Still Doomed to Deficits:
An Update on US Trade Elasticities

by

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Abstract

This paper updates the examination of aggregate and disaggregate import and export demand functions for the United States reported in Chinn (forthcoming), extending the sample up to the 1975q1-2004q4 period. Using the Johansen maximum likelihood approach, an export demand function is readily identified. Cointegrating relationships are identified for all aggregates, although the import price elasticities are quite low for aggregate imports. The resulting point estimates also confirm the persistence of the income asymmetry first noted by Houthakker and Magee (1969), although in a slightly diminished form. In addition, non-oil, non-computer imports are found to be much more sensitive to exchange rate changes than aggregate imports. Nonetheless, the price elasticities are still quite low relative to other estimates. Moreover, approximately one-sixth of US imports are apparently insensitive to exchange rate variations. One policy implication of these findings is that dollar depreciation -- unaccompanied by a realignment of growth trends -- is insufficient to substantially reduce the US trade deficit.

Keywords: imports, exports, elasticities, competitiveness, unit labor costs.

JEL Classification: F31, F41

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1. Introduction

This note updates the results in Chinn (forthcoming), examining the relationship between U.S. aggregate trade flows, real exchange rates and incomes. The update is motivated by the large movements in the price of oil, which have strongly influenced the U.S. trade deficit (illustrated in Figure 1) in recent months.

The analysis relies upon the Johansen procedure, which is used to determine whether cointegrating relations exist, and how trade flows respond to deviations in long run relationships. Special attention is focused on how the results differ depending upon the exact measure of the exchange rate used and the composition of the trade variable examined. Four measures are examined – two consumer price index (CPI) based indices, a producer price based index (PPI) and a unit labor cost (ULC) based index – as each one exhibits somewhat different behavior.

In contrast to earlier findings, in all cases a statistically significant relationship between trade flows, U.S. income and the real exchange rate is identified. However, for U.S. imports, the price elasticity is fairly low.

2. Empirical Specification

The import and export equations are written (assuming log-linear functional forms):

$$im_t = \beta_0 + \beta_1 q_t + \beta_2 y_t^{US} + \varepsilon_{2t} \qquad (1)$$

$$ex_t = \delta_0 + \delta_1 q_t + \delta_2 y_t^{RoW} + \varepsilon_{1t} \qquad (2)$$

where $\delta_1 > 0$ and $\delta_2 > 0$ and $\beta_1 < 0$ and $\beta_2 > 0$.

One can interpret equations (1) and (1) as semi-reduced form equations. It is important to differentiate this expression from other import and export specifications that relate the trade flow to a trade price. In those cases, one is conditioning up the exchange rate change being passed through into prices. Here, the exchange rate pass through and the price effect on trade flow are collapsed into one composite parameter. To the extent that one takes the real exchange rate as "more exogenous" than the relative price of imports, this approach makes more sense when the economic question at hand is "what is the response of imports to a one percent change in the real exchange rate?"

3. Data and Estimation

3.1 Data

For measures of trade flows, data on real imports and exports of goods and services (2000 chain weighted dollars) were used. Domestic economic activity was measured by U.S. GDP in 2000 chain weighted dollars. Foreign economic activity was measured by real Rest-of-World GDP, weighted by U.S. exports to major trading partners.

Four different dollar indices were utilized. The first two are the Federal Reserve Board's broad and major currencies trade weighted value of the dollar. This index uses the CPI as the deflator. The second is the J.P. Morgan broad trade-weighted index, deflated using the PPI. The third is the IMF's trade-weighted index deflated using unit labor costs. All four series are shown in Figure 3 (in logs, rescaled to equal 0 in 1987q1, and displayed so that higher values indicate a stronger dollar).[1] Additional details on all these variables are contained in the Appendix 1.

[1] The various exchange rate indices also differ in terms of their construction. The Fed index uses time varying trade weights, while the J.P. Morgan index uses fixed trade weights, with one discrete change in the weights.The IMF series uses fixed trade weights,

The first three indices approximate measures of "price competitiveness". Of these, the CPI-deflated measure is probably the least desirable on a priori grounds since it incorporates the prices of many non-traded goods that are unlikely to be relevant to flows of traded goods (although they might be indicative of costs of services).

