mark, Nelson C., and Donggyu Sul. 2002. *Cointegration Vector Estimation by Panel DOLS and Long-Run Money Demand.* Technical Working Paper 287. Cambridge, MA: National Bureau of Economic Research.
Mark, Nelson C., Masao Ogaki, and Donggyu Sul. 2003. *Dynamic Seemingly Unrelated Cointegration Regression.* Technical Working Paper 292. Cambridge, MA: National Bureau of Economic Research.
Marquez, Jaime. 2002. *Estimating Trade Elasticities.* ADVANCED STUDIES IN THEORETICAL AND APPLIED ECONOMETRICS 39. Boston, MA: Kluwer Academic Publisher.
Marquez, Jaime. 1999. Long-Period Trade Elasticities for Canada, Japan, and the United States. *Review of International Economics* 7, no. 1: 102–16.
Sawyer, W. Charles, and Richard L. Sprinkle. 1996. The Demand for Imports and Exports in the U.S.: A Survey. *Journal of Economics and Finance* 20: 147–78.
Schich, Sebastian, and Florian Pelgrin. 2002. Financial Development and Investment: Panel Data Evidence for OECD Countries from 1970 to 1997. *Applied Economics Letters* 9: 1–7.
Schott, Peter K. 2004. Across Product Versus Within-Product Specialization in International Trade. *The Quarterly Journal of Economics* 119: 647–77.
Smith, Ron P. 2000. Estimation and Inference with Non-Stationary Panel Time-Series Data. Paper prepared for the RC33 Conference, Cologne.
Stern, Robert M., Christopher F. Baum, and Mark N. Greene. 1979. Evidence on Structural Change in the Demand for Aggregate U.S. Imports and Exports. *Journal of Political Economy* 87: 179–92.
Stone, Joe A. 1979. Price Elasticities of Demand for Imports and Exports: Industry Estimates for the U.S., the E.E.C, and Japan. *Review of Economics and Statistics* 61: 306–12.
Truman, Edwin. 2005. *Postponing Global Adjustment: An Analysis of the Pending Adjustment of Global Imbalances.* Institute for International Economics Working paper 05-6. Washington.
United Nations Department of Economics and Social Affairs, Statistical Office. 1975. Standard International Trade Classification, Revision 2. Statistical Papers, Series M No.34/Rev. 2. New York: United Nations.
Welsch, Heinz. 1987. An Aggregate Import Demand Model for Long-Term Projections. *Jahrbücher für Nationalökonomie und Statistik* 203: 372–89.
Wilson, John F., and Wendy E. Takacs. 1979. Differential Responses to Price and Exchange Rate Influences in the Foreign Trade of Selected Industrial Countries. *Review of Economics and Statistics* 61: 267–79.
Wooldridge, J. M. 2002. *Econometric Analysis of Cross Section and Panel Data.* Cambridge, MA: MIT Press.
Wren-Lewis, Simon, and Rebecca L. Driver. 1998. *Real Exchange Rates for the Year 2000.* POLICY ANALYSES IN INTERNATIONAL ECONOMICS 54. Washington: Institute for International Economics.

Figure 1 US trade balance by principal end-use categories



Source: Bureau of Economic Analysis, International Transactions Accounts.

Table 1 Trade share by principal end-use category (in percent)

	Imports		**Exports**	
	1980	**2004**	**1980**	**2004**
ISM-ex	31	26	29	14
Capital goods	34	40	13	23
Consumer goods	8	13	14	25
Autos	8	11	11	15
Other	20	12	43	23
Memo: Trade as a share of GDP	10.7	15	9.4	9.8

ISM-ex = industrial supplies and materials, excluding oil

Note: "Other" defined as petroleum products and feeds, foods, and beverages.

Source: Bureau of Economic Analysis.

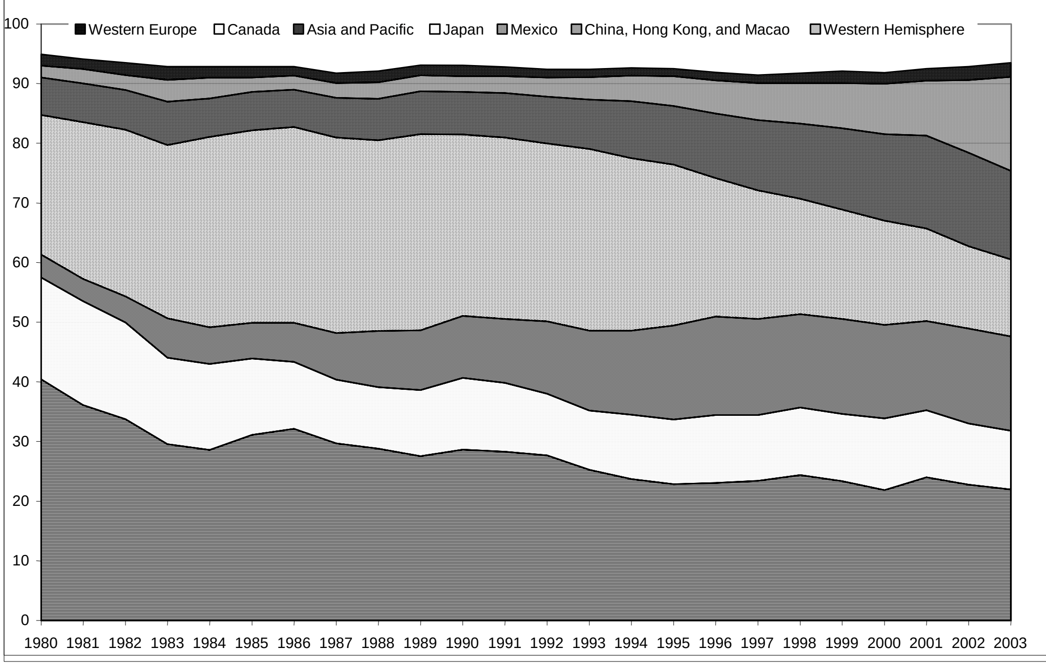
Table 2 Trade shares by country/region (in percent)

Country/ region	Exports 1980	Exports 2004	Imports 1980	Imports 2004
Europe	33	23	19	22
Canada	19	24	17	18
Mexico	7	14	5	11
Japan	9	6	13	9
China	2	4	1	13
Asia without China and Japan	15	18	20	18
Latin America without Mexico	11	7	10	7
Australia	1	2	1	1
Other	3	2	14	3

Note: "Other" includes Africa and international organizations.

Source: Bureau of Economic Analysis.

Figure 2 Regional/country shares of US capital goods imports (percent)



Note: Former Soviet Union, Eastern Europe, Middle East, and Africa not shown.

Source: UN Comtrade database.

Table 3 Estimates for activity and relative price elasticities for US exports and imports

	Data period	Method	Level of disaggregation	Exports		Imports	
				Relative price	Activity	Relative price	Activity
Previous research							
Houthakker and Magee (1969)	Annual 1951–66	OLS	Goods and services	–1.51	0.99	–1.03	1.68
Hooper, Johnson, and Marquez (2000)	Quarterly 1956–96	ECM (SR), Johansen (LR)	Goods and services	–0.5* (SR) –1.5* (LR)	1.8* (SR) 0.8* (LR)	–0.1 (SR) –0.3* (LR)	1.0* (SR) 1.8* (LR)
Wren-Lewis and Driver (1998)	Quarterly 1980–95	ECM (SR), Johansen (LR)	Goods	–0.96 (SR) –0.65 (SR)	1.12 (SR) 1.21 (LR)	–0.38 –0.18	2.43 (SR) 2.36 (LR)
Our study							
GDP as income[a]	Annual 1980–2003	Country-and-commodity fixed effects, dynamic panel	Panel of 4 categories of goods	–0.07** (SR) –0.2** (LR)	2.79** (SR) 1.44** (LR)	–0.17 (SR) –0.28 (LR)	4.11** (SR) 2.22** (LR)
Matched expenditure and matched prices[b]				–0.03# (SR) –0.09 (LR)	0.58** (SR) 1.19** (LR)	–0.09 (SR) 0.10 (LR)	1.00** (SR) 1.63** (LR)

SR = short run
LR = long run
ECM = error correction model
OLS = ordinary least squares
*, ** = significant at 1 percent and 5 percent, respectively
= significant at 10 percent

a. Imports: Null rejected for GDP as income; not rejected for relative prices
Exports: Null rejected for GDP as income; null rejected for relative prices
b. Imports: Null rejected for "activity"; not rejected for relative prices.
Exports: Null rejected at 1 percent level for "activity"; null rejected at 10 percent level of significance for relative prices.

