Title
Incomes, Exchange Rates and the U.S. Trade Deficit, Once Again

Author
Chinn, Menzie

Publication Date
2002-12-22

Incomes, Exchange Rates and the U.S. Trade Deficit, Once Again

Menzie D. Chinn

University of California, Santa Cruz
and National Bureau of Economic Research

Center for Global, International and Regional Studies
Working Paper 2002-4

This version: December 14, 2002

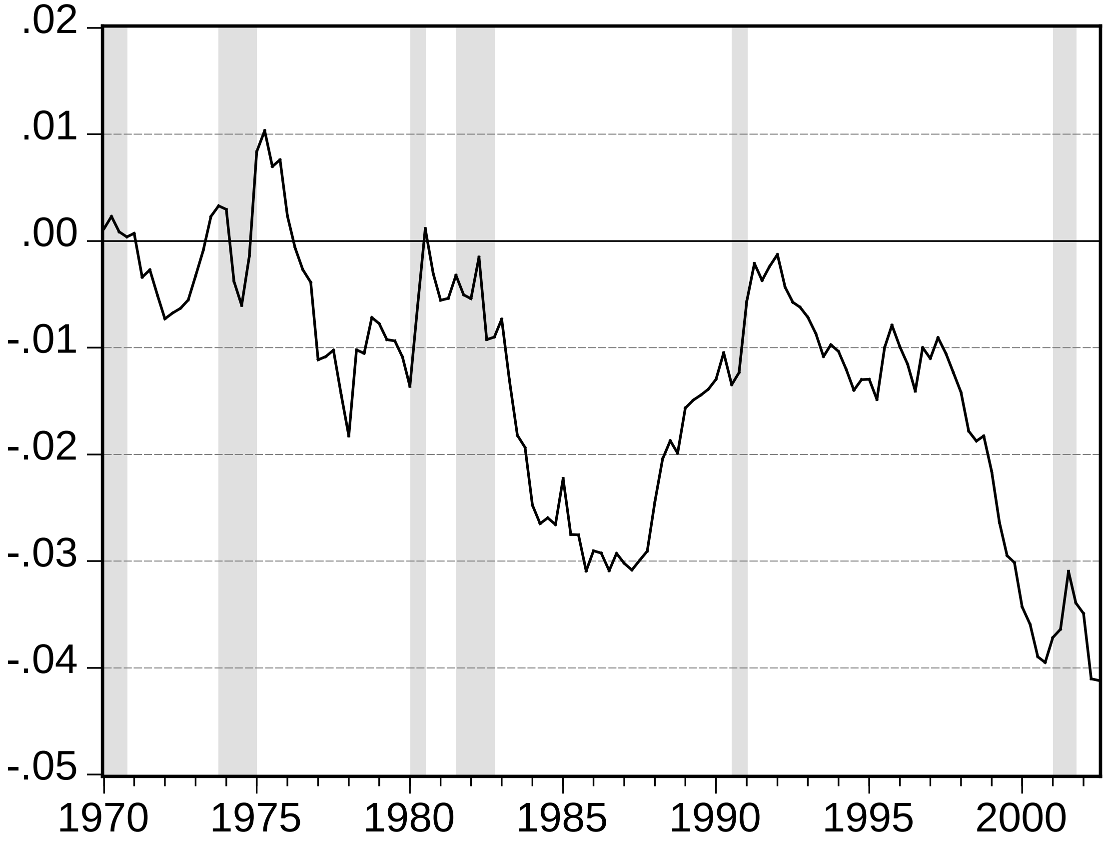

Figure 1: Nominal U.S. Trade Balance to GDP ratio (SAAR). Source: BEA (National income and product accounts, Nov. 26, 2002), and NBER for recession dates. The end date for the last recession is the author's estimate.

Incomes, Exchange Rates and the U.S. Trade Deficit, Once Again

Abstract: This paper discusses recent developments in the empirical modeling of U.S. import and export flows, and the implications for adjustment of the trade balance in response to changes in the value of the dollar and relative incomes. The results of examining the behavior of trade flows in the period spanning the late 1990's boom and dollar appreciation are also reported. The estimates for the updated data do not exhibit the income asymmetry typically found in other studies, although a reduction in the current account would require a substantial real depreciation, holding all else constant.

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

JEL Classification: F31, F41

Acknowledgements: The views reported herein are solely the author's, and do not necessarily represent those of the institutions the author is currently or previously affiliated with. Faculty research funds of the University of California are gratefully acknowledged.

Correspondence: From Sept. 1, 2002-June 30, 2003: NBER, 1050 Massachusetts Avenue, Cambridge, MA 02138. Tel/Fax: (617) 588-1454/868-2742.
Email: chinn@ucsc.edu

1. Introduction

The ever-expanding U.S. trade deficit has prompted recurring predictions of a current account adjustment and dollar depreciation. Although these predictions have yet to be validated – indeed the trade deficit/GDP ratio has exceeded the 4 percent level[1] despite the slowdown in U.S. growth – most observers would agree that at some time in the future the trade and current account balances move toward surplus.

How the external adjustment U.S economy takes place is of interest to economists in both the policy-making and academic communities.[2] For the former group, the question is how much of a real exchange rate adjustment, combined with changing growth rates at home and abroad, is necessary to effect the adjustment of the U.S. economy to the lower capital inflows that are anticipated. For the latter, the issue is whether the observed correlations summarized by the estimated trade sensitivities to price and income changes[3] prove durable, or are a function of other, deeper factors. Of specific interest is the question whether the well-known income elasticity asymmetry first noted by Houthakker and Magee (1969) persists.

Hence, in both arenas, there is some urgency to the mission of estimating the macroeconomic determinants of aggregate flows. Indeed, in an interesting confluence of policy and academic concerns, some have pinned hopes for stabilizing the trade deficit on

---

[1] Although a 5.1% figure is commonly cited as the ratio of the real trade deficit to real GDP ratio, the underlying calculation of this ratio is not valid since it relies upon summing chain weighted quantities that do not obey summing up constraints. See Whelan (2000).

