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The US Trade Deficit: A Disaggregated Perspective

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Abstract

The paper prepares new estimates of the elasticity of US trade flows using bilateral trade data for 31 countries, using different measures of expenditure, and including alternative proxies for global supply-cum-variety. Using disaggregated data on bilateral trade from UNCOMTRADE database we examine four different categories of goods based on the Bureau of Economic Analysis' 'end-use' classification system—autos, industrial supplies and materials (excluding energy) consumer goods, and capital goods—finding that these four categories behave differently from a panel aggregated over the full commodity set. We find that using expenditure by category group is a superior measure of income compared with GDP and yields far more plausible values for these trade elasticities. We find that industrial and developing countries have different income and relative price elasticities for these four product groups. The relative prices for the industrial countries have plausible parameter values. We find that variety is an important variable for capital goods. Whereas we obtain more plausible values for the trade elasticities, ones that are consistent with theoretical priors, our predictions for imports are poor compared to the benchmark model that uses US GDP as the measure of expenditure. On the other hand, for exports, our new estimates do better at predicting exports than does the benchmark model that uses GDP as the measure of expenditure.

JEL classification F4, F17.

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By the end of 2004, the US current account deficit reached $665 billion or almost 6 percent of GDP; in early 2005, the trade deficit alone was on a trajectory for $730 billion. In dollar terms, this is the largest net financing received by any country ever; as a share of GDP, it is much larger than ever experienced by a large industrial country. Pundits, policymakers, financiers, and researchers want to know how the deficit got so large. They are even more interested in its future path.

Modeling the determinants of trade flows with the elasticities approach has a very long history in empirical work on international economics. Key ingredients to the external balance dynamic are the elasticity of demand for exports and imports with respect to economic activity, the elasticity of exports and imports with respect to prices, and the influence of other factors including global supply and increased variety. What has changed to warrant more analysis in this vein?

Considering US trade patterns over the last 25 years, a changing commodity composition of trade and a changing country composition of trade may be particularly important in understanding both the widening of the trade deficit and its future trajectory. Country composition may matter because comparative advantage could change quickly when 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 and because the composition of aggregate demand may change over time. In addition, for both country and commodity composition, differences in growth rates of difference categories of expenditure in the US compared with that of our trading partners' could be particularly important in explaining US trade.

The paper prepares 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-cum-variety. Using disaggregated data on bilateral trade from UNCOMTRADE database we examine four different categories of goods based on the Bureau of Economic Analysis' 'end-use' classification system—autos, industrial supplies and materials (excluding energy), consumer goods, and capital goods—finding that these four categories behave differently from a panel aggregated over the full commodity set. We find that using expenditure by category group is a superior measure of income compared with GDP and yields far more plausible values for these trade elasticities. We also find that industrial and developing countries have different income and relative price elasticities for these four product groups. The relative prices for the industrial countries have plausible parameter values. We find that variety is an important variable for some product groups. Whereas we obtain more plausible values for the trade elasticities, ones that are consistent with theoretical priors, our predictions for imports are poor compared to the benchmark model that uses US GDP as the measure of expenditure. On

the other hand, for exports, our new estimates do better at predicting exports than does the benchmark model that uses GDP as the measure of expenditure.

The new elasticities yield insights on the sources of the widening of the US trade deficit and have implications going forward for demand management. The differences in relative price elasticities across income groups, in conjunction with complementary research on pass-through undertaken by other authors, yields insights on the implications of certain exchange rate regimes. Together these results on demand and relative prices by country and commodity group give a sobering view of the challenges of US external adjustment going forward.

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 3 presents and discusses data on the US trade deficit that initiated this investigation. Section 4 discusses our data. Section 5 presents the econometric approach. Section 6 discusses results. Section 7 summarizes our findings, presents some implications, and notes areas for further work.

2: 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 and 1948). 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 Johnson, Hooper, and Marquez (2000) for a concise summary of the model).

All studies find – as expected – that an increase in domestic income will raise the domestic demand for imports and that an increase in foreign 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 its exports.

The size of the coefficients on income and relative price, however, varies greatly by study, by time period, and by countries analyzed. The inclusion of different or additional explanatory variables in the model, and the kind of trade data used (all commodities, manufactured merchandise, or services) also affects the size of the estimated elasticities. In their survey of import and export demand elasticities for the United States, Sawyer and Sprinkle (SS)(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 et al. 1979) to 2.151 (Wilson and Takacs 1979). The median (mean) estimate of the 24 studies on total US imports referenced in SS is 2.02

(2.14). The median (mean) estimate of the 17 studies on total US merchandise exports referenced in SS is 1.12 (1.02).

These estimates of US trade elasticities have the characteristic that the export elasticity is much smaller than the import elasticity. In this regard they replicate the earliest and most well-known estimations of these elasticities by H.S. Houthakker and Stephen Magee (HM). In a 1969 article, they find that the U.S. income elasticity for total imports is 1.7 (autocorrelation corrected estimate presented in the appendix) and the foreign income elasticity for American exports is around 1. Subsequent studies have confirmed this inequality in income elasticities for US import and export demand. In one of the more recent studies, Hooper, Johnson, an Marquez (HJM) (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.

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. Without a trend change in relative prices (also not consistent with long-run convergence), the US absorbs all global production and the rest of the world buys all of the US assets.[1] So, researchers continue investigating the HM puzzle and have run different data samples, considered more precise measures for certain variables, employed different estimation techniques, and added new independent variables to the basic Houthakker and Magee specification.

One approach to the HM puzzle is to take on directly the changes in the commodity composition of US trade over the past 20 to 30 years by estimating import and export equations for different categories of goods and services. If the composition of a country's trade has changed significantly over time, one might expect that its trade elasticities are not constant. Researchers have found different income and price elasticities for different goods categories throughout (for example Stone (1979), for a survey see Sawyer and Sprinkle (1996), Marquez (2002) estimates elasticities for different categories as well, see Deardorf et. al (2000) and Mann (2003) for services. HJM cannot reject the hypothesis the trade elasticities are constant over time, but they hold the country composition of trade fixed at the 1995 shares.

Another approach is to focus on "the notorious inadequacies of import and export price indexes" (Houthakker and Magee, p112). Mis-specified prices will have, as their reflection, mis-estimated income elasticities (as well as mis-estimated price elasticities themselves). There are several problems with the relative price term. Goldstein and Khan (1985) discuss the difficulty of choosing a relative price measure that matches the traded good with the domestic substitute. They note that the two series used most often to proxy for domestic substitutes for the traded product is the GDP deflator and the wholesale price index, both of which include a considerable share of non-traded goods. Researchers have also investigated to what extent conventional price indexes for traded goods do not reflect new product introductions, nor take account of the effect of changes in global supply on prices and therefore on demand.

[1] Krugman and Baldwin (1987).

Some researchers try to quantify the importance of new supply or new varieties. Broda and Weinstein (2003) show that between 1972 and 2002 the number of varieties[2] imported by the US increased by 252 percent (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. More generally, Hummels and Klenow (2004) find that as countries industrialize and grow, their exports not only increase in nominal value, but 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 variety coming from countries with higher productivity.

Given that new products and different varieties appear to be important, some researchers have created new price indexes. Robert Feenstra (1994) re-estimates price indexes for six narrowly defined manufacturing goods.[3] 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. His new price indexes, used in a model for US imports of the six different goods, substantially reduce the estimated income elasticity of US import demand for these six products. Marquez (2002) also constructs a new variable using both Feenstra's price-index methodology and a variant on the relative capital stock term originally used in Helkie and Hooper (1988). His variable reduces income elasticities for US imports of producer goods, but not of services or consumer goods.

A third alternative recognizes that price indexes are, to a great degree 'given'.[4] So, 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 side and to the demand side.

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

- Joseph Gagnon, in three recent papers (2003, 2004a, 2004b), finds a significant supply effect (defined as potential output growth or relative GDP of the exporting country) that, in its absence, leads to overestimation of the coefficient on income in a US import regression.

- 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

[2] Weinstein and Broda define as a "good" an 8-digit or 10-digit category in the Harmonized Tariff System; a "variety" is a good from a particular country.
[3] Feenstra considers imports of men's leather athletic shoes, men's and boys' cotton knit shirts, stainless steel bars, carbon steel sheets, color teevision receivers, and portable typewrites, and for comparison purposes gold and silver bullion between 1967 and 1987.
[4] Meaning that they come as an index created by the statistical agencies.

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.

- 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[5], whereas the importer's income elasticity decreases over time.

- Cline (2005) puts the trading partner GDP into the workhorse model and finds that reduces the trade elasticities.

A final issue is that most of the studies to date focus on data from the industrial countries, for which trade data, prices, and real expenditures are readily available, even on a quarterly basis. Marquez (2002) is one of the first – to our knowledge – who estimates comprehensive trade elasticities for Asian countries. He finds that these newly estimated elasticities added to estimated elasticities for G-7 countries including the United States give a fuller picture of world trade and re-instate the world trade identity (world exports equal world imports) that previous estimates did not provide. Asia's share in world trade has, in Marquez's words, risen from "insignificance to dominance"(p. 91). Hence an adequate model of international trade should estimate trade of industrial countries *and* emerging market economies.

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, or the role for burgeoning intermediate trade. 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 on increased foreign supply (and thus lower prices and thus more demand for imports) and some of the explanation comes from increased domestic demand for variety, holding income constant, and some of the explanation is from increased fragmentation of production and imports of intermediates (so-called round-trip trade). Although these propositions with regard to global supply, variety, and round-trip trade should equally be valid for the fast-growing United States itself, there are few investigation of the US export equation. [6]

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. In Paul Krugman's (1989) '45-degree rule,'[7] 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, at fixed income, the apparent demand curve for the

[5] 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.
[6] Gagnon (2003a) estimates regression 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).
[7] "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.

varieties shifts out and there is no deterioration in the terms of trade. Schott's findings reject any lower-price part of the story; 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, it is tilting in their favor.

All told, in spite of recent attempts to introduce new variables to the basic model of trade flows, the asymmetry in the US income elasticities of trade remains a persistent feature of empirical research on international trade. Closer attention to changes in trading partners and commodity composition of trade, and taking better account of global supply and demand for variety are the predominant directions of the research undertakings to date. We will continue with these directions and also add a consideration of the proper 'income' variable itself, better matching this variable to the disaggregated commodity composition of trade. So, we have four dimensions for our analysis: trading partner, composition of trade, variety-cum-global supply, type of economic activity.

