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How Far Has the Dollar Fallen?

Abstract: It is widely known that the dollar has fallen relative to its peak in 2002. However, the extent of the decline depends upon the composition of the basket of currencies used in calculating the dollar's value. Further, the appropriate index depends upon the question being asked, with the type of price deflators used – if any – dependent upon the question at hand. Various measures of the dollar's value are discussed, and compared, including alternative weights based on liabilities and assets, instead of the standard trade flow weights.

Keywords: effective exchange rate, competitiveness, the trade deficit, asset and liability valuation effects

JEL Classification Nos.: F31, F41

1. Introduction

How far has the dollar fallen? For obvious reasons, this is a question of central import to policymakers and business leaders. But the question is actually quite difficult to answer. As Figure 1 illustrates, the 41% depreciation in the dollar/euro rate from February 2002 to January 2005 has not been representative of a broad based decline. Nor has the 21% decline in the dollar/yen rate. In fact, the Fed's broad, trade weighed index of the dollar's value has only registered a 17% decline.

This result suggests that great care has to be taken in measuring, and interpreting, movements in the dollar's value. Not only does the answer depend upon the index that is being used, it also fundamentally depends upon the question one is asking. To answer the question of how euro area investors view returns on US financial assets, one might wish to use the euro/dollar rate. But as a quick summary measure of how the global investors might view such returns, one might wish to use a dollar index.

Similarly, if one is interested in how competitive US firms are against firms in other industrialized countries, a different index may be more appropriate. Yet another measure might be of greater relevance if one is concerned with firms in both emerging markets as well as other industrialized countries.

The central message of this paper is that the appropriate definition and calculation of the exchange rate depends upon a complex interplay of the model of interest and data availability and reliability. Below, I investigate this issue, focusing on the US situation as a concrete example.

2. Nominal Exchange Rate Indices

It is obvious that differing bilateral exchange rates may very well have different trends. However, this point is driven home by Figure 1, which illustrates the euro and yen exchange rates, and the Fed's broad dollar index. The divergences may be particularly substantial when the inflation differentials are great, as they tend to be when taking into account emerging markets. Hence, measures of the dollar's value evaluated using the United States' major trading partners will differ from that based upon other important trading partners. And it will yet again differ from a broad measure that incorporates both groups. All three series, tabulated by the Federal Reserve, are depicted in Figure 2.

This figure highlights the fact that the choice of exchange rate index is not merely of academic concern. Here, the dollar has in fact depreciated over the past three years, when focusing on a basket of major currencies associated with the euro area, Japan and so forth. Yet, it has barely budged when one considers a set of currencies associated with emerging markets such as Argentina, Brazil, Chile, Colombia, Mexico, Venezuela, China, Hong Kong, India, Indonesia, Korea, Malaysia, the Philippines, Singapore, Taiwan, Thailand, Israel, Saudi Arabia and Russia.[1]

3. Real Exchange Rate Indices

3.1 Describing the various measures

There is something of a mystery as to why one wants to examine nominal exchange rate indices, especially when the weights used to calculate the indices are based upon bilateral trade weights. Typically, analysts are more interested in the real, or "inflation-adjusted", exchange rates:

$$R_t \equiv \frac{E_t \times P_t}{P_t^*} \qquad (1)$$

where E is the number of foreign currency units required to purchase one US dollar, P (P*) is the price of a bundle of American (foreign) goods. The real value of the dollar is the number of bundles of foreign goods required to purchase one bundle of American goods. To make an index, one then takes an average of the bilateral dollar values.

When one makes an index of the value of the dollar, one then faces two key questions. The first is what weights to use (how heavily should the yen fit in, versus the euro, or the pound). The second is what prices to use. As it turns out, neither of these questions are inconsequential.

Suppose one is concerned with what prices consumers pay for goods that are traded versus those that are produced at home. The Fed's measures of the real value of the dollar, corresponding to those illustrated in Figure 2, are depicted in Figure 3. While it is difficult to discern the divergence from the nominal counterparts in post-2002 trends, taken over the entire sample, some interesting patterns arise. One obvious aspect is that over the entire 11 year period,

[1] These series are described in detail in Leahy (1998).

the dollar gained value in real terms against a basket of other important trading partners by approximately 9.4%. The nominal appreciation was much greater, at 44.7%.