[2] See Baily (2002) for an extensive discussion of sector specific as well as macroeconomic issues related to a large dollar depreciation.

[3] Technically, these “sensitivities”are elasticities. For instance, the income elasticity of imports is the percent change in imports for a one percent change in GDP. Since all the trade flows, incomes and exchange rates are expressed in log terms, sensitivities and elasticities are identical in this paper.

a convergence of the income sensitivities of the U.S. and her trading partner economies, combined with accelerated growth in the rest of the world.

This study first surveys the recent literature on the determinants of trade flows. It then adds to the current literature by updating the estimates of price and income sensitivities for U.S. imports and exports. Finally, the implications of these point estimates are recounted.

To anticipate the empirical results, I find that there is a statistically significant relationship between total exports of goods and services, U.S. income and the real exchange rate. However, for total U.S. imports, there appears to be little evidence of such a link. Only by allowing for a structural break in 1995, or excluding computers, do I find a long run import relationship. Furthermore, in these sets of estimates, the income elasticity asymmetry of Houthakker and Magee (1969) largely disappears.[4]

2. The Context

In the third quarter of 2002, the nominal trade deficit reached -$432.6 billion at a seasonally adjusted annual rate, or 4.1% of GDP (see Figure 1). In absolute terms, this was a record, and even expressed in proportion to GDP, this was a substantial figure. In the preceding quarter, the real value of the dollar, as measured by the Federal Reserve, was only about 15% below its peak in 1985 (see Figure 2). To the extent that the strong value of the dollar had priced some American goods out of international competition, it might be argued that a depreciation of the dollar will bring about a commensurate adjustment of the trade deficit.

---

[4] This study is not the first one to provide an explanation for the income elasticity asymmetry. Helkie and Hooper (1988) argue that inclusion of relative supply, via a relative capital stock measure, makes the gap in elasticities disappear. Arora et al. (2001) obtain estimated income elasticities that appear to be converging.

There are two reasons to question this view. First, it is not clear that this measure of the dollar's value is the most appropriate. Second, it is similarly unclear that a drop of the magnitude currently envisaged – say 20% -- would be sufficient to effect the trade balance adjustment that many observers envisage.

Turning to the first point, note that alternative measures of the value of the dollar yield different stories about the dollar's strength. For instance, if costs of production – rather than prices – are the metric, then by the IMF's reckoning, the dollar is some 40% below its previous peak. If this is the more relevant measure, then the deterioration in the trade balance is not due to an overly strong currency. On the other hand, if wholesale (rather than consumer) prices are more relevant for trade flows, then the dollar is indeed near its 1985 peak, according to the J.P. Morgan index.

The insightful observer will note that in any event, a dollar depreciation is required. But any depreciation will be insufficient to remedy the situation because of the Houthakker-Magee finding that the income sensitivity of imports exceeds that of exports by about 0.6. Hence, one perspective is that in the absence of *secular* dollar decline – irrespective of measurement – the trade deficit will continue to expand even if U.S. income growth is the same as the rest-of-the-world's.

It is against this backdrop that one needs to evaluate these questions. What is the proper measure of the dollar? And does the Houthakker-Magee asymmetry persist even in the recent period. The remainder of the paper examines these questions.

3. A Review of the Literature

In order to examine the questions outlined above, an analytical framework is required. In particular, it is necessary to know what theory implies about the roles of income and relative prices.

The empirical specification commonly used to analyze the macroeconomic determinants of the trade balance is motivated by the traditional, partial equilibrium view of trade flows. In this framework, the demand for traded goods arises because not all the demand for goods can be satisfied by domestic production. As long as different countries Goldstein and Khan (1985) provide a clear exposition of this "imperfect substitutes" model.

Imposing the equilibrium conditions that supply equals demand, then one can write out import and export equations (assuming log-linear functional forms):

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

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

where *im*, *ex*, *q* and *y* are (log) real imports, exports, real exchange rate and income, and $\delta_1 > 0$ and $\delta_2 > 0$ and $\beta_1 < 0$ and $\beta_2 > 0$.

One can interpret equations (1) and (2) as semi-reduced form equations.5 For instance, the second expression combines the relationship between the relative import price and imports and the relationship between the exchange rate and relative prices into one equation. 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?"

I have sidestepped the more problematic issue of whether one can conduct policy experiments in this framework, as all these variables are in theory jointly determined. However, as Obstfeld and Rogoff (2000) remark, the exchange rate often seems to have a

[5] The interpretation of these parameters is structural. An alternative view is associated with the Krugman (1989); there, the income elasticities are functions of income growth rates at home versus those abroad.

life of its own, such that experiments of this nature may not be so unreasonable to consider.

Rose and Yellen (1989) estimated regressions of the type outlined above, but focused on the *trade balance*. They examined monthly data over the 1960-85 period, and failed to detect evidence of any long run relationship in levels[6], so they estimated these relationships in growth rates. In general, regardless of the estimation approach, they failed to find a significant impact of relative prices on the trade balance. For our purposes, the important point is that this finding held up to disaggregation to individual import and export flows.

Meade (1992) provides a useful update to the Rose and Yellen results. Using the additional data including the post-1987 adjustment in the trade deficit, she found that there was evidence of a long run relationship between real nonagricultural exports with the real exchange rate and foreign income. Meade's results differ from Rose and Yellen's largely because of the difference in sample period, which spanned the reduction in the trade deficit in the late 1980's. However, in her study, imports failed to exhibit evidence of a long run relationship between the levels of the variables.

Recent work has relied on more powerful econometric techniques, such as the multivariate maximum likelihood estimation procedure of Johansen (1988). In conjunction with additional data, this procedure has provided more evidence of long run relationships than obtained in previous studies. Johnston and Chinn (1996) find evidence of a long run relationship between nonagricultural nonfuel trade flows, incomes and the real exchange rate over the 1973-93 period. Wren-Lewis and Driver (1998) rely upon two estimation procedures, one of which is the Johansen procedure. They too find evidence of

[6] In this paper, the phrase "long run relationship in levels" is equivalent to the term "cointegration", coined by Engle and Granger. See Chinn (1991) for a general discussion.

long run relationships over the 1980-95 period, for disaggregate components (goods, services) of U.S. trade flows.