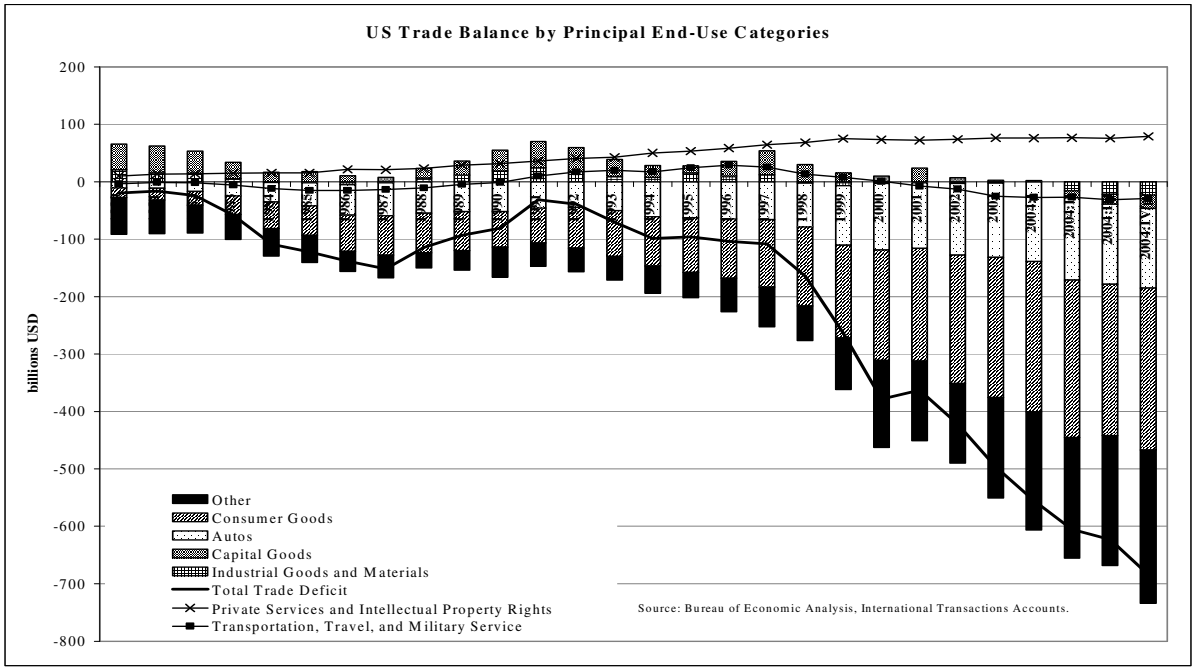
3: Graphical evidence to support a disaggregated approach

The data requirements of the dimensionality of the analysis are substantial, and will be discussed in greater detail in Section 4 as well as the Appendix. Taking a broad brush, is there evidence to suggest that such a data-intensive effort might bear fruit? Will the estimates of the income and relative price elasticities of US trade differ by trading partner, or commodity group? Would using different measures of economic activity address the Houthakker-Magee asymmetry? Do such equations predict trade flows better?

Changing commodity composition of trade

One chart suffices to spur the investigation. Chart 1 shows the net trade balance of the US divided into the Bureau of Economic Analysis's end-use categories of capital goods, industrial supplies and material-excluding oil (IMS-ex), consumer goods, and autos and auto parts. (For completeness, the chart also shows net trade in two categories of services and net trade in 'other'—petroleum and agriculture products).

Chart 1



Before considering net trade, however, how important are these BEA end-use categories in total trade? (Table 1 and Appendix Charts A1.1 and A1.2) Two very large categories of both imports and exports are capital goods and ISM-ex, with the share of capital goods rising from 1980 to 2004 and the share of ISM-ex falling over the same period. Capital goods is an interesting category because of the potential role for both global supply and variety. In particular, burgeoning trade in diverse information technology products, the role for foreign direct investment, and the fragmentation and globalization of the production process of these goods makes the capital goods category of particular interest for our research approach. Moreover, from a macroeconomic perspective, global investment cycles may differ from global GDP cycles, with consequences for US capital goods exports and imports. In particular, this global investment cycle may be an important factor underpinning one of the most notable features of the trade data-- the very slow growth of exports of capital goods since 1997.

Table 1	Trade share by principal end-use category			
	exports		imports	
	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
other defined as: oil and agr.				
Source: Bureau of Economic Analysis				

With respect to net trade, up until 1997, net trade in capital goods and ISM-ex cycled through larger and smaller surpluses depending in large part on the US and global business cycles. Since about that time, however, the trade balance in this category has not recovered even as global GDP growth has revived. From a surplus of about $50 billion in 1997 (3/4 capital goods and ¼ ISM-ex), this balance is now in deficit some $50 billion (about equal both categories). This change may reflect the initial and continued effects of the appreciation of the dollar. It may be due to relatively slow growth of investment in US exporters' markets abroad, including persistent fallout from the Asian financial crises, which has been masked by more robust aggregated measures of economic activity such as GDP. Given the share of exports, tepid investment abroad would weigh more heavily on US exports of capital goods than on US trade overall. Or, technology may have enabled a permanent change in the international supply chain for variety and production of capital goods, perhaps to center on China.

Consumer goods is a large category with a dramatic increase in the share of US imports. The share of consumer goods in total merchandise imports rose dramatically to account for 25 percent of merchandise imports in 2004. The share of consumer goods in total merchandise exports rose only modestly and accounts for only 13 percent of exports. Autos and auto parts are a modestly expanding share of trade, probably mostly due to fragmentation of production, accounting for 11 percent of merchandise exports and 15 percent of merchandise imports (2004).

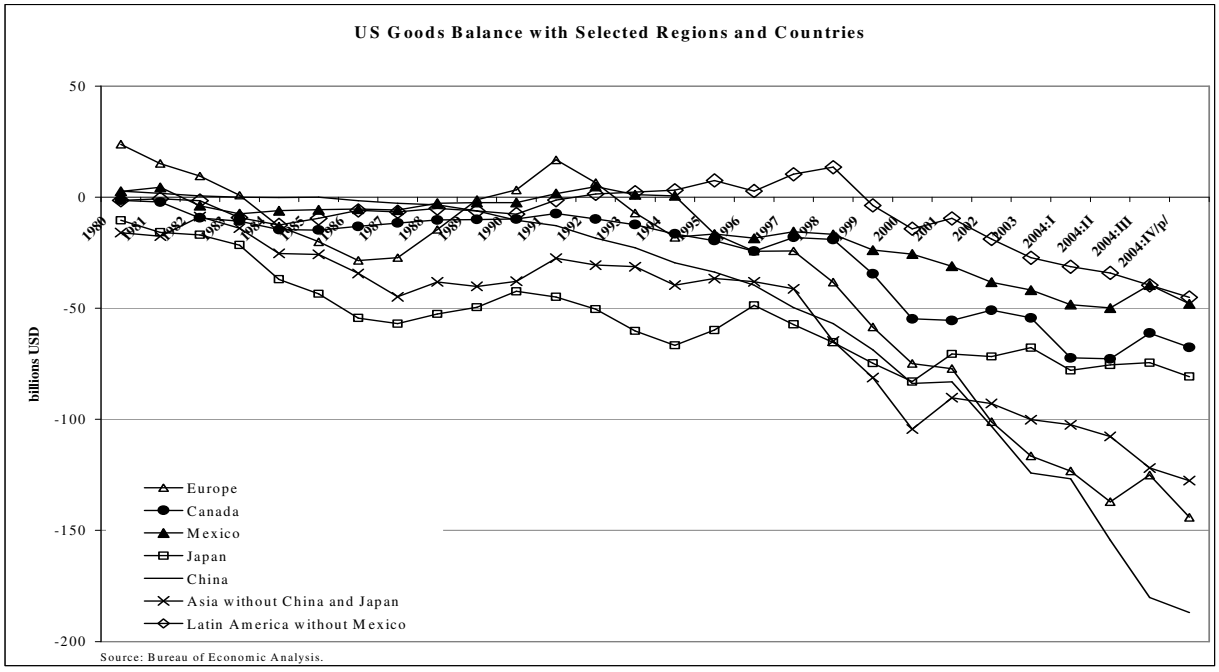
The biggest component of the non-oil/non-agriculture[8] trade deficit is in consumer goods. When added to the net deficit in autos, nearly three-quarters of the increase in the non-'other' trade deficit since 1997 can be accounted for by these two categories, which are both related to personal consumption expenditures. Moreover, only outright recession (in 1991 and 2001) stemmed the widening in these components of net trade. For some consumer goods (such as apparel and shoes) a story of lost comparative advantage is plausible. But, for the full range of consumer and automotive products it does not seem to square with the historical and continued global competitiveness in manufactured capital goods, in that at least some types of consumer goods demand the same high-productivity and high-variety production techniques as do capital goods. Is the story about the consumer goods deficit simply a reflection of extraordinarily robust domestic consumption in the United States teamed with new patterns of global supply?

Changing country composition of US trade

The second dimension of this investigation is the changing country pattern of trade flows and net trade. On the one hand, Chart 2 suggests that there is no particular reason to pursue a strategy of country disaggregation. It shows that the net trade deficit of the United States is broadly distributed across all of our trading partners. Over all countries and regions, there are large, and in most cases increasing, trade surpluses vis-à-vis the US. The widening US trade imbalance is not just about imports from China or Mexico, but is broad-based across all trading partners. Indeed, the worsening of the bilateral US trade balance vis-a-vis Western Europe is about the same dollar magnitude as with China (1992-2003). On the other hand, the trajectory of the trade deficit with China is without compare.

[8] Oil and Agricultural Products are shown in the chart as "other".

Chart 2



Moreover, consider how the share of trade with countries and regions has changed over time. (Table 2 and Appendix Charts A2.1 and A2.2) Trade with the industrial countries in general has stayed relatively stable, with the share of imports remaining at about 50 percent and exports falling from 60 to 54 percent (1980-2004). With regard to trade flows, the share of imports from certain countries and regions has changed dramatically, with the share of imports from China increasing from 0 to 14 percent over the period, the share of exports to non-China, non-Japan Asia doubling to 11 percent, and the share of trade with Latin America (less Mexico) contracting.

Table 2	Trade shares by country/region			
	exports		imports	
	1980	2004	1980	2004
Europe	32.0%	23.8%	19.2%	21.9%
Canada	18.6%	23.5%	17.3%	16.8%
Mexico	6.8%	13.8%	5.1%	10.4%
Japan	9.3%	6.3%	12.5%	8.5%
China	3.7%	8.2%	0.4%	14.2%
Asia without China and Japan	5.7%	10.9%	7.3%	8.8%
Latin America without Mexico	10.5%	7.7%	10.0%	7.0%
Other (Australia, Africa, Int'l Org.	3.8%	3.5%	19.3%	4.0%
Source: Bureau of Economic Analysis				

The large size of the capital goods trade, the large increase in the consumer goods share of imports and of the trade deficit, the changing shares of trade with countries in Asia, as well as with the NAFTA partners suggests that closer inspection of trade flows by country and

commodity is warranted. However, the Bureau of Economic Analysis (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 by product trade 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.

4: Our database on the commodity and country composition of US trade

Our database includes a 31 country sample of bilateral trade with the US aggregated into end-use-proxy categories; a matched set of expenditure data and relative prices, and proxies for variety in each end-use-proxy group.

Constructing bilateral trade data and choosing trade prices

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

The first requirement is to match the BEA end-use categories. Roughly, our 'ISM-ex' category covers raw materials and intermediate goods, '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 the BEA end-use categories that are the focus of our graphical evidence. Table A1 in the Appendix shows the complete list and Appendix Charts A4.1 –A4.4 present the data by commodity group and major countries of interest.

The second requirement is data for 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, total merchandise exports, and its share in trade in each of our four end-use-proxy 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 is insufficient data on expenditure and prices needed to employ the workhorse model. We also excluded South Africa. Hence, our sample of bilateral trade pairs includes 30 countries from Asia and the Pacific, North America, Latin America, and Western Europe. Trade data on a comparable basis for Taiwan comes from that country's statistical office for a total of 31 countries in the database.

Because of our intended econometric approach, we needed a uniform panel with the same set of countries for each of the end-use-proxy groups for both imports and exports. As a consequence, 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 consumer imports, 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 mostly with Canada, Mexico, Japan and Germany.

To employ the workhorse model of trade, we need real exports and real imports. We deflated all nominal values by the corresponding end-use export and import price indexes from the Bureau of Labor Statistics. This assumes that import and export prices are the same across all trading partners, which inspection of country specific time series data from BLS rejects. Such country-specific trade-price data are unavailable at sufficient time series length, and not on a commodity basis. Sufficiently long time series price indexes are available on the end-use basis.

Constructing matched expenditure variables and relative prices

A key issue for comparative analysis is the measure of economic activity to employ in the workhorse model. The standard measure of economic activity used in trade equations is real GDP. Certainly in aggregate trade equations this makes sense. However, with the commodity decomposition analyzed in this paper, it makes sense to better match the activity variable to the trade variable. Hence we use real consumption expenditures for trade in consumer goods and autos, and real investment expenditures for trade in ISM-ex and capital goods.

There is another rationale for using a measure of economic activity other than GDP. The systematic deterioration of the US current account deficit and the comparable rise in current account (and trade) surpluses around the world (as documented in Truman (2005) and Mann (2005)) suggests a systematic bias in the GDP measure of economic activity affecting US trade flows. 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 our GDP.