Actually, the weighting issue is a bit more complicated than was implied earlier. One might think that the currencies are weighted by the importance in bilateral trade. But since firms in one country not only compete against firms in another country, these firms can also compete in third markets. Hence, trade weighting can take on a more complicated form to allow for competition in third markets. This is the case for the indices published by the Federal Reserve Board, the ECB, the BIS and the IMF.2

What price measure to use? The Fed measure, along with many other typical indices of the real value of the dollar, incorporates CPIs. While this calculation makes sense on pragmatic grounds – most countries produce the series on a timely basis – the variable's relevance is a bit limited by the fact that large components of consumers purchases are not tradable. Indeed, the real exchange rate adjusted by consumer prices turns out to be a function of the ratio of the relative nontradables price in one country relative to another is, and consequently relates primarily to the condition of internal balance in the two countries. Hence, the decision to calculate of the CPI deflated real exchange rate is almost always driven by expediency and data availability rather than an interest in this variable directly

If one is interested in the relative price that achieves *external* balance in trade in goods and services, what macroeconomic policymakers allude to as price competitiveness – then one might want to use *producer* prices. In this view, a weaker domestic currency (in real terms) means that it is easier to sell domestic goods abroad. This suggests using producer price indices (PPIs) or wholesale price indices (WPIs).

A related concept is cost competitiveness (Marsh and Tokarick, 1996). To see how this variable is related to the preceding one, consider a markup model of pricing:

$$P_t = \left[(1+\mu_t)(ULC_t)\right] \qquad (2)$$

[2] Trade weighting by trade flows assumes that goods originating from different countries are equally substitutable (Armington, 1969). This need not be the case, and Spilimbergo and Vamvakidis (2003) have shown that OECD country trade flows are not equally substitutable with non-OECD trade flows.

where μ is percentage markup, and *ULC* is unit labor costs, equal to the nominal wage rate divided by labor productivity per hour. Re-expressing (1) using equation (2), and assuming that markups are constant ($\mu_t = \mu$) yields:

$$R_t = \left[\frac{E_t \times ULC_t}{ULC_t^*} \right] \tag{3}$$

(where the constant has been suppressed). In this case, the real exchange rate is the nominal rate adjusted by wages and productivity levels, and in some ways more closely resembles the measure of competitiveness as used in popular discussion. As US productivity levels rise, the real value of the dollar declines holding all else constant. This definition of the real exchange rate fits in with a Ricardian model of trade (Golub, 1994).

It is hard to break down the effects of differing deflators and differing weights into constituent parts. That's because no organization calculates indices using the same weights and different deflators, or different weights and the same deflators. As a second best option, one can plot the different real series, keeping in mind the differences in weighting schemes. Interestingly, the deflation by the CPI and PPI series do not appear to matter altogether that much, according to Figure 4. On the other hand, the rapid productivity growth experience in the US, relative to its industrial country trading partners, results in a large divergence between the ULC deflated index and the other series. In fact, the 2002 peak for this index is 30% below the 1985 peak, compared to 12% using the more conventional CPI measure.

Interestingly, even since the most recent peak, there's been a noticeable divergence in behavior of the different measures. As of October, the dollar has become 28% more cost-competitive, as opposed to 19% on a price-competitiveness basis.

This calculation highlights the challenges of determining why the differences exist. The CPI and PPI measures involve many currencies, while the unit labor cost measure involves only the industrial countries, due to data limitations: unit labor costs are only available on a timely basis for the developed economies. Hence, the emerging markets of East and South Asia that have become increasingly important particularly on the import side, are omitted from the unit labor cost comparison. Hence, US competitiveness vis a vis other developed economies might miss the big picture of the overall US situation.