Finally an exhaustive study conducted by Hooper et al. (1998) also found evidence of a long run relationship for both U.S. exports and imports over the 1960-1994 period, using relative prices (either import or export prices relative to broad deflators) or a real effective exchange rate. Interestingly, they obtain an incorrect sign for the price sensitivity for imports when using a real effective exchange rate index. That is, a weaker dollar is associated with greater imports, according to their results.[7]

In two of these studies, the income asymmetry first noted by Houthakker and Magee is reconfirmed. Wren-Lewis and Driver (1998) estimate income sensitivities for goods imports of 2.36, and for goods exports of 1.21. While the asymmetry is reversed for services, services are only a small component (about a quarter) of total exports, and are an even smaller proportion of imports. Similarly, Hooper et al.'s estimations of income sensitivities for total imports exceed those of exports by about 0.4 to 0.5.

4. Updating the Conventional Wisdom

I now turn to analyzing the behavior of U.S. trade flows in a period that spans the turn of millennium boom and bust in the U.S. economy. The analysis is conducted on data from a variety of sources. For measures of trade flows, data on real imports and exports of goods and services (1996 chain weighted dollars) were obtained. These series are depicted in Figure 3. Domestic economic activity was measured by U.S. GDP in 1996 chain weighted dollars, while foreign economic activity was measured by Rest-of-

[7] Hooper et al. (1998) directed their attention primarily at results using relative prices (e.g., the price of imports relative to the general price deflator). In those cases, they typically obtained larger price elasticity estimates.

World GDP (expressed in 1996 dollars). This measure rest-of-world GDP is weighted by U.S. exports to major trading partners.

Three different exchange rate indices were utilized. The first is the Fed's major currencies trade weighted value of the dollar; the second is the J.P. Morgan broad trade-weighted real exchange rate, deflated using the PPI. The third is the IMF's trade-weighted real exchange rate deflated using unit labor costs. (All three of these series were depicted in Figure 2, rescaled to equal 0 in 1973q1.[8]

The first two variables approximate measures of "price competitiveness". On theoretical grounds the PPI deflated measure is preferable to the CPI-deflated measure because the latter since it incorporates the prices of many non-traded goods that are unlikely to be relevant to flows of traded goods. On the other hand, the fact that CPI's are widely available and are more comparable across developed economies may lend the CPI deflated measure a practical advantage.

The third measure merits some more detailed discussion. The unit labor cost deflated measure is best thought of as an empirical proxy for "cost competitiveness. Assuming that prices are determined by wages and a fixed cost-markup, then the real exchange rate is the nominal rate adjusted by wages and productivity levels. As productivity levels rise, the real dollar cost of production falls. In contrast, rising U.S. wages cause an appreciated real dollar. This definition of the real exchange rate also fits in with a Ricardian model of trade (Golub, 1994). However, it is likely to be an imperfect

[8] The various exchange rate indices also differ in terms of their construction. The Fed index only covers the major trading partners, while the J.P. Morgan series covers twenty three countries. The IMF series comparing unit labor costs only covers industrialized countries for which detailed cost data are available. See Chinn (2002b) for a detailed discussion of the characteristics of these indices.

measure of cost competitiveness, as it only incorporates labor, rather than total, costs, and even these are imprecisely measured.

The empirical exercise is applied to data spanning a period of 1975q1-2001q2. This period includes two episodes of dollar appreciation and two episodes of dollar depreciation. The sample is ended at 2001q2 in order to omit possible distortions in the trade flow relationships due to the events of 9/11.

The estimation procedure (described in Appendix 2) provides estimates of the long run coefficients as well as the coefficients describing how fast each of the variables adjusts back to the long run equilibrium. These “reversion coefficients” are of interest for a number of reasons. First, the reversion coefficients on the trade flows should be negative, and statistically significant, indicating that imports and exports respond to a disequilibrium in the long-run relationship by closing the gap. Second, to the extent that one would like to interpret the estimated coefficients as structural parameters it would be useful to be able to interpret the trade flows as responding to exogenous movements in the other variables, while the reverse is not true.[9]

The regression results for exports of goods and services are reported in Table 1. Overall, the results are favorable toward a finding of a long run relationship; in all cases evidence of cointegration is obtained. The sensitivity of exports to the real exchange rate is between 0.7 to 0.8 when using the CPI deflated measure, and slightly higher – 0.8 to 0.9 – when using the PPI deflated measure. Overall, income sensitivity estimates are relatively robust. They range from 1.7 to 2. The price sensitivity is somewhat less than identified using the unit labor cost measure. In this case, the price sensitivity is 0.5 to 0.6. The income sensitivity also appears to be somewhat lower too.

[9] Technically speaking, this is equivalent to weak exogeneity of these two variables, i.e., statistically insignificant reversion coefficients for the exchange rate and income.

The reversion coefficients in the bottom panel of Table 1 indicate that it is only export flows that respond to disequilibria in the long run export relationship. In other words, the real exchange rate and foreign income are weakly exogenous for exports. Depending upon the deflator used, the rate at which exports respond ranges from 10% to 17% per quarter. Using the unit labor cost deflator, the reversion rate is more rapid, at roughly 23% per quarter.

The results are somewhat less promising for imports. As shown in columns 1-3 of Table 2, it turns out it is not possible to identify a statistically significant import relationship, regardless of the real exchange rate measure used. Only if an exogenous dummy is imposed at 1995q1 is there evidence for cointegration (Chinn, 2002b). Since the *economic* meaning of such a variable is difficult to discern, it behooves the researcher to search for a specification that does not require such an intervention variable.

After some experimentation, it turns out that imports excluding computers, computer parts and peripherals, can be modeled without reliance upon a structural break. Economically speaking, this result makes sense given the boom in trade in computers and parts since 1995 combined with rapid changes in computer prices have probably altered the underlying demand relationships (Council of Economic Advisers, 2001). This adjustment is consistent with the procedure followed by Lawrence (1990) and Meade (1991).