We construct three measures of economic activity from country-specific real GDP, real private consumption expenditure, and real private gross fixed investment and we will test for the difference in trade-weighted real GDP as compared to trade-weighted matched expenditure in the econometric analysis.

As inputs to the constructed measures of economic activity, for exports, we use the country-specific real per capita consumption expenditure, investment, and GDP multiplied by population from the Penn World Tables.[9] On the import side, United States real GDP, real consumption expenditure and real investment are all from the BEA's National Income and Product Account (NIPA) tables. Real consumption expenditure is matched to consumer and auto trade and real investment is used to model trade in capital goods and industrial supplies. A key econometric

[9] Since the Penn data only extend through 2000 we use the growth of these 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. We discuss in the appendix the alternative choice of using the IMF's nominal values and matched deflators for GDP, consumption, and investment for the full analysis.

exercise is to compare the 'income' elasticities across these alternative measures of economic activity and commodity groups.

In our analysis, we take the relative price variable of the workhorse model (trade price relative to domestic competing substitute) as given.[10] Relative prices for US imports are the ratio of the end-use specific import price index and the corresponding US "domestic" price index: The PPI is used for ISM-ex and capital goods. CPI-commodities (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 Charts A3.1 and A3.2 display the movement of selected indexes.

Constructing variety

Recent literature has focused on adding variables to the workhorse model to offset the inadequacies of official price indexes. A global supply or a variety variable either simulates the entry of dynamic emerging market economies into global market or proxies for countries' ability to provide greater variety of goods to the United States. A global supply variable would account for an outward shift of the global supply curve, which enables the United States to buy more imports at lower prices. The variety variable takes account of the differences in quality of goods within a product group, and implies that variety in imports (exports) available to US consumers (foreign buyers) has grown; with a taste for more variety consumers demand more different goods, everything else held equal. 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 (2003) as well as Gagnon (2003a), we construct a variety-series by counting the number of SITC 4-digit categories that are included in each end-use proxy-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.[11] In 1980, China only provided 46 categories under the capital goods heading, "metal working machine tools" being the biggest in nominal dollar terms ($18 million); in 2003 China supplied 125 goods out of 136 different 4-digit categories in capital goods, with $9 billion worth of "peripheral automatic data processing units" as the largest and $6 billion of office machines accessories as the second largest category. Varieties from other developing countries have also risen: Capital Goods-

[10] Most recent studies estimate prices as part of a set of simultaneous equations (HJM 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.

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

variety from non-Japan Asia increased by 76 percent; and 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 similarly 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.

5: Econometric implementation

Our panel thus comprises import and export data, activity variables and relative prices for 31 US partner countries, 24 years and 4 different commodity groups (all-in-all 2976 observations). Each commodity group panel contains 31 time series. The whole panel consists of the four commodity panels stacked on top of each other. We use a dynamic panel specification to model bilateral trade flows. Our model allows us to estimate both short term and longer-term effects of changes in the explanatory variables – similar to an Error Correction Model (ECM) common in time series estimations:

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

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

The coefficients on the differenced natural logarithms will yield the short-run effects: a one percentage point change in economic growth will effect the growth in imports or exports by how much?

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:

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

So the coefficient on economic activity, here, would show the effect of a one percent increase in GDP, investment, or personal consumption expenditure on real trade flows.

We estimate the four commodity group panels separately using country-fixed-effects and the whole panel using "commodity-country"-fixed effects (allowing for 124 different unobserved effects, one for each individual country-good combination). We estimate the classic workhorse model using real GDP as the activity variable; then we estimate a similar model using the different expenditure variables as economic activity proxies; and we add our constructed variety variable to the estimation to control for growth in variety in US trade. Finally we interact both

economic activity and relative prices with dummies for China or for industrial countries respectively.[12]

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 and did not make sense. Ideally, one might try to estimate this panel using a Vector Error Correction Model (VECM) suited for dynamic panel data estimation – these techniques have been introduced only very recently and 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). Moreover, their applicability to our relatively short time series of annual data is questionable.

Kennedy (2003, p. 313) acknowledges the problematic nature of dynamic panel data estimation, but he refers to studies showing that the bias induced when the time variable exceeds 30 observations is offset by the greater precision of fixed effects estimators as opposed to general least squares or instrumental variable regressions (also see Wooldridge 2002, chapter 11, for a discussion of this). Our time series comprises 24 years; and we proceed without corrective action.

6: Results and discussion

This section discusses the findings of the econometric exercise. We wish to compare across commodity decomposition as well as 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, examine China in particular, and review whether the post 1997 period appears different from the rest of the sample.

Benchmark regression, alternative time periods, and matched expenditure vs. GDP

For the first comparison to previous research, we use the 31-country and 4-commodity whole panel to run a benchmark regression for US imports and US exports. Presented are short run and long run estimates for the elasticity estimates for income and for relative prices from representative previous work. (Table 3)

[12] We also looked into a dummy variable for Asia interacted with activity, relative price, and variety, but the results were not particularly interesting.

Table 3	Data Period	Method	Level of Disaggregation	Exports		Imports	
				Relative Price	Income	Relative Price	Income
Previous Research							
Houthakker, Magee (1969)	Annual 1951-66	OLS	Goods and Services	-1.51	.99	-1.03	1.68
			Nonagricultural Exports	-1.03	1.12		
			Finished Manufactures	-1.22	1.17		
			Crude Materials			-0.18 (LR)	0.61 (LR)
			Semimanufactures			-1.83 (LR)	1.11 (LR)
			Finished Manufactures			-4.05 (LR)	2.63 (LR)
Hooper, Johnson, Marquez (1998)	Quarterly 1956-1996	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 (LR)	1.12 (SR) 1.21 (LR)	-0.38 (SR) -0.18 (LR)	2.43 (SR) 2.36 (LR)
This study							
GDP as income	Annual 1980-2003	Fixed Effects, Dyanmic Panel	Panel of 4 categories of goods	-0.07* (SR) -0.20 (LR).	2.97**(SR) 1.44**(LR)	-0.17#(SR) -0.28 (LR)	4.11** (SR) 2.22** (LR)
matched expenditure and matched prices	Annual 1980-2003	Fixed Effects, Dynamic Panel	Panel of 4 categories of goods	-0.03*(SR) -0.09 (LR)	0.58**(SR) 1.19**(LR)	-0.17 (SR) 0.45 (LR)	1.00** (SR) 1.66** (LR)

The first question is how our dataset, run 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 (SR) but are similar to the long-run (LR) estimates that come from regressions run over sample periods starting from the 1980s such as Wren-Lewis and Driver. 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, 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** makes a very significant difference to the estimated income elasticities. Both the SR and the LR elasticities are much lower—and more plausible from a theoretical perspective —in particular on the import side. This suggests that the GDP variable may not be the correct measure of economic activity that drives trade flows. The H-M asymmetry with respect to economic activity still persist, both in the short-run and long-run, but the magnitude of the asymmetry is much much 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), their significance level does not improve in this panel specification of the 4-commodity model.

Adding global supply, variety, or round-trip trade

Recent papers investigating the Houthakker-Magee asymmetry have argued that the income elasticity, particularly on the import side, is overstated because of a missing variable in the standard regression formulation which is either global supply or increased variety. That is, using GDP and a GDP-based relative prices as the only driver of trade flows leaves out another rationale for trade, which comes from increased global supply and lowered prices and/or increased global availability of varieties and/or intermediate (so-called round-trip) trade). When we replace GDP by matched expenditure variables, this alone significantly improves the plausibility of the estimated income elasticities, but the arguments for including a measure of global supply, or variety, or round-trip trade remains.

The choice of global supply-cum-variety variables varies across several studies. We experimented with several common in the literature. Growth in supply, proxied by the level of real GDP of the trading partner. Round-trip trade proxied by the lag growth in real GDP in the trading partner or, alternatively, by foreign direct investment in the US and US FDI abroad by trading partner. Variety, proxied by the variable discussed above.

Table 4 shows results for the whole panel where alternative global supply-cum-variety-cum-roundtrip trade variables are compared individually.[13] On the export side, neither variety proxy was significant when GDP is used as the measure of economic activity. On the import side, both variety proxies were significant. Using the foreign GDP variable in the import equation reduced the long-run GDP elasticity substantially to where it is almost unreasonably low. But, for both imports and exports, simply adding a proxy for global variety does not appreciably reduce the very high short-run GDP elasticities, nor reduce the H-M asymmetry.

In contrast, in the regression using the matched expenditure variables as the measure of economic activity, both measures of global supply-cum-variety were significant. As well, the fit of the regression improved with the added variables. The next discussion details evidence that supports the use of the constructed variety proxy and the matched expenditure as income proxy.

We also investigate the round-trip trade hypothesis along with a variety effect. On the import side, there is some evidence that round-trip trade might be an important feature of US import flows in addition to variety. Inspection of the disaggregated panel reveals that only trade in autos and auto parts has this feature. On the export side, the evidence is stronger that round-trip trade may be an important feature of US exports. Inspection of the disaggregated panel finds that this round-trip trade is particularly important for consumer goods and modestly important for capital goods.

[13] Despite the plausibility of the FDI story, that variable was not significant in most regressions and is not shown.

Table 4	Exports			Imports		
		Variety, supply, or RT			Variety, supply, or RT	
Whole panel	**Income**	**Supply or RT**	**Variety**	**Income**	**Supply or RT**	**Variety**
GDP	2.77** (SR) 1.44** (LR)	Not included	0.31	4.02** (SR) 1.90** (LR)	Not included	0.63**
GDP	2.80** (SR) 1.36** (LR)	0.17 Supply shift	X	4.04** (SR) 0.75** (LR)	0.72* Supply shift	Not Included
Matched expenditure	0.66**(SR) 0.72**(LR)	1.15** supply shift	X	0.98**SR) 0.55 (LR)	0.73** Supply shift	Not Included
Matched expenditure	0.58**(SR) 1.09**(LR)	Not included	0.91**	0.98**SR) 1.66** (LR)	Not included	0.70**
Matched expenditure	0.70**(SR) 1.54**(LR)	0.11** (RT)	2.1**	1.00**SR) 1.56** (LR)	0.41** (RT)	0.75**

Supply shift: log level of GDP in trading partner representing global supply capacity
Round-Trip (RT): log change in GDP in trading partner lagged one period
Variety: as constructed above from SITC and countries.

Disaggregated panel: Do coefficients vary across product categories?

As illustrated by the previous table, the matched expenditure variables yield elasticities more in keeping with the expected values. The next exercise validates that proposition by examining the four categories individually, as well as includes the variety proxy. (Table 5)

Table 5	Level of disaggregation (rsqM), (rsqX)	Exports			Imports		
		Relative Price	**Matched Expenditure**	**Variety-categories**	**Relative Price**	**Matched Expenditure**	**Variety-categories**
Matched expenditure and matched prices Annual 1980-2003 ECM	Capital goods (.16, .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 (.18, .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)	-.21
	Autos and parts (.20,.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 (.26), (.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 (.25, .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**

Comparing the elasticities on matched expenditure and variety, it appears that disaggregation into the four commodity groups does matter. On the export side, the SR 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. The LR elasticities of consumer and autos are greater

than the panel estimate. The fact that the LR consumer good elasticity at 1.37 suggests the slack consumer demand abroad could play in the evolution of US exports of consumer goods.

US capital goods grew robustly prior to 1997, but have experienced slack growth since, a feature of the data of particular interest given the size of the category in US exports. The results from these regressions indicate that the investment elasticity is a bit less than one for the whole period. But, the variety effect is quite strong. Robust growth in the early part of the sample may be due to both variety effects, which would be consistent with high productivity growth in US capital goods, as well as a global investment boom. In later years, with more slack global investment, particularly in the other industrial countries of Europe and Japan, as well as an appreciated dollar vis-à-vis these countries, variety alone might be the factor keeping US capital goods exports growing even as much as they have. In other words, without increased variety, demand for US exports might have stagnated even more.