The fourth measure merits some more detailed discussion. The unit labor cost deflated measure is best thought of as an empirical proxy for "cost competitiveness". It is an imperfect measure, at best, measuring labor costs, rather than total costs. To see how this variable is related to the PPI based index, consider a markup model of pricing:

$$p_t^T = \log\left[(1+\mu)\left(\frac{W_t}{A_t}\right)\right] \qquad (3)$$

where p^T is the log nominal price of tradable goods, μ is percentage markup, W is the nominal wage rate, A is labor productivity per hour. W/A is therefore unit labor cost. Re-expressing the real exchange rate yields the following formula for the real exchange rate as a function of unit labor costs.

$$q_t^{ULC} = e_t - (w_t^{US} - a_t^{US}) + (w_t^{RoW} - a_t^{RoW}) \qquad (4)$$

(holding markups constant). In this case, the real exchange rate is the nominal rate adjusted by wages and productivity levels. As productivity levels rise, the real dollar cost

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although in using a spliced series in this analysis, a change in trade weights is artificially introduced. Both the Fed and IMF series account for third market effects using the Armington assumption. See Chinn (2004b) for a detailed discussion of the characteristics of these indices.

of production falls, while rising wages cause an appreciated real dollar. This definition of the real exchange rate also fits in with a Ricardian model of trade (Golub, 1994).

3.2 Estimation

Estimation is implemented on data spanning a period of 1975q1-2004q4. This period spans three episodes of dollar appreciation and three episodes of dollar depreciation. Since the optimal lag length was identified as 2 in Chinn (forthcoming), estimation is implemented imposing a uniform lag length. The vector error correction model (VECM) is estimated using the Johansen maximum likelihood technique.

For the import system, the procedure estimates the following vector error correction model: [2]

$$\begin{aligned}
\Delta im_t^{US} &= \gamma_{10} + \varphi_1 (im_{t-1}^{US} - \beta_1 q_{t-1} - \beta_2 y_{t-1}^{US}) + \gamma_{11} \Delta im_{t-1}^{US} + \gamma_{12} \Delta q_{t-1} + \gamma_{13} \Delta y_{t-1}^{US} + \varepsilon_{1t} \\
\Delta q_t &= \gamma_{20} + \varphi_2 (im_{t-1}^{US} - \beta_1 q_{t-1} - \beta_2 y_{t-1}^{US}) + \gamma_{21} \Delta im_{t-1}^{US} + \gamma_{22} \Delta q_{t-1} + \gamma_{23} \Delta y_{t-1}^{US} + \varepsilon_{2t} \qquad (5) \\
\Delta y_t^{US} &= \gamma_{30} + \varphi_3 (im_{t-1}^{US} - \beta_1 q_{t-1} - \beta_2 y_{t-1}^{US}) + \gamma_{31} \Delta im_{t-1}^{US} + \gamma_{32} \Delta q_{t-1} + \gamma_{33} \Delta y_{t-1}^{US} + \varepsilon_{3t}
\end{aligned}$$

For exports, the system estimated is:

$$\begin{aligned}
\Delta ex_t^{US} &= \gamma_{40} + \varphi_4 (ex_{t-1}^{US} - \delta_1 q_{t-1} - \delta_2 y_{t-1}^{RoW}) + \gamma_{41} \Delta ex_{t-1}^{US} + \gamma_{42} \Delta q_{t-1} + \gamma_{43} \Delta y_{t-1}^{RoW} + \varepsilon_{4t} \\
\Delta q_t &= \gamma_{50} + \varphi_5 (ex_{t-1}^{US} - \delta_1 q_{t-1} - {}_2\, y_{t-1}^{RoW}) + \gamma_{51} \Delta ex_{t-1}^{US} + \gamma_{52} \Delta q_{t-1} + \gamma_{53} \Delta y_{t-1}^{RoW} + \varepsilon_{5t} \qquad (6) \\
\Delta y_t^{RoW} &= \gamma_{60} + \varphi_6 (ex_{t-1}^{US} - \delta_1 q_{t-1} - \delta_2 y_{t-1}^{RoW}) + \gamma_{61} \Delta ex_{t-1}^{US} + \gamma_{62} \Delta q_{t-1} + \gamma_{63} \Delta y_{t-1}^{RoW} + \varepsilon_{6t}
\end{aligned}$$

[2] For expositional simplicity, I have assumed only one cointegrating relationship per system; in fact neither theory nor econometric technique requires this condition.