3.2 Competitiveness and US trade deficit adjustment

Competitiveness brings up an obvious topic of concern. The task of determining the factors driving the trade balance has taken on a more urgent cast as the 2004 U.S. trade deficit has surged to over 5% of GDP. A critical policy question is whether the dollar depreciation experienced thus far will be sufficient to shrink the deficit substantially. There is an enormous literature evaluating the responsiveness of trade flows to exchange rates, as well as the more current issue of US trade deficit adjustment.[3] Here, I don't seek to add to that literature, but merely highlight how views held by some parties may be less solidly grounded than is widely believed.

In particular, there is a common view that the depreciation that has thus far occurred is sufficient to close the trade deficit. This may turn out to be a correct assessment, but it is by no means resolved. Even the recent speech by Fed Chairman Alan Greenspan (2005) on the prospects for current account adjustment – widely perceived as an upbeat assessment – actually incorporates many allowances for the uncertainties involved in the process of trade adjustment..

In further examining whether sufficient exchange rate adjustment has occurred in order to close the deficit, one needs to first determine which measure of the exchange rate is most appropriate. A little experimentation yields a conjecture. In Figure 5, the nominal trade balance divided by GDP is plotted against the real dollar exchange rate in logs (essentially, the log of the inverted Fed broad index). The visually apparent correlation supports the textbook view that dollar depreciations are associated with trade deficit corrections.

However, as the saying goes, appearances can be deceiving. The correlation seems to break down over the latest seven year period. The gap can be partly attributable to the omission of growth effects, but an incorrect guess regarding the dollar measure would also be an explanation. The only way to identify the cause is by resorting to formal statistical analysis, such as that undertaken by Chinn (2004). The main conclusion is that if the issue is the US trade

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[3] On the former, see Goldstein and Khan (1984) for an early survey, and Rose (1991), Marsh and Tokarick (1996), and Johnston and Chinn (1996) for the more recent literature. Regarding the prospects for adjustment in the trade adjustment, see Mann (1999; 2004), Bergsten and Williamson (2004), and Roubini and Setser (2004).

deficit, then there appears to be no single measure of the dollar's value that is related to both export and import flows.

Consider a model where goods sourced from different countries are imperfect substitutes. This partial equilibrium model yields the familiar import and export functions that comprise the conventional open economy macro model,

$$im_t = \beta_0 + \beta_1 r_t + \beta_2 y_t^{US} + \varepsilon_{2t} \qquad (3)$$

$$ex_t = \delta_0 + \delta_1 r_t + \delta_2 y_t^{RoW} + \varepsilon_{1t} \qquad (4)$$

where $\delta_1 < 0$ and $\delta_2 > 0$ and $\beta_1 > 0$ and $\beta_2 > 0$, and lower-case letter denote the logs of the upper case letters.

In words, increases in the relative price of domestic goods relative to foreign goods causes the quantity of imports to fall and those of exports to rise. Domestic economic activity induces an increase in imports, while an increase abroad stimulates exports, ceteris paribus. Underlying these equations is an assumption that import and export supply curves are both perfectly elastic.

Chinn estimates these relationships for the U.S. real exports and imports (in chained 1996$) over the 1975q1-2003q2 period. Domestic economic activity was measured by U.S. real GDP, while foreign economic activity was measured by Rest-of-World GDP (also expressed in 1996 dollars). This measure of rest-of-world GDP is obtained by weighting national GDPs by their share of total exports.

Three different exchange rate indices are utilized: the Federal Reserve Board's major currencies trade weighted exchange rate; the J.P. Morgan broad trade-weighted real exchange rate, deflated using the PPI; and the IMF's trade-weighted real exchange rate deflated using unit labor costs. (Greater details on the characteristics of these indices are summarized in the Appendix 2).