On the import side, differences in estimated expenditure elasticities from the panel to the disaggregated commodities are substantial. The large SR (and LR) consumer good elasticity is consistent with the continued robust consumer expenditure growth in the US in general (and which shows up as the trending down in the household savings rate in the National Income and Product Accounts). It is perhaps a surprise that the variety proxy is not significant for this category[14] which further substantiates the story that strong US import growth is mostly about strong consumer demand, rather than a falling relative prices or love of variety story.

Imports of capital goods also provide some interesting observations. The SR elasticity is quite low, suggesting that contracts may be in place which take time to run off before demand augment imports. The much higher LR elasticity supports this notion. Since the variety is quite significant, this suggests that on the import side, both shifting of and a variety-tilting effect could be important for determining import demand. Our variety variable might also be a proxy for round-trip trade. The increased variety we document in capital goods may be due in large part to increased fragmentation of the production process of capital goods (in particular information technology products). This fragmentation may be reducing the relative price of imports faster than is incorporated into the official price index.

Comparing the coefficients in the import and export equations for capital goods yields interesting observations. First, the variety effect for exports of capital goods is much more important than for imports of capital goods. This supports the Schott hypothesis that a high-wage country can maintain international competitiveness through high productivity growth and by producing more high value-added varieties. Second, the SR expenditure elasticity is higher for exports than for imports. This suggests that a coordinated business-cycle increase in investment demand around the globe would initially boost exports more than imports.

Comparing the coefficients in the import and export equations for consumer goods also is interesting. Since the variety effect is not present, just demand (and presumably relative prices, albeit not significant here) drive consumer goods trade. The US consumer has a higher SR predilection to consume imports compared to the foreign consumer-a well know feature. However, in the LR, the differences are not so pronounced. Therefore a global business-cycle

[14] Marquez (2002) found his variety variable significant for producer but not consumer goods.

down-turn (or one centered in the US) would tend to narrow the US trade deficit through the consumer-good channel.

There are some puzzles. Why are the coefficients in the auto category so substantially different? This might have to do with imports coming from NAFTA and Asia (mostly Japan) but exports principally are to NAFTA.

Disaggregating by level of income: Are industrial countries different?

Comparing the results for industrial and developing countries suggests that these two groups respond differently to income and relative price and evidence some particularly interesting results for capital and consumer goods (Table 6a and 6b).

First, with respect to relative prices, the 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. Second, with respect to investment and capital goods, for exports, the elasticity for industrial countries does not differ from that of developing countries; but for imports, the investment elasticity of US imports of capital goods from industrial countries does differ from that of developing countries. Third, with respect to consumption expenditure and consumer goods, for exports, the elasticity of foreign demand from industrial countries differs from that of developing countries; but for exports, the elasticity of foreign consumer demand for US consumer goods is the same across both income groups.

What does all this add up to? First, with respect to *capital goods* trade, changing **relative prices** in industrial countries, and net trade, these coefficients are consistent with a story that dollar appreciation has, ceteris paribus, hurt 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[15] may, ceteris paribus, turn-around the net trade deficit in capital goods that was described earlier in this paper.

Second, with respect to capital goods trade, changing **investment growth**, and net trade, 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 exports of capital goods. Put together, the deterioration of net trade in capital goods comes from both dollar appreciation and the slower investment growth abroad.

Third, the fact that the **variety** effect is smaller for imports than for exports suggests that consistent with Schott, US capital goods export growth, even such as is it, is importantly underpinned by variety.

[15] 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).

For *consumer goods*, the story is somewhat different because the 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 and, particularly given the higher relative price elasticity, encouraged consumer 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 may, ceteris paribus, reduce the net trade deficit in consumer goods that was described earlier in this paper.

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 high elasticity of demand has encouraged imports of consumer goods from all trading partners. Slower consumption growth abroad (but more specifically in the industrial countries) has tended to yield slower growth in exports of consumer goods. Put together, the deterioration of net trade in consumer goods comes from both dollar appreciation (with greater imports of luxury, price sensitive goods from industrial countries and reduced exports of similarly price-sensitive goods to industrial countries) and the slower consumption growth abroad.

Table 6a Level of disaggregation	**Imports**				
	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) 0.78** (LR)	-0.24# (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** (SR)	-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
Panel of 4 categories of goods .	1.23 **(SR) 0.85**(LR)	0.61** (SR) 2.54**(LR)	-0.54 (SR) -1.4** (LR)	0.32 (SR) 2/79 **(LR)	0.50**

&--dummy for industrial countries is not significant.

Table 6b: Level of disaggregation	Exports				
	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
Panel of 4 categories of goods	0.18 **(SR) 0.85 **(LR)	0.58**(SR) 1.2 ** (LR)	-0.52 **(SR) -0.843 **(LR)	- 0.02 (SR) -0.04 (LR)	0.8**

Is China different?

For a number of reasons, we might expect China to be different from other countries in this specification of US trade dynamic. 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.

A similar set of regressions investigates whether China is appreciably different from the rest of the world; only selected results are shown. For *capital goods* imports, the elasticity with respect to trade with China differs from that of the rest of the world, particularly in the LR, with a very high long-run import elasticity; this is consistent with the charts and tables. On the export side, China has a higher elasticity of demand for US imports, which differs significantly from the rest of the world. Above, when the sample was split between industrial and developing world we could not distinguish demand elasticities for the two income groups, so China is different with respect to demand elasticities for capital goods.

For consumer goods, it may come as a surprise, but we cannot distinguish the demand elasticity for consumer goods imports from China from that of the rest of the world. Moreover, perhaps even more of a surprise, China's demand for US consumer goods imports does appear to be different, and of higher responsiveness in the long-run compared to the rest of the world. This is consistent with the consumer good story from the split panel. So, for consumer goods, China is not different. This corroborates evidence that imports of consumer goods from China simply replaced imports of these goods from other trading partners, which is what we observed in the COMTRADE data (see Appendix charts A4.1-A4.4).

With respect to relative prices, there is not much evidence that China differs from the rest of the world. Given the previous discussion of how relative prices do differ between the industrial and developing countries, although they do not overall sample, implies that over all US trade, the relative price behavior of the developing world dominates the estimation, so in this respect China is like the rest of the developing world.

Table 7a Level of disaggregation	**Imports**				
	Matched Expenditure Non-China ROW	**Matched Expenditure China**	**Relative Price Non—China ROW**	**Relative Price China**	**Variety**
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 (SR)	-0.13
Panel of 4 categories of goods	0.99 **(SR) 1.32**(LR)	041& (SR) 6.51**(LR)	-0.19 (SR) -0.01 (LR)	0.32 (SR) 0.13(LR)	0.69**

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&--dummy for China countries is not significant.

Table 7b: Level of disaggregation	**Exports**				
	Matched Expenditure Non-China	**Matched Expenditure China**	**Relative Price non-China**	**Relative Price China**	**Variety**
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
Panel of 4 categories of goods	0.57 **(SR) 1.08 **(LR)	0.38&(SR) 1.2 & (LR)	-0.23 **(SR) -.09 (LR)	- 0.55**(SR) -0.71 (LR)	0.9**

Is the world different after 1997?

Based on a eye-ball examination of trade flows in earlier sections, not to mention the various financial effects of the year, 1997 may represent an important break-point in the dynamic relationship between trade, expenditure, and relative prices. After 1997, the US trade deficit trajectory steepens dramatically. Exports stagnate as non-US domestic demand falters with the Asian economies suffering from the fall-out from their financial crises and the industrial countries experiencing relatively slow growth. US imports increase, first due to the stock-market induced consumption and investment boom, and then robust housing equity and tax cuts further fuel consumption expenditure. 1997 also starts a rapid increase in the share of trade with China and other Asian countries, particularly in the capital goods category. But, does 1997 look like a

break-point from the standpoint of the estimation? Table 8a and 8b compare coefficients for the longer and shorter sample periods. In further work we will test for the stability of these coefficients over the two sample periods. Only first impressions are given here.

For exports, the expenditure elasticities for the shorter sample appear larger across all the categories in both the short and long run. Some of the differences appear to be large—for consumer goods and autos. For varieties, in contrast, the longer sample shows higher coefficients, particularly for the capital goods group and the whole-panel results. In fact, that variety is not significant for the whole panel in the shorter sample period is a surprise because the high-productivity performance of the US manufacturing sector is not just a post 1997 phenomenon.

For imports, the expenditure elasticities are in some cases larger in the longer sample particularly in the long-run estimation (capital goods, consumer goods in the LR but not SR, whole panel). Also in contrast with the export side, the variety coefficients are higher for the shorter sample period, which is consistent with the trajectory of China's increase in variety, the growth of which peaked in about 1997 (even as variety continued to increase, it decelerated).

Summarizing, the H-M asymmetry appears to be accentuated in the longer sample period compared with the shorter time period, which is consistent with the US economy increasingly driving global growth through strong domestic demand during the years when non-US domestic demand weakened. Varieties appear increasingly important in determining exports for the longer sample period; and they seem less important in determining imports for the shorter sample period for imports. This is consistent with US exporters moving up productivity and variety in an effort to maintain global market share particularly when global demand is weak and the dollar is strong. It may also be a consequence of increasingly sophisticated global buyers of capital goods with an increased taste for variety. Whereas on the import side, with China taking over more import categories from other countries, the number of varieties could be growing more slowly in the latter part of the sample period. Consumers may be becoming more jaded with regard to variety.

Table 8a	**Level of disaggregation**	**Exports**			
		Matched Expenditure 1980-1997	**Matched Expenditure 1980-2003**	**Variety-categories 1980-1997**	**Variety-categories 1980-2003**
Matched expenditure and matched prices Annual 1980-2003 ECM	Capital goods)	0.90 ** (SR) 1.01 **(LR)	0.79**(SR) 0.88 **(LR)	3.01 **	4.66**
	Consumer goods	1.50 ** (SR) 1.73 ** (LR)	0.713**(SR) 1.37**(LR)	-0.42	0.16
	Autos and parts	2.39 **(SR) 1.63**(LR)	1.03**(SR) 1.13**(LR)	.70	0.92
	ISM-ex (.	0.43** (SR) 1.06 ** (LR)	0.35**(SR) 0.94**(LR)	0.35	0.99
	Panel of 4 categories of goods (.	0.78 ** (SR) 1.34 ** (LR)	0.58**(SR) 1.09**(LR)	0.46 (surprise)	0.91**