3.3 Empirical Results

The long run elasticities are reported in Table 1. The price elasticities are in Panel A while income elasticities are in Panel B. For exports, the price elasticities range from 0.68 to 0.84. For imports, the results are much more variable, depending upon the trade aggregate that is examined. In fact, for total goods and services, the price elasticity is low – between 0.11 and 0.27 – and not statistically significant. Chinn (forthcoming) appeals to arguments by Meade (1991) and Lawrence (1990) that computer imports are difficult to account for. Excluding computers yields slightly higher elasticities, but still not statistically significant.[3]

There is good reason to consider an aggregate excluding petroleum. The trade equations in (1) and (2) are derived from an imperfect substitutes model, well suited to manufactured goods. However, oil is a natural resource commodity that does not quickly respond to market signals, and exhibits trends due to resource depletion. When excluding oil and computers from the import aggregate, one then obtains a statistically significant price elasticity, ranging between 0.29 to 0.49. The highest elasticity comes from a specification using a PPI deflated exchange rate.

It is perhaps unsurprising that neither computer imports nor petroleum imports can be modeled in a manner that suggests any sensitivity to exchange rate movements. After all, oil is denominated in dollars. And the price of imports of computers, parts, and peripherals appears dominated by movement

[3] The contrast with the results in Chinn (forthcoming) is of note. The failure to find a statistically significant price elasticity is probably driven by the surge in oil imports and oil prices in the period since 2001q2 (the end of the sample in the previous study).

One implication of the exchange rate coefficient estimates is that the Marshall-Lerner condition only barely holds even in the long run; the sum of the (absolute value of the) point estimates extends from just under unity to as high as 1.33.

It is somewhat surprising to find that imports, regardless of definition, do not respond strongly to relative unit labor costs. One possible reason for the weakness of the link is that this measure incorporates trading patterns and productivity trends of other industrial countries (Zanello and Desruelle, 1997), and import sources are oriented slightly more towards LDCs than are export destinations.[4]

The results are also relevant for the Houthakker-Magee (1969) findings. On the income side, exports respond between 1.7 to 2.0 percent for each one percentage point increase in rest-of-world income. In contrast, aggregate imports rise about 2.4 percentage points for each percentage point increase in US GDP. While the income elasticity drops a bit for the no-computers aggregate, the imports ex oil ex computers still exhibits a disturbingly high elasticity of 2.3 to 2.5. This set of findings suggests that the Houthakker-Magee income asymmetry persists.

5. Summary

Basic stylized facts identified in Chinn (forthcoming) remain largely unchanged when extending the data by three and a half years.

- Export price elasticities are estimated to be in a tight range of 0.7 and 0.8.
- Import price elasticities are more dispersed, but are typically low.
- Export income elasticities exceed import elasticities.

[4] Furthermore, unit labor costs are probably subject to greater measurement errors, as they are quite difficult to measure.

One new finding is for non-oil, non-computer imports of goods and services. The price elasticity for this aggregate is as high as 0.49. That implies that from a position of balanced non-oil, non-computer trade, a depreciation induces an improvement, in the long term.

Since neither oil nor petroleum imports – which account for about 15% of 2004 nominal imports – respond to exchange rates, this implies that the response of the total trade balance will be less pronounced than for the non-oil non-computer trade balance.

In sum, in the absence of realignment of income trends in the US relative to abroad, it would be unlikely for the dollar depreciation that has thus far occurred to effect to reduce the US trade deficit to something like 2 percentage points of GDP, let alone to balance.

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Table 1

Johansen Cointegration Results
1975q1-2004q4

Panel A: Price Elasticities				
	Exports - goods and svcs	Imports - goods & svcs	Imports - goods & svcs, no computers	Imports - goods & svcs, no oil, no computers
Fed (broad)	**0.836**	-0.107	-0.177	**-0.428**
Fed (major)	**0.824**	-0.268	-0.241	**-0.336**
JP Morgan (PPI broad)	**0.791**	-0.110	-0.177	**-0.491**
IMF (unit labor cost)	**0.679**	-0.120	-0.174	**-0.293**

Panel B: Income Elasticities				
	Exports - goods and svcs	Imports - goods & svcs	Imports - goods & svcs, no computers	Imports - goods & svcs, no oil, no computers
Fed (broad)	**1.990**	**2.372**	**2.131**	**2.343**
Fed (major)	**1.971**	**2.308**	**2.134**	**2.376**
JP Morgan (PPI broad)	**2.041**	**2.381**	**2.136**	**2.317**
IMF (unit labor cost)	**1.711**	**2.413**	**2.195**	**2.477**