The regression results for exports of goods and services are reported in Panel A of Table 1. Overall, the results are favorable toward a finding of a long run relationship; in all cases evidence of a long run relationship is obtained.[4] The sensitivity of exports to the real value of the

[4] Technically, the long run relationship is cointegration. The cointegrating relationships are identified using the Johansen maximum likelihood technique; see Chinn (2003) for more details.

dollar is 2.3 when using the CPI deflated measure, and slightly lower when using the PPI deflated measure. Overall, income sensitivity estimates are more precisely estimated, falling in the range of 1.7 to 2. The price sensitivity is somewhat smaller, at 0.7, when identified using the unit labor cost measure. Of the three specifications, perhaps the most reliable is the one using this last exchange rate measure, since only in that instance are both coefficients statistically significant.

The results are somewhat less promising for imports. As shown in the first three columns of Panel B of Table 1, it turns out it is not possible to identify a statistically significant effect for the real exchange rate, regardless of the real exchange rate measure used. It turns out that the only series that can be modeled without appeals to some sort of structural break is the import series excluding computers, computer parts and peripherals.[5] 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).[6]

Column 4 of Panel B 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 the price sensitivity, while small, it is plausible and close to being statistically significant at conventional levels.

One interesting aspect of the results is that the responses of imports and exports to dollar changes barely sums to greater than one. This means that a dollar depreciation will barely improve the trade balance, starting from balanced trade. Starting from unbalanced trade – i.e., imports far exceeding exports – the trade balance will deteriorate as a result. Of course, this argument assumes that growth effects are held constant. In fact, since imports respond more strongly to American growth than exports respond to foreign growth, *in the absence of more robust economic activity abroad or slower growth at home*, the trade balance will continue to deteriorate, or at best, stabilize at the current ratio to GDP.

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[5] Lawrence (1990) and Meade (1991) have undertaken similar approaches to this issue.

[6] Nominal computers and computer parts accounted for a peak of 7% of total imports in 2000, declining to about 5% in 2003. As early as 1980, the proportion was less than ½ of 1%.

4. Nominal Effective Exchange Rates Yet Again

In the preceding discussion, it has been taken as a given that the appropriate weights are those associated with trade flows. Yet, there is no reason why trade weighting should be appropriate for all questions.[7] Recently, it has been pointed out that recent exchange rate changes have had substantial effects on the net international investment position of the United States. Tille (2003) was one observer who early on noted that because US assets are predominantly denominated in foreign currencies, while US liabilities are mostly denominated in dollars, dollar depreciation induces a large positive revaluation effect. Hence, over the short to medium term, the net international investment position is heavily influenced by dollar movements.

These effects are potentially very large. Tille (2005) estimates that in 2003, exchange rate effects accounted for a change in the net international investment position equal to 5% of GDP. The large depreciation in that year, combined with a large gross position in foreign currency denominated assets, meant that assets gained value in dollar terms.[8]

Table 2, drawn from Tille (2005), shows the currency composition of gross assets and gross liabilities. Roughly a third of US foreign assets are denominated in dollars, and the remainder is foreign currency denominated. Of this portion, nearly a third is accounted for by the euro, and a sixth by the pound. The yen and the Canadian dollar are the next in line. All other Asian currencies aside from the yen only account for about a tenth of foreign currency denominated assets. In contrast, 95% of all liabilities are in dollars. Figure 6 depicts the asset and liabilities weighted indices of the dollar. Given the high proportion of dollar denominated liabilities, the liabilities weighted index exhibits little variation. In contrast, the asset weighted index does move substantially.

Interestingly, as illustrated in Figure 7, movements in the liabilities weighted dollar index are not too dissimilar to those in the major currencies index. Nonetheless, neither that, nor the broad index, fully captures the valuation effects on liabilities. Thus, for the question of valuation effects, it does matter what weights are used.

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[7] Suggestions to calculate asset and liability weighted currency indices have been forwarded in different contexts. See Makin and Robson (1999), as well as Gourinchas and Rey (2005a).

[8] Lane and Milesi-Ferretti (2001, 2002) noted the importance of valuation effects in a cross country study.

5. Concluding Thoughts

How far has the dollar fallen? There is no single answer to this question. If the issue is asset returns in the euro area versus the US, then the answer is 41%. If the issue is export adjustment it is 33%; import adjustment, 22%. If the concern is liability valuation effects, the relevant number is 23%. In other words, a sensible discussion of what policies should be undertaken requires a clear understanding of where policy has taken us. Hopefully, this essay has helped in that regard.