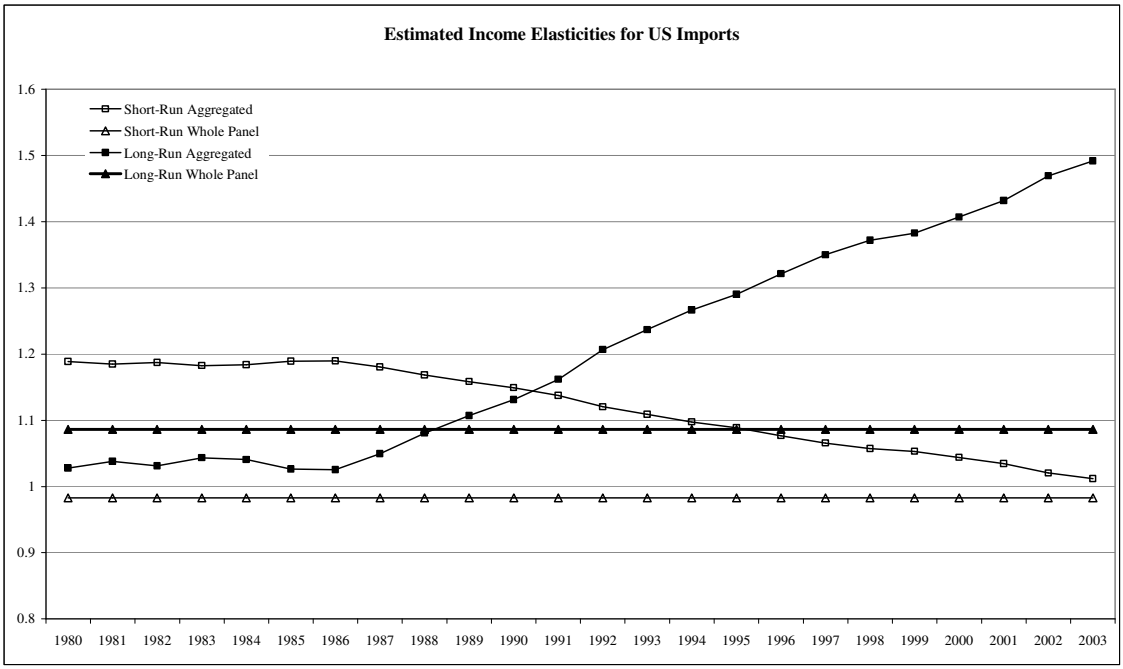
Table 8b	Level of disaggregation	Imports			
		Matched Expenditure 1980-1997	Matched Expenditure 1980-2003	Variety-categories 1980-1997	Variety-categories 1980-2003
Matched expenditure and matched prices Annual 1980-2003 ECM	Capital goods	0.45* (SR) 1.27 (LR)	0.48**(SR) 1.54**(LR)	1.96**	1.74**
	Consumer goods	5.09** (SR) 1.33# (LR)	3.73**(SR) 1.69**(LR)	0.05	-.21
	Autos and parts	9.33** (SR) 2.27 # (LR)	9.01**(SR) 2.21**(LR)	1.30 **	0.54
	ISM-ex	1.04** (SR) 1.30** (LR)	1.03**(SR) 0.64 (LR)	0.24#	0.52#
	Panel of 4 categories of goods	.963** (SR) 1.34** (LR)	1.00** (SR) 1.40** (LR)	0.93**	0.70**

Changing trade shares and trade elasticities

The results indicate that industrial and developing countries differ in their elasticities of income and relative price. The share of these two groups in trade have changed over time, in particular for imports. Hence, the assumption of a constant elasticity of US imports with respect to US expenditure may be rejected.

Chart 3a and b generates the elasticities for expenditure from the regression, which splits the panel into industrial and developing countries and then re-aggregates these elasticities with the time-varying weights of these two groups in trade. This yields a picture of sharply rising short-run expenditure elasticity of US imports, and a drifting down of long-run elasticity. Country shares of exports have changed less, hence there is little time-varying impact on the elasticity of US exports with respect to foreign expenditure over time.

Chart 3a and 3b



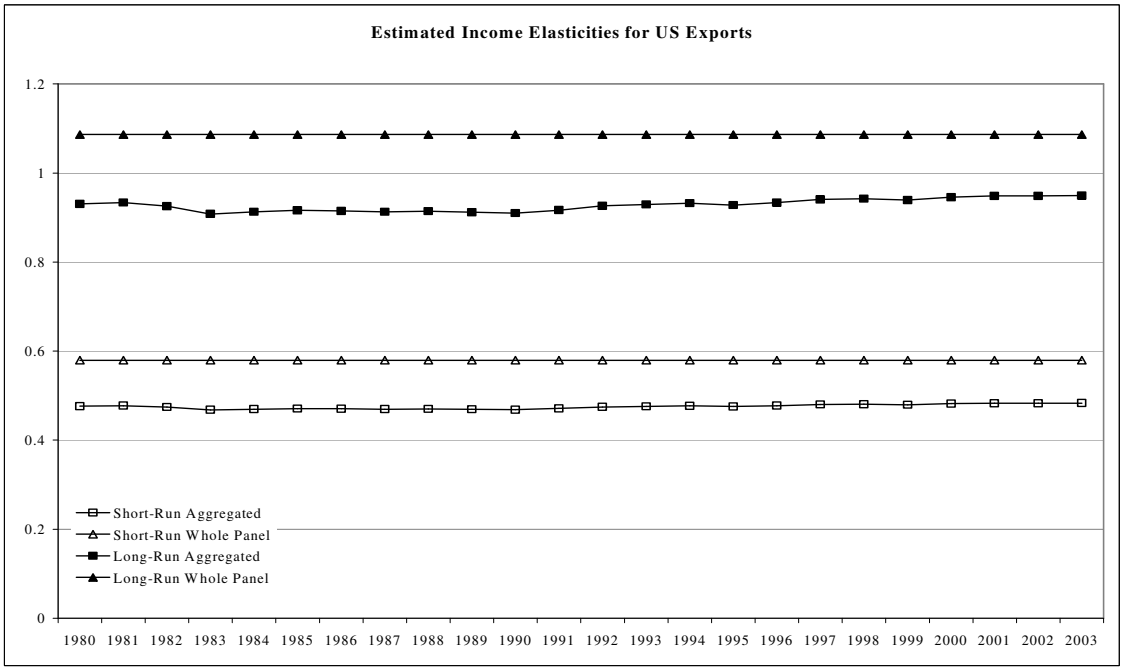


Chart 3b

7: Summary of findings, implications, and direction for further work.

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, variety, and round-trip trade. We examine four different categories of goods based on the Bureau of Economic Analysis' 'end-use' classification system—autos, industrial supplies and materials (excluding energy), consumer goods, and capital goods. We consider whether industrial and developing countries differ in their elasticities and whether China is different. We consider whether the years after 1997 are different from the whole sample 1980-2003.

Findings

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

2. The four categories behave differently from an aggregated panel. This confirms what other researchers find, that "more" manufactured the good, the higher the elasticity.

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

4. 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.

5. Variety is an important variable for some product groups, particularly capital goods. Constructing this variable using 6-digit level trade from the Harmonized System may bear additional fruit. In addition, round-trip trade may be important. Further analysis is necessary.

6. 1997 may initiate a break in the dynamic relationship between trade flows and expenditure, but further analysis is necessary.

7. The assumption of a constant elasticity of US imports with respect to US expenditure may be rejected because of trending difference in the share of industrial and developing countries in trade.

Do these new elasticities predict better?

Research on the H-M asymmetry has always had to address the tension between the theoretical plausibility of the estimated elasticities that are the asymmetry-- the fact that they violate any notion of LT global equilibrium—and the affirmed excellence of these simple equations to predict US exports and imports in the short and medium term. This tension is borne out with our analysis as well

On the import side, we obtain more plausible values for the trade elasticities, ones that are consistent with theoretical priors; but our predictions are poor compared to the benchmark model that uses US GDP as the measure of expenditure. On the other hand, for exports, our new

estimates do better at predicting exports than does the benchmark model that uses GDP as the measure of expenditure. So, we have made much progress on addressing what HM said in their original paper was the more difficult of the two elasticities—the export elasticity. But, we have a lot more work to do on the import side to find elasticities that meet theoretical norms and also predict well.

To investigate whether our approach using matched expenditure, matched relative prices, and variety is superior to the benchmark model that uses GDP and GDP deflators as denominators for relative prices, we take the estimates from the models run on data through 1997 and use these elasticities and the actual values for the right-hand-side (RHS) expenditure variables and variety variable to predict what imports and exports would be for the years 1998 to 2003. We compare the actual with the predicted values in each year (Tables 9a and 9b).

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For simplicity and a first cut, we ignore the actual data on value of relative prices on the RHS, since for the regressions aggregated over the whole sample of countries, relative prices often were not significant. Table 9a shows that the matched expenditure model is far superior for exports, where the benchmark model greatly over predicts exports. Incidentally, comparing the predictive performance of the two matched-expenditure models for imports (whole panel vs. sum of 4 panels--one over predicts, the other underpredicts) gives another indication of the extent to which the elasticities on the individual commodity expenditures vary across the product groups.

For a second examination of this question, we use the model of matched expenditure, with the industrial country dummies and variety, and compare that to the benchmark model for the two categories of imports and exports of greatest interest: consumer goods and capital goods. (Table 9b). The benchmark model (which uses US and foreign GDP does very well at predictions of consumer goods imports and exports from 1997-2003. For exports however, specifically consumer goods exports and for capital goods exports, the matched-expenditure model with industrial country dummies and variety is better using the metric of total error.

Table 9a: Prediction to 2003 based on coefficients estimated 1980-1997

Prediction less Actual Value (billions)	Matched Expenditure -Whole Panel		Matched Expenditure-Sum of 4 Panels		Benchmark Model (GDP as expenditure)	
	Imports	Exports	Imports	Exports	Imports	Exports
1998	-38.13	-12.78	13.40	-6.41	10.14	19.23
1999	-96.25	-25.22	24.55	-15.40	21.65	40.92
2000	-174.94	-44.00	28.74	-34.13	12.01	45.04
2001	-143.04	-22.16	124.52	-7.07	86.35	103.53
2002	-191.51	0.03	158.49	16.58	94.46	151.52
2003	-207.08	33.69	239.89	53.05	155.59	165.68
Total error	-850.95	-70.43	589.59	6.62	380.20	525.92

Table 9b: In-sample predictive performance									
Prediction less Actual Value (billions)		Benchmark Model (GDP as expenditure) consumer goods		Benchmark Model (GDP as expenditure) capital goods		Matched Expenditure-Consumer Goods		Matched Expenditure -Capital Goods)	
						with industrial country dummies			
		Imports	Exports	Imports	Exports	imports	exports	imports	exports
1998		0.56	2.48	-15.72	-0.49	18.94	0.98	-20.04	-11.95
1999		4.40	4.85	-28.89	3.18	46.65	-0.45	-41.85	-18.76
2000		-4.02	2.47	-61.46	-5.17	70.03	-6.69	-83.44	-29.04
2001		2.68	6.48	-35.80	17.76	107.75	-2.76	-73.49	-21.06
2002		-6.43	13.27	-31.36	45.40	134.34	0.83	-81.90	-1.37
2003		-5.43	10.54	-33.66	53.81	171.37	-6.24	-94.30	17.93
Total error		-8.24	40.08	-206.90	114.50	549.08	-14.33	-395.01	-64.24

Conclusions and further work

These new elasticities yield insights on the sources of the widening of the US trade deficit and have implications going forward for demand management—in particular, slack US exports appear importantly to be related to slack consumption and investment abroad, which has been masked by measures of GDP that incorporate net exports to the US. Factors beyond strong US consumer demand or love of variety are bolstering US imports of consumption.

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 on how certain exchange rate regimes, pricing-to-market behavior, or other factors more prevalent to developing country exporters mutes the price signal, which is consistent with recent work on disaggregate pass-through (Campa and Goldberg, and Matazzi et al, Federal Reserve (2005)).

The evidence from this analysis suggests that the matched-expenditure model for exports, disaggregated across commodity groups is worth continued investigation. Not only do the elasticities have more plausible values, but the equation performs better in-sample than the benchmark model. 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 capital goods requires additional work, perhaps with a better specification of the round-trip variable.