Bold Face indicates significance using 10% MSL using asymptotic standard errors

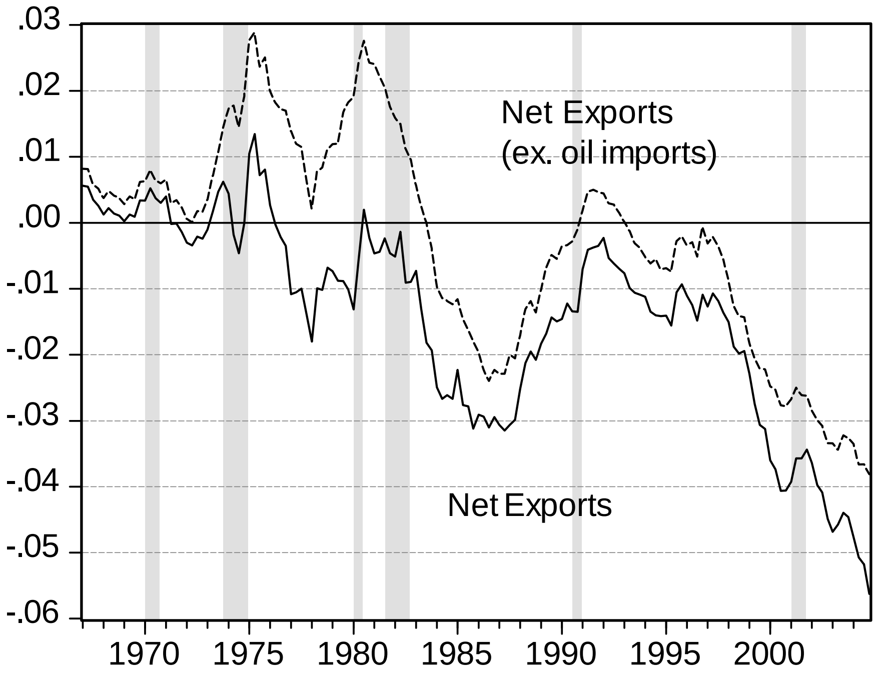

Figure 1: Nominal U.S. Net Exports and Net Exports ex. Oil Imports to GDP ratio, SAAR. Source: BEA and NBER.