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Appendix 1: Data Appendix

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- Data for Section 3 includes data drawn from Bureau of Economic Analysis, accessed February 8, 2005. The data are described in Chinn (2003).

Appendix 2

Table A1: Details of Selected US Dollar Indices

	Deflator	Trade weights	Index type	Comments
IMF *rec*	CPI , HP filtered	Allows for third market competition	Fixed base year weights	
IMF *reu*	Unit labor cost , HP filtered	Allows for third market competition	Fixed base year weights	Only available for selected industrialized countries
JP Morgan "narrow"	PPI	Bilateral, for OECD countries	Fixed base year weights	Only available for OECD countries
JP Morgan "broad"	PPI	For OECD and emerging markets	Fixed base year weights (post-2003 series include China weights)	Available for OECD countries and emerging markets.
FRB "major"	CPI	For major trading partners	Chain weighting	United States
FRB "other important trading partners"	CPI	For other important trading partners	Chain weighting	United States
FRB "broad"	CPI	For broad set of trading partners	Chain weighting	United States
FRB Atlanta	CPI	For broad set of trading partners	Intermittent updating	United States
Bank of England	CPI	Allows for third country compeition	Fixed base year weights, adjusted	United States, and other industrialized countries

Source: Zanello and Desruelle (1997), Leahy (1998), Hargreaves and Strong (2003), Acree (1999).

Table 1
U.S. Export and Import Equation
1975q1-2003q2

Panel A: Exports Coeff	Pred	CPI defl. [1]	PPI defl. [2]	ULC defl. [3]
r	(-)	-2.281* (0.596)	-1.949* (0.622)	-0.726*** (0.090)
y	(+)	1.695 (0.233)	1.987 (0.205)	1.615* (0.053)

Panel B: Imports Coeff	Pred	CPI defl. Imports [1]	PPI defl. Imports [2]	ULC defl. Imports [3]	PPI defl. Imports ex. Comp. [4]
q	(+)	0.211 (0.150)	0.115 (0.230)	0.137 (0.143)	0.308† (0.162)
y	(+)	2.287*** (0.069)	2.293*** (0.085)	2.234*** (0.092)	2.002*** (0.057)

Notes: "Coeff" is the coefficient from equation (3 and 4 respectively) (standard errors in parentheses). "Pred" indicates predicted sign.. Coefficients are long run parameter estimates from the Johansen procedure. N is the effective number of observations included in the regression. *(**)[***] denotes significance at the 10%(5%)[1%] level, using a likelihood ratio test for the relevant zero restriction. Source: Chinn (2005), Tables 1 and 2.
† Significant at 12% level.

Table 2: Currency composition of U.S. assets and liabilities
end 2003, $ billions

	Assets							Share to total	
	Official	FDI	Equity	Debt	Banks	Other	Total	F-E-D	Total
Total	268.3	2,730.3	1,972.2	502.1	1,776.3	614.7	7,864.0		
US $	190.6	14.8	11.4	333.7	1,671.9	490.5	2,712.8	6.9%	34.5%
Non-US $	77.8	2,715.5	1,960.8	168.5	104.4	124.2	5,151.1	93.1%	65.5%
Euro	21.9	817.8	564.5	90.1			1,494.3	28.3%	19.0%
U.K. pound		422.8	433.7	16.4			872.9	16.8%	11.1%
Japanese yen	17.6	112.1	208.8	25.1			363.6	6.6%	4.6%
Canadian dollar		293.7	109.6	21.5			424.7	8.2%	5.4%
Swiss franc		132.0	92.5	0.1			224.6	4.3%	2.9%
Latin American curr.		203.7	63.2	0.5			267.4	5.1%	3.4%
Caribbean curr.		238.7	208.5	0.2			447.5	8.6%	5.7%
M-East and African curr.		57.8	29.3	1.0			88.1	1.7%	1.1%
Other European curr.		100.9	58.8	8.2			168.0	3.2%	2.1%
Other Asian curr.		335.9	191.6	5.3			532.8	10.2%	6.8%
Other	38.2		0.2		104.4	124.2	267.0		3.4%