8: Appendix Material

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9: Appendix Charts in a separate file

Appendix Material

The US Trade Deficit: A Disaggregated Perspective

by

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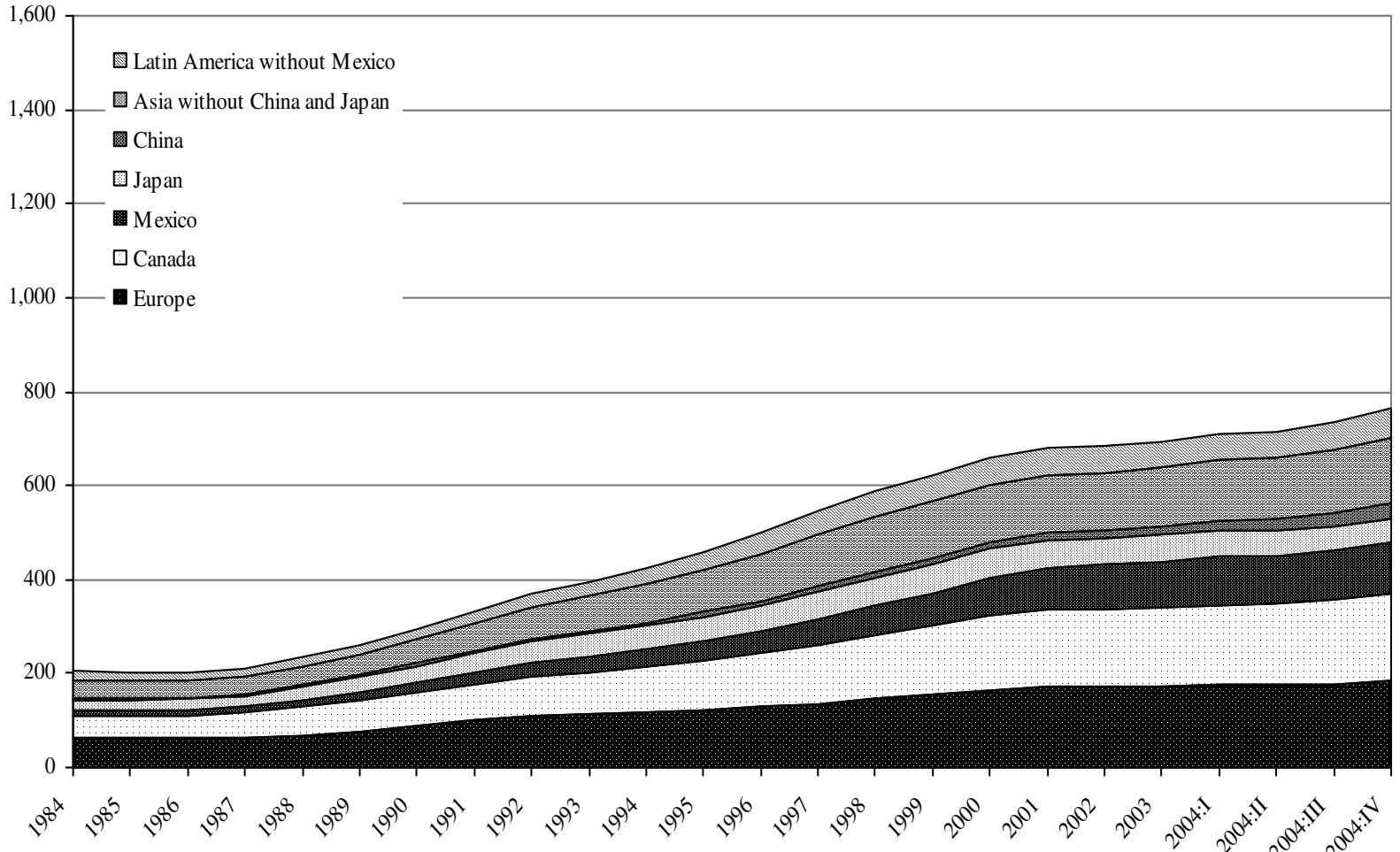
Prepared for the NBER Project
G-7 Current Accounts: Sustainability and Adjustment
Conference meeting May 31-June 2 Newport, Rhode Island

Table A1: Definition of proxy-end-use commodity groups (constructed using SITC-Rev.2)

Autos	Capital Goods	Consumer Goods	Industrial Supplies and Materials
7810-7849, 7861, 7869: road vehicles and parts excepts 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.

Chart A1.1: Country/Area Shares for US Exports

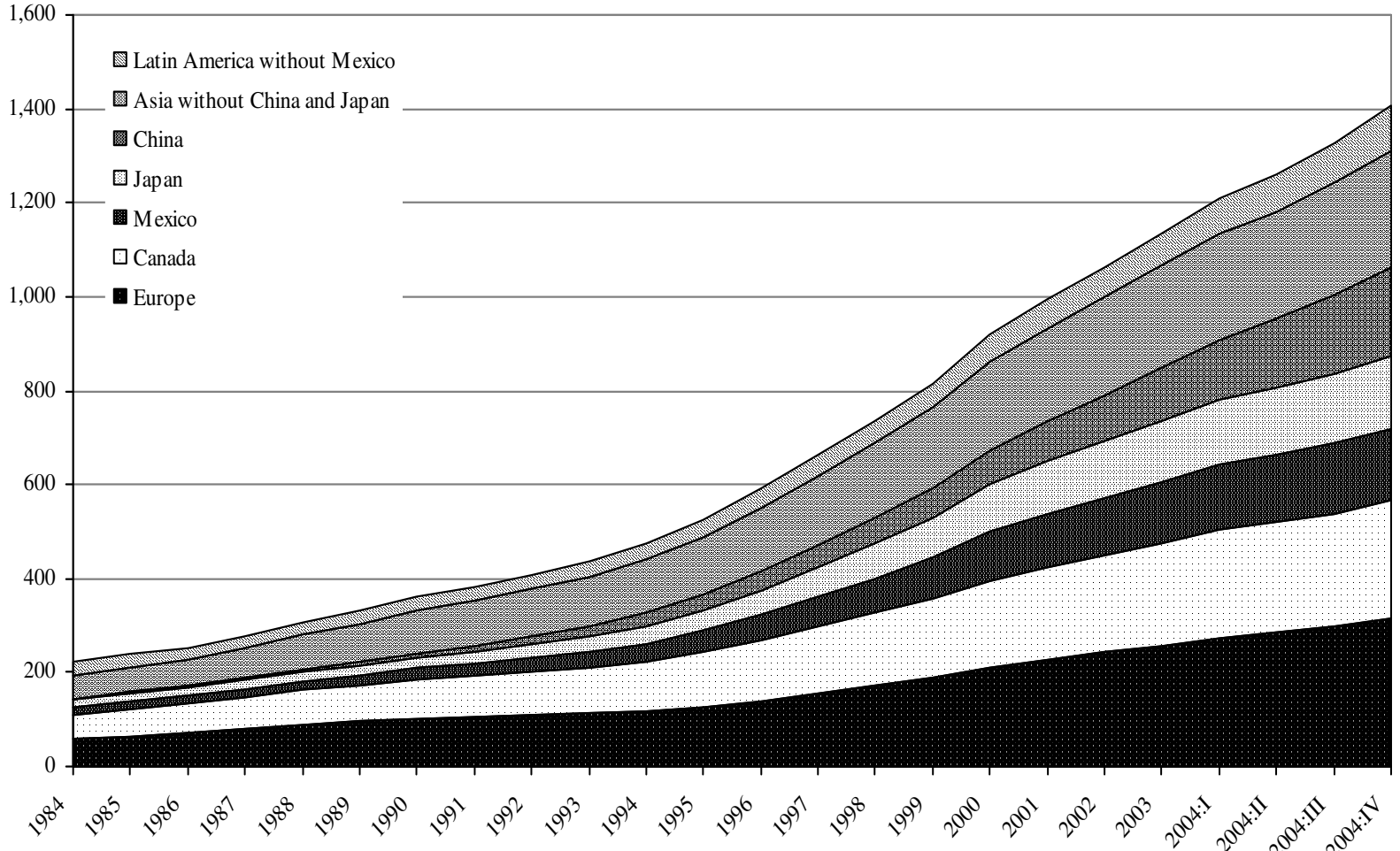
(5-year moving average; $billions; not shown: Africa, International Organizations, and Australia)



Source: Bureau of Economic Analysis.

Chart A1.2: Country/Area Shares for US Imports

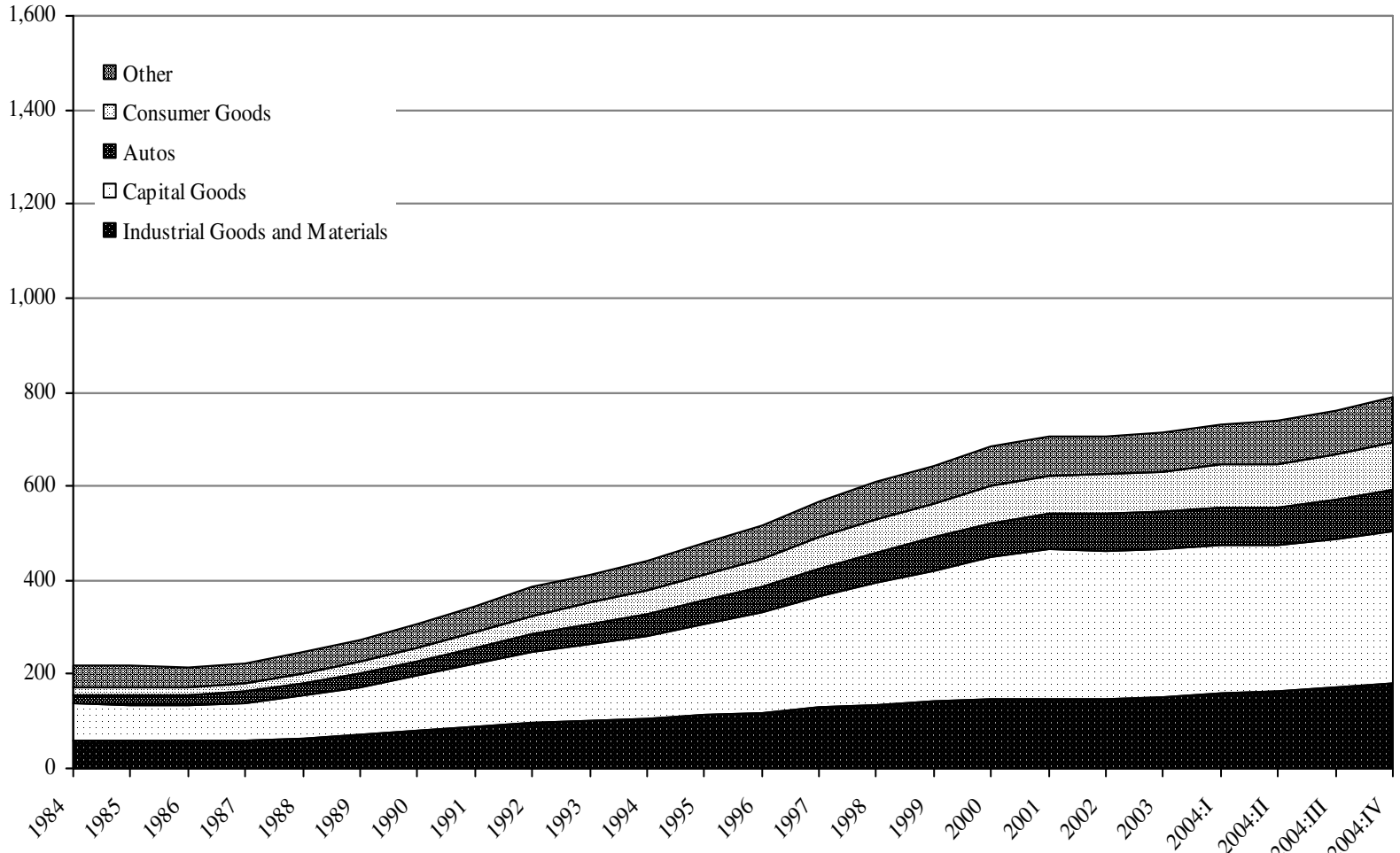
(5-year moving average; $billions; not shown Africa, International Organizations, and Australia)



Source: Bureau of Economic Analysis.