Column 4 of Table 2 reports estimates using this alternative measure of imports of goods and services. In this case, a long run relationship is detected. The income sensitivity is in line with other estimates, and while the price sensitivity, while small, it is plausible and statistically significant. Chinn (2002) finds that computer and computer part imports are unexplained by movements in the PPI deflated real exchange rate, suggesting that aggregation of non-computer and computer imports is inappropriate.

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 is just over unity. Thus, if the trade balance is already in deficit, then a depreciation may in fact result in a deterioration in the deficit.

It may be useful to summarize at this point what has been learned in revisiting this subject. Regarding the adjustment process for U.S. trade flows, these results pave the way for a revision of the conventional wisdom. Consider Table 3. In the top panel, various estimates of import sensitivities are reported. While the estimated income sensitivity appears much in line with those obtained by Hooper et al., and most other studies (see Mann, 1999, Table 8.2; Lawrence, 1990), the price sensitivities provide a different story. The estimate of non-computer import price sensitivity in column (4) is correctly signed, in contrast to those obtained by Hooper et al., and larger than that reported by Wren-Lewis and Driver (1998).

The differences are even more striking on the export side; the estimated export price and income sensitivities are noticeably higher than those reported by Hooper et al. as well as Wren-Lewis and Driver. The fact that the income sensitivity is essentially the same as the import income sensitivity has profound implications. In this set of estimates, the Houthakker-Magee asymmetry is no longer apparent; hence, a secular decline of the dollar is no longer required.

5. Conclusions and Implications

There are several revisions to our general understanding of the behavior of U.S. trade flows that arise from this and other recent studies. First, a stable long run relationship exists for U.S. exports, the real exchange rate and rest-of-world income. In contrast, aggregate U.S. imports are quite difficult to model, regardless of the real exchange rate measure used. Only by allowing for a structural break in 1995q1 can some evidence for a long run relationship be found. However, even in this case, the price sensitivity is economically small and statistically insignificant.

Aggregate imports *excluding computers*, peripherals and parts do, however, appear to be related to the real exchange rate and income in a stable fashion. It is not possible to isolate a plausible demand function for imports of computers. The exchange rate coefficient is invariably wrong-signed, while income picks up a large proportion of the variation.

One important finding is that the asymmetry in income sensitivities, first pointed out by Houthakker and Magee (1969) no longer applies. The income sensitivity of export demand is the same as that of non-computer imports. [10]

What policy implications follow from these empirical results? It is not the intent of this study to make predictions regarding the future path of the U.S. trade deficit. Indeed, doing so would require making predictions regarding the future paths of income at home and abroad, as well as the value of the dollar. Forecasting these variables at any time would be an enterprise fraught with hazards, but in this period of uncertainty, it would seem to be particularly foolhardy to speculate.

However, one can draw two general conclusions from the empirical analyses. First, the relevant measure of the dollar – a broad based PPI deflated index – does indicate that the U.S. currency is quite strong, and by the third quarter of 2002, not too far away from its 1985 peak. Hence an exogenous depreciation of the dollar is likely to spur substantial trade balance adjustment.

[10] These income elasticity estimates still deviate from the value of unity implied by the standard imperfect substitutes model, combined with the assumption that traded goods are normal goods. However, relaxing any number of assumptions can lead to non-unitary elasticities, including trade in intermediate goods, or increasing returns to scale production. See Hong (1999) for a recent survey.

Second, the import price sensitivity remains quite low. This finding suggests that improvements in the U.S. trade balance may require large movements in the value of the dollar, especially when starting from an initial position of deficit. For instance, if the dollar had been 20% weaker than it actually was in the 2002q3, then the steady state level of exports would have been $1.28 trillion instead of $1.07, while imports would have been less by only a relatively small proportion, at $1.51 trillion instead of $1.56. Assuming that pass through of exchange rate changes into import and export prices is about 0.5, the nominal trade deficit would be about $241.5 billion, substantially less than the actually recorded level of $432.6, resulting in a trade deficit/GDP ratio of approximately 2.3%.[11]

[11] This calculation relies upon CPI stabilization and a constant nominal GDP. A more appropriate calculation might refer to ratios of nominal GDP to domestic absorption. This means the improvement is from 4.3% to 2.4%.

References

Arora, Vivek, Steven Dunaway and Hamid Faruqee, 2001, "Chapter II: Sustainability of the U.S. External Current Account Deficit," *United States: Selected Issues*, IMF Country Report No. 01/149 (Washington, DC: IMF, August).

Baily, Martin, 2002, "Persistent Dollar Swings and the U.S. Economy," mimeo (Washington, DC: IIE, October).

Bannerjee, Anindya, Juan Dolado, John W. Galbraith and David Hendry, 1993, Co-integration, Error Correction, and the Econometric Analysis of Non-Stationary Data (Oxford: Oxford University Press).

Cheung, Yin-Wong and Kon. S. Lai, 1993, "Finite-Sample Sizes of Johansen's Likelihood Ratio Tests for Cointegration," *Oxford Bulletin of Economics and Statistics* 55(3): 313-328.

Chinn, Menzie, 2002a, "Doomed to Deficits? Aggregate U.S. Trade Flows Revisited," Working Paper #525 (Santa Cruz: Dept. of Economics, University of California, July).

Chinn, Menzie, 2002b, "The Measurement of Real Effective Exchange Rates: Applications to East Asia," paper presented at the Australia-Japan Research Center/China Center for Economic Research conference on "Deepening Financial Arrangements in East Asia," Beijing University, March 24-25, 2002.

Chinn, Menzie, 1991, "Beware of Econometricians Bearing Estimates: Policy Analysis in a 'Unit Root' World," *Journal of Policy Analysis and Management 10* (4) (Fall): 546-567.

Council of Economic Advisers, 2001, *Economic Report of the President* (Washington, D.C.: U.S. GPO, January).

Goldstein, Morris and Mohsin Khan, 1985, "Income and Price Effects in Foreign Trade," in R. Jones and P. Kenen (eds.), *Handbook of International Economics*, Vol. 2, (Amsterdam: Elsevier), Chapter 20.