	Liabilities								Share to total	
	Official	FDI	Equity	Debt	Treasury	Banks	Other (1)	Total	F-E-D	Total
Total	1,474.2	2,435.5	1,538.1	1,853.0	542.5	1,887.2	784.5	10,515.0		
US $	1,474.2	2,435.5	1,538.1	1,442.5	542.5	1,825.7	722.0	9,980.5	93.6%	94.9%
Non-US $				410.5		61.5	62.4	534.4	6.4%	5.1%
Euro				247.6				247.6	3.9%	2.4%
U.K. pound				66.9				66.9	1.1%	0.6%
Japanese yen				64.0				64.0	1.0%	0.6%
Canadian dollar				1.5				1.5		
Swiss franc				19.0				19.0		
Latin American curr.										
Caribbean curr.										
M-East and African curr.										
Other European curr.										
Other Asian curr.				2.9				2.9		
Other				8.6		61.5	62.4	132.5		1.3%

(1): includes U.S. currency held abroad

Source: Tille (2005), Table 2.

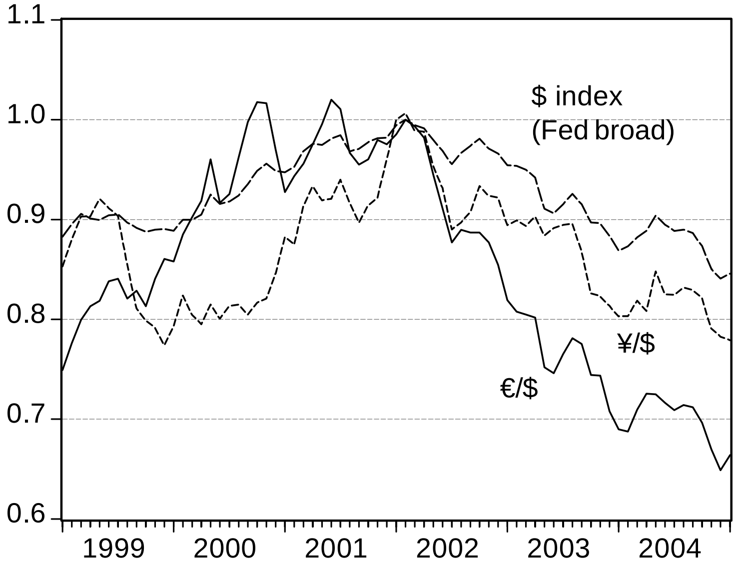

Figure 1: Euro/dollar, yen/dollar and trade weighted dollar Index (Fed, broad), rescaled to February 2002 = 1.0.