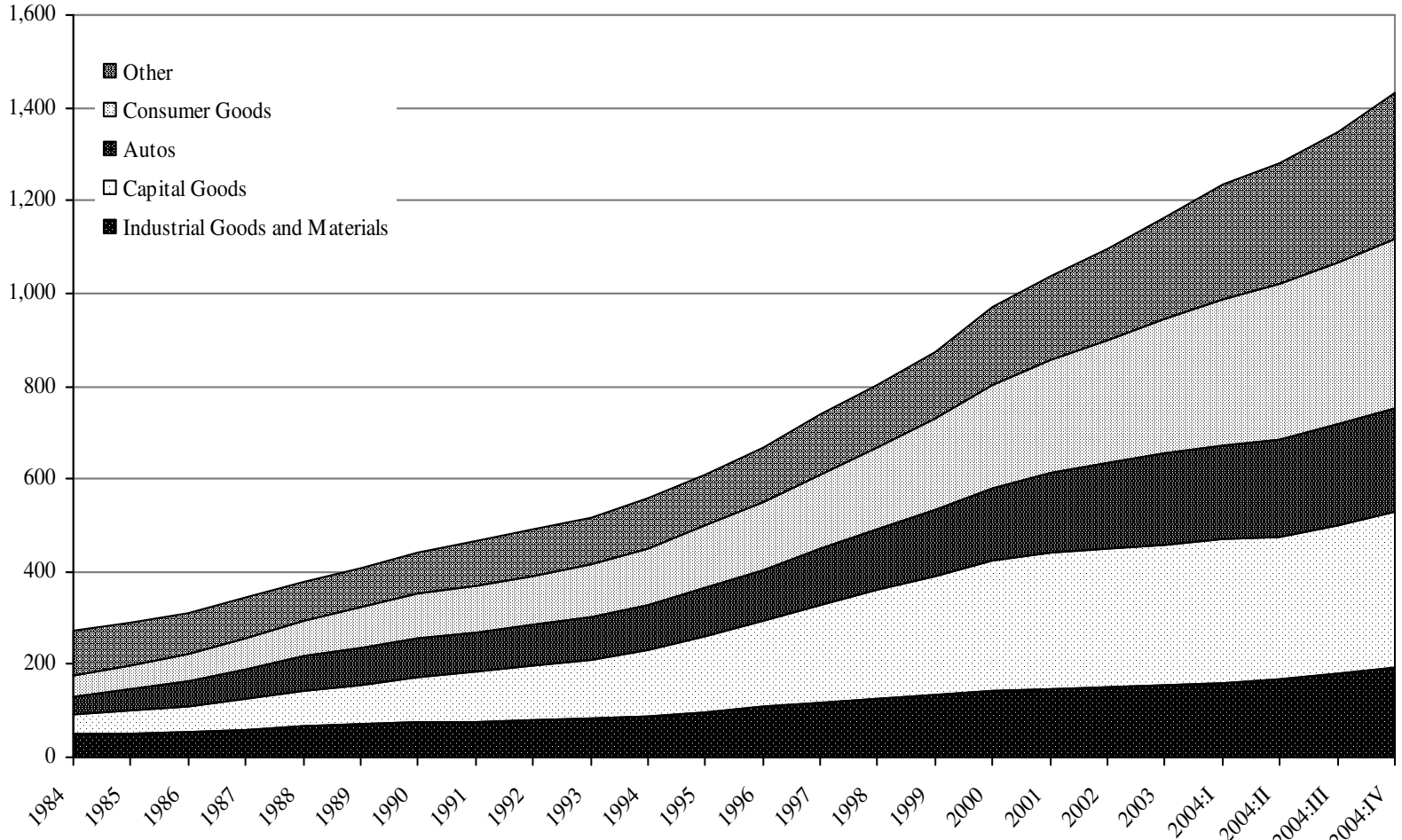
Chart A2.1: Commodity Shares of US Exports

(5-year moving average; $billions; missing: Africa, International Organizations, and Australia)



Source: Bureau of Economic Analysis.

Chart A2.2: Commodity Shares of US Imports (5-year moving average; $billions; missing: Africa, International Organizations, and Australia)



Source: Bureau of Economic Analysis.