Table 4 Regressions by commodity group with country fixed effects

	Level of disaggregation (R^2 *M*, R^2 *X*)	Exports			Imports		
		Relative price	Matched expenditure	Variety categories	Relative price	Matched expenditure	Variety categories
Matched expenditure and matched prices Annual 1980–2003	Capital goods (0.16, 0.38)	-0.021(SR) 0.012 (LR)	0.79**(SR) 0.88 **(LR)	4.66**	-0.25 (SR) 1.56#(LR)	0.48**(SR) 1.54**(LR)	1.74**
	Consumer goods (0.18, 0.32)	-0.02(SR) 0.07(LR)	0.713**(SR) 1.37**(LR)	0.16	-0.40#(SR) 3.64 (LR)	3.73**(SR) 1.69**(LR)	-0.21
	Autos and parts (0.20, 0.26)	-0.07 (SR) -0.3#(LR)	1.03**(SR) 1.13**(LR)	0.92#	0.48(SR) 1.35(LR)	9.01**(SR) 2.21**(LR)	0.54
	ISM-ex (0.26, 0.31)	0.01 (SR) 0.02 (LR)	0.35**(SR) 0.94**(LR)	0.99	-0.13 (SR) 1.36 (LR)	1.03**(SR) 0.64* (LR)	0.52#
	Panel of 4 categories of goods (0.25, 0.14)	-0.03*(SR) -0.09(LR)	0.58**(SR) 1.09**(LR)	0.91**	-0.17(SR) 0.16(LR)	1.00** (SR) 1.40** (LR)	0.70**

SR = short run
LR = long run
# = significant at 10 percent
*, ** = significant at 1 percent and 5 percent, respectively

Wald Test: Null hypothesis that SR and LR are the same
Autos
Imports: income coefficients reject; prices not reject
Exports: income coefficients reject; prices reject at 5 percent level

Capital goods
Imports: income coefficients reject, prices not reject
Exports: income coefficients reject, prices not reject

Consumer goods
Imports: income coefficients reject, prices not reject
Exports: income coefficients reject, prices not reject

Industrial supplies and materials-excluding oil (ISM-ex)
Imports: income coefficients reject, prices not reject
Exports: income coefficients reject, prices not reject

Table 5a Import regressions using a dummy variable for industrial trading partner with country fixed effects

Level of disaggregation	Matched expenditure, industrial country	Matched expenditure, developing country	Relative price, industrial country	Relative price, developing country	Variety categories, 1980–2003
Capital goods	1.29** (SR) 0.77** (LR)	-0.40# (SR) 3.12** (LR)	-0.31 (SR) -0.71 **(LR)	-0.20 (SR) 5.01**(LR)	1.42**
Consumer goods	3.52 & (SR) 1.32 & (LR)	4.156** (SR) 1.96* (SR)	-1.35 ** (SR) -4.34 ** (LR)	0.86* (SR) 14.34** (LR)	-0.19
Autos and parts	8.16 **(SR) 1.59 ** (LR)	9.72* (SR) 3.53 ** (LR)	0.72 (SR) -1.71 (LR)	2.28# (SR) 6.88 (LR)	0.32
ISM-ex	1.52**(SR) 0.26 (LR)	0.97** (SR) 1.47 ** (LR)	-0.29 (SR) 1.97 (LR)	0.16(SR) 0.86(LR)	0.17

SR = short run
LR = long run
& = dummy for industrial countries is not significant
# = significant at 10 percent
*, ** = significant at 1 percent and 5 percent, respectively

Wald Test: Null hypothesis that LR and SR are the same

Capital goods: Expenditure for both groups rejects the null.
Consumer goods: Relative price for both groups rejects the null.
Autos: Expenditure for developing countries rejects the null
Industrial supplies and materials-excluding oil (ISM-ex): Expenditure for developing countries rejects the null and for industrial country at the 10 percent level.

Table 5b Export regressions using a dummy variable for industrial trading partner with country fixed effects

Level of disaggregation	Matched expenditure, industrial country	Matched expenditure, developing country	Relative price, industrial country	Relative price, developing country	Variety categories, 1980–2003
Capital goods	0.67& (SR) 0.70* (LR)	0.79 **(SR) 0.94 **(LR)	-0.38**(SR) 0.12 (LR)	-0.014 (SR) 0.013 (LR)	5.2**
Consumer goods	0.45 **(SR) 1.09**(LR)	0.69**(SR) 1.64 **(SR)	-0.45 **(SR) -0.58 # (LR)	0.014 (SR) 0.022 (LR)	-0.12
Autos and parts	1.19 *(SR) 0.66*(LR)	1.41 ** (SR) 1.22 ** (LR)	-0.922 ** (SR) -1.55** (LR)	0.043(SR) -0.19(LR)	0.79
ISM-ex	0.32 & (SR) 0.81 ** (LR)	0.37**(SR) 1.46**(LR)	-0.02 (SR) -1.18**(LR)	0.01 (SR) -0.26 (LR)	-0.46

LR = long run
SR = short run
& = dummy for industrial countries is not significant
# = significant at 10 percent
*, ** = significant at 1 percent and 5 percent, respectively

Wald Test: Null hypothesis that SR and LR are the same

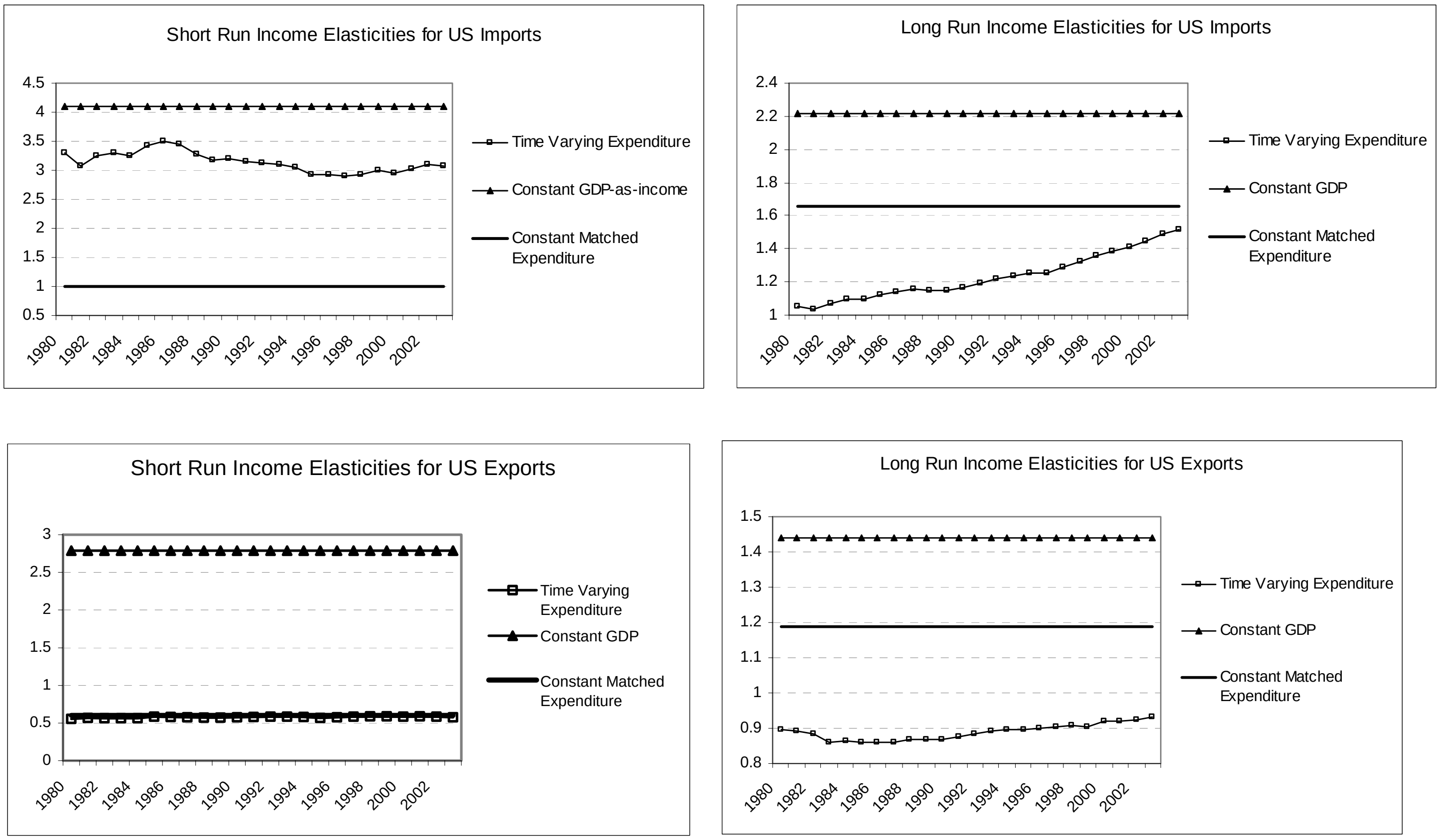
Capital goods: Expenditure for developing countries rejects the null.
Consumer goods: Expenditure for developing countries reject (1 percent level); expenditure industrial countries reject (5 percent level); relative prices industrial countries reject (1 percent level).
Autos: Expenditure for developing countries and relative prices for industrial countries reject the null.
Industrial supplies and materials-excluding oil (ISM-ex): Expenditure for both groups reject; relative prices for industrial countries reject (5 percent level).