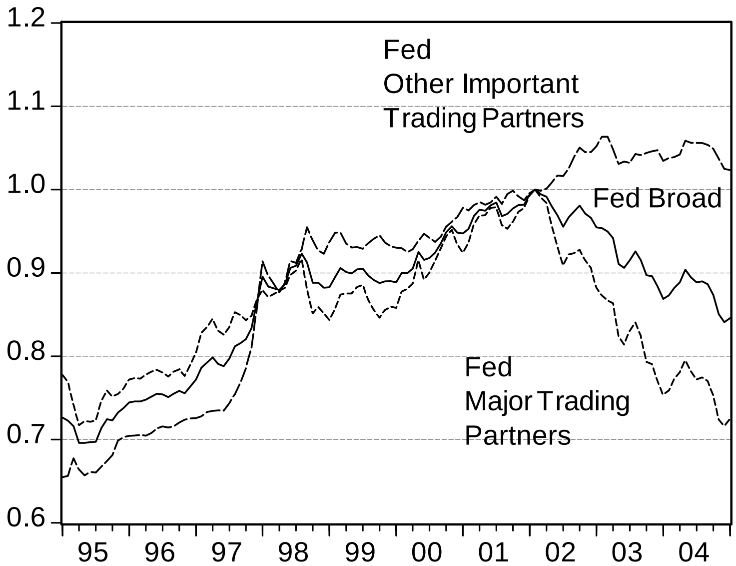

Figure 2: Federal Reserve Board dollar indices, rescaled February 2002 = 1.0

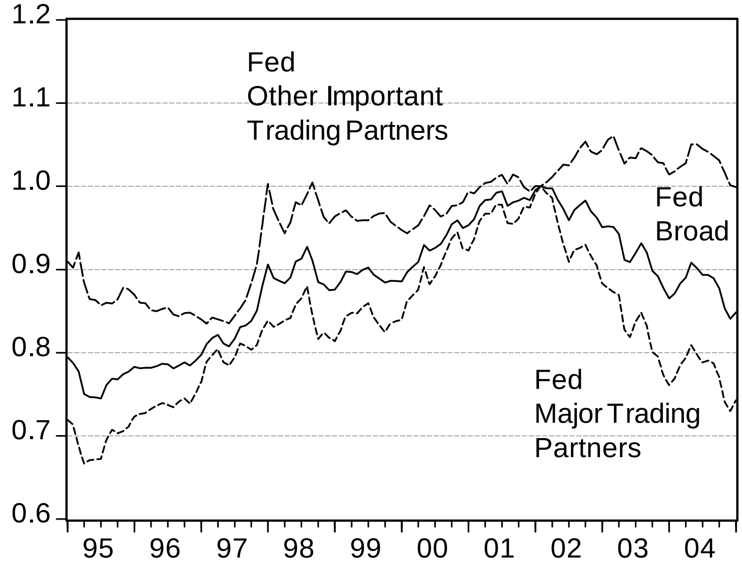

Figure 3: Federal Reserve Board real dollar indices, rescaled February 2002 = 1.0

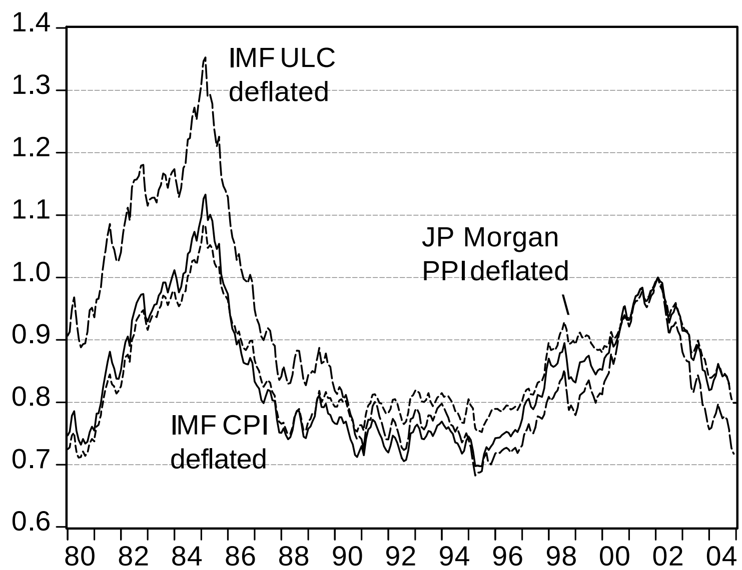

Figure 4: Consumer price, producer price and unit labor cost deflated Real dollar indices, rescaled February 2002 = 1.0.

