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U.S. External Adjustment: Progress and Prospects

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Abstract

This paper presents an empirical analysis of the progress in U.S. external adjustment through 1988 and prospects for continued adjustment over the years ahead. Our analysis, based in part on a partial-equilibrium model of the U.S. current account, suggests that adjustment was slower than "expected" during 1986-87, and faster than expected during the first half of 1988. The model was about "on track" in the second quarter of 1988, but did not anticipate the drop off in the trade balance in the second half of the year. We consider various model extrapolations of the U.S. external balance with exchange rates and income growth rates held unchanged. Our model, as well as those of other researchers, indicate that the U.S. external balance will narrow somewhat further during 1989, but will begin to widen again thereafter. This view may be overly pessimistic, due to some limitations of the models. In order to assess the credibility of these projections, we consider the issue of model uncertainty and construct error bands around the model projections using stochastic simulation techniques.

U.S External Adjustment: Progress and Prospects

William L. Helkie and Peter Hooper[1]

I. Introduction and Summary

This paper updates earlier work on the U.S. external deficit by Helkie and Hooper (1988). In this update we consider the progress in U.S. external adjustment through 1988, and prospects for continued adjustment over the period ahead. The analysis is based in large part on the partial-equilibrium model of the U.S. current account presented in earlier work.

We begin in Section II with a review of recent data on U.S. merchandise trade and service account transactions. When the trade deficit finally began to narrow in the second half of 1987, it did so at a surprisingly rapid pace through mid-1988. This pace of adjustment dropped off sharply in the second half of 1988 as the deficit actually showed signs of widening again. This abrupt shift raises questions about the "persistence" of the adjustment process. No significant clues to the peculiar pattern of adjustment can be found in the commodity and

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1. This paper was prepared for the Japanese Economic Planning Agency's International Symposium on "International Payments Adjustment in the United States and Japan," Tokyo, February 8-9, 1989. We have benefitted greatly from discussions with Jaime Marquez, who developed the programs for computing the confidence intervals contained in Section IV. We also thank Ralph Bryant for his comments on our earlier draft, and Kathryn Larin, Carolyn Litynski, and Edward Prescott for their research assistance. This paper represents the views of the authors and should not be interpreted as reflecting the views of the Board of Governors of the Federal Reserve System or other members of its staff.

geographical composition of trade flows or in the pattern of shifts in domestic demand at home or abroad. We also dismiss constraints on U.S. output capacity in manufacturing as a significant factor.

In Section III we compare the actual path of adjustment with what might have been expected on the basis of historical experience, using predictions with the Helkie-Hooper ("HH") model. This analysis suggests that adjustment was slower than "expected" during 1986-87, and faster than expected during the first half of 1988. By the third quarter of 1988 the model prediction was about in line with the actual balance. The model suggests that there may be room for further adjustment in net services than had taken place by that time, but this is an area in which the model is subject to considerable uncertainty.

In Section IV we consider model projections with exchange rates and income growth rates held about unchanged. The HH model as well as other models suggest that under these assumptions, the deficit will narrow somewhat further during 1989, but will begin to widen again thereafter, as the positive effects of the past depreciation of the dollar diminish. We suggest that these model extrapolations may be overly pessimistic in that they do not allow for continuing adjustment to the large labor cost differential that has emerged in favor of the United States as a result of the decline in the dollar.

In Section V we address more formally the general question of model uncertainty and its implications for error bands around the model projections. Our efforts to quantify these error bands suggest that there may be sufficient room for significant further narrowing of the external deficit with a plausible range of uncertainty about the model projection

due to the equation residuals in the model. Our conclusions are presented in Section VI.

II. Review of Recent Developments

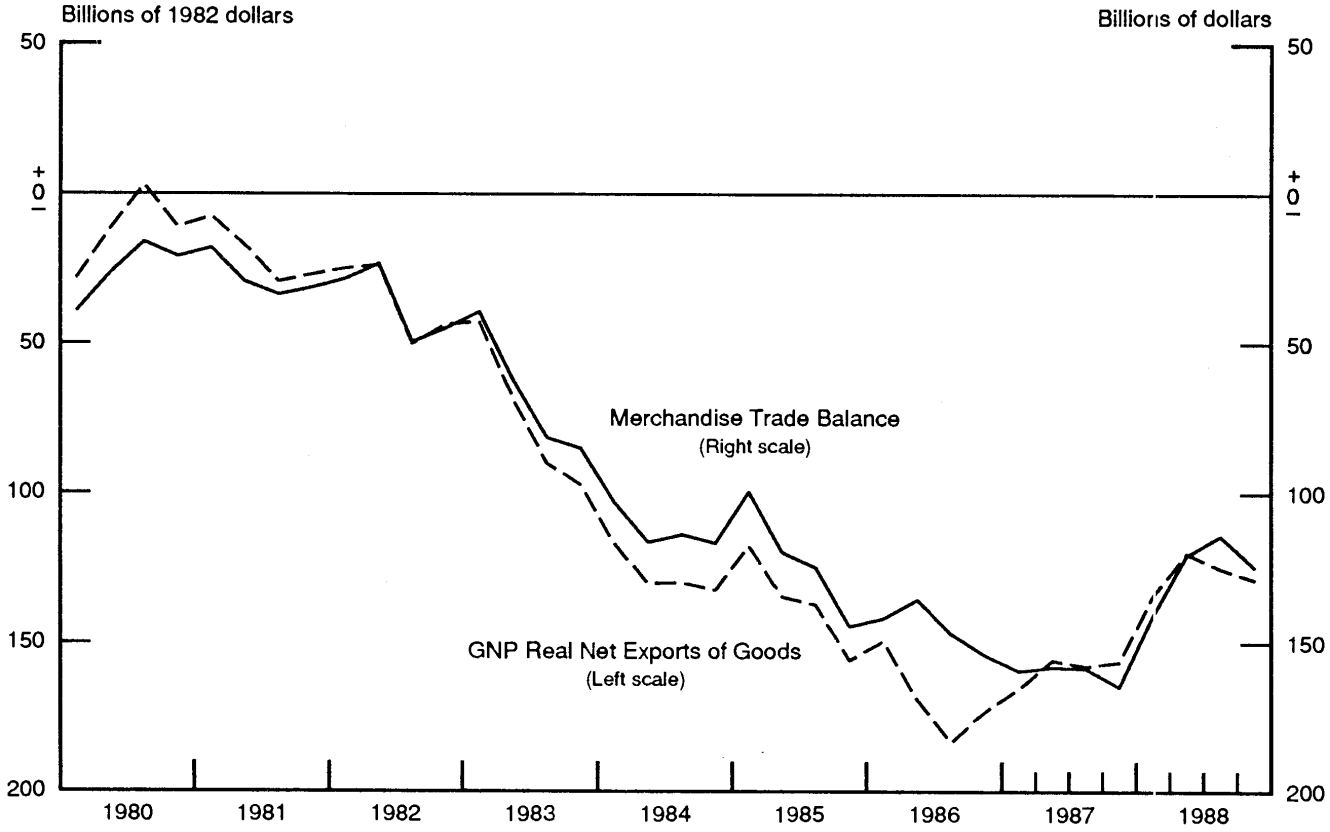
This section begins with a discussion of recent progress in U.S. external adjustment. We then consider how that progress measures up to prior expectations based on the predictions of a model that captures average historical experience.

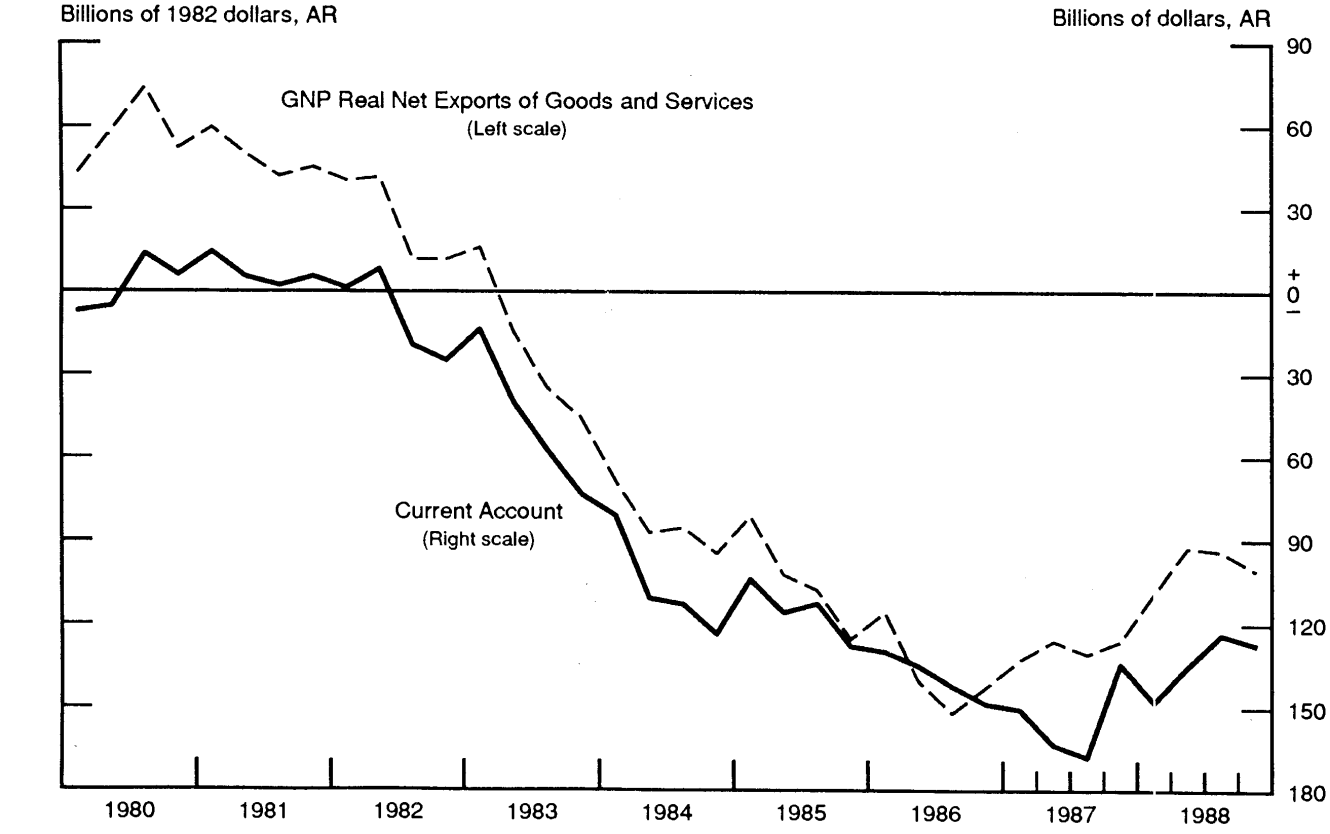
Movements in the U.S. trade and current account (or goods and services) balances in both nominal terms and real terms, are shown in Chart 1. The balances reached a low point in real terms in the second half of 1986, and in nominal terms about a year later. The merchandise trade deficit narrowed sharply during the first half of 1988, but leveled-off and even began to widen again somewhat in the second half of the year. The trends in imports and exports underlying this pattern of adjustment can be seen in the top panel of Table 1. Both the volume and value of exports accelerated sharply during the first half of 1988, while the volume and value of imports leveled-off. In the second half of the year (based on data through November), export growth slowed dramatically, while import growth picked up and actually exceeded export growth, particularly in real terms.

Movements in the overall current account balance during this period were influenced primarily by trends in the trade balance and by a sharp increase in capital gains on U.S. direct investment abroad at the end of 1987 (as indicated in the bottom panel of the table). The temporary surge in capital gains (line 4 in the table) was associated with the depreciation

Chart 1

U.S. External Balances





U.S. Trade and Service Account Transactions

	Percentage Change, Annual Rate		
	1987Q4 / 1986Q4	1988Q2 / 1987Q4	1988Q4 / 1988Q2
Merchandise Exports			
Value	20	37	7
Quantity	20	29	1
Merchandise Imports			
Value	15	1	8
Quantity	8	–1	8

Levels

(Billions of dollars, seasonally adjusted annual rates)

	1987		1988			
	Q3	Q4	Q1	Q2	Q3	Q4
1. Merchandise Trade Balance	–159	–165	–141	–121	–114	–123e
2. Net Services	3	48	6	–3	3	
3. Net Direct Investment Income	27	75	29	22	29	
4. of which, Capital Gains	2	45	2	–10	–9	
5. Other Income, Net	–22	–25	–24	–30	–30	
6. Other Services, Net	–2	–2	1	4	4	
7. Net Transfers	–12	–18	–13	–11	–13	
8. Current Account	–168	–134	–148	–135	–124	
9. Current Account, excluding Capital Gains in Direct Investment	–170	–179	–150	–125	–115	

e = estimate based on average of October and November

of the dollar during the latter part of 1987, which raised the dollar value of both U.S. direct-investment holdings abroad and the flow of income receipts from those investments. Excluding capital gains, the current account (line 9) bottomed out in the fourth quarter of 1987 with the trade balance, and showed roughly the same pattern of change during the first three quarters of 1988. Growing net payments on portfolio assets (line 5) associated with the mounting U.S. net foreign indebtedness and an increase in interest rates during 1988, were about offset by continuing large positive net direct investment income receipts (line 3) and an improving trend in other services, net (line 6).

Thus, an analysis of the movements in the merchandise trade balance is key to understanding trends in the overall external balance. As was suggested in the top panel of Table 1, as well as in Chart 1, most of the movement in the trade balance can be explained by changes in trade volumes. This is confirmed in Table 2, which shows that trade prices contributed little or nothing (directly) to the shifting trends in imports and exports during 1988. Total import prices rose very little throughout the year, extending the trend observed in 1987. Continuing declines in the prices of imported oil and computers were about offset by increases in the prices of other imports throughout 1988. (As indicated in the chart below the table, spot oil prices turned up at the end of the year, suggesting that import prices would rise somewhat in the first half of 1989.) Export price increases in 1988 did pick up noticeably from the 1987 pace, but, overall, remained about the same in the second half of the year as in the first half. A significant part of the 1988 acceleration, reflected a surge in agricultural prices induced by drought conditions in the United States.

Table 2

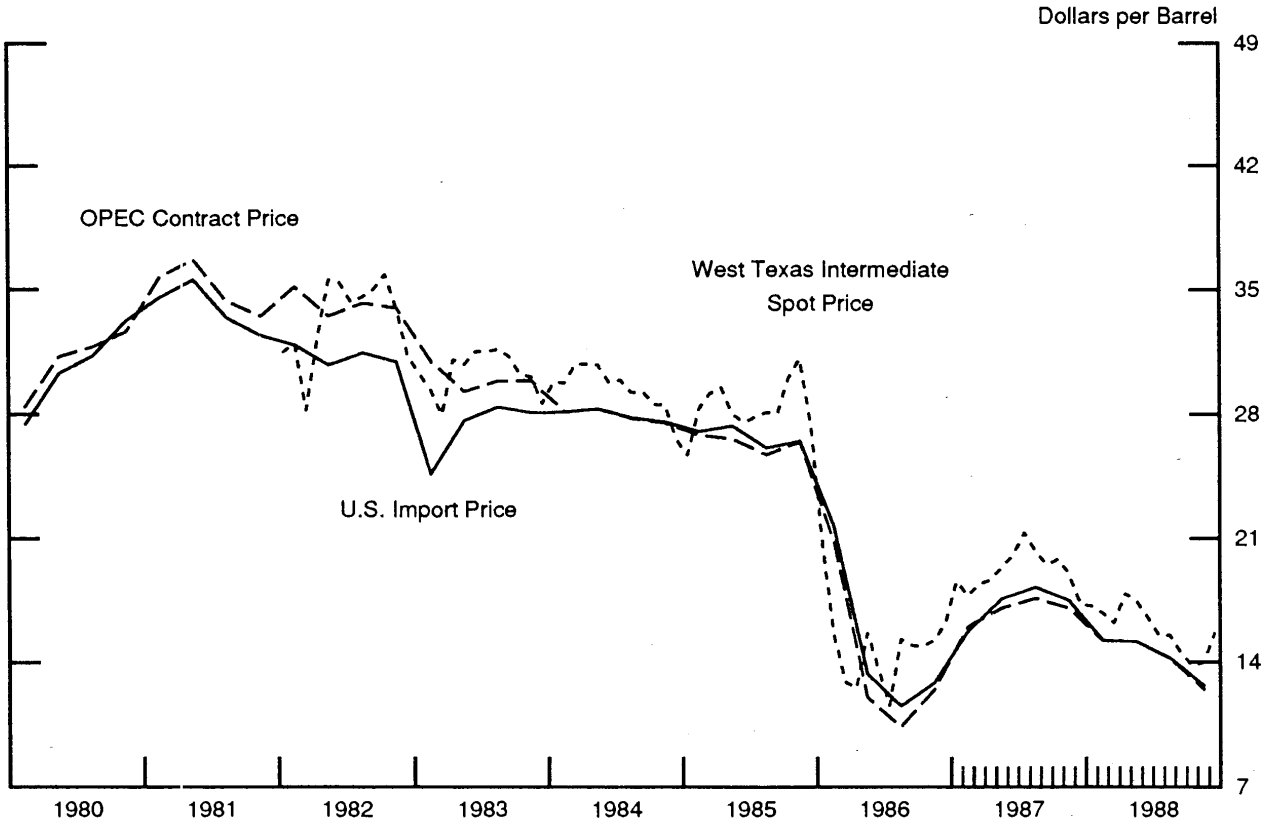
Trade Price Changes*

(Percent annual rate)

	1987:Q4 / 1986:Q4	1988:Q2 / 1987:Q4	1988:Q4 / 1988:Q2	1988:Q4e / 1988:Q3
1. **Total Imports**	**2**	**5**	**0**	**1**
2. Oil	–19	–25	–29	–36
3. Non–oil	7	10	5	7
4. Excluding computers	7	10	5	7
5. Computers	–13	–9	–3	–12
6. **Total Exports**	**1**	**8**	**7**	**3**
7. Agricultural	–3	25	25	0
8. Nonagricultural	2	6	3	4
9. Excluding computers	2	6	4	4
10. Computers	–13	–9	–3	–12

* GNP fixed weight price indexes.
e = estimate based on average of October and November.

Oil Prices



Price increases for nonagricultural commodities were fairly strong in the first half of the year, but slowed in the second half.

An analysis of developments in import and export volumes and values, by commodity and by region is presented in Table 3. On the import side, by commodity, all major categories of nonoil imports fell noticeably in real terms during the first half of 1988 and rebounded in the second half of the year. By region, imports from Japan showed the sharpest swing from decline to rebound during 1988, while those from Western Europe and the Asian NICs showed more subdued swings in the same direction.

On the export side, by commodity, agricultural exports showed the most pronounced swing from positive to negative during 1988, as shipments to the Soviet Union were bunched into the first half of the year, and as the drought may have affected shipments in the second half. However, a broad range of nonagricultural goods decelerated significantly as well. Exports to Western Europe, Japan, and the Asian NICs, which had grown exceptionally rapidly during the first half of the year, showed no further growth (and in some cases showed actual declines) in the second half of the year.

The key question concerning U.S. external adjustment at this juncture is whether the slowing of adjustment in the trade balance in the second half of 1988 reflects a temporary pause after an unusually rapid pace in the first half of the year, or a down-shift that is likely to be sustained. On the surface there seems to be little in the pattern of growth in domestic demand at home and abroad that can explain such a wide swing in U.S. real net exports during the course of the year. As indicated in the top panel of Table 4, U.S. personal consumption growth did increase in 1988 relative to 1987 and undoubtedly contributed to the strength of

Table 3

U.S. Trade By Commodity and Region

Export Volume by Commodity
(Percent change, annual rate)

	1987Q4 / 1986Q4	1988Q2 / 1987Q4	1988Q4[e] / 1988Q2
1. Agricultural	4	28	–23
2. Nonagricultural	23	30	4
3. Computers	55	30	13
4. Capital goods excluding computers	18	11	
5. Automobiles	20	18	
6. Consumer goods	18	36	
7. Industrial Supplies	7	22	
8. All Other	25	14	
9. Total Merchandise	**20**	**29**	**1**

e = estimate based on average of October and November

Nonagricultural Export Value
(Percent change, annual rate)

	1987:Q4 / 1986:Q4	1988:Q2 / 1987:Q4	1988:Q4[e] / 1988:Q2
1. Canada	18	28	8
2. Western Europe	17	49	0
3. Japan	23	42	3
4. Asian NICs	56	65	–13
5. Other	20	14	30
6. Total	**22**	**34**	**8**

e = estimate based on average of October and November

Import Volume by Commodity
(Percent change, annual rate)

	1987Q4 / 1986Q4	1988Q2 / 1987Q4	1988Q4[e] / 1988Q2
1. Oil	2	10	10
2. Non–oil	9	–3	6
3. Computers	73	27	5
4. Capital goods excluding computers	10	10	
5. Automobiles	5	–14	
6. Consumer goods	0	–7	
7. Industrial Supplies	3	–9	
8. All Other	9	–11	
9. Total Merchandise	**8**	**–1**	**7**

e = estimate based on average of October and November

Non–oil Import Value
(Percent change, annual rate)

	1987:Q4 / 1987:Q4	1988:Q2 / 1987:Q4	1988:Q4[e] / 1988:Q2
1. Canada	11	26	–1
2. Western Europe	13	–7	–2
3. Japan	6	–11	31
4. Asian NICs	20	2	9
5. Other	16	16	13
6. Total	**12**	**3**	**9**

e = estimate based on average of October and November

Table 4

U.S. and Foreign Real Growth

	Q4/Q4			1988			
	1986	1987	1988	Q1	Q2	Q3	Q4
1. U.S. GNP (%)	2.0	5.0	2.5	3.4	3.0	2.5	2.0
2. Personal Consumption (%)	4.6	1.8	3.7	4.5	3.0	3.8	2.8
3. Business Fixed Investment (%)	–7.3	8.8	5.4	7.6	15.0	4.0	–3.7
4. Change in Business Fixed Investment (Billions 1982$)	—	—	—	66.0	35.0	39.5	29.2
5. Rest of World GNP* (%)	2.7	3.9	3.3	4.1	2.2	3.7	3.4

* All regions, weighted by shares in U.S. bilateral exports.

U.S. Exports and Manufacturing Capacity Utilization

	Share of Total Exports in 1987 (%) (1)	Share of Net Shipments in 1987 (%)* (2)	Capacity Utilization Rates Highs 1978–80 (3)	1988:Q4 (4)
1. Total Manufacturing	**82**	--	**86.5**	**84.4**
Selected Categories:				
2. Nonelectrical Machinery	16	17	86.0	82.2
3. Chemicals	10	17	82.9	89.7
4. Motor Vehicles	8	21	93.3	86.1
5. Electrical Machinery	8	13	89.9	78.1
6. Food	5	5	85.1	80.9
7. Instruments	4	17	88.9	83.4
8. Primary Metals	2	7	97.1	90.5
9. Lumber	2	8	87.9	84.7
10. Paper	2	7	92.7	94.5
11. Fabricated Metals	1	5	87.4	84.6
12. All Other Manufacturing	20	--	--	--

e = estimated.
* Export share of total U.S. shipments net of intra-industry shipments.

imports overall. However, consumption, inventories and especially business fixed investment grew more rapidly in the first half of 1988 than in the second half, contrary to the pattern of import growth. And, growth in U.S. markets abroad, on average, does not show any signs of having decelerated significantly in the second half of the year when U.S. export growth slowed.

One theory is that the recent slowdown in U.S. net exports reflects the effects of capacity constraints in key U.S. manufacturing sectors. As indicated in the bottom panel of Table 4, however, capacity utilization rates at the end of 1988 were at or above their 1978-80 peaks in only two manufacturing sectors that are key to exports: chemicals and paper.[2] In most other sectors that are important to exports utilization rates were still noticeably below previous peaks. Moreover, if such constraints had been significant, some pickup in export price inflation might have been expected, but as we noted above, overall nonagricultural export prices actually decelerated during the year.

A second theory is that the rise in the dollar during 1988 had positive "J-curve" effects (through lower import prices) that tended to reduce the deficit initially, and were reversed later in the year. As indicated in the top panel of Chart 2, the dollar rose noticeably towards the middle of 1988, and fell back again somewhat in the second half of the year. However, most of the beneficial effect on import prices came in the second half of the year (largely in the third quarter). As we saw in Table 2, increases in import prices were noticeably stronger in the first half of 1988 than in the second half.

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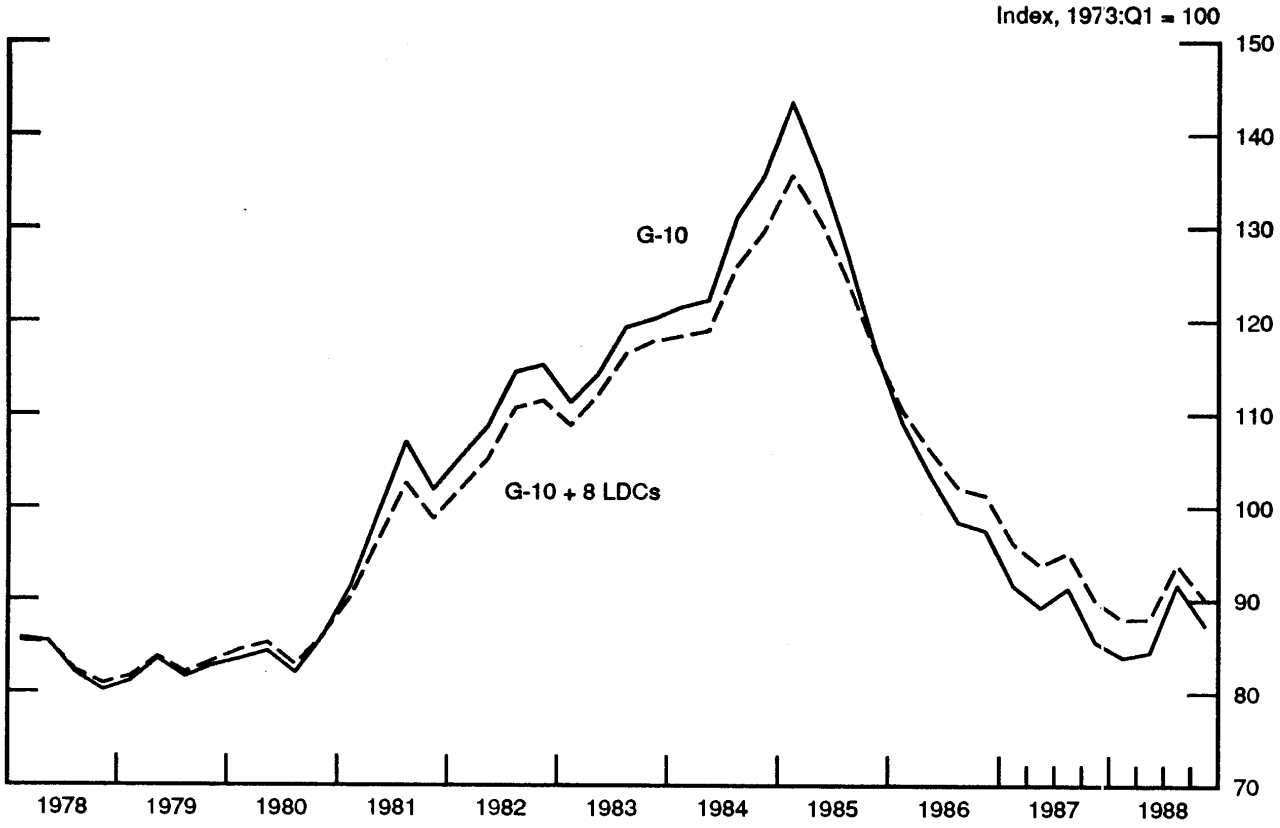
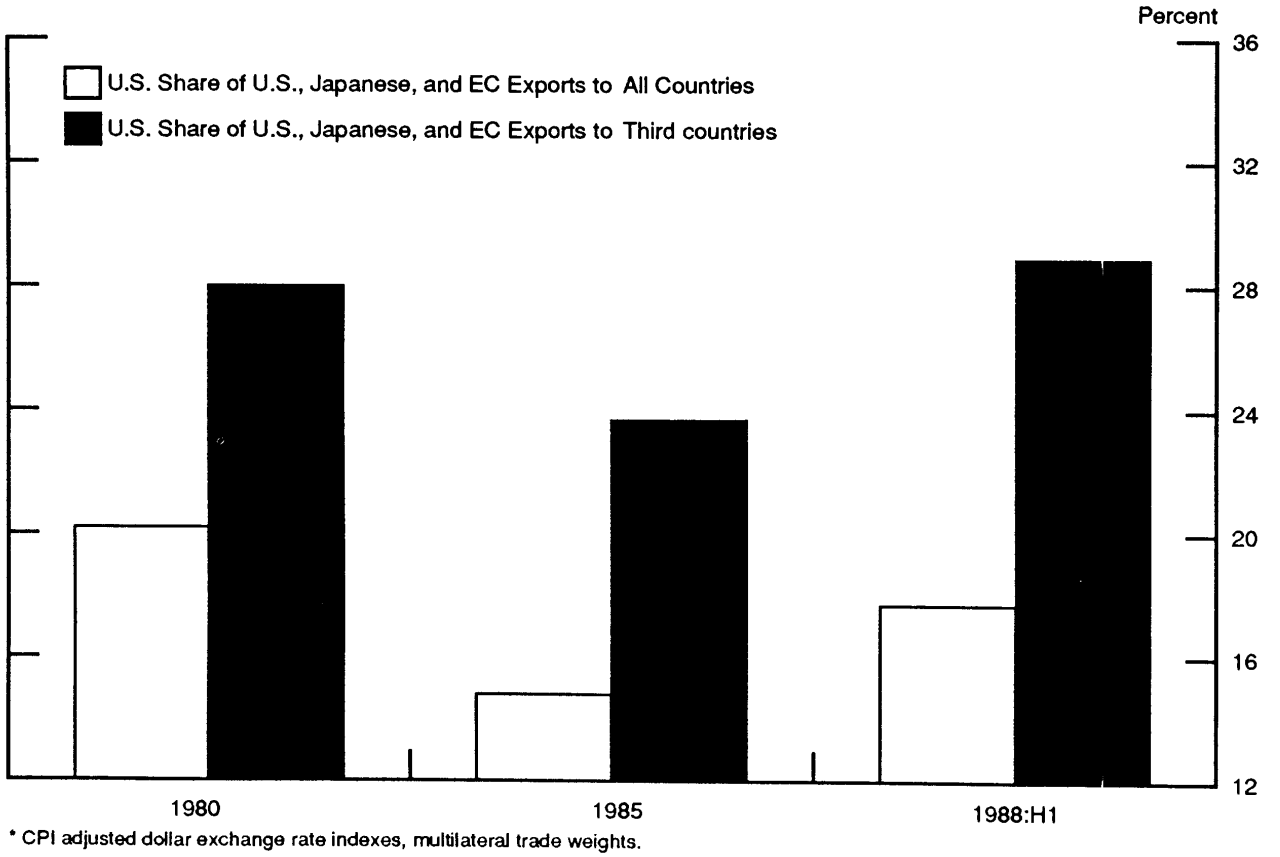
2. Utilization rates for certain primary metals, most notably aluminum (not shown in the table), were also quite high.

Chart 2

Real Dollar Exchange Rates*



U.S. Shares of OECD Export Volumes



* CPI adjusted dollar exchange rate indexes, multilateral trade weights.

A third possible explanation for recent changing of external adjustment is that the stimulative effects of the decline in the dollar through 1987 have weakened significantly as time has gone by, particularly with the strengthening of the dollar during 1988. Data on world trade shares (illustrated in the bottom panel of Chart 2) indicate that in the first half of 1988, U.S. real exports, as a share of total U.S., EC, and Japanese real exports, were about mid-way between their peak in 1980 and their low point in 1985. With the dollar's real exchange rate currently not too far above its 1980 level, these data suggest that significant further adjustment in response to the current level of exchange rates could still be in the pipeline. However, these shares are distorted to some extent by the more rapid growth of demand (and imports) in the United States than in other countries during the 1980s. When U.S. real exports are compared to Japanese and EC exports to third countries (i.e., not including exports to the United States, Japan or the EC), the U.S. share has already returned to its 1980 peak, suggesting less scope for "pipeline optimism." For a more complete assessment of the implications of the current mix of growth and exchange rates for the U.S. external balance we turn next to model simulations.

III. Actual Adjustment Relative to Model Predictions.

In this sub-section we investigate the progress of U.S. external adjustment to date relative to what might have been expected on the basis of previous historical experience as embodied in a partial equilibrium model of the U.S. external accounts. This model, which is basically the U.S. foreign sector in the Federal Reserve Board Staff's Multicountry Model

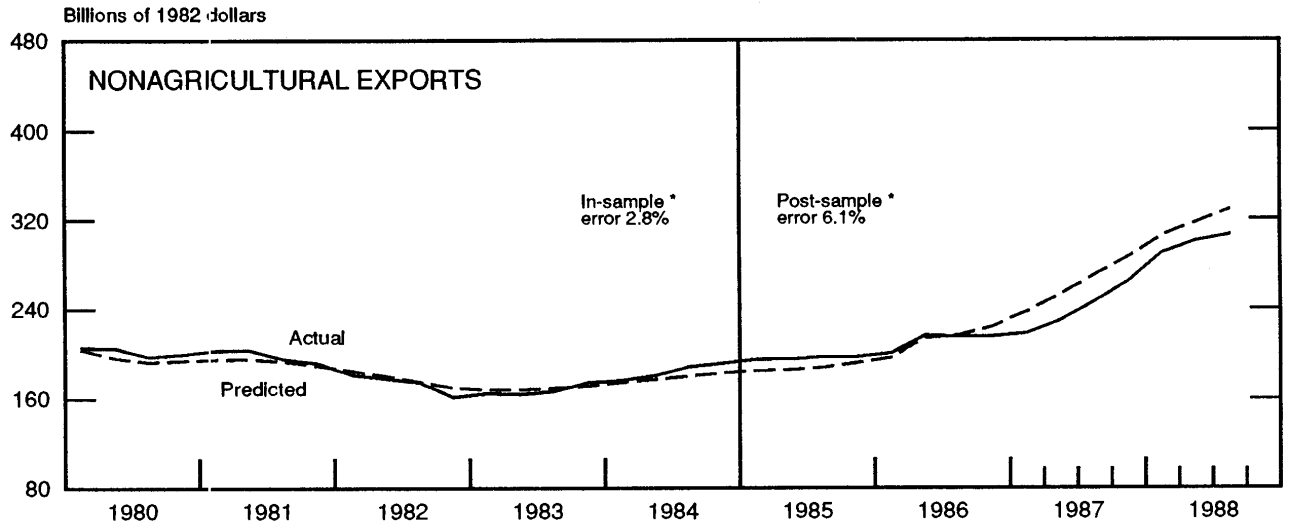
(MCM), is documented in Helkie and Hooper (1988) and will be referred to as the HH model to differentiate it from general-equilibrium simulations of the MCM. Two minor changes have been made to the model as it was documented by Helkie and Hooper (1988). These changes, which involve re-estimation of the non-agricultural export price and nonoil import price equations, are documented in the appendix.

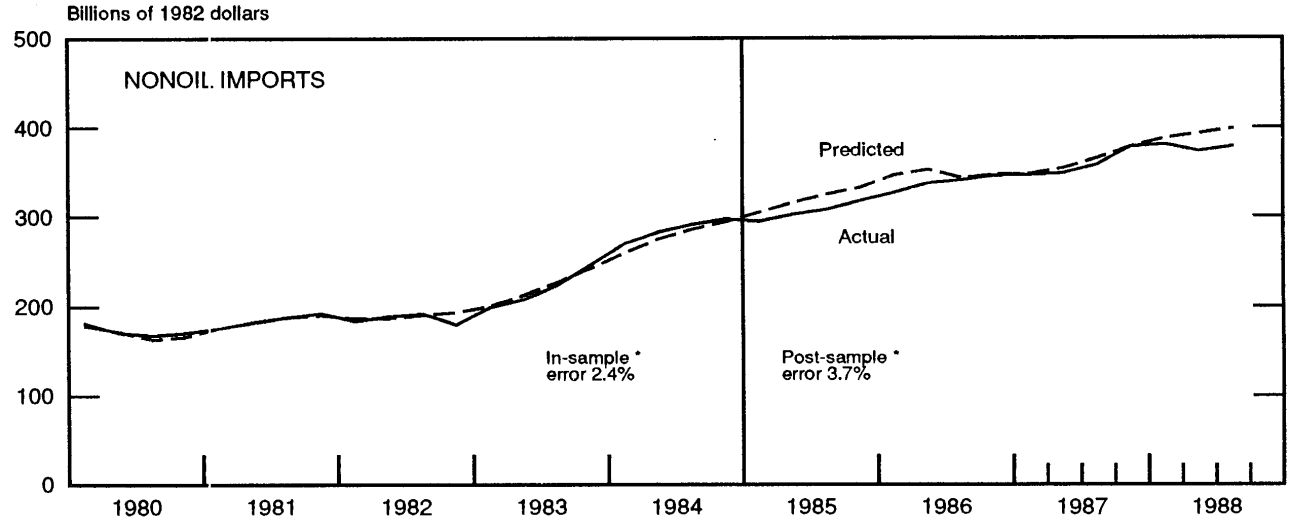
The predictive performance of key individual equations and the overall model are shown in charts 3 to 5. Each figure shows an actual value (solid line), a model prediction (dashed line), and a summary of the root-mean-squared prediction errors (RMSE). These RMSEs are expressed as percentages of the historical means, and in the case of balances or net flows as a percentage of the mean of the sum of the underlying gross flows (for example, total exports plus total imports for the trade balance). The RMSEs are calculated separately for that part of the past decade which is within the sample used for parameter estimation (ending in 1984Q4) and that interval that is outside the sample period. The model predictions are based on actual values of the income, relative price and other determinants of trade prices and volumes. In order to provide a more stringent test of the predictive power of the structural variables included in the model, autoregressive residuals are not included in the model predictions.

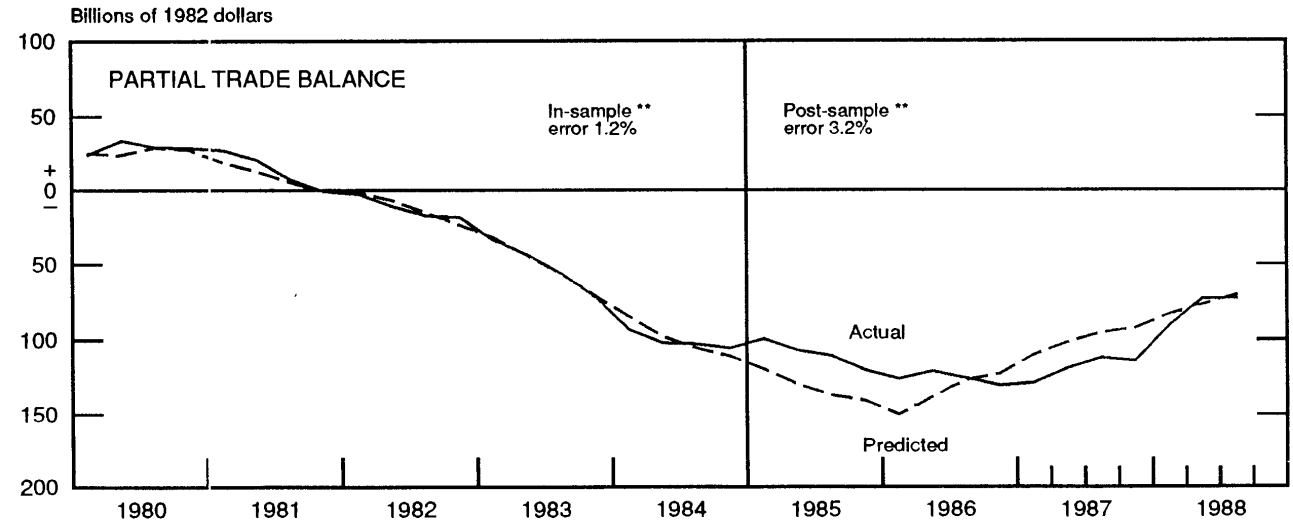
The key equations in the HH model that relate movements in the trade and current account balances to changes in relative prices and incomes are those for volumes of non-agricultural exports and non-oil imports. As shown in the bottom panel of Chart 3, the model underpredicted the level of the real partial trade balance (real non-agricultural exports minus real non-oil imports) during 1985 and early 1986. However, the model also predicted an earlier and much sharper turn-around in the real partial

Chart 3

Actual and Predicted Merchandise Trade Volumes 80Q1-88Q3





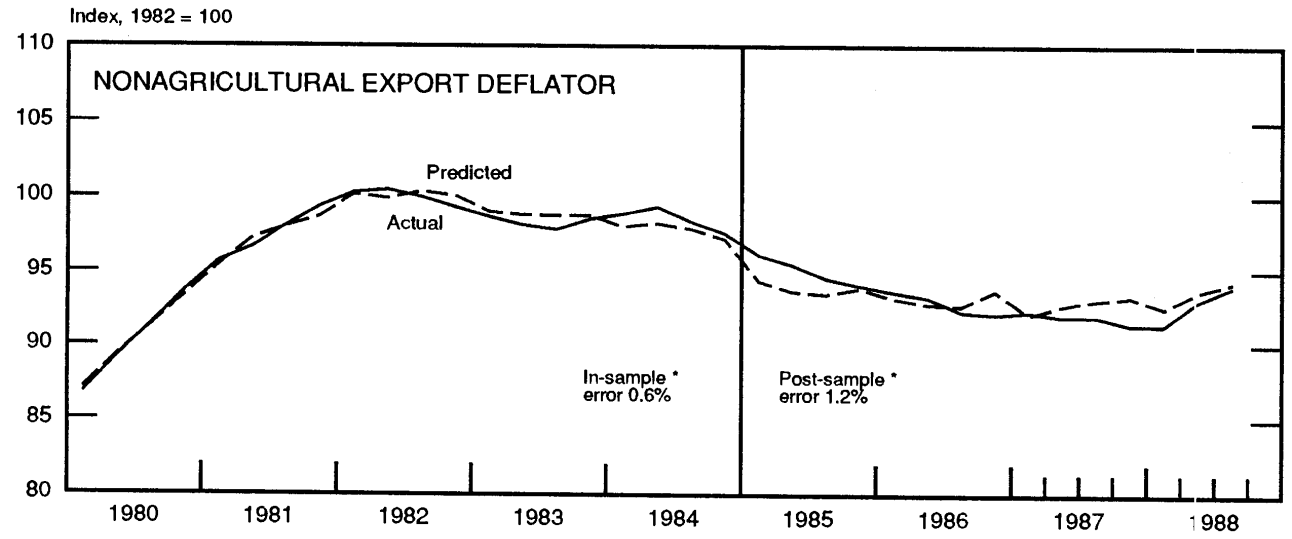


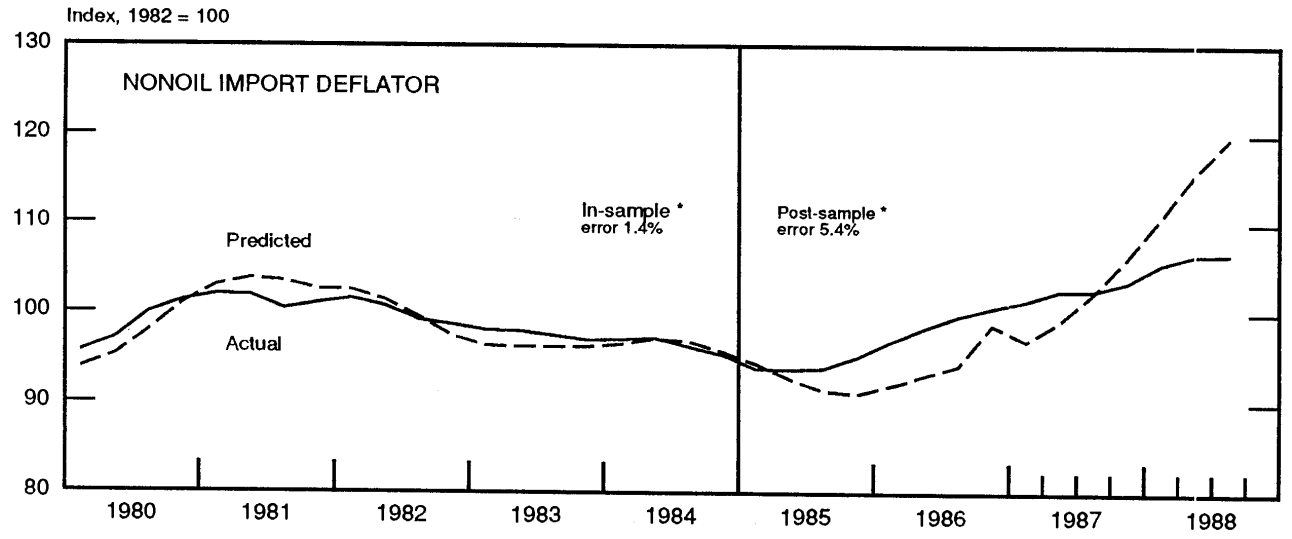
* Root mean square prediction error as a percentage of sample mean of actual value.

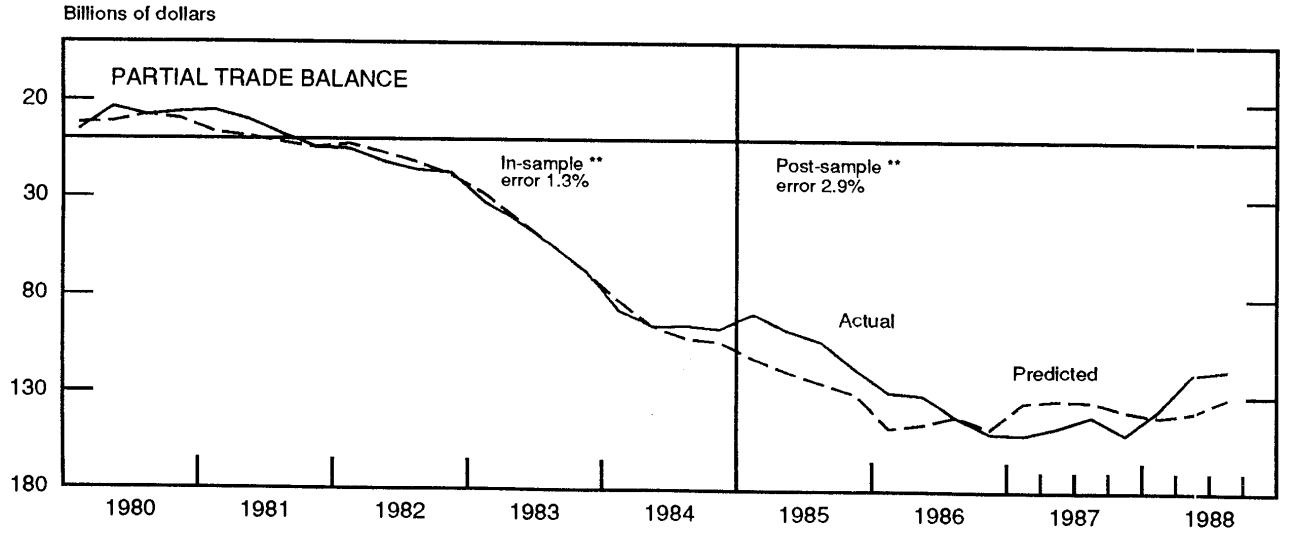
** Root mean square prediction error as a percentage of sample mean of non-agricultural exports plus non-oil imports.

Chart 4

Actual and Predicted Trade Prices and Trade Balance





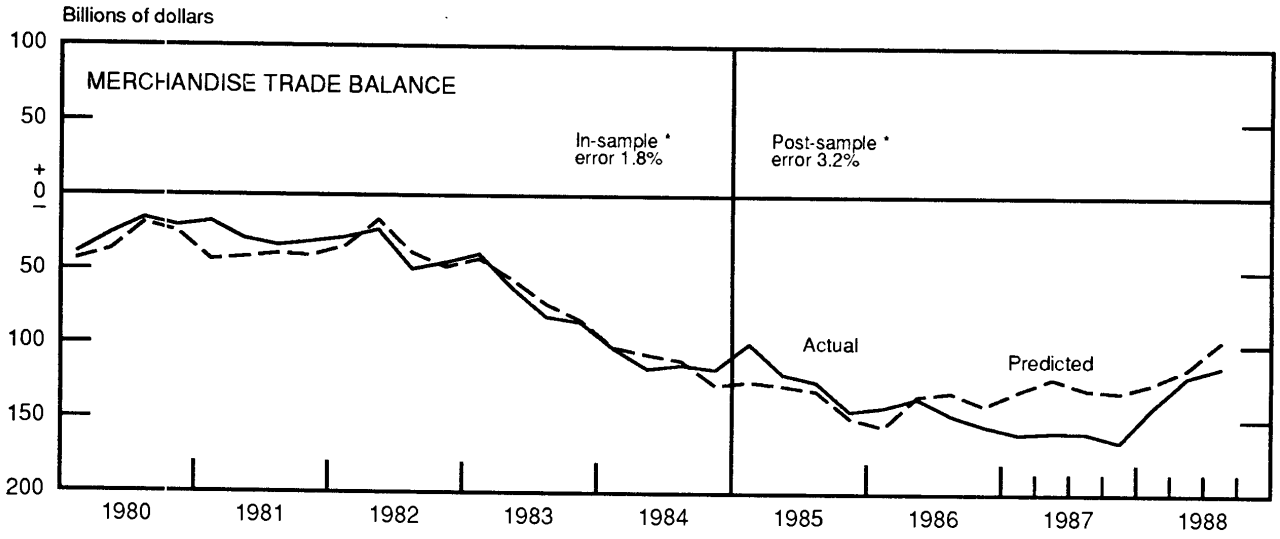


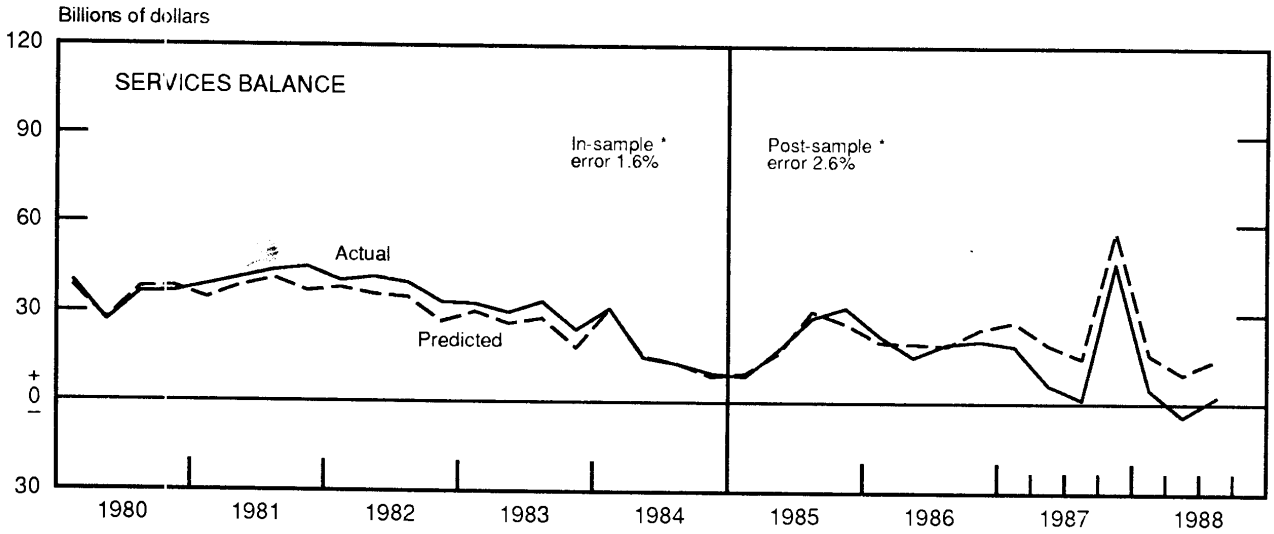
* Root mean square prediction error as a percentage of sample mean of actual value.

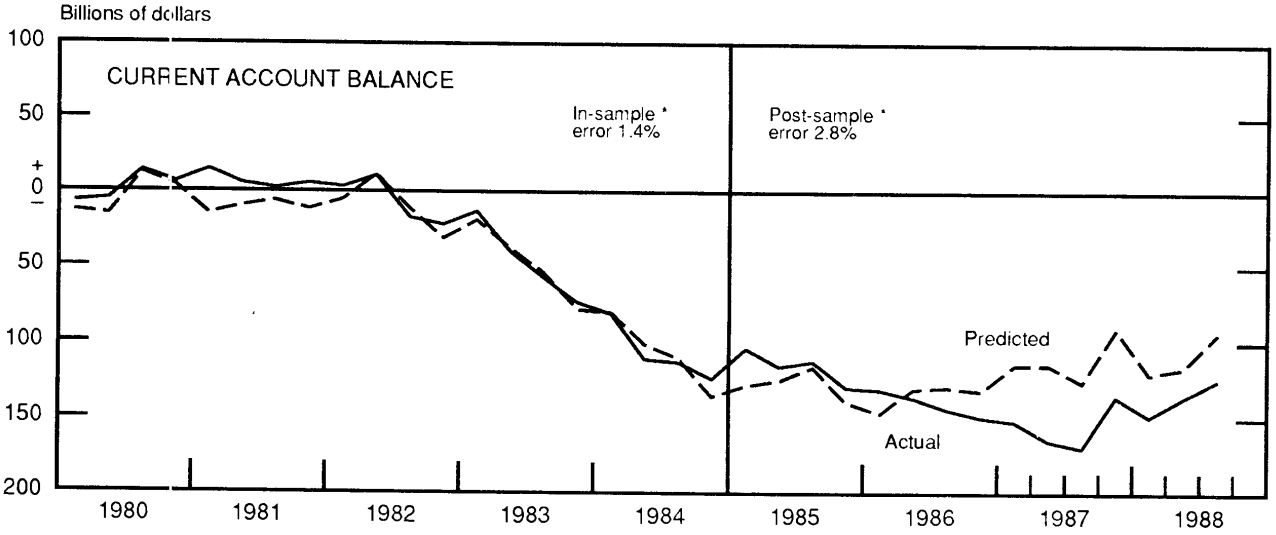
** Root mean square prediction error as a percentage of sample mean of non-agricultural exports plus non-oil imports.

Chart 5

Actual and Predicted U.S. External Balance







* RMSE expressed as a percentage of sample mean of merchandise exports plus imports, service receipts plus payments, and exports plus imports of goods and services respectively.

trade balance than actually took place, and overpredicted the level of that balance during 1987 and early 1988. The real partial trade balance then advanced more rapidly than the model's prediction during the first half of 1988, bringing the actual balance and the model back in line by the second and third quarter. In brief, the speed of adjustment in the first half of 1988 was faster than expected, but that adjustment merely "made up" for the unexpected persistence of the real deficit during 1987. One might infer from this error pattern that the lags in the response of trade volumes to changes in relative prices are somewhat longer than those captured in the model. However, the "actual" data for 1986-88 are still subject to potentially significant historical revision.

The predictions of the trade price equations are shown on Chart 4. Non-agricultural export prices have evolved pretty much as expected given realized values of wholesale prices in the United States and abroad. That is, the relationship between the difference between U.S. wholesale and non-agricultural export prices and foreign dollar prices does not appear to have changed during the 1980s. On the other hand, the relationship among U.S. nonoil import prices, foreign wholesale prices, exchange rates, and nonoil commodity prices appears to have changed. The explanation for this phenomenon relates to the measurement of U.S. trade deflators. A key component of the deflators is a hedonic price index for computers, which has been falling at an annual rate of more than 10 percent in recent years. The share of computers in the variable-weighted deflator for nonoil imports has risen from near zero in 1982 to nearly 25 percent in 1988, and has been a major factor in holding down the rate of increase in the overall deflator. Since this price behavior is not reflected in available measures of foreign wholesale prices, the equation has been overpredicting the rate

of increase in import prices in recent years, as indicated in the second panel of Chart 4.[3]

With import prices over-predicted, the model underpredicts the level of the nominal partial trade balance in 1988, as indicated in the third panel. When computers are excluded, the model tracks non-oil import prices more closely and is about in line with the recorded nominal partial trade balance in the third quarter of 1988. In the fourth quarter (not shown in the chart), the partial trade balance fell relative to the model's prediction, however.

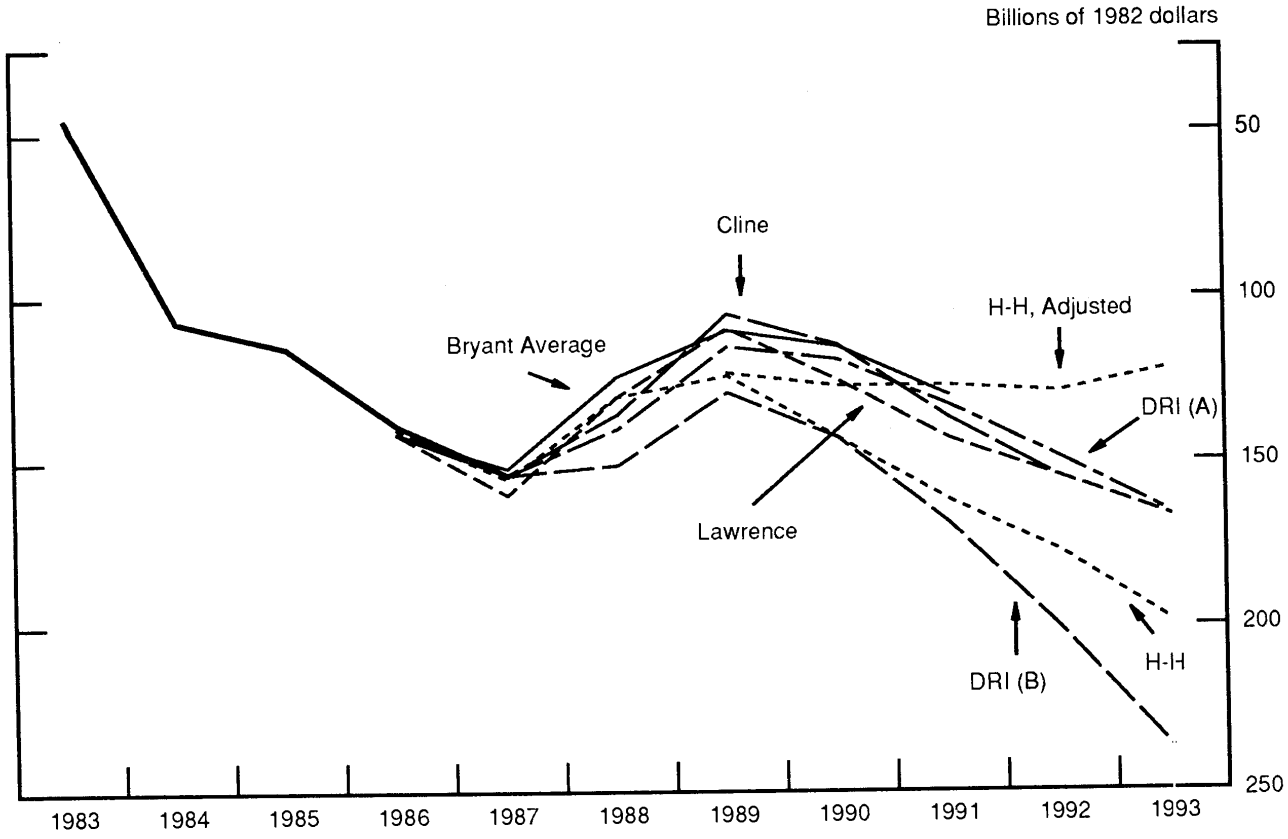
As can be seen in Chart 5, the model's prediction of the broader balances follows (and is driven by) its prediction of the partial trade balance. The model shows a somewhat higher level of agricultural exports net of oil imports than occurred in 1988; it also suggests a higher level of net services. Overall, the model's predictions of the trade balance and the current account have been above the actual balances over the past two years. The gap between model and actual narrowed significantly in the first half of 1988, but widened again somewhat in the second half.

We hesitate to conclude, solely on the basis of the pattern of errors in Chart 5, that there is room for significant additional adjustment in the current account at the present levels of its determinants. The model's past predictions of agricultural exports, oil imports, and service transactions have shown significantly larger errors than its predictions of the components of the partial trade balance. Moreover, these components

3. The same problem does not show up on the export side, because the U.S. domestic price of computers is factored in on the right hand side of the export deflator equation.

Chart 6

Extrapolations of the U.S. Current Account



Assumptions

U.S. and Foreign Growth	2-1/2 to 3 percent per year 1988-1993.
Real Dollar Exchange Rate	Unchanged from 1987 Q4 average.
Oil Price	Unchanged in real terms.

(especially net services) are subject to substantially greater data revision than other components of the current account.

IV. Prospects

As we noted earlier, the question now on the mind of most analysts of the U.S. external balance is, has it reached a plateau, or is there significantly more improvement still in the pipeline? What can be gleaned from model predictions about this issue?

Figure 6 shows some extrapolations of the current account deficit based on simulations of the HH model and a number of other partial-equilibrium models. Many of these projections were run earlier in 1988, but the assumptions under which they were run are still broadly relevant. Assuming that U.S. and foreign growth expand at a rate of 2-1/2 - 3 percent per year and the real value of the dollar remains unchanged from its 1987Q4 average (which was slightly below its 1988Q4 level), the HH model projects that the U.S. current account deficit will decline somewhat further in 1989, rise to its 1987 peak level by 1991, and then expand at a rate of 10 percent per year. A similar story is told by the extrapolations of the other models. Movements in the exchange rate affect the current account with little more than a two-year distributed lag in most of these models. With the real value of the dollar essentially unchanged after 1987, the positive effects of the depreciation disappear after 1989. Thereafter, similar growth rates in exports and imports imply a growing trade deficit, to which we add growing net investment income payments to foreigners.

These projections may be overly pessimistic. The models and the data upon which the parameters are based may not take into account the

distinct possibility that U.S. prices and labor costs are now significantly below those in other major industrial countries. Hooper (1988) and Hooper and Larin (1988) have estimated that manufacturing unit labor costs in the United States were as much as 30 percent below those in other major industrial countries, on average, at exchange rates prevailing in the third quarter of 1988. Cost differentials of this magnitude, if they are expected to persist, could induce ongoing adjustment beyond the 2-3 year adjustment horizon in the models even if the dollar does not decline further. Such longer-run adjustment would take the form of a shifting of manufacturing output capacity towards the United States and away from countries with higher labor costs.

In a preliminary attempt to amend the HH model projection for such a shift in output capacity, that model's relative supply variable was altered under the assumption that manufacturing investment in the United States would continue to grow at the 10 percent annual rate recorded in 1988, and that net investment in manufacturing in other major industrial countries would show zero growth for several years. The resulting shift in relative output capacity was enough to level-off the current account balance, as indicated by the path labeled "HH adjusted" in Chart 6.[4] The recent behavior of business fixed investment in the United States and abroad suggest that this adjustment may in fact be somewhat optimistic. Investment intention surveys suggest that manufacturing investment in the United States will grow by significantly less than the 10 percent advance recorded in 1988, while investment in other industrial countries appears to

4. See Hooper (1988) for a more detailed description of how this adjustment was made in the model, as well as a description of the other model projections included in the chart.

have been considerably stronger than expected during 1988, and could well continue to grow at a healthy pace in 1989.

The projections of the external balance that are derived from our model are random variables and therefore subject to several sources of uncertainty. These sources include the stochastic nature of the underlying process we are trying to model, the choice of model specification, the values of the parameters of the model, which when estimated are random variables, and errors in data measurement. Uncertainty in the model's projections may be wide enough to encompass significantly greater external adjustment than has occurred to date. We attempt to quantify such uncertainty bands more formally in the next section.

V. Model Uncertainty

The historical model-based projections of the merchandise trade and current account balances depend on the estimated parameters of the model -- basically income and price elasticities -- and the equation residuals. Since both the model parameters and the equation residuals are random variables, the model projection of the trade balance is also a random variable. In this section we present a 95-percent confidence band around the historical model projection based on the uncertainty due to the model's equation residuals based on methods outlined by Fair (1986) and recently applied to trade models by Marquez (1988).

The calculation of the confidence interval around the model's forecast is complicated by the specification of the model. Since the specification of the trade volume and price equations are log-linear, the implicit function projecting the trade balance is nonlinear. Because of

this nonlinearity, it is very difficult to estimate the parameters of the error distribution for the projection of the trade balance, per se, directly from the parameters of the error distribution of the behavioral equations in the model. We have therefore, used stochastic simulation techniques to calculate the 95 percent confidence interval around the model's trade balance projection.

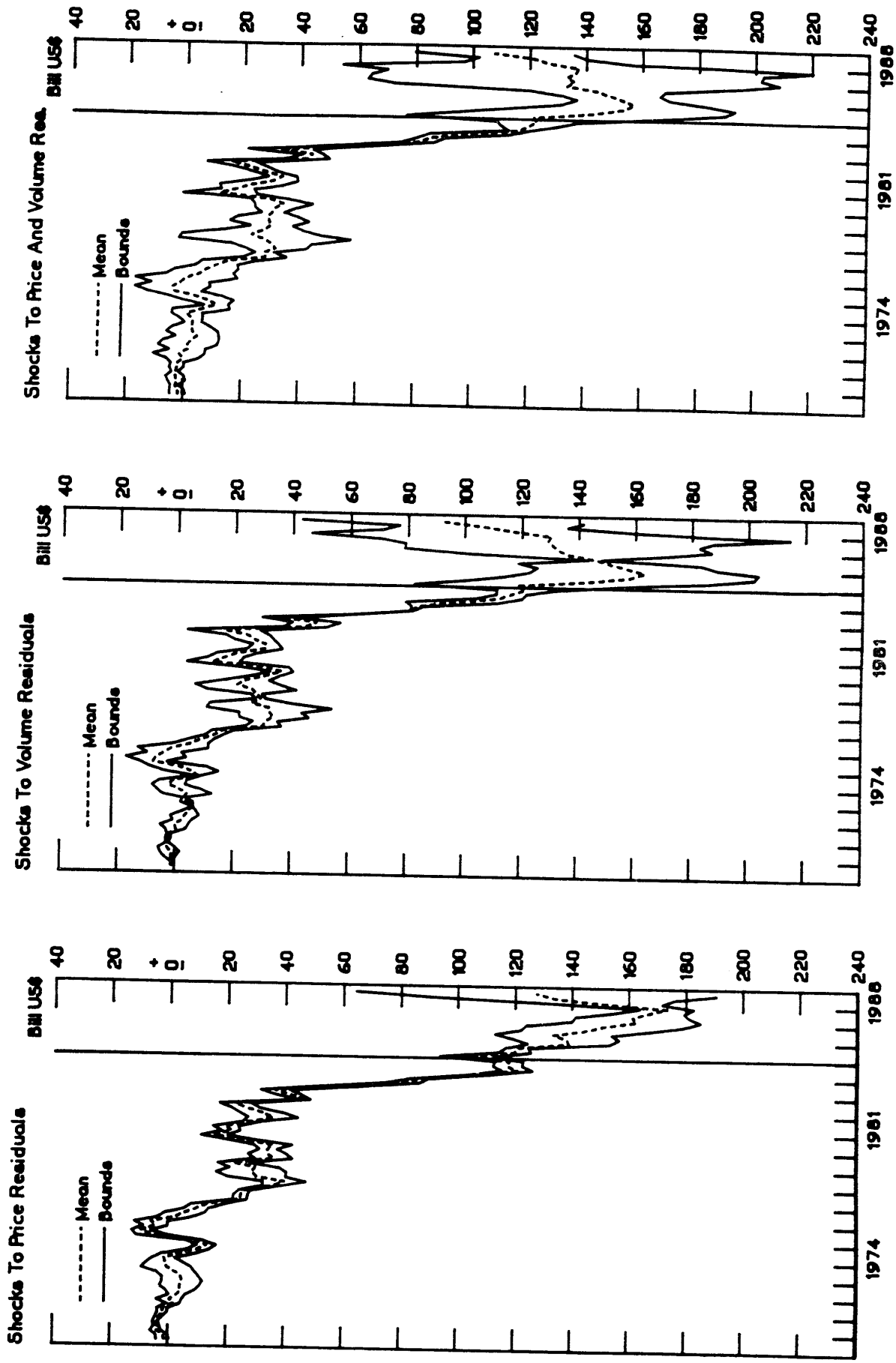
The stