How Large a Dollar Adjustment to Reduce the US Imbalance?

By

Martin Neil Baily

Peterson Institute for International Economics

Presented at the joint Bruegel, KIIEP, and Peterson Institute Workshop on Adjusting Global Imbalances, held in Washington DC, February 8-9 2007

Paper revised March 19, 2007

This is a report on ongoing research and the findings are subject to revision and correction.

This paper will ask how large an adjustment of the dollar—that is to say, how large a change in the Federal Reserve Broad Real Exchange Rate index—would be required if the US current account deficit were to be reduced on a sustained basis to about 3 percent of GDP. The approach taken here will be partial equilibrium, in the sense that I will not explore the macroeconomic adjustment that would be required both here in the US and in the rest of the world in order to effect the large rebalancing of global trade. Instead, I draw on joint work with Robert Z. Lawrence in which we found a strong empirical regularity relating the US trade balance to the real exchange rate (see Baily and Lawrence 2006). It is not news to say that the value of the dollar affects the trade balance, but it is remarkable to see how clearly that relationship comes through in the data for the past twenty-five years.

Up until now, we have been loath to use our empirical findings to say how large an adjustment of the dollar would be needed to achieve any given current account goal. Economics is replete with "stable" empirical relationships that turn out not to be stable as economic conditions change--indeed we did not find the relation to be completely stable over the period 1981-2006. Nevertheless, the relationship revealed is both striking and stable enough to provide a useful perspective on dollar adjustment. It provides a baseline magnitude against which more complete analyses can be compared. It tells us the size of

the dollar adjustment that would be needed for a reduction of the trade deficit if the past relationship between the two variables were to hold in the future. It allows us to look at the model estimates of dollar adjustment developed for this conference and see how they fall relative to the historical pattern.

Ignoring the income or savings-investment adjustment does not connote a lack of awareness of the necessity of such adjustment if the US deficit is to be reduced. If the US current account deficit is to be reduced on a sustained basis, there will have to be a substantial currency adjustment that is supported by a reduction in the level of US spending relative to US production.

There have been very large fluctuations in the price of oil over time and the US is a large net importer of oil. Figuring out how the price of oil affects the relationship between the US trade balance and the exchange rate is a very hard question. Will oil-producing countries spend or save the additional revenue they receive from higher oil prices? If they spend the money, will they buy US goods or goods from the rest of the world? If they save the money, will they hold US dollar assets or other assets? And so on. This paper does not solve this tough general equilibrium problem, but it does take a step forward in assessing the impact of changing oil prices and it suggests what that might imply for future adjustment.

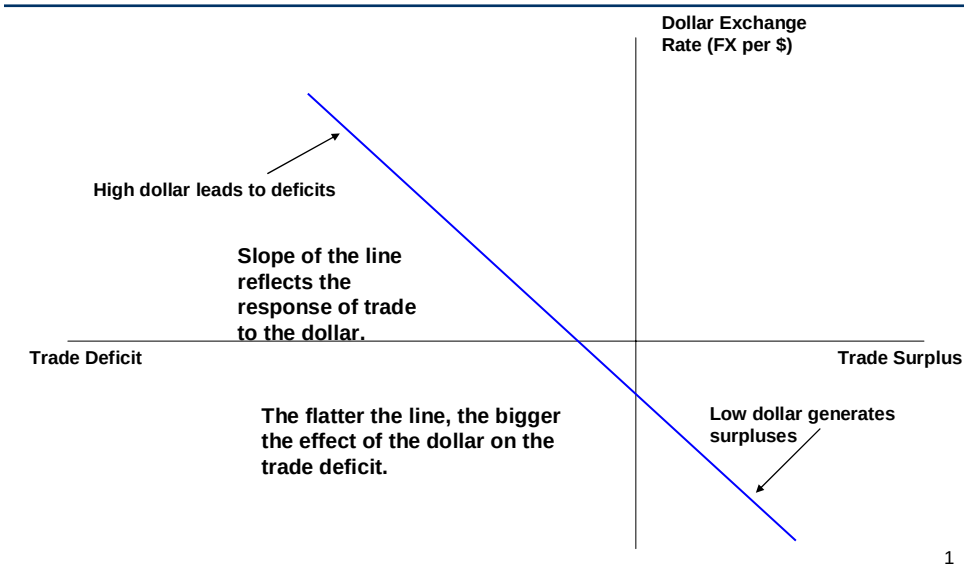
The Value of the Dollar and the Trade Balance in Theory

In Baily and Lawrence (2006) we start with a simple two-country two-good model in which the terms of trade are determined by the production conditions or supply in the two countries and the demands for the two goods.[1] We expand the model to allow for trade imbalance between the two countries, financed by an income transfer between them. After making key assumptions about relative demand in the two countries, we show how to derive a simple relationship between the terms of trade of a country and the magnitude

[1] Early demonstrations of the determination of the terms of trade in the pure theory of trade can be found in Marshall (1930) and Meade (1952).

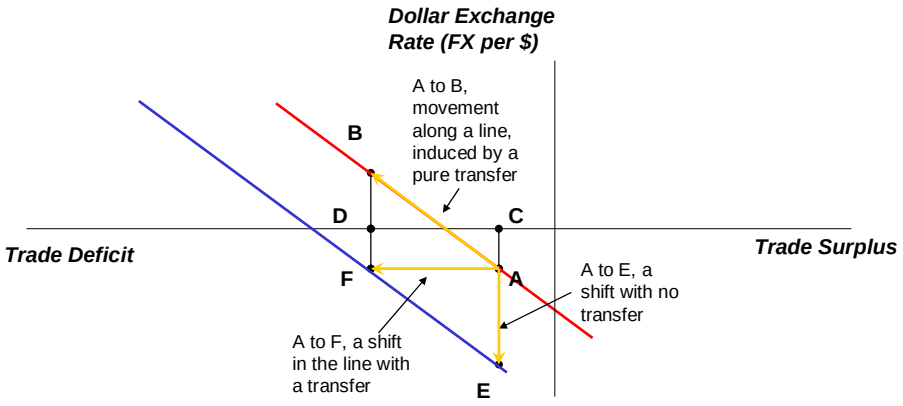
of its trade balance. Figure 1 illustrates, where we take the real exchange rate as a proxy for the terms of trade.

Figure 1: The Relation Between the Trade Balance and the Dollar



Changes in demand or changes in technology result in shifts in this line, and we suggest that such shifts can be interpreted as changes in a country's trade performance (or perhaps in its trade competitiveness). Figure 2 illustrates, showing how the trade balance can shift as a result of a pure transfer or in combination with a shift in trade performance.

Figure 2: To What Extent is the Trade Deficit a Movement Along the Schedule or a Shift In the Schedule?



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There is a second way of getting to the same relation between the dollar and the trade balance using the specification of import and export equations. This approach lacks any underlying theory of what determines the terms of trade, being based on the reduced form approach that characterizes much empirical work on trade flows. Such studies look at how exports and imports respond to prices or the exchange rate and they yield estimated coefficients that capture the elasticities of either exports or imports with respect to the variables in question (log-linear specifications are often used). Cline (2005) provides a clear summary of the important findings of recent estimated equations, which I represent as follows.

$$X = F(Z_1)RER^{-\alpha} \qquad (1)$$

$$M = G(Z_2)RER^{\beta} \qquad (2)$$

Thus $$tb = h(Z) - (\alpha+\beta)rer \qquad (3)$$

Equation (1) shows exports depending on a set of variables Z_1, representing cyclical variables and shift variables, such as the growth of productive capacity in the rest of the world. Exports then also depend on the real exchange rate, RER, with an elasticity of -α.

Equation (2) shows the similar relation for imports, which depend on cyclical and shift variables Z_2 and on the exchange rate, with an elasticity of β. Equation (3) takes the natural log of the ratio of exports to imports, tb, which then depends upon the log of the ratio of F(.) to G(.), expressed as h(Z). The ratio of exports to imports then depends upon the exchange rate (rer the log of the index) with an elasticity of $-(\alpha+\beta)$. Equation (3) gives therefore a simple log linear relation between the trade balance and the exchange rate. The reduced form trade equations, therefore, yield the same relationship that came out of our model and that was pictured in Figures 1 and 2.