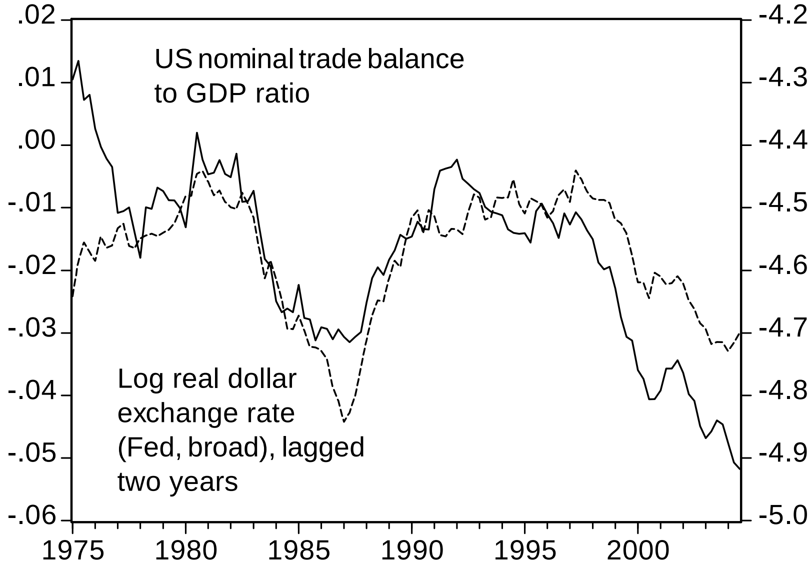

Figure 5: US nominal trade balance to GDP ratio and
log real dollar exchange rate (Fed, broad), lagged two years.

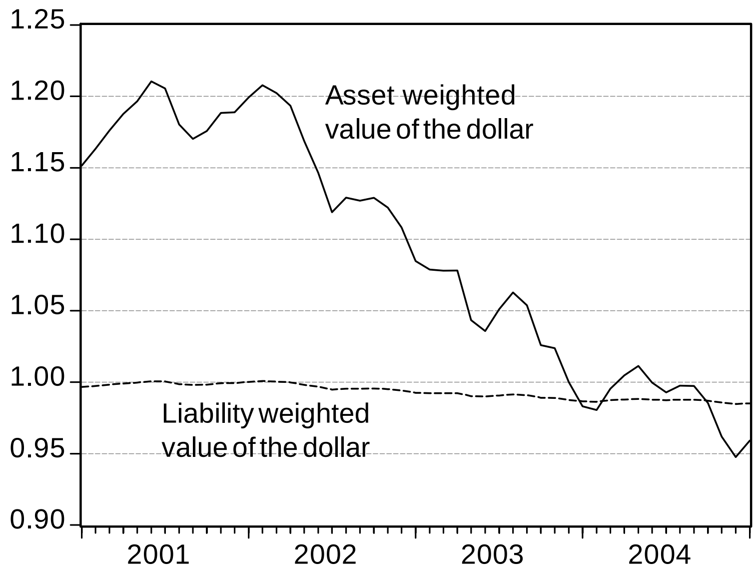

Figure 6: Asset and liability weighted value of the US dollar.
Source: author's calculation based on weights in Tille (2005).

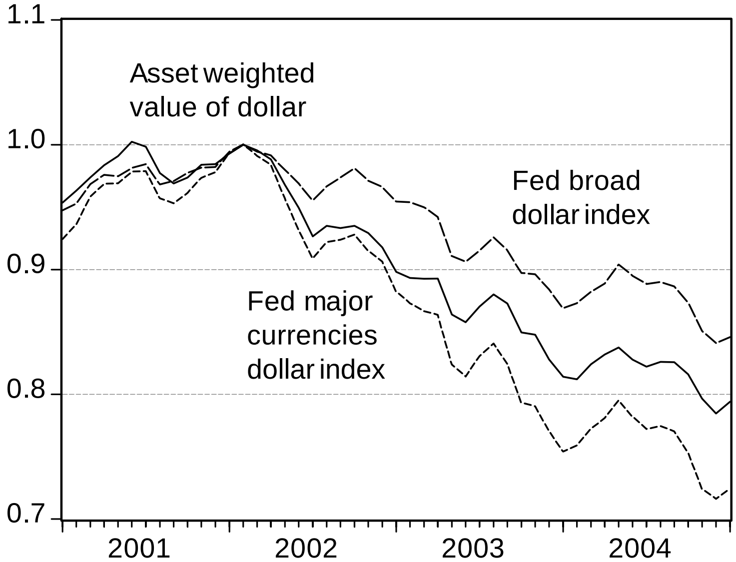

Figure 7: Asset weighted and trade weighted values of the US dollar.