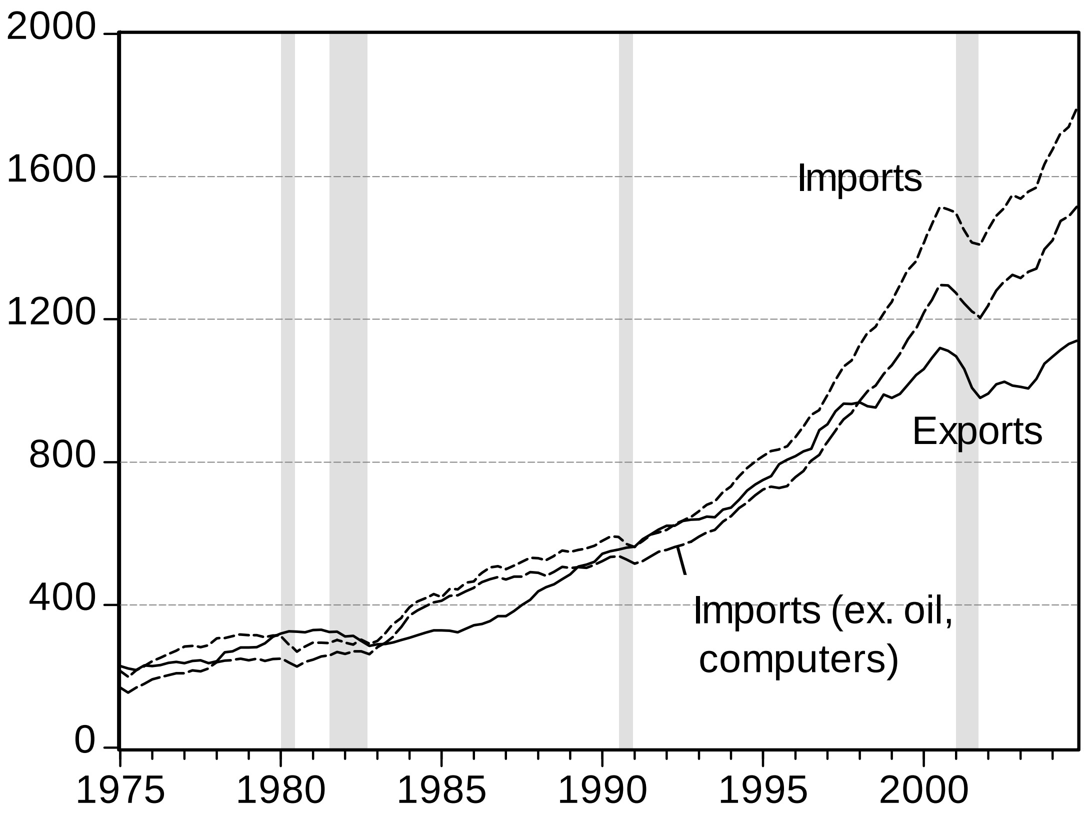

Figure 2: Exports and Imports of Goods and Services, in billions of chained 2000 dollars, SAAR. Source: BEA and NBER.

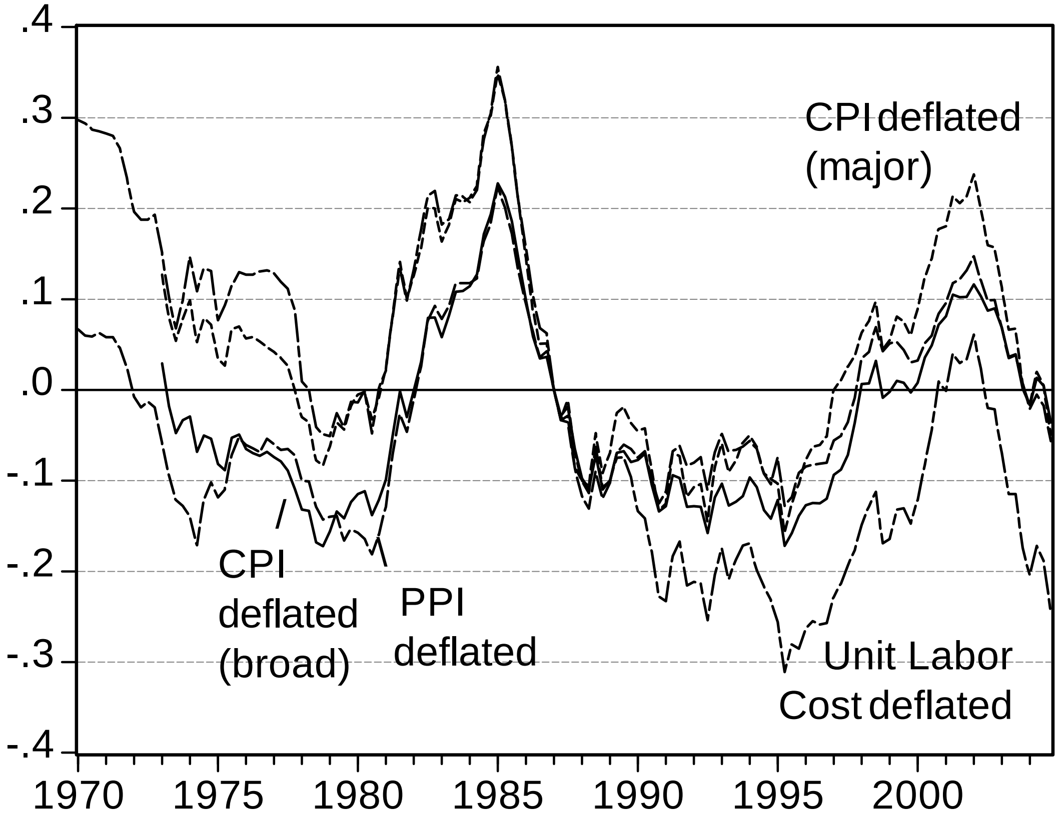

Figure 3: Indices of the U.S. Dollar effective exchange rate, in logs rescaled to 1987q1=0. Source: Federal Reserve Board, J.P. Morgan and IMF.