Estimating the Trade and Exchange Rate Relationship

The measure of the trade balance we use is the ratio of exports to imports. This is not the traditional measure of the dollar trade deficit or surplus, but is consistent with equations (1) to (3) above. When the ratio of exports to imports is unity, trade is balanced. Deviations from balance show up as deviations from unity, so it is an index of the trade balance.[2] The actual variable we plot is the percentage deviation of the ratio of exports to imports from trade balance, calculated using logs. When our variable is zero, trade is balanced. When it is at, say, –40 percent, then exports and imports differ by about 40 percent.[3] Baily and Lawrence (2006) showed the underlying data and indicated the steps leading from the dollar values of trade to the actual variable used in our relation.

The measure of the real exchange rate used is the Federal Reserve's Broad real dollar index, although other exchange rate measures work pretty well also. We re-based the index to equal unity in 2000. We then use the natural log of this index as our exchange rate measure, again reflecting the trade equations, and we also multiply by 100. When the index equals zero, it is equal to its 2000 value. When it is, say, –20 percent, it is about 20 percent below its 2000 value.

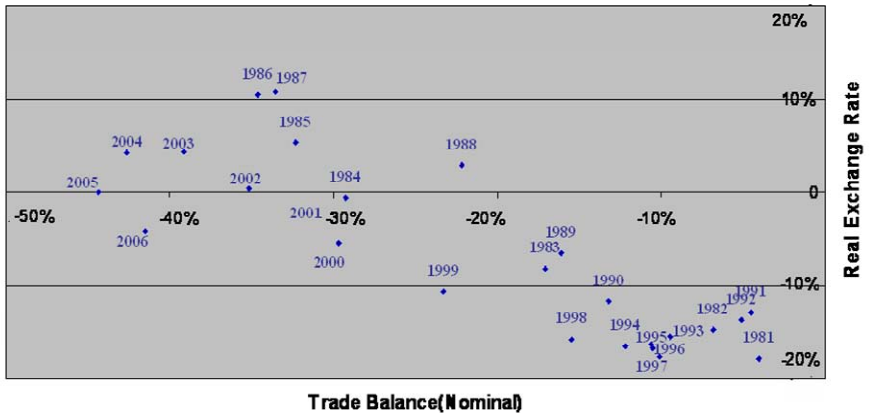
[2] One difference between our ratio trade balance and the conventional one is that the ratio improves any time exports grow faster than imports. In the dollar difference, US imports are currently so much larger than exports, that the deficit can grow even in exports grow at a faster rate than imports.

[3] We use the natural log of the ratio of exports to imports times 100. When this is equal to –40, this corresponds to exports being about 30 percent lower than imports or imports being about 50 percent higher than exports, averaging to about a 40 percent difference.

We also know that there is a substantial lag in the impact of the exchange rate on trade. When the trade balance is measured in current dollars, there can actually be a worsening of the deficit for a period after a dollar decline, as the rise in the price of imports is greater than the effect of the dollar decline on real exports and imports. For this relation I assume a distributed lag effect over three years. The dollar has 25% of its impact lagged one year; another 50% in the second year, and the final 25% in the third year.[4]

Figure 3 plots the resulting relationship and it is clear that there is a powerful relation between the trade balance and the exchange rate. Other factors may indeed be at work, but it is hard to ignore this fundamental relationship. The simple model of the trade balance and the exchange rate postulated above appears to "work" in practice. The relationship is not completely stable, however. Each annual observation is marked on the figure and it is clear that the points from 1981 to the early 1990s lie above or to the right of later years.

Figure 3: The Relation between the Trade Balance and the Real Exchange Rate 1981 - 2006



Source: Data from BEA. Exchange rate is lagged one, two and three years (weighted). Fed real broad exchange rate index.

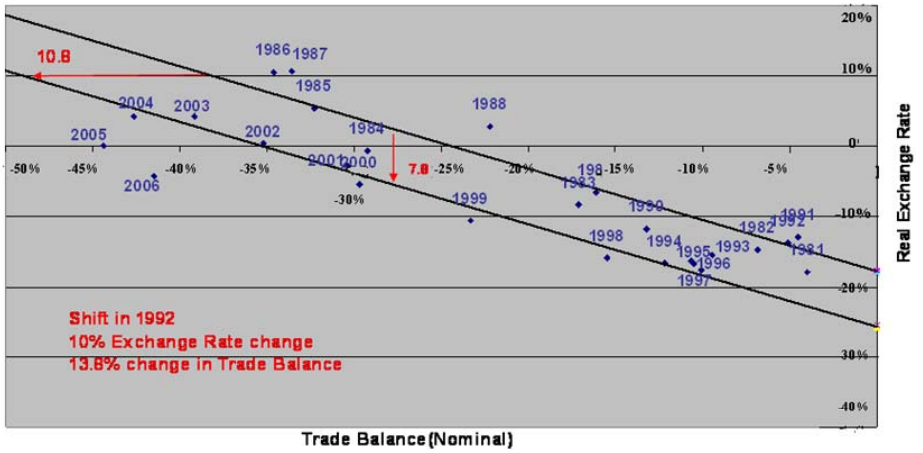
[4] The exchange rate is calculated as a weighted geometric mean and again the variable plotted is calculated as the natural log times 100.