Golub, Stephen, 1994, "Comparative Advantage, Exchange Rates and the Sectoral Trade Balances of the Major Industrial Countries," *IMF Staff Papers* 41, pp. 286-313.

Hargreaves, Derek, 1993, "Rebasing and Reweighting of J.P. Morgan Effective Exchange Rate Indices," *World Financial Markets* (New York: J.P. Morgan, Nov. 19), p. 23.

Helkie, William and Peter Hooper, 1988, "The U.S. External Deficit in the 1980's: An Empirical Analysis," in R. Bryant, G. Holtham and P. Hooper (eds.) *External Deficits and the Dollar: The Pit and the Pendulum* (Washington, DC: Brookings Institution).

Hong, Pingfan, 1999, "Import Elasticities Revisited," *Discussion Paper* No. 10 (NY: United Nations Department of Economic and Social Affairs, September).

Hooper, Peter, Karen Johnson and Jaime Marquez, 1998, “Trade Elasticities for G-7 Countries,” *International Finance Discussion Papers* No. 609 (Washington, DC, Federal Reserve Board, April). Revised version published as *Princeton Studies in International Economics* No. 87 (Princeton, NJ: Princeton University, 2000).

Houthakker, Hendrik and Stephen Magee, 1969, “Income and Price Elasticities in World Trade,” *Review of Economics and Statistics* 51: 111-25.

Johansen, Søren, 1988, “Statistical Analysis of Cointegrating Vectors,” *Journal of Economic Dynamics and Control 12*: 231-54.

Johansen, Søren, and Katerina Juselius, 1990, “Maximum Likelihood Estimation and Inference on Cointegration - With Applications to the Demand for Money,” *Oxford Bulletin of Economics and Statistics 52*: 169-210.

Johnston, Louis D. and Menzie Chinn, 1996 , “How Well Is America Competing? A Comment on Papadakis,” *Journal of Policy Analysis and Management 15*(1) (Winter) , pp. 68-81.

Krugman, Paul, 1989, “Differences in Income Elasticities and Trends in Real exchange Rates,” *European Economic Review* 33: 1031-1054.

Lawrence, Robert Z., 1990, “U.S. Current Account Adjustment: An Appraisal,” *Brookings Papers on Economic Activity* No. 2, pp. 343-382.

Leahy, Michael P., 1998, “New Summary Measures of the Foreign Exchange Value of the Dollar,” *Federal Reserve Bulletin* (October), pp. 811-818.

Mann, Catherine, 2002, “Perspectives on the U.S. Current Account Deficit and Sustainability,” *Journal of Economic Perspectives* 16(3): 131-152.

Mann, Catherine, 1999, *Is the U.S. Trade Deficit Sustainable*? (Washington, DC: IIE).

Meade, Ellen, 1992, “A Fresh Look at the Responsiveness of Trade Flows to Exchange Rates,” Paper prepared for the annual meetings of the Western Economic Association, San Francisco, July 9-13 (June 1992).

Meade, Ellen, 1991, "Computers and the Trade Deficit: the case of the falling prices" in P. Hooper and D. Richardson, (eds.) *International Economic Transactions: Issues in Measurement and Empirical Research*, NBER Studies in Income and Wealth vol. 55.

Obstfeld, Maurice and Kenneth Rogoff, 2000, “Perspectives on OECD Economic Integration: Implications for U.S. Current Account Adjustment,” *Global Economic Integration: Opportunities and Challenges* (Kansas City: Federal Reserve Bank of Kansas City).

Rose, Andrew, 1991, “The Role of Exchange Rates in a Popular Model of International Trade: Does the ‘Marshall-Lerner’ Condition Hold?” *Journal of International Economics* 30: 301-316.

Rose, Andrew and Janet Yellen, 1989, “Is There a J-Curve?” *Journal of Monetary Economics* 24, pp. 53-68.

Whelan, Karl, 2000, “A Guide to the Use of Chain Aggregated NIPA Data,” *Finance and Economics Discussion Papers* 2000-35 (Washington, DC: Board of Governors of the Federal Reserve System, June).

Wren-Lewis, Simon and Rebecca Driver, 1998, *Real Exchange Rates for the Year 2000* (Washington, DC: Institute for International Economics).

Zanello, Allesandro, and Dominique Desruelle, 1997, “A Primer on IMF’s Information Notices System,” *Working Paper* WP97/71 (Washington, DC: International Monetary Fund).

Table 1
U.S. Exports Equation
1975q1-2001q2

Long Run Coeff	Pred	CPI defl. [1]	PPI defl. [2]	ULC defl. [3]
cointegration		yes	yes	yes
q	(+)	0.798*** (0.185)	0.871*** (0.173)	0.590*** (0.010)
y	(+)	1.865*** (0.075)	1.997*** (0.059)	1.639*** (0.059)
lag		2	2	2
N		106	106	106
Reversion coefficients				
Im	(-)	-0.096*** (0.021)	-0.109*** (0.026)	-0.158*** (0.030)
q	(-)	-0.015 (0.032)	-0.017 (0.031)	-0.084 (0.050)
y	(+)	0.002 (0.004)	0.008 (0.005)	0.001 (0.006)

Notes: "Coeff" is the coefficient from equation (1) or (2). "Pred" indicates predicted sign. "Cointegration" indicates whether evidence of cointegration is detected using the 10% significance level. Coefficients are long run parameter estimates from the Johansen procedure described in the text. Lag is the number of lags in the VAR specification of the system. N is the effective number of observations included in the regression. Sm *(**)[***] denotes significance at the 10%(5%)[1%] level. Source: Tables 2 and 3 from Chinn (2002).