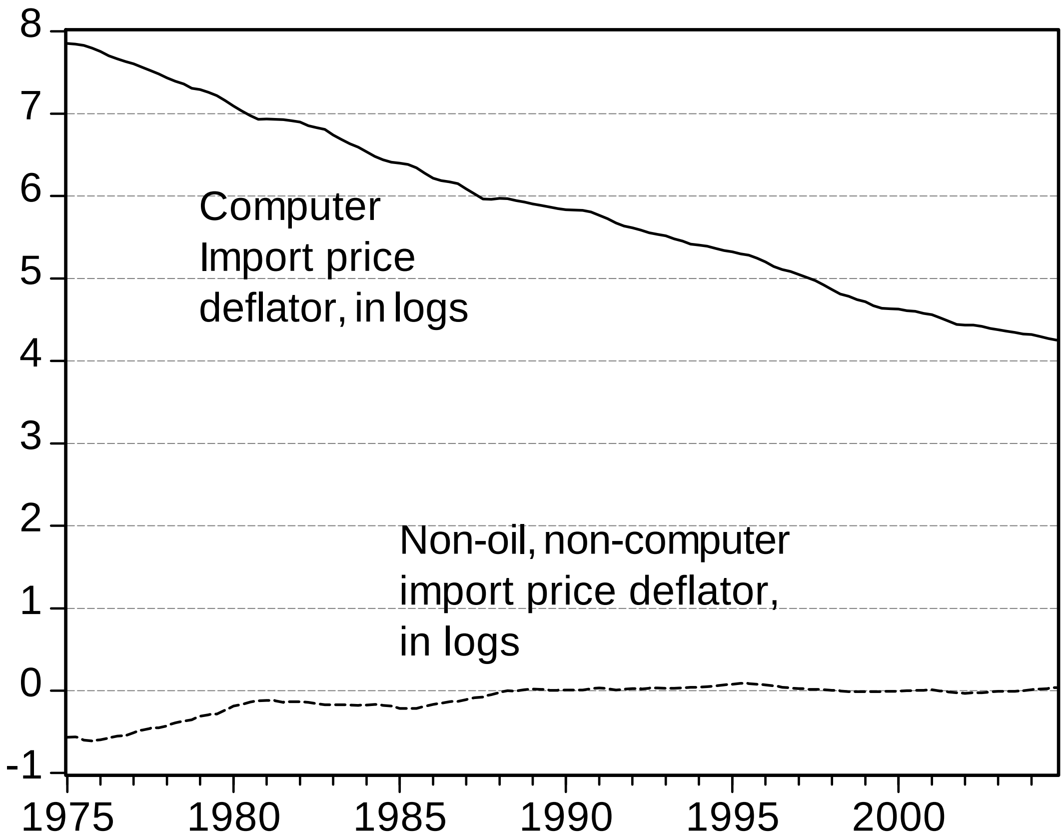

Figure 4: Price indices for computer imports and for non-oil, non-computer imports. Source: BEA and author's calculations.

Appendix 1: Data Sources and Description

Exchange Rate Indices

- US "Major currencies" and "broad" trade weighted exchange rate (CPI deflated). Source: Federal Reserve Board website, http://www.federalreserve.gov/releases/h10/Summary/indexnc_m.txt . Weights are listed at http://www.federalreserve.gov/releases/h10/Weights/ . Data accessed April 2005. See Leahy (1998) for details.
- JP Morgan, accessed February 2005. "Broad" trade-weighted real exchange rates (PPI-deflated). 1990=100, 1990 trade weights for 1987-2001; 1980 trade weights for 1970-86 (weights exclude China). Hong Kong series adjusted by Hong Kong retail price index. Source: J.P. Morgan, http://www.jpmorgan.com. For a description, see Hargreaves and Strong (2003).
- Trade-weighted real exchange rates (unit labor cost-deflated). 1990=100, 1988-1990 trade weights, series *reu*. Series spliced to previous *MERM* series (1985=100), accessed in 1994. Unit labor costs are filtered using the HP filter. See Zanello and Desruelle (1997) for details.

Trade Flows, Economic Activity

- Real and nominal imports and exports of goods and services, and gross domestic product (2000 chain weighted dollars). Source: BEA.
- Non computer imports, calculated using Tornqvist approximation. See Whelan (2000) for an explanation of the procedure.
- Rest-of-World GDP (2000 dollars). U.S. exports weighted rest-of-world GDP. Updated over 2004q4-2004q4 period using growth rates for countries accounting for 77% of total exports.