Table 6 Regressions using a dummy variable for China as trading partner with country fixed effects

Level of disaggregation	Matched expenditure, rest of world	Matched expenditure, China	Relative price, rest of world	Relative price, China	Variety
a. Imports					
Capital goods	0.47** (SR) 1.41** (LR)	0.027& (SR) 9.78 ** (LR)	-0.43 (SR) 1.23#LR)	4.08** (SR) 9.85*(LR)	1.65**
Consumer goods	3.81** (SR) 1.65** (LR)	0.54& (SR) 4.31& (SR)	-0.42 (SR) 3.15 (LR)	0.0.40 (SR) 12.5 (LR)	-0.13
b. Exports					
Capital goods	0.79** (SR) 0.89**(LR)	1.88 **(SR) 0.74&(LR)	0.01 (SR) 0.047 (LR)	-0.01 (SR) -1.18(LR)	4.8**
Consumer goods	0.66 **(SR) 1.33**(LR)	0.20**(SR) 2.25**(LR)	-0.45 **(SR) -0.58 # (LR)	0.014 (SR) 0.022 (LR)	0.4

SR = short run
LR = long run
& = dummy for China is not significant
# = significant at 10 percent
*, ** = significant at 1 percent and 5 percent, respectively
Rest of world = All US trading partners except China

Figure 3 Income elasticities for US imports and exports

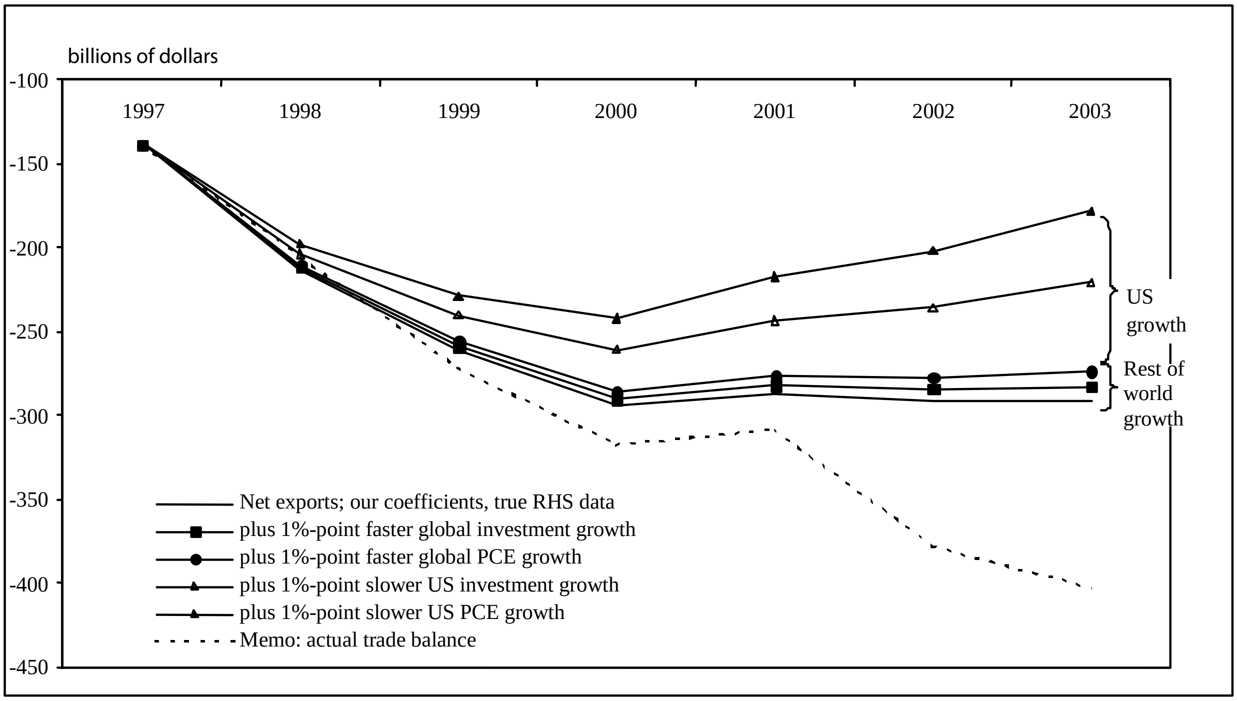


Source: Authors' regression results; trade weights from UN Comtrade database.

Table 7 Summary of in-sample predictive performance (billions of US dollars)

				Predictions								
	Actual			Matched expenditure, variety, and industrial country dummies (from tables 5a and 5b)			GDP as income and aggregate trade flows (from table 3)			GDP as income, product-specific coefficients		
Year	Imports	Exports	Net Exports	Imports	Exports	Net Exports	Imports	Exports	Net Exports	Imports	Exports	Net Exports
1997	664	526	-138									
1998	741	535	-206	795	543	-252	766	579	-187	767	572	-195
1999	834	562	-272	886	564	-323	853	594	-259	859	587	-272
2000	941	624	-318	983	621	-361	939	641	-298	946	635	-311
2001	890	581	-308	1021	634	-387	982	665	-318	982	662	-320
2002	938	560	-378	970	593	-377	952	603	-349	952	602	-349
2003	975	572	-403	1050	613	-437	1025	586	-438	1039	586	-452
				Errors: Prediction less actual value								
1998				54	8	-46	25	44	18	26	37	11
1999				53	2	-51	19	32	13	25	25	0
2000				41	-2	-44	-2	17	20	4	11	7
2001				131	53	-78	93	84	-9	92	81	-11
2002				32	33	1	14	43	29	13	42	29
2003				74	40	-34	49	14	-35	63	14	-49
Total error				386	**134**	-252	198	234	**36**	225	211	**-14**

Figure 4 "What if" scenarios: US net exports (billions of dollars)



PCE = personal consumption expenditure
RHS = right-hand side

Sources: Authors' regression results and calculations; Bureau of Economic Analysis; Penn World Tables; IMF International Financial Statistics; Bureau of Labor Statistics; UN Comtrade database; University of British Columbia Pacific Exchange Rate database.