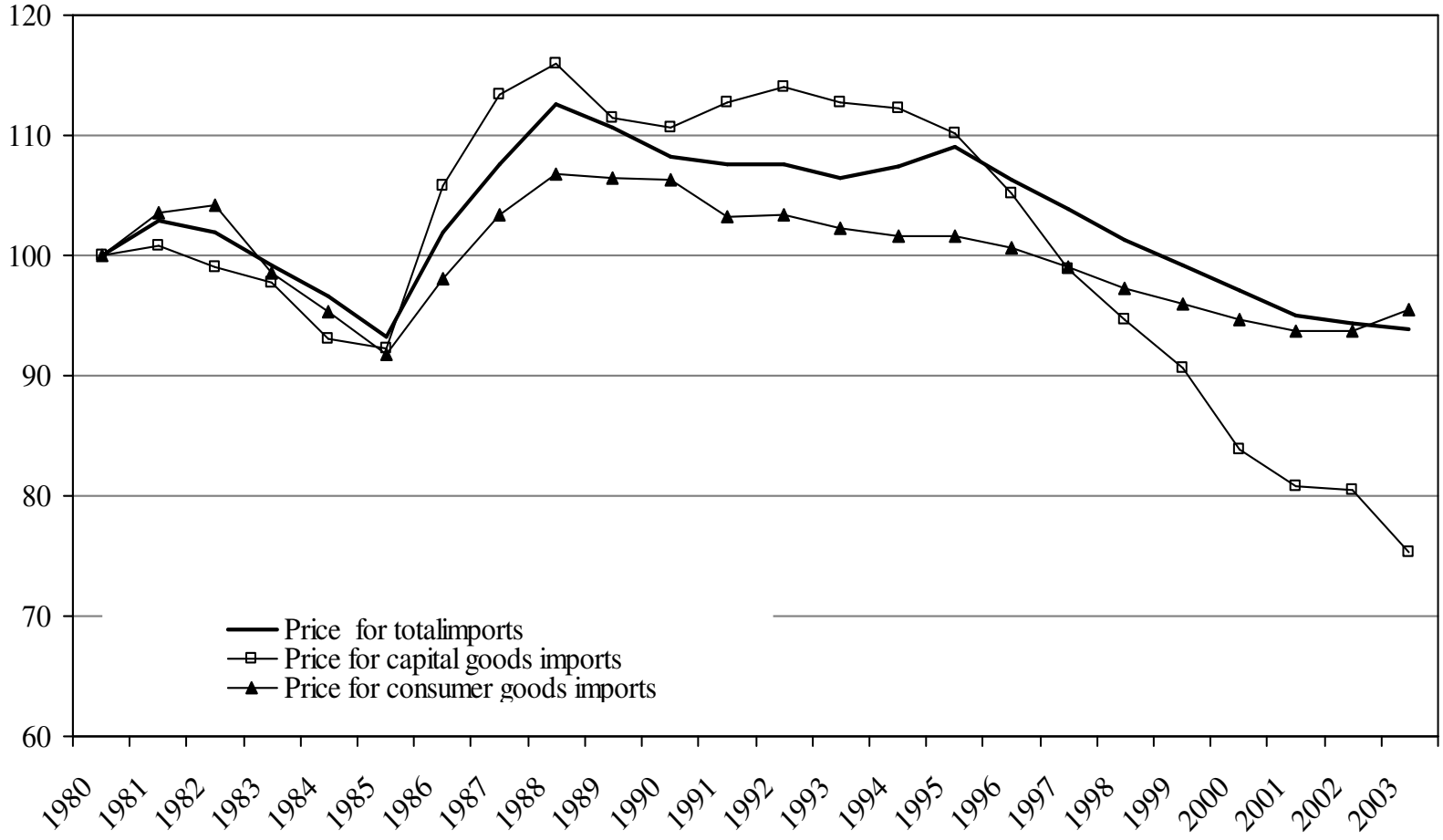
Chart A3.1: Relative US Export Prices,

Index 1980 = 100

Source: Bureau of Labor Statistics; trade weights
from UN COMTRADE

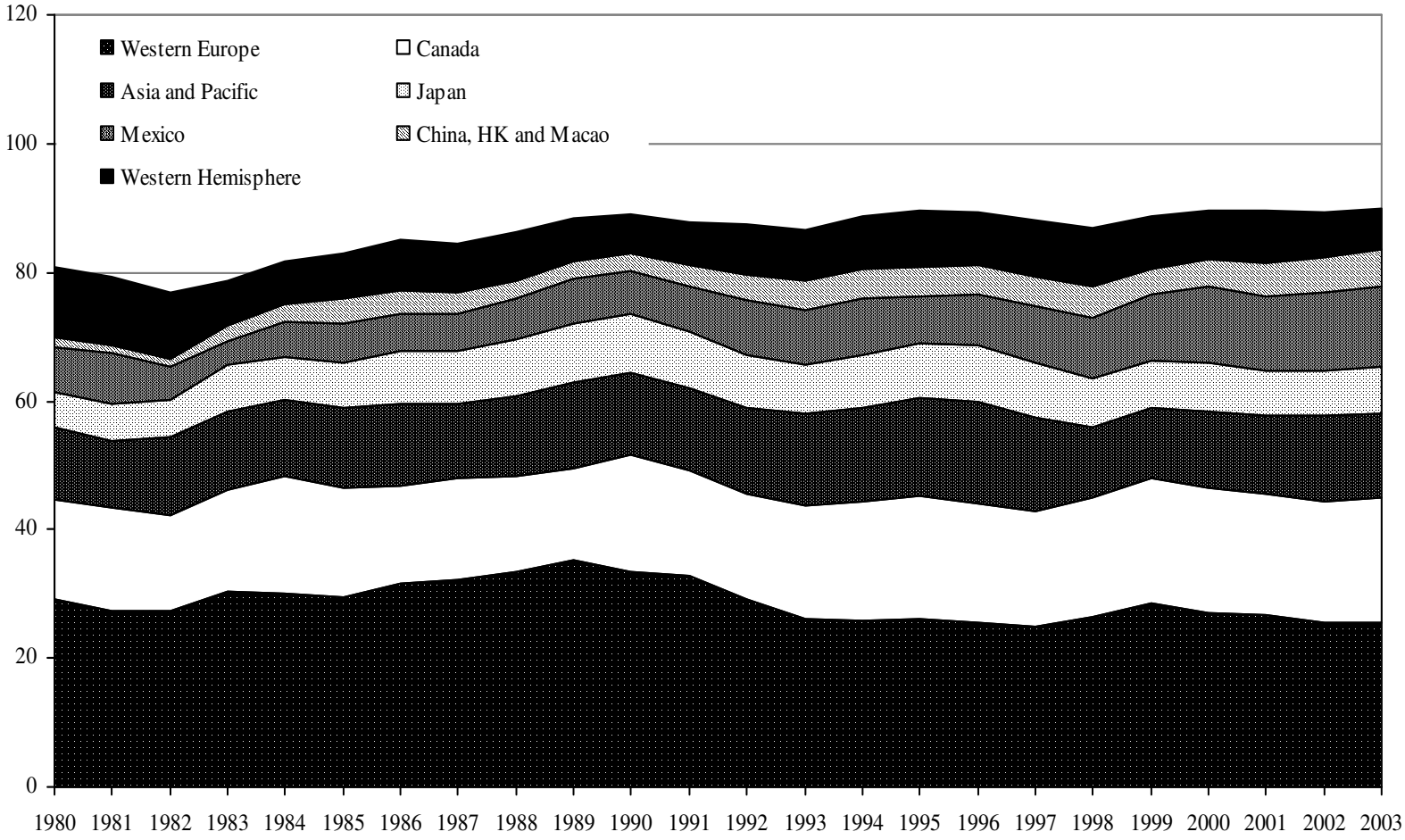
Chart A3.2: Relative US Import Prices,

Index 1980 = 100



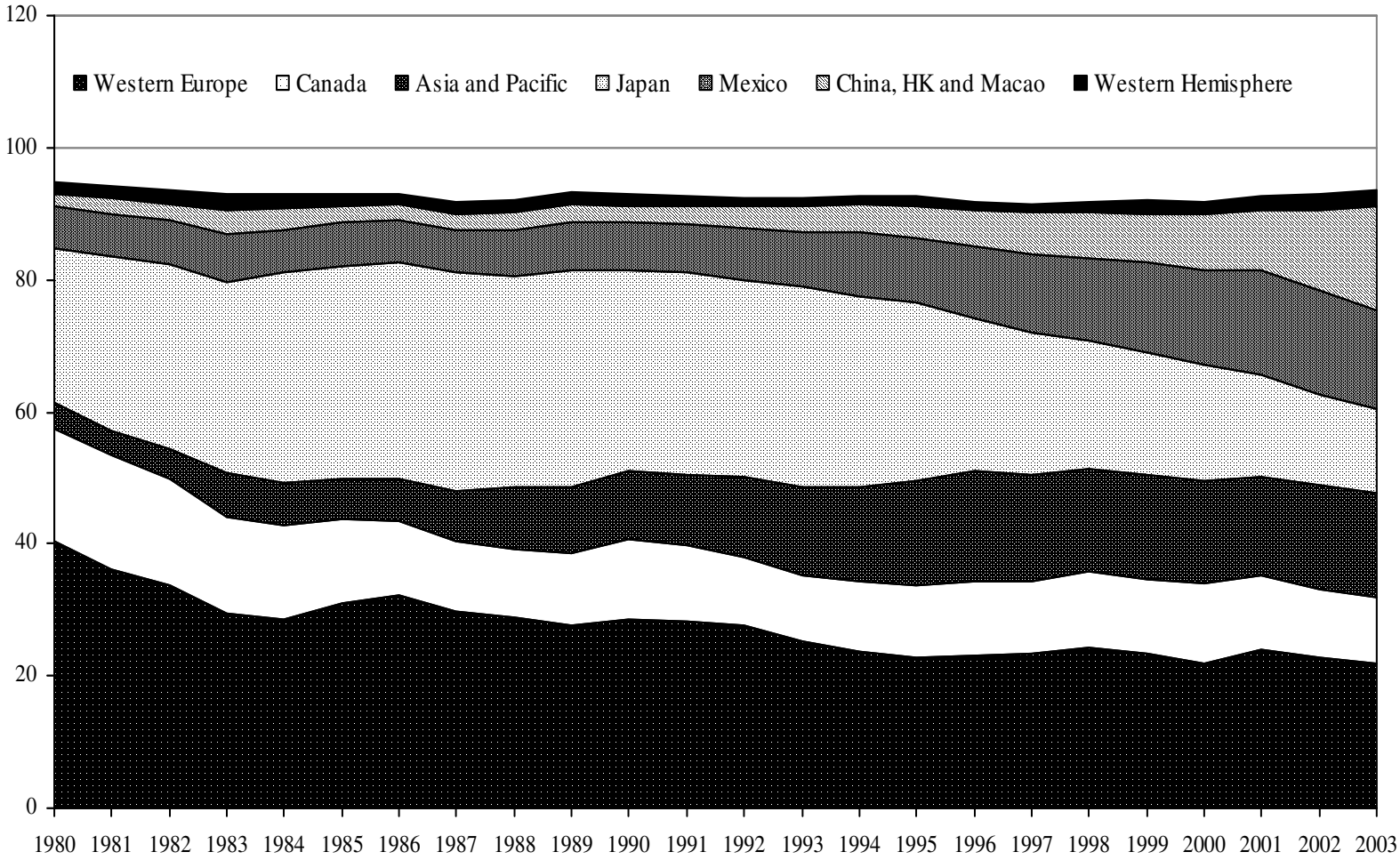
Source: Bureau of Labor Statistics; trade weights
from UN COMTRADE

Chart A4.1: Country/Area Shares for US Capital Goods Exports (5-year moving average; $billions; missing: Africa, Middle East, Eastern Europe, USSR/Former SU)



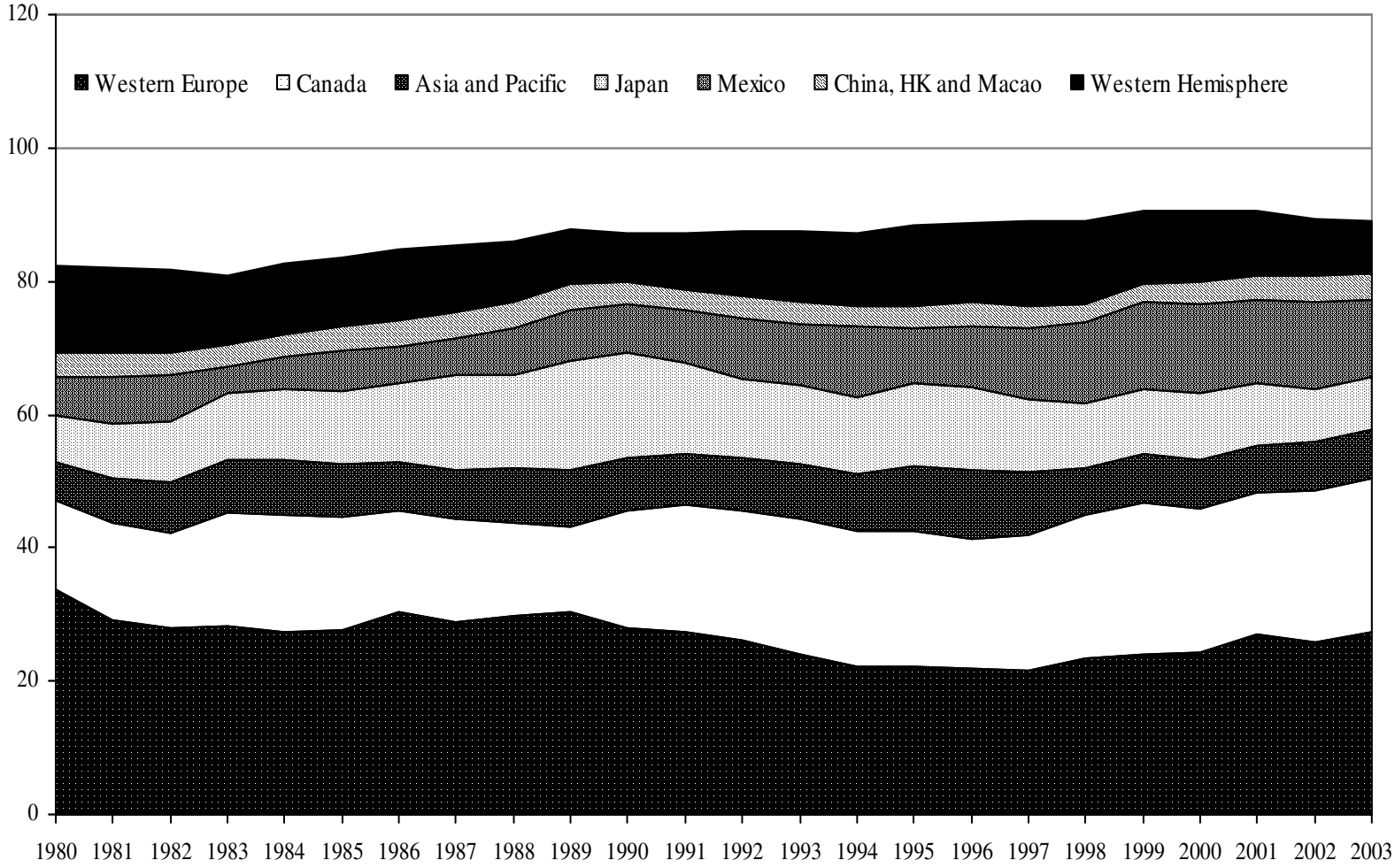
Source: UN COMTRADE.

Chart A4.2: Country/Area Shares for US Capital Goods Imports (5-year moving average; $billions; missing: Africa, Middle East, Eastern Europe, USSR/Former SU)



Source: UN COMTRADE.

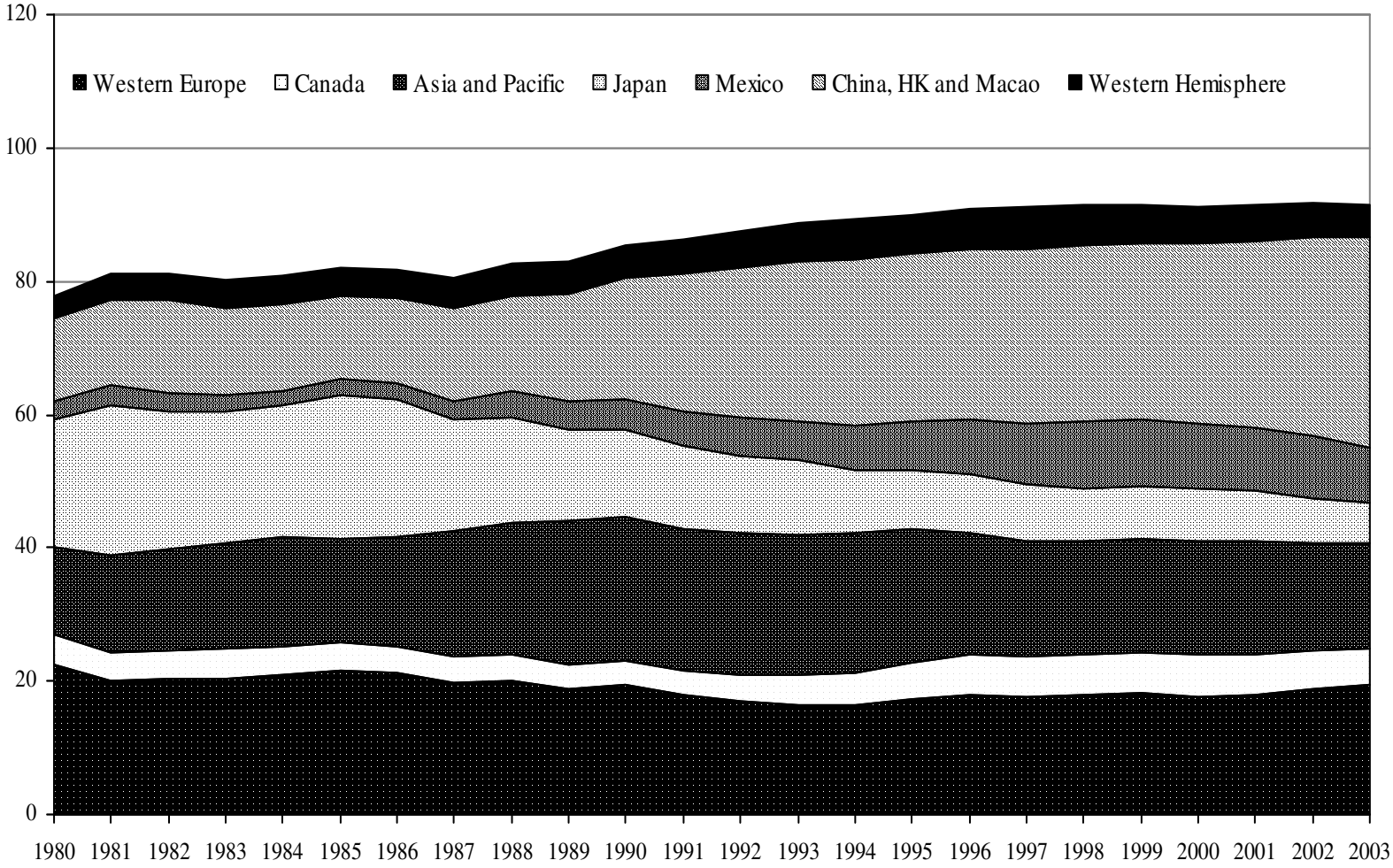
Chart A4.3: Country/Area Shares for US Consumer Goods Exports (5-year moving average; $billions; missing: Africa, Middle East, Eastern Europe, USSR/Former SU)



Source: UN COMTRADE.

Chart A4.4: Country/Area Shares for US Consumer Goods Imports

(5-year moving average; $billions; missing: Africa, Middle East, Eastern Europe, USSR/Former SU)



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