Parameters of the Estimated Relationship. As in Baily and Lawrence, a simple regression line is now fitted to the data Figure 3 (Equation (3) is estimated) assuming a one-time shift in the relation (an intercept shift), with the best fit occurring when the shift took place in 1992. We found that a single shift in the early 90s, rather than a continuous movement over the extended time period gave the best fit. This shift took place in the early 1990s, but the specific year is not estimated with precision. Small variations in the specification change the shift point from 1992 to 1993 or 1994.

The results are illustrated in Figure 4. It is assumed that the slope of the line remains the same in the two periods, but this assumption is accepted by the data. That slope implies that a 10 percent reduction in the exchange rate will, after a lag of three years, result in a 13.8 percent reduction in the trade balance—the implied sum of elasticities is -1.38 (t-statistic 12). This figure is quite in line with mainstream estimates of the responsiveness of trade flows to exchange rate changes.[5] The shift in the line indicates that a given trade balance is associated with a dollar that is 7.8 percent lower after the early 90s than it was in the prior period; or that a given value of the dollar is associated with a trade balance (deficit) that is 10.8 percent higher in magnitude.

[5] For example, Cline's work suggested a responsiveness of 1.3. The results reported here differ somewhat from those given in Baily and Lawrence 2006. We are still trying to understand the differences. The data for 2006 were added and that made a slight difference. The main difference, however, seems to come from using a different regression package.

Figure 4: The Relation between the Trade Balance and the Real Exchange Rate shifted in the early 1990s



Source: Data from BEA. Exchange rate is lagged one, two and three years (weighted). Fed real broad exchange rate index.

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The 1992-2006 line hits the vertical axis at –26 percent. In principle, this says that if US and global economic conditions were to cause the dollar to settle 26 percent below its 2000 value, or 18 percent below its January 2007 value, then the US would achieve trade balance, after a lag. There are pitfalls to any such extrapolation, however, and I will explore later in the paper what this work may imply for meeting the goal set by this conference of a current account deficit of 3 percent of GDP.

The Problem of Endogeneity In his comments on the conference version of this paper Barry Eichengreen raised the possibility that the relationship shown in Figure 4 (and in subsequent related figures) could be distorted by the fact that the exchange rate is an endogenous variable. This is a legitimate concern, one that plagues most macroeconomic time series empirical work. But there are several reasons why this concern should be muted for the conclusions here.

First, the slope of the estimated line implies a sum of import and export elasticities that is very consistent with a long history of careful estimation of trade equations. These results are not out in left field.

Second, the identifying assumption is that there is a substantial lag between changes in the exchange rate and changes in the trade balance. Specifically, the exchange rate variable is lagged one, two and three years back with 75 percent of the weight being on the two and three year lags. In the presence of serial correlation, of course, lags do not entirely solve the problem, but they do help. Indeed most time-series work relies on much shorter lags to identify relationships.

Third, consider the nature of any reverse causality. Reverse causality would mean that changes in the trade deficit caused changes in the exchange rate and because of the serial correlation in the variables this is biasing the relation shown in Figure 4. It is believable that larger and larger trade deficits put downward pressure on the value of the dollar. If this is the case and if the serial correlation means that this reverse causality gets carried over into the estimates shown here, then Baily and Lawrence will have underestimated the impact of the dollar on the trade deficit. The true relationship is even stronger than we estimate. It is hard to make the argument that Figure 4 has been *created* by reverse causality. It would have to be that larger and larger trade deficits cause the value of the dollar to increase.

Fourth, the fit of the relationship is very good. In Figure 4 the fit is over 0.8 and when we adjust for oil prices the R-squared exceeds 0.9.