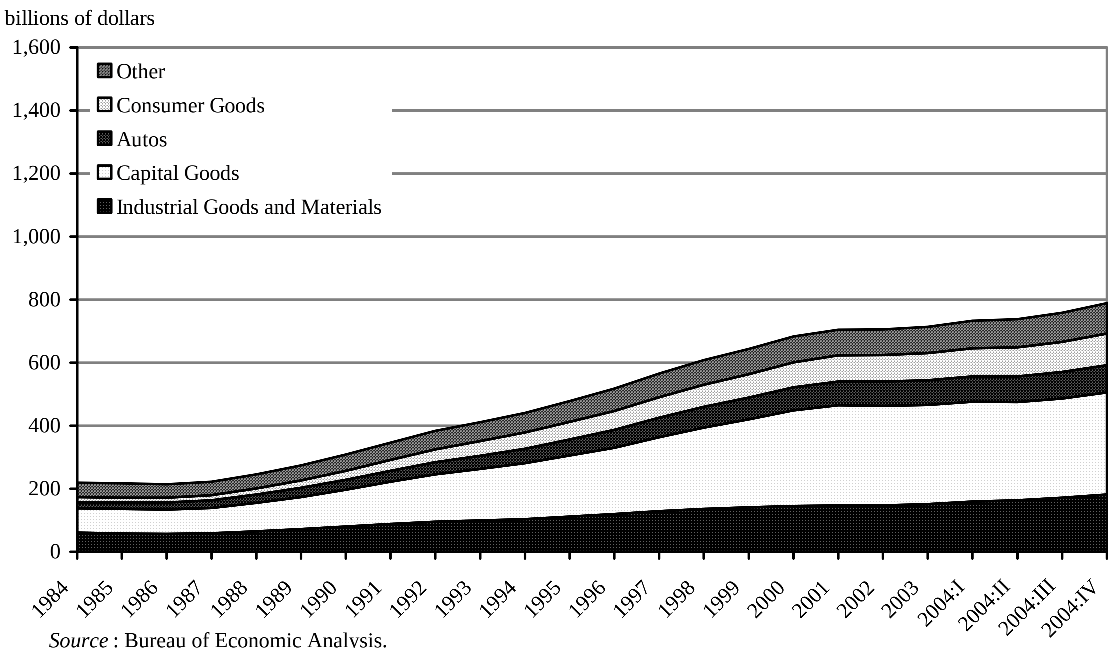
APPENDIX

Table A.1 Definition of proxy end-use commodity groups

Autos	Capital goods	Consumer goods	Industrial supplies and materials
7810-7849, 7861, 7869: road vehicles and parts except motorcycles and bicycles and their parts. 6251, 6252: tires for road vehicles.	6253: tires for aircraft. 71-75: heavy machines for all industrial sectors and agriculture, office machines. 7641-7649: telecommunications and broadcasting equipment. 771-774, 778: electrical equipment and electronic equipment. 7911-7938: transport equipment other than road vehicles. 87: laboratory and medical and other scientific equipment; precision instruments.	1221-1223: tobacco manufactured. 5411-5419: pharmaceuticals and cosmetics. 5530-5543: perfumes, soaps and detergents. 6121-6129: articles of leather and footwear. 6354: manufactures of wood for domestic use. 6581-6597: textile and non-textile furnishings, floor coverings, rugs and other articles made from fabric. 6651-6674: china, glassware, precious stones. 6960-6978: household items made of metal. 7611-7631: televisions, radio, etc. 775: household appliances. 785: motorcycles, bicycles and parts. 821: furniture. 8310: travel goods. 84-85: apparel and footwear. 88-89: photographic equipment, spectacles, watches, printed matter, and miscellaneous consumer goods.	Chapter 2: crude materials inedible, except fuels. Chapter 4: animal and vegetable oils and waxes. 51-53: organic and inorganic chemicals; dyeing, tanning and coloring supplies. 551: Essential oils. 56-59: fertilizers, explosives, plastics and miscellaneous chemical materials. 611, 613: leather and fur. 621, 628: rubber. 633- 635: wood and cork manufactures (except 6354 for domestic use). 64: paper and pulp. 655-657: yarn and textiles. 661-664: non-metallic mineral products. 67, 68: iron and steel and non-ferrous metals. 691-695, 699: manufactures of metal. 776: semiconductors, cathodes, diodes, photocells, etc. 81: sanitary, plumbing, heating and lighting fixtures and other building material.

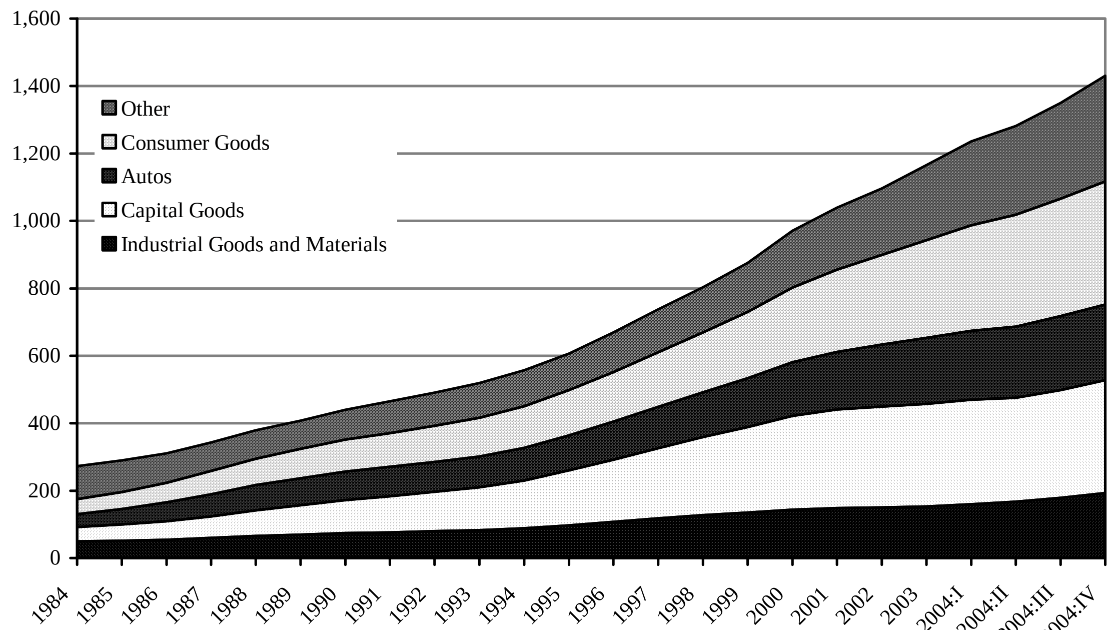
Note: This table is constructed using the Standard International Trade Classification (SITC), Revision 2.

Figure A1.1 Commodity shares of US exports
(5-year moving average; billions of dollars; not shown: Africa, international organizations, and Australia)



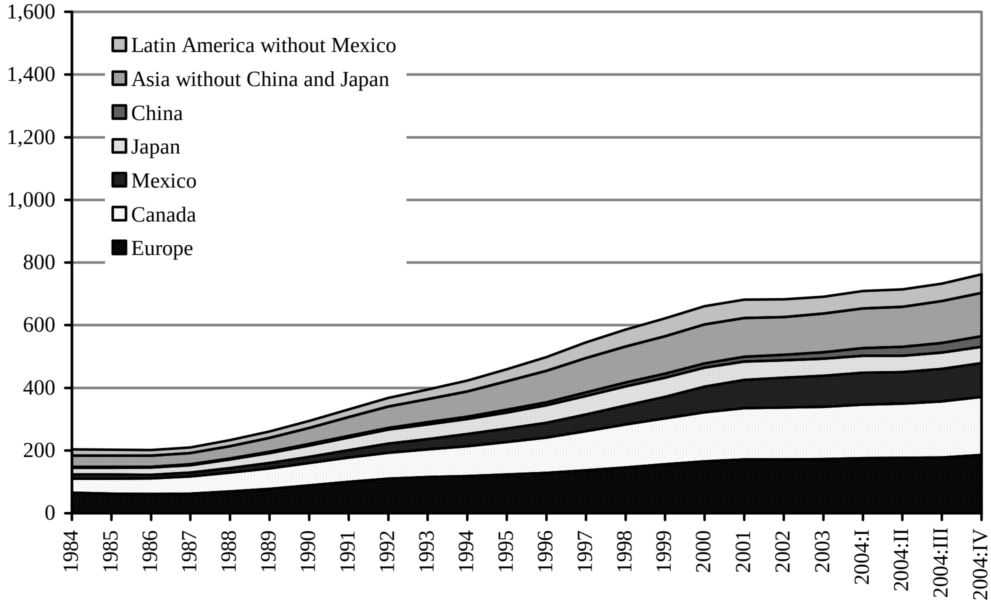
Source : Bureau of Economic Analysis.

Figure A1.2 Commodity shares of US imports
(5-year moving average; billions of dollars; not shown: Africa, international organizations, and Australia)



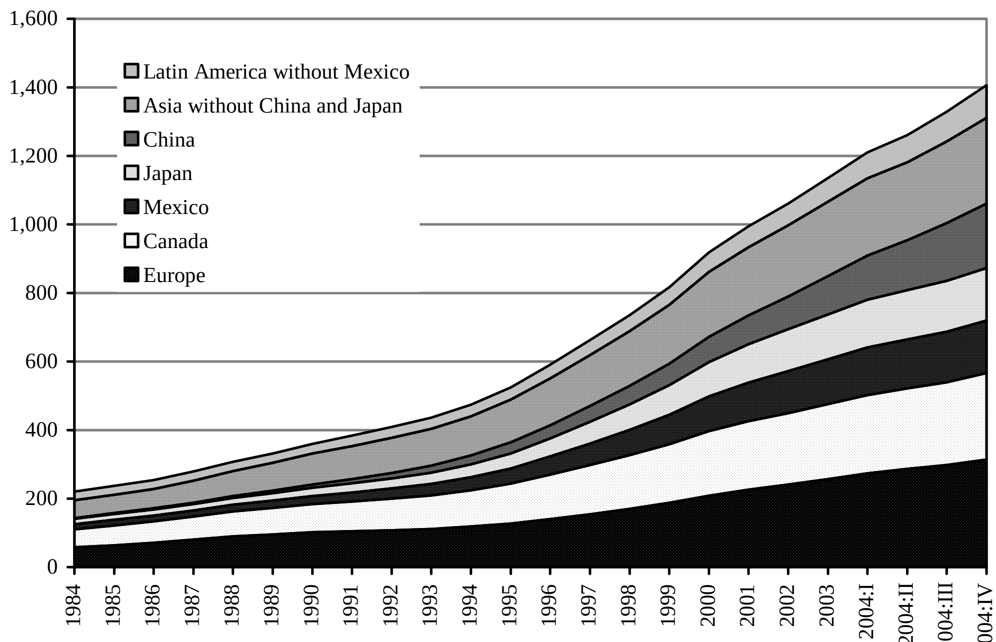
Source : Bureau of Economic Analysis.

Figure A2.1 Country/area shares of US exports
(5-year moving average; billions of dollars; not shown: Africa, international organizations, and Australia)



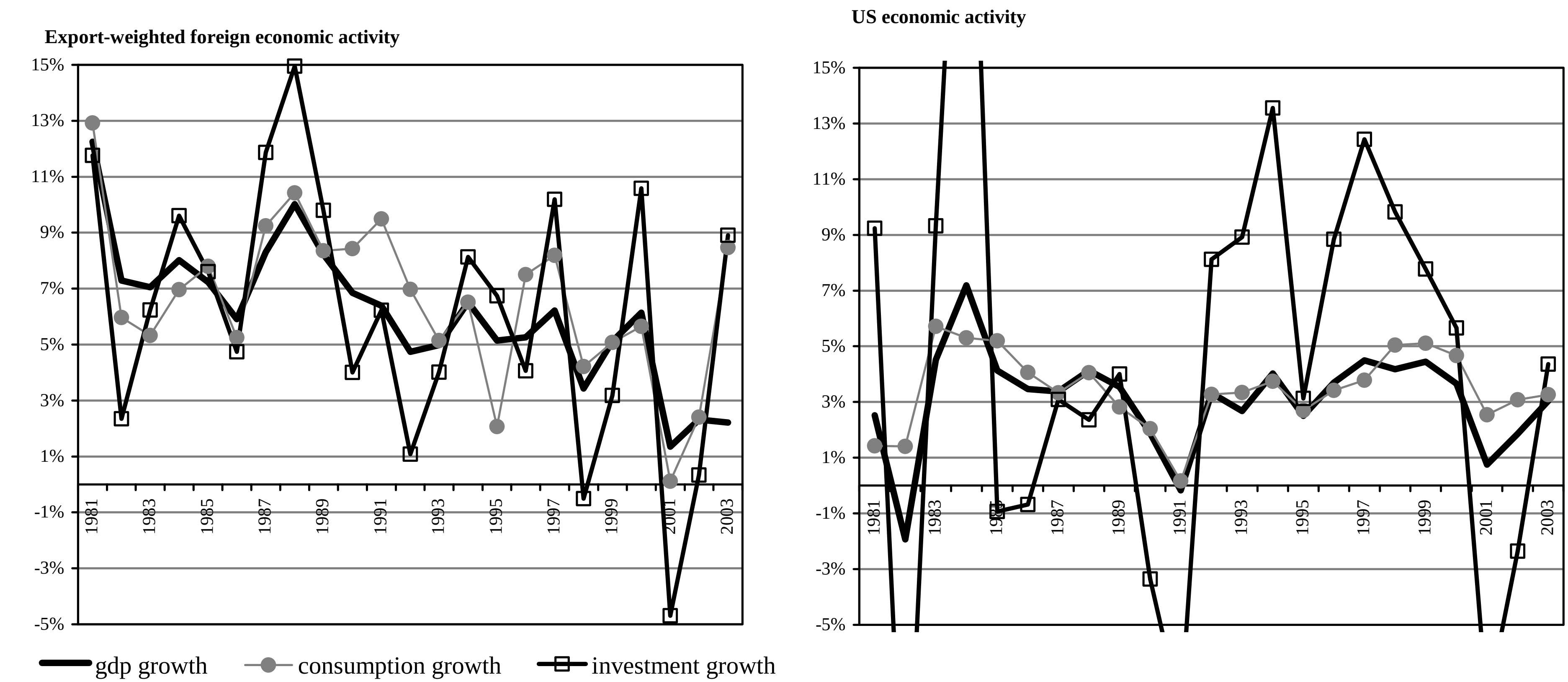
Source : Bureau of Economic Analysis.

Figure A2.2 Country/area shares of US imports
(5-year moving average; billions of dollars; not shown: Africa, international organizations, and Australia)



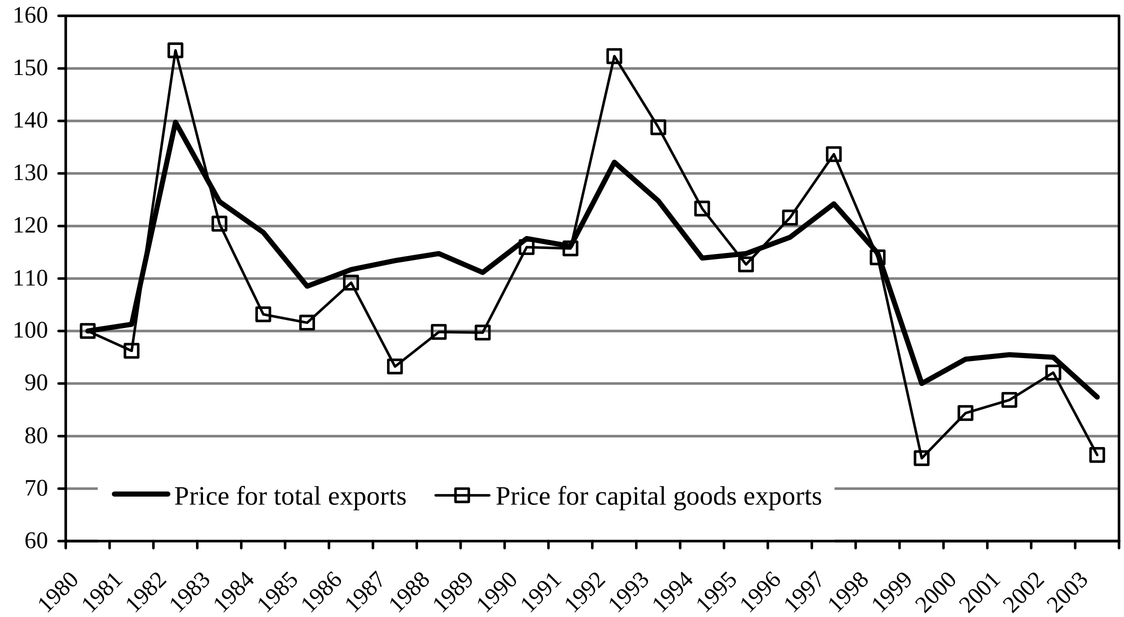
Source : Bureau of Economic Analysis.

Figure A3.1 Economic activity variables



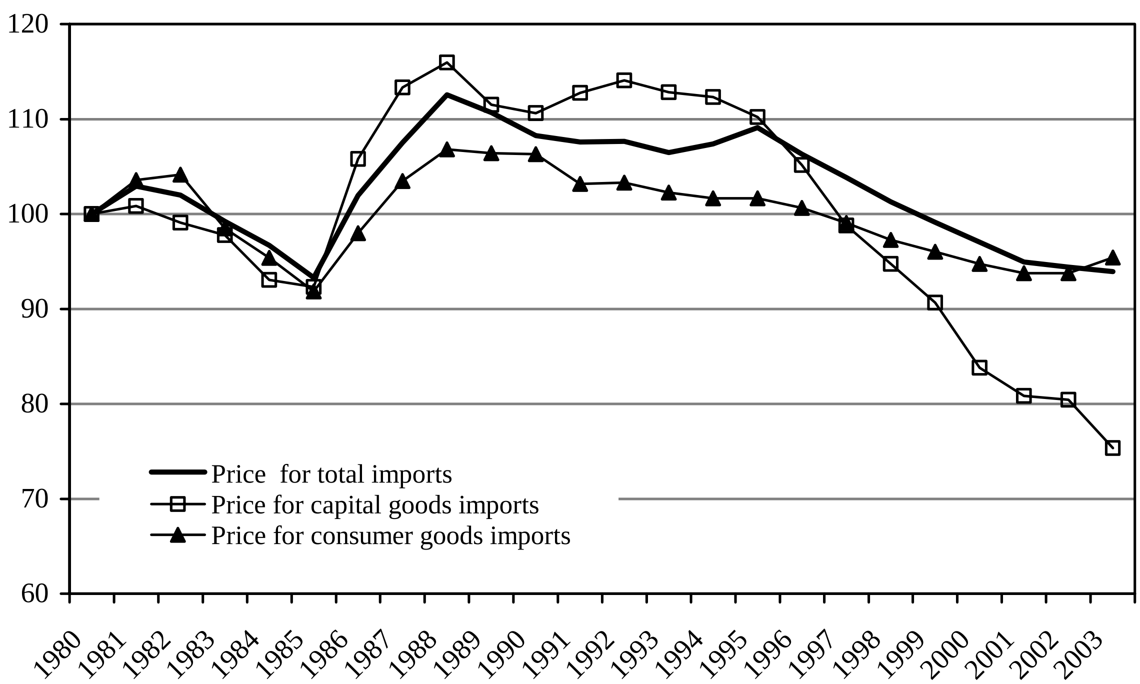
Source: Authors' calculations; Bureau of Economic Analysis; Penn World Tables.

Figure A3.2 Relative US export prices
(index 1980=100)



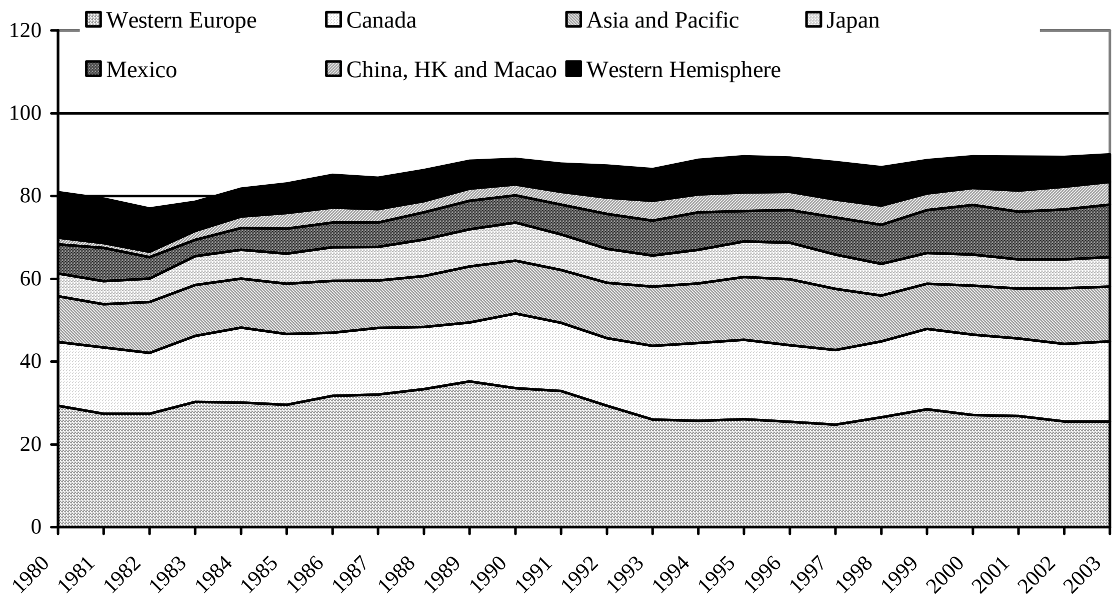
Source: Bureau of Labor Statistics; trade weights from UN Comtrade database.

Figure A3.3 Relative US import prices
(index 1980=100)



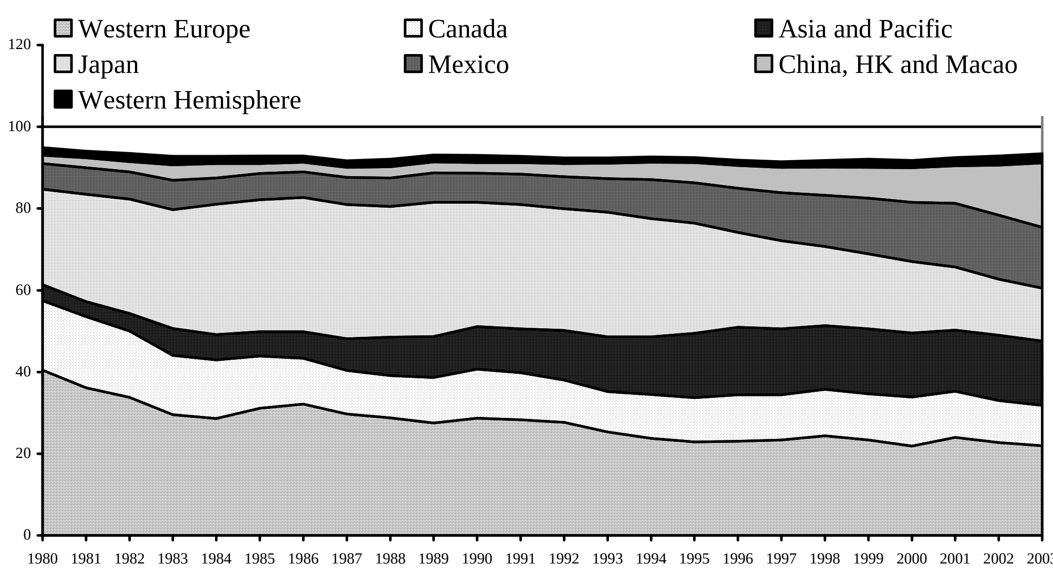
Source: Bureau of Labor Statistics; trade weights from UN Comtrade database.

Figure A4.1 Country/area shares of US capital goods exports
(percent; residual: Africa, Middle East, Eastern Europe, USSR/former Soviet Union)



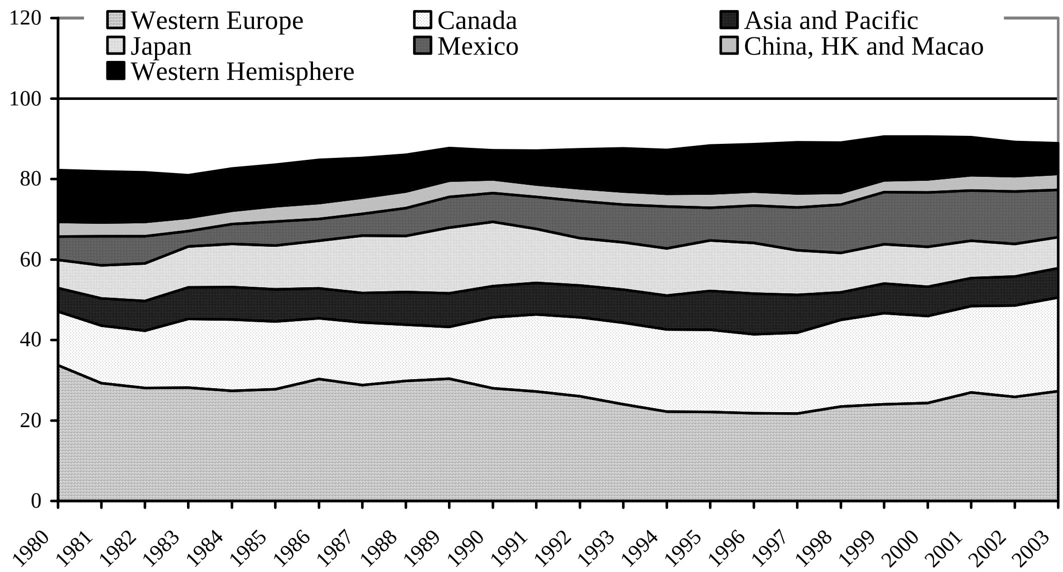
Source : UN Comtrade database.

Figure A4.2 Country/area shares of US capital goods imports
(percent; residual: Africa, Middle East, Eastern Europe, USSR/former Soviet Union)



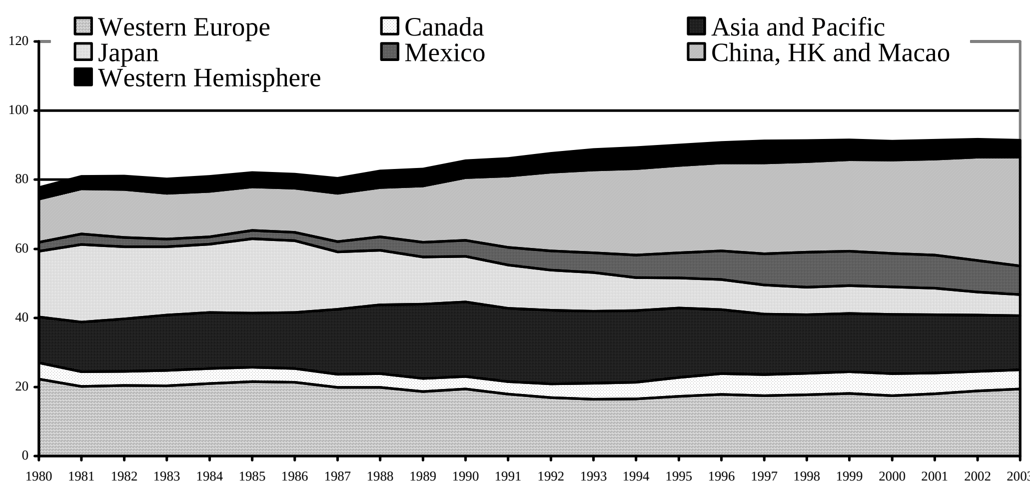
Source: UN Comtrade database.

Figure A4.3 Country/area shares of US consumer goods exports
(percent; residual: Africa, Middle East, Eastern Europe, USSR/former Soviet Union)



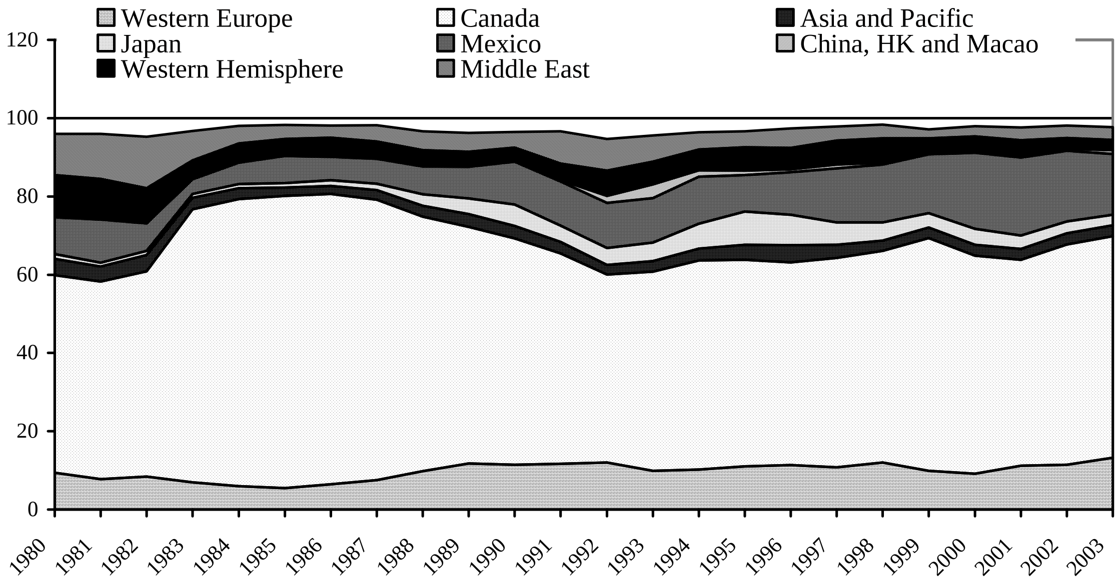
Source : UN Comtrade database.

Figure A4.4 Country/area shares of US consumer goods imports
(percent; residual: Africa, Middle East, Eastern Europe, USSR/former Soviet Union)



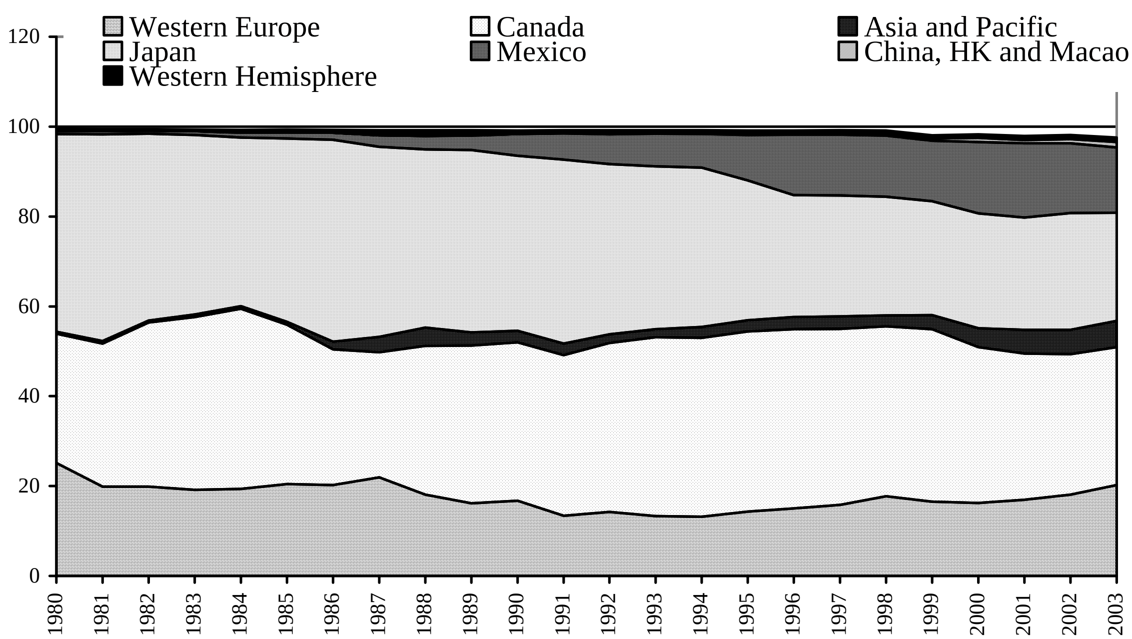
Source : UN Comtrade database.

Figure A4.5 Country/area shares of US auto exports
(percent; residual: Africa, Eastern Europe, USSR/former Soviet Union)



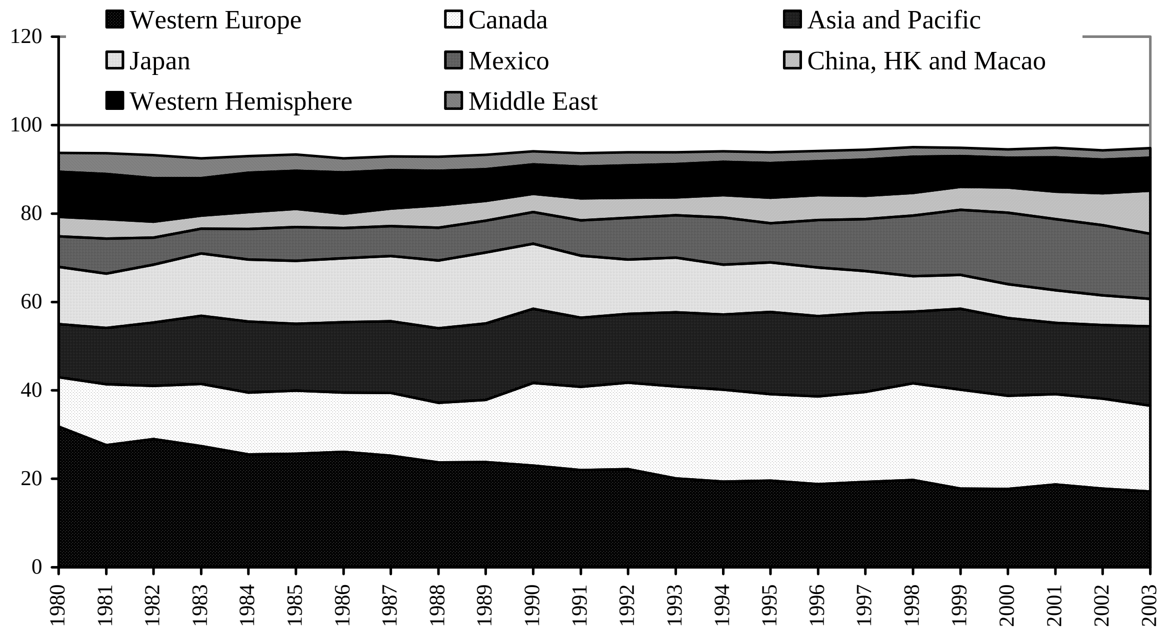
Source : UN Comtrade database.