Table 2
U.S. Imports Equation
1975q1-2001q2

Long Run Coeff	Pred Comp.	CPI defl. Imports [1]	PPI defl. Imports [2]	ULC defl. Imports [3]	PPI defl. Imports ex. [4]
Cointegration		No	No	No	Yes
q	(-)	-0.177 (0.129)	-0.172 (0.164)	-0.086 (0.120)	-0.295** (0.136)
y	(+)	2.288*** (0.062)	2.264*** (0.063)	2.310*** (0.088)	1.994** (0.049)
lag		2	2	2	4
N		106	106	106	106
Reversion coefficients					
Im	(-)	-0.113** (0.042)	-0.111*** (0.040)	-0.103** (0.040)	-0.159*** (0.048)
q	(+)	0.040 (0.050)	0.034 (0.037)	0.022 (0.050)	0.022 (0.046)
y	(+)	0.019 (0.013)	0.016 (0.012)	0.020* (0.012)	0.015 (0.015)

Notes: "Coeff" is the coefficient from equation (1) or (2). "Pred" indicates predicted sign. "Cointegration" indicates whether evidence of cointegration is detected using the 10% significance level. Coefficients are long run parameter estimates from the Johansen procedure described in the text. Lag is the number of lags in the VAR specification of the system. N is the effective number of observations included in the regression. *(**)[***] denotes significance at the 10%(5%)[1%] level. Source: Chinn (2002), Tables 1,3 and 4.

Table 3
Selected Estimates of Trade Sensitivities

Panel 3.1: Imports

Long Run Coeff.	Hooper et al. (1998) [1]	Wren-Lewis[1/] & Driver (1998) [2]	Chinn total [3]	Chinn ex. Comp. [4]
q	0.11 to 0.13	-0.18	-0.184	-0.295
y	2.11 to 2.22	2.36	2.038	1.994
Smpl	1960-94	1980-95	1975-2001	1975-2001
Reversion coefficients				
Im	0.04 to -0.10	na	-0.201	-0.159

Panel 3.2: Exports

Long Run	Hooper et al. (1998) [1]	Wren-Lewis[1/] & Driver (1998) [2]	Chinn total [3]
q	0.52 to 0.72	0.65	0.871
y	1.68 to 1.81	1.21	1.997
Smpl	1960-94	1980-95	1975-2001
Reversion coefficients			
Ex	-0.20 to -0.35	na	-0.209

Notes: "Coeff" is long run parameter estimates from the Johansen procedure described in the text. Real exchange rate index is unit labor cost deflated, unless otherwise noted. "Reversion" is the reversion coefficient for the relevant trade flow. Source: Hooper et al. (1998), Wren-Lewis and Driver (1998) and author's calculations.

[1/] Goods only.

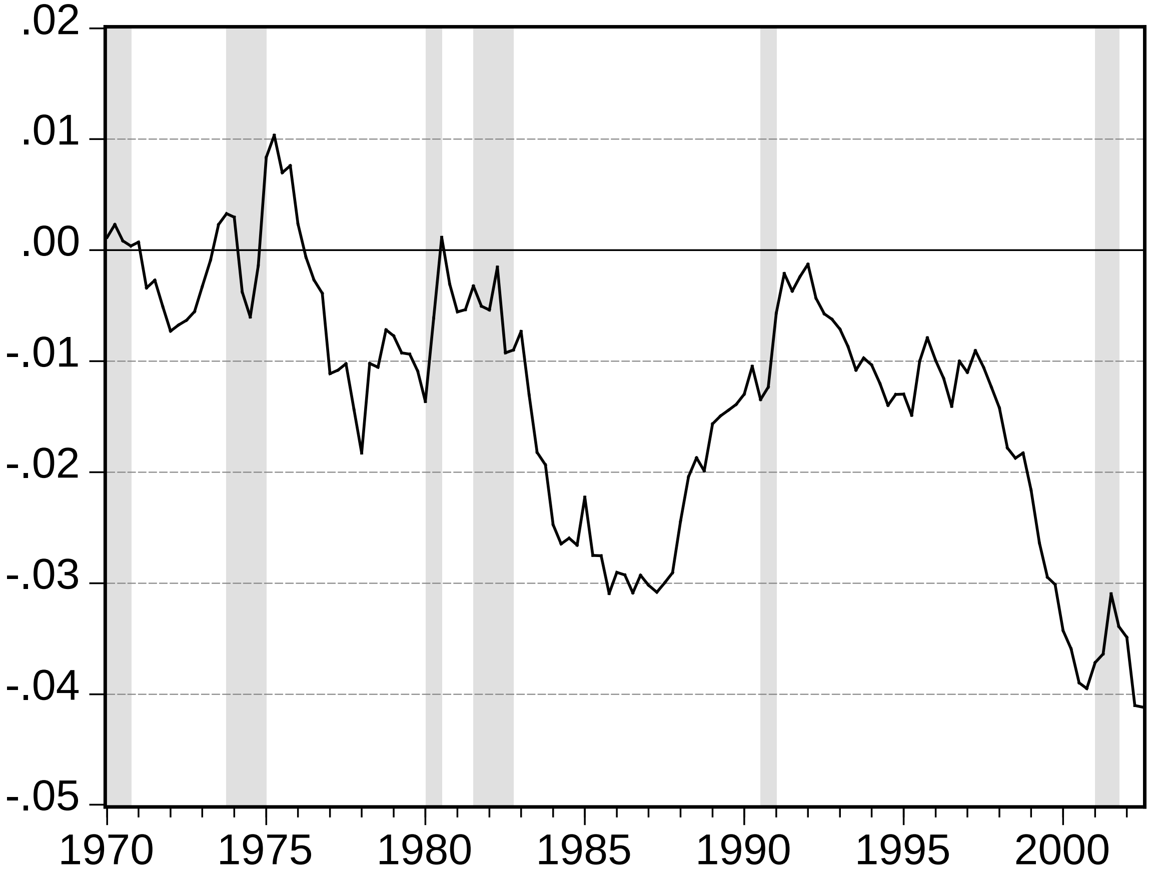

Figure 2: Nominal U.S. Trade Balance to GDP ratio (SAAR). Source: BEA (National income and product accounts, Nov. 26, 2002), and NBER for recession dates. The end date for the last recession is the author's estimate.

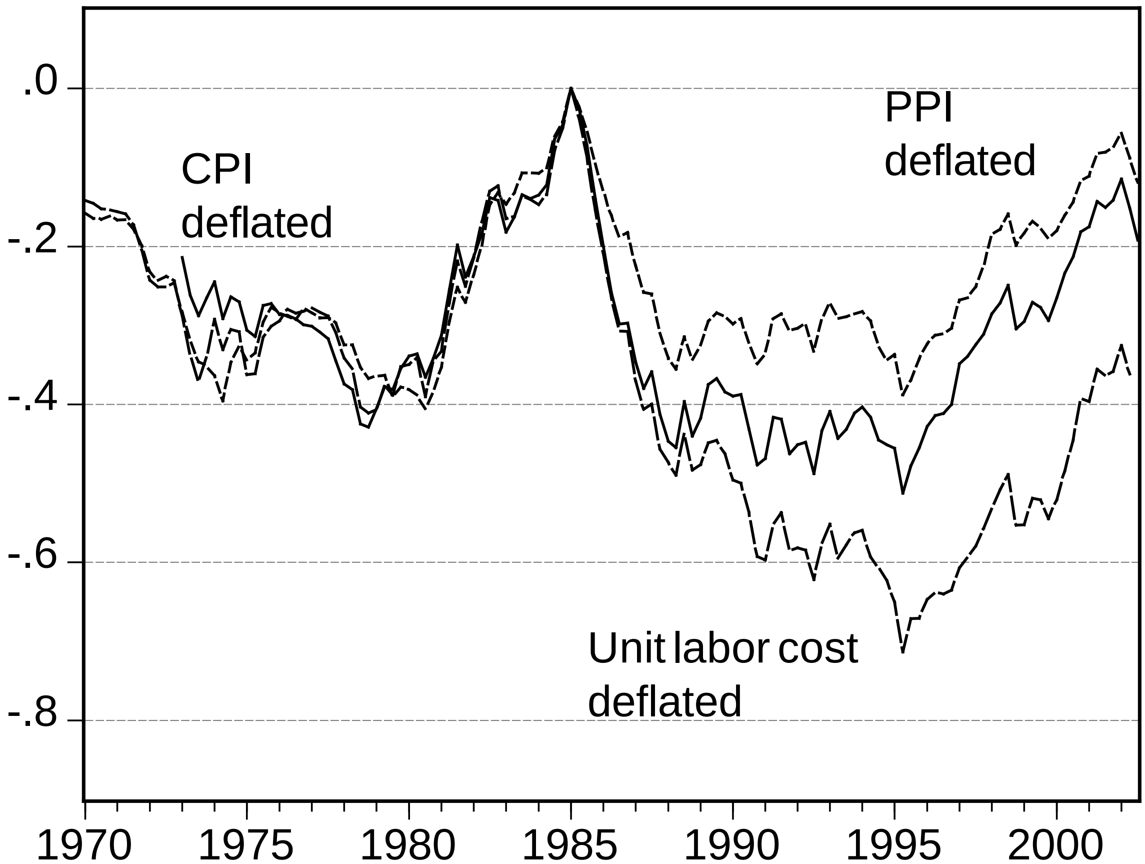

Figure 2: Indices of the U.S. Dollar Effective Exchange Rate (in logs, normalized to 1985q1=0). Sources: Federal Reserve Board, J.P. Morgan and IMF.

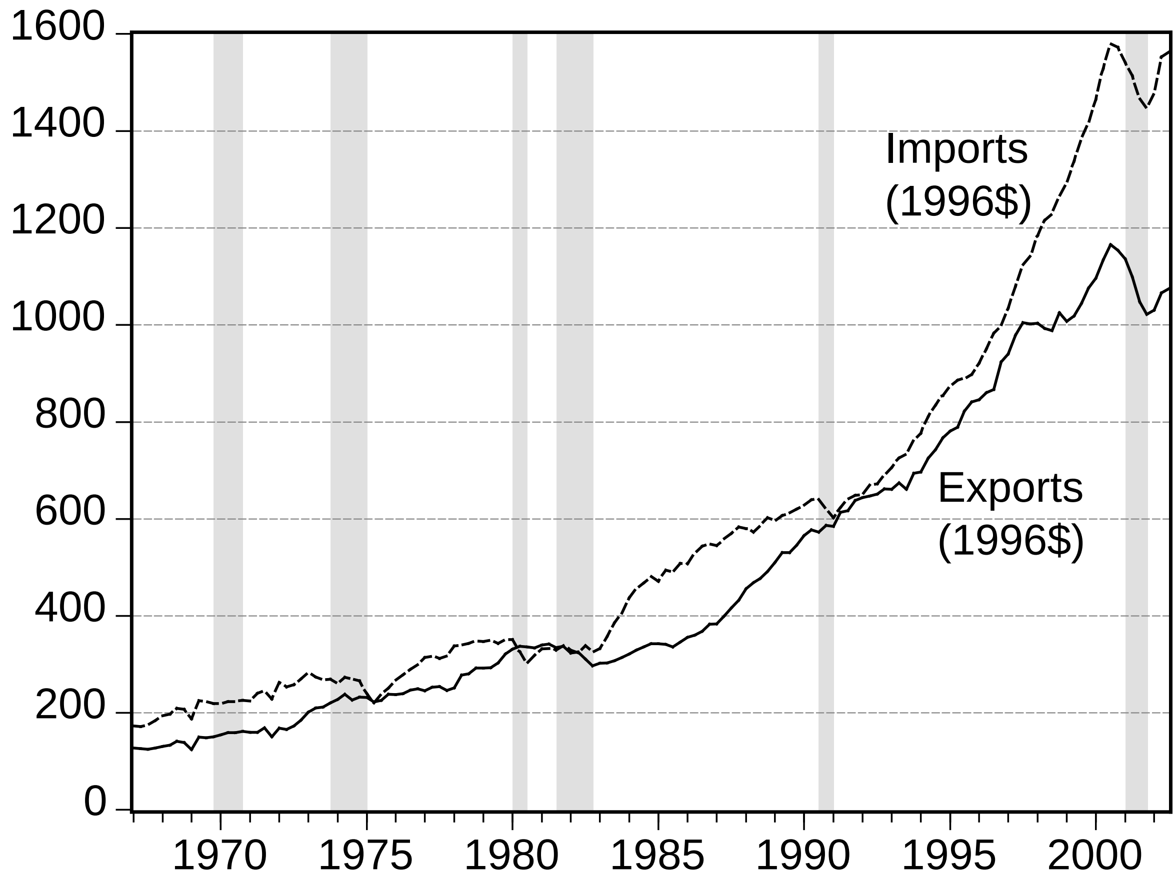

Figure 3: Exports and Imports of Goods and Services, in chained 1996$ (SAAR). Source: BEA (National income and product accounts, November 26, 2002).

Appendix 1: Data Sources and Description

Exchange Rate Indices

- US "Major" 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 June 29th. See Leahy (1998) for details.
- "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://www2.jpmorgan.com/MarketDataInd/Forex/REXB.bin. Data accessed June 29th. For a description of the series construction, see Hargreaves (1993).
- Trade-weighted real exchange rates (unit labor cost-deflated). 1995=100, 1988-1990 trade weights. Source: *International Financial Statistics* May 2002 CD-ROM, line *reu*, for 1978q1-2002q1 sample. Series spliced to previous *reu* 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 imports and exports of goods and services (1996 chain weighted dollars). Source: Federal Reserve Bank of St. Louis (FRED) website.
- Real imports and exports of non-computer goods and services, and of non-computer goods (1996 chain weighted dollars). Source: personal communication from BEA, and post-1987, calculated using Tornqvist approximation. See Whelan (2000) for an explanation of the procedure. Computer imports before 1987 are measured using fixed weight measures (the difference between chain weighted and fixed weighted imports was minor in 1987q1), extending back to 1970. For observations recorded as NA, it was assumed computer imports were $0.05 billion.

- U.S. GDP (1996 chain weighted dollars). Source: Federal Reserve Bank of St. Louis (FRED) website.
- Rest-of-World GDP (1996 dollars). U.S. exports weighted rest-of-world GDP. Source: personal communication from Federal Reserve. Updated over 2000q3-2001q4 period using regression on country trading partner GDP; R^2 of regression 0.99.

Appendix 2: Estimation Methodology

The estimation is implemented using a maximum likelihood procedure, which simultaneously identifies the existence or absence of long run relationships between the levels of the variables, estimates those long run relationships if they exist, and also detects the short run dynamics.

Estimation proceeds in two steps: (1) Lag length selection and (2) estimation of the vector error correction model (VECM). The latter step entails interpretation of the cointegration results, and examination of the short run dynamics.

The lag length is determined by the minimum AIC for the unconstrained VAR, with the lag lengths of up to 8 lags considered. In all cases, the 2 lag specification yields the minimum AIC.

The Johansen (1988) and Johansen and Juselius (1990) maximum likelihood procedure is implemented in order to test for cointegration and identify the cointegrating vector. For the import system, the procedure estimates the following vector error correction model:

$$\begin{aligned}
\Delta im_t^{US} &= \gamma_{10} + \varphi_1(im_{t-1}^{US} - \beta_1 q_{t-1} - \beta_2 y_{t-1}^{US}) + \gamma_{11}\Delta im_{t-1}^{US} + \gamma_{12}\Delta q_{t-1} + \gamma_{12}\Delta y_{t-1}^{US} + \varepsilon_{1t} \\
\Delta q_t &= \gamma_{20} + \varphi_2(im_{t-1}^{US} - \beta_1 q_{t-1} - \beta_2 y_{t-1}^{US}) + \gamma_{21}\Delta im_{t-1}^{US} + \gamma_{22}\Delta q_{t-1} + \gamma_{23}\Delta y_{t-1}^{US} + \varepsilon_{2t} \qquad \text{(A1)} \\
\Delta y_t^{US} &= \gamma_{30} + \varphi_3(im_{t-1}^{US} - \beta_1 q_{t-1} - \beta_2 y_{t-1}^{US}) + \gamma_{31}\Delta im_{t-1}^{US} + \gamma_{32}\Delta q_{t-1} + \gamma_{33}\Delta y_{t-1}^{US} + \varepsilon_{3t}
\end{aligned}$$

For exports, the system estimated is:

$$\Delta ex_t^{US} = \gamma_{40} + \varphi_4(ex_{t-1}^{US} - \delta_1 q_{t-1} - \delta_2 y_{t-1}^{RoW}) + \gamma_{41}\Delta ex_{t-1}^{US} + \gamma_{42}\Delta q_{t-1} + \gamma_{43}\Delta y_{t-1}^{RoW} + \varepsilon_{4t}$$

$$\Delta q_t = \gamma_{50} + \varphi_5(ex_{t-1}^{US} - \delta_1 q_{t-1} - {}_2\, y_{t-1}^{RoW}) + \gamma_{51}\Delta ex_{t-1}^{US} + \gamma_{52}\Delta q_{t-1} + \gamma_{53}\Delta y_{t-1}^{RoW} + \varepsilon_{5t} \qquad \text{(A2)}$$

$$\Delta y_t^{RoW} = \gamma_{60} + \varphi_6(ex_{t-1}^{US} - \delta_1 q_{t-1} - \delta_2 y_{t-1}^{RoW}) + \gamma_{61}\Delta ex_{t-1}^{US} + \gamma_{62}\Delta q_{t-1} + \gamma_{63}\Delta y_{t-1}^{RoW} + \varepsilon_{6t}$$

Two test statistics for testing the alternative of cointegration against the null of no cointegration are calculated: the trace and the maximum eigenvalue statistic. Both are referred to, although generally they will agree on the existence of a cointegrating relationship, and the number of cointegrating vectors.[12]

There are also additional specification issues related to the allowance for constants and trend terms in either the data or the cointegrating vector. For most of the specifications, the AIC selects a model with deterministic trends allowed in the data, but not in the cointegrating vector.[13]

[12] Cheung and Lai (1993) have shown that it is often important to account for degrees of freedom when using highly parameterized VARs. However, with the short lag lengths implemented and relative parsimony of the specifications, the conclusions would be unchanged using finite sample critical values.

[13] See Chapter 8 of Banerjee, et al. (1993) for additional discussion.