In conclusion, none of these arguments means that bias has been entirely eliminated. This paper is designed to inform the reader about the recent historical pattern of movements in the dollar and the trade deficit. As noted at the outset, regularities in economics often breakdown when they are used to extrapolate different situations and that may happen to the relation between the dollar and the deficit. *Caveat emptor.*

Cyclical Effects[6] Estimates of import and export equations typically include other variables as well as prices or the exchange rate—the Z variables in the above

[6] The discussion of cyclical variables and trend shifts in the next section are based on 1981 to 2005 data.

specification—and cyclical effects are often included. A traditional rule of thumb on such effects is that a one percent rise in the level of US GDP relative to potential increases imports by 3 to 4 percent after a lag. A one percent rise in the level of foreign GDP increases US exports by about 1.5 percent.

We tried adding cyclical variables to the relation shown in Figure 4, using US GDP relative to potential and the US unemployment rate as proxies for the US cycle. And then we used the deviation of rest of world GDP from its trend (a five year centered moving average) and deviations of rest of world trade from its trend as proxies for the rest of world cycle. These cyclical variables were not close to being statistically significant (t values below unity) and were rather trivial in estimated impact or even with the wrong sign. Adding them made little difference to the responsiveness of trade to the exchange rate or the shift in the line in the early 90s. As a further check, we flagged boom years and slump years and years with strong economic growth and years with weak economic growth. We could see no systematic pattern between years with cyclical differences.

It is generally accepted that cyclical effects on US trade are present and we do not dispute that. What we do find is that over the period 1981 to 2005, the net results of such effects on the US trade balance (as defined here) is very small and does not alter the estimated relation between the trade balance and the exchange rate. We note that over the 1981-2006 period, US and rest of world cycles often moved together, creating offsetting impacts on US trade.

Trend Variables. As well as cyclical variables, most trade equation estimates include variables to capture structural shifts. Our approach to this question has been a simple one. We labeled each year's data and looked at how trade performance varied over the time period. A specification with a single shift in the relation, taking place in the early 90s, then fit the data very well indeed. This approach has advantages, but it does not accord with the usual econometric approaches.

We therefore applied three alternatives to the data. The first was the one proposed in the famous article of Houthakker and Magee (1969). An important conclusion from this work was that the increase of US exports stimulated by a one percent increase in the income of the rest of the world was smaller than the increase in US imports stimulated by a one percent increase in US income. This "Houthakker-Magee" effect implied that if US and world GDP were growing at the same rate, then the relation between the trade balance and the exchange rate would shift over time. In fact, the value of the dollar consistent with US trade balance would decline continuously over time unless US GDP growth were far slower than world growth.

Applying the Houthakker-Magee result to the trade balance 1981-2005 did not work at all. Over this time period, US growth and rest-of-world growth were similar in magnitude. Given the estimated parameters from their study, this would imply a very large shift in the trade performance line, much, much larger than actually occurred. The fact that we did observe a decline in trade performance over the period is consistent with the spirit of Houthakker and Magee, but the magnitude of the effect and the fact that it did not occur continuously are very different from what they found in an earlier period.

We then turned to another trade specification described by Bill Cline as the "Krugman-Gagnon" specification. We constructed an adjusted trade balance to take account of global and US trend growth and the US business cycle with the Krugman-Gagnon parameters given by Cline. This specification is symmetric, so that the dollar is not forced to decline endlessly over time. It did not work well either, in terms of fitting past data or revealing the shifting relation between the exchange rate and the trade balance.

In a paper written in 1990, Lawrence estimated import and export equations and used a Houthakker-Magee framework that differed from the original in greatly attenuating the differences in elasticities for US and world growth. This model fit the data here pretty well and is certainly a possible alternative to the one-time shift given in Figure 4. His specification predicts that our line would move slowly down or to the left over time. The one-time shift fits the actual data better than the gradual shift, but we could not rule

out the possibility that the pattern Lawrence observed in his earlier work is still in effect today.

Earlier Years The real exchange rate of the dollar did not change by very much from after the war until 1971, so that it is not possible to identify exchange rate effects before that date. But after 1971, the dollar moved substantially, we have added the years 1972 to 1980 to the regression analysis described earlier, looking at the entire period 1972 to 2005 and covering all three episodes of dollar change. With all the years included, the exchange rate continues to be a key determinant of the trade balance (t statistic over 10), although adding the earlier years lowers the responsiveness slightly.[7] The shift in the 90s is estimated as 11.7 percentage points, rather than 10.8. Overall, therefore, the results we gave earlier are not changed very much by the inclusion of the 1970s. These results may suggest the impact of the exchange rate on trade has increased over time, perhaps because more companies are able to move production location to different sites around the world. More important, there appears to have been a dramatic shift in trade performance that occurred in the 1970s. Modeling fully what happened during this period is a topic for future research, but it appears there was an adverse shift in US trade performance in the 1970s that was much larger than the one that occurred in the early 90s.

Why Did Trade Performance/Competitiveness Decline in the 1990s?

The obvious answer to the question is that the US has suffered a secular decline in its trade performance since World War II, a finding that dates back to the Houthakker-Magee work. Most people attribute this to the fact that the US was the dominant economic power in 1945 and that the rest of the world has been catching up ever since, or overtaking in some industries. Is it a surprise that there was a modest loss of US trade performance in the 1990s or is the surprise that the loss was relatively small? I noted above that the trade performance line moved down much more in the 1970s than it did in the 1990s.

[7] Since there appears to be some cyclical movement of the trade balance in the 1970s, variables were included to capture the US cycle (the adult male unemployment rate) and the global cycle (the deviation of rest of world GDP from a centered five year moving average). Neither variable turns out to be significant.

Also worth noting is that the productivity boom that started in 1996 did not help US trade competitiveness. This boom was located in high-tech manufacturing and in services, notably wholesale and retail. The productivity boom in high-tech did not help US trade because this industry sources globally. In fact the US ran a small trade deficit in high-tech as the demand for equipment boomed in the US in the 1990s. The increased productivity in wholesale and retail actually facilitated imports. Countries selling into the US market found an open and efficient transportation and distribution system, eager to find cheap goods, high quality goods and a greater variety of goods. The wealth boom, associated partly with the productivity boom, mostly caused a movement along a given line in Figure 2, but it may have also caused some shift in the line.

Many people might attribute the loss of US trade performance in the 1990s to the rise of China and other low-wage manufacturing centers, and perhaps to India in services off-shoring. That is not so clear, however. The growth of US imports has not been faster than the growth of US total spending. The trade deficit seems to be more because of weakness on the export side, where the US is competing much more with Europe, Japan and Canada.

The Role of Oil and a Possible Second Shift in the Relation

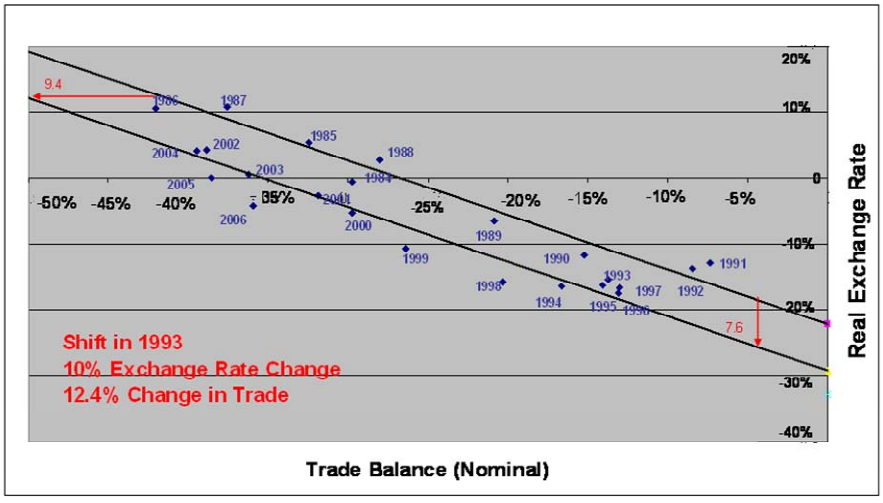
The increased price of oil in recent years has been a big deal for the US trade accounts. If the price of oil had not risen in the previous six years, but the US had imported the same quantity of oil in 2006, the cost of oil imports would have been about $154 billion lower. The value of oil exports would have been lower by about $14 billion, giving about a $140 billion impact on the dollar value of the deficit—other things equal.

In this section I look at the impact of oil price changes on the trade balance—doing this in two ways. The first approach was to re-do Figure 4 with price of oil imports and exports are held constant at their 2000 level. This means that the impact of the changing US dependence on foreign oil (in terms of barrels of oil) is captured, but the impact of the changing price of oil is taken out. The price used is the BEA's price deflator for oil imports, but as a reference, a barrel of West Texas Intermediate was about $30 in 2000.

This approach is of course an oversimplification because if the price of oil had not risen after 2000, American consumers would have had more money to spend on other things and other imports would likely have been higher at any given exchange rate.

Figure 5 shows the result, with oil import and exports held at their 2000 level but everything else kept the same, that is, all other imports and exports are in nominal dollars. The results of this what-if experiment are interesting. Since 2000, the rise in the price of oil has "distorted" the picture of the changing trade balance. In Figures 3 and 4 the trade balance was moving sharply more negative until 2004 and came down only a little in 2005 and 2006—with the end result that the balance was –41.5 percent in 2006 compared to –30.0 percent in 2000. With the price of oil held constant, we see that the turning point in the deficit stays at 2004, but the deterioration through 2004 was less and the improvement subsequently was greater. The balance in 2006 with a constant oil price was "only" -35.9 percent.

Figure 5: The Trade Balance and the Real Exchange Rate: Oil Price Fixed at its 2000 level



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Also striking, however, is the fact that holding the price of oil constant affects earlier years also. In 1991 and 1992 the previous data showed the US with close to balanced

trade, an imbalance of only around -2 percent. With oil at the 2000 level, however, the deficit is larger at around –7 or –8 percent.

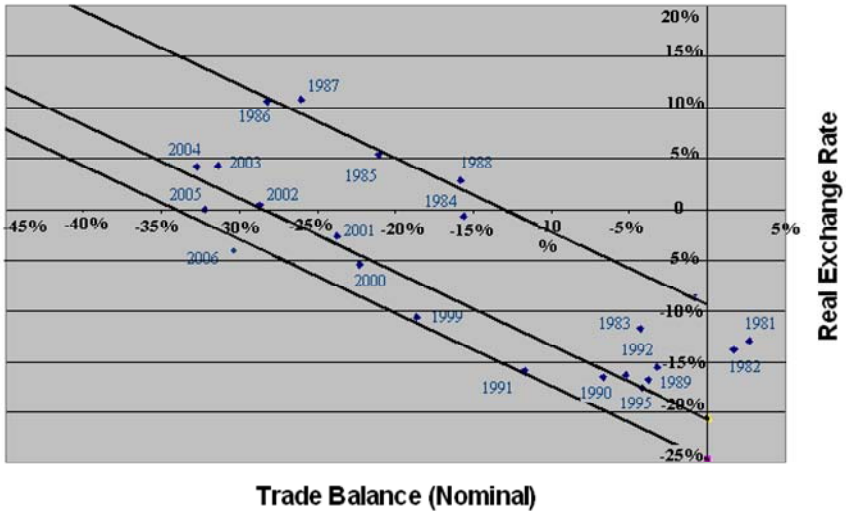
Figure 5 also shows the regression lines for the oil adjusted data. One difference is that the fit of the points is tighter; in fact the adjusted R-squared rises to 0.94 compared to a figure of 0.85 in the prior results. The fact that a simple log linear regression with the exchange rate and a single shift can fit the data so well is striking. A second difference is that the slope of the line is a bit steeper indicating a somewhat smaller in magnitude response of the trade balance to changes in the exchange rate—a 10 percent change in the real exchange rate results in a 12.4 percent change in the trade balance. The exchange rate remains highly significant with a t value of 19. The shift now occurs in 1993 and it is a bit smaller at a 7.6 percent downward shift on the dollar. This is a rather trivial difference, however, indicating that the loss of US trade performance in the 1990s was not the result of oil price changes.

A Second Decline in Trade Performance and an Alternative Oil Adjustment. After completing the work reported in Figure 5, I decided that perhaps this was not the most useful approach in order to figure out what decline in the dollar would be associated with any given level of the trade balance. And it also seemed possible, looking at Figure 5, that there had been a further deterioration in US trade performance after 2004.

In terms of the oil adjustment, the alternative approach is simply to take oil out of the trade data and estimate the relation between the trade balance and the exchange rate for non-oil trade. To test whether or not there has been a significant worsening of trade performance in the last couple of years an additional variable was added to the regression, allowing for an intercept shift in 2005. Figure 6 shows the results and the shift 2005 is just significant, perhaps surprising given that it applies to only two observations. This result does not provide a systematic test of the hypothesis that there has been a significant movement in US trade performance in the past couple of years. It is easy to see that 2005 and 2006 are off the line, but these two years do not provide enough information to be at all certain about the persistence of any further shift in trade

performance. However, the results here are consistent with the hypothesis that there may have been a modest additional deterioration in trade performance even for non-oil trade.

Figure 6: The Trade Balance and the Real Exchange Rate (excluding oil imports and exports



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Meeting the Goal of a Current Account Deficit of Three Percent of GDP

This analysis is focused on the trade effects of exchange rate adjustment, but of course income flows are also important to the current account and so are transfers. In future work I plan to look more closely at the way in which income flows might be affected by a currency adjustment—it is important to integrate the impact of currency change on both trade and income flows. For now I take the easy way out. Cline (2005) estimates that a three percent current account deficit would be associated with a $300 billion trade deficit in 2010. In this paper, that translates into a trade deficit of –10 percent, and so that is taken at the target. How large a depreciation of the dollar would be needed to get the overall deficit in goods and services to be -10 percent (imports exceeding exports and the difference between the two being about 10 percent).

The smallest estimate of the decline in the dollar to reach a trade deficit of -10 percent comes from Figure 4. Extrapolating down the line indicates an exchange rate at around -18 percent, meaning a value for the Fed real exchange rate index 18 percent below its

2000 value, or about 10 percent lower than its value in January 2007. However, that number seems much too small in magnitude for the needed dollar adjustment. It implicitly assumes that the price of oil will return to its rough average level of the 1992 to 2006 period and it assumes that in fact there has been no further change in US trade competitiveness since 1992.

A larger estimate comes from Figure 6, which shows the non-oil trade balance in relation to the exchange rate, suggesting that non-oil trade would be balanced with a dollar 25 percent below its 2000 level (after a lag). What would the non-oil trade balance have to be in order to reach a -10 percent overall trade balance? That of course depends on the price of oil and the future path of oil consumption, two variables that are interlinked. Moreover, it is quite likely that a further decline in the dollar would itself increase the dollar price of oil. Again, I have not tried to model this fully, but have made a simple calculation. I extrapolated the growth rates of oil imports and exports and looked at the size of the oil trade deficit at different prices of oil. The price of oil has been around $60 lately. If oil were to fall back to around $40 a barrel, then an overall trade balance of -10 percent would allow a small deficit in non-oil trade. If oil were to rise beyond $60 (as seems rather likely), then non-oil trade would have to be in surplus to reach the target. Trying out different oil prices indicated that a value of the dollar 23 to 30 percent below its 2000 level or roughly 15 to 20 percent below its January 2007 level would generate an overall trade deficit of -10 percent.

Other people have suggested what it would take to reduce the deficit to three percent of GDP. William Cline in his analysis for this workshop says that a 20 percent depreciation of the dollar from where it was in January 2007 would get us to this level. In a consultation with Edwin Truman, he indicated that a somewhat smaller depreciation is required, about 15 percent from today.

The empirical analysis in this paper is based on looking at the historical experience of US trade and the dollar over the past 25 years, taking into account the impact of changing oil prices. This analysis reaches the conclusion that a further depreciation of between 15 and

20 percent on the Fed's real broad dollar index would be needed to reach a trade deficit roughly consistent with a three percent current account deficit (using Cline's estimates of the income flows).[8] This finding is very consistent with Cline and Truman; and like them I recognize that a substantial income-saving-investment adjustment would be needed to reduce the current account deficit, along with the dollar adjustment.

There were a number of assumptions and simplifications made in this analysis, leaving scope for further refinement of the approach. Since one picture can be worth a thousand words (or perhaps a hundred equations) so the hope is that the pictorial representation of the trade and exchange rate relation may provide a useful and simple tool.

[8] This conclusion does not represent a prediction. It is entirely possible that the US will continue to run current account deficits far larger than 3 percent of GDP. And, as C. Fred Bergsten and Ken Rogoff have indicated, a dollar crash is also possible.

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