Figure A4.6 Country/area shares for US auto imports
(percent; residual: Africa, Middle East, Eastern Europe, USSR/former Soviet Union)



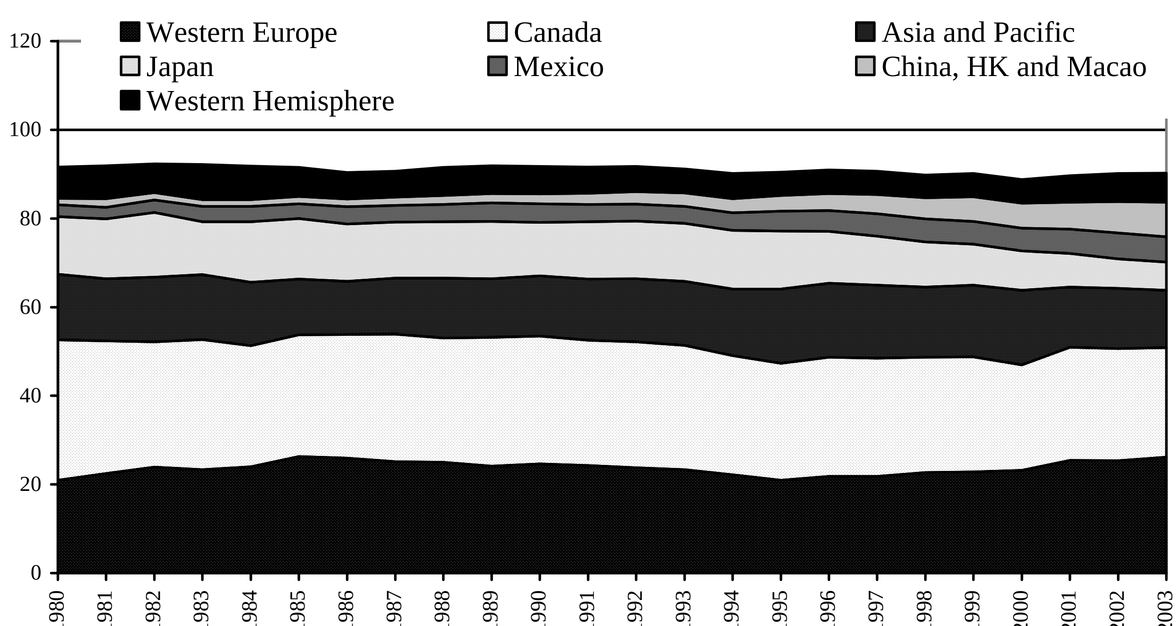
Source : UN Comtrade database.

Figure A4.7 Country/area shares of US industrial supplies exports
(percent; residual: Africa, Eastern Europe, USSR/former Soviet Union)



Source : UN Comtrade database.

Figure A4.8 Country/area shares of US industrial supplies imports
(percent; residual: Africa, Middle East, Eastern Europe, USSR/former Soviet Union)



Source: UN Comtrade database.

Table A5.1 In-sample performance of models using short-run coefficients: Consumer goods
(billions of dollars)

Year	Actual data			Matched expenditure w/variety and industrial-country dummies			GDP model		
	Imports	Exports	Net exports	Imports	Exports	Net exports	Imports	Exports	Net exports
1998	194.17	75.43	-118.73	218.91	76.65	-142.26	198.40	81.66	-116.73
1999	215.54	79.11	-136.43	248.97	78.42	-170.55	223.09	83.25	-139.84
2000	247.39	89.91	-157.48	271.88	83.42	-188.46	242.38	89.81	-152.56
2001	246.00	87.76	-158.24	290.79	92.86	-197.92	258.95	96.70	-162.25
2002	268.59	83.84	-184.75	286.06	87.53	-198.53	262.27	90.65	-171.62
2003	290.79	89.41	-201.38	318.87	87.45	-231.42	297.83	86.67	-211.16
1998				24.74	1.21		4.23	6.23	
1999				33.43	-0.69		7.55	4.15	
2000				24.49	-6.49		-5.02	-0.10	
2001				44.78	5.10		12.94	8.94	
2002				17.47	3.69		-6.32	6.81	
2003				28.08	-1.96		7.04	-2.75	
Total error				172.99	0.87		20.43	23.27	

Table A5.2 In-sample performance of models using short-run coefficients: Capital goods
(billions of dollars)

Year	Actual data			Matched expenditure w/variety and industrial-country dummies			GDP model		
	Imports	Exports	Net exports	Imports	Exports	Net exports	Imports	Exports	Net exports
1998	229.95	231.33	1.38	212.85	236.63	23.78	218.09	248.10	30.01
1999	262.27	241.97	-20.30	242.52	248.02	5.49	254.28	254.53	0.25
2000	312.02	270.07	-41.95	273.39	277.47	4.08	285.69	277.54	-8.16
2001	290.13	251.96	-38.17	306.30	282.53	-23.76	318.26	296.35	-21.91
2002	295.21	231.81	-63.41	293.92	261.89	-32.03	308.71	261.25	-47.46
2003	313.64	231.11	-82.53	301.08	262.21	-38.87	318.05	245.31	-72.74
1998				-17.10	5.30		-11.85	16.77	
1999				-19.75	6.04		-8.00	12.56	
2000				-38.62	7.40		-26.33	7.47	
2001				16.17	30.58		28.12	44.39	
2002				-1.30	30.08		13.50	29.45	
2003				-12.56	31.10		4.41	14.20	
Total error				-73.16	110.50		-0.15	124.83	

Table A5.3 In-sample performance of models using short-run coefficients: Autos
(billions of dollars)

Year	Actual data			Matched expenditure w/variety and industrial-country dummies			GDP model		
	Imports	Exports	Net exports	Imports	Exports	Net exports	Imports	Exports	Net exports
1998	126.11	53.72	-72.39	168.23	60.10	-108.13	146.88	63.50	-83.38
1999	150.39	54.72	-95.68	187.83	58.51	-129.31	159.39	63.67	-95.71
2000	163.51	57.47	-106.04	218.86	61.51	-157.35	185.02	68.46	-116.56
2001	157.50	53.20	-104.30	219.33	61.86	-157.47	180.30	62.60	-117.70
2002	168.72	56.68	-112.04	199.51	54.75	-144.76	169.59	56.40	-113.20
2003	171.46	58.49	-112.97	216.95	66.53	-150.42	194.41	61.68	-132.73
1998				42.12	6.38		20.77	9.78	
1999				37.43	3.80		9.00	8.96	
2000				55.34	4.04		21.51	10.99	
2001				61.83	8.67		22.80	9.40	
2002				30.80	-1.93		0.88	-0.28	
2003				45.49	8.04		22.95	3.19	
Total error				273.02	28.99		97.91	42.04	

Table A5.4 In-sample performance of models using short-run coefficients: Industrial supplies and materials, excluding oil (billions of dollars)

Year	Actual data			Matched expenditure w/variety and industrial-country dummies			GDP model		
	Imports	Exports	Net exports	Imports	Exports	Net exports	Imports	Exports	Net exports
1998	190.50	174.61	-15.89	194.73	169.35	-25.37	203.72	178.97	-24.75
1999	205.57	185.93	-19.64	207.15	178.82	-28.33	222.24	185.47	-36.77
2000	218.52	206.29	-12.23	218.74	198.99	-19.75	232.46	198.74	-33.72
2001	195.87	188.16	-7.71	204.55	196.81	-7.74	224.44	206.78	-17.66
2002	205.73	187.59	-18.14	190.59	188.91	-1.68	211.08	193.93	-17.15
2003	199.57	193.47	-6.09	212.94	196.47	-16.48	228.34	192.58	-35.76
1998				4.23	-5.25		13.22	4.36	
1999				1.58	-7.11		16.67	-0.46	
2000				0.22	-7.30		13.94	-7.56	
2001				8.68	8.66		28.57	18.62	
2002				-15.14	1.32		5.35	6.34	
2003				13.38	2.99		28.78	-0.89	
Total error				12.94	-6.69		106.52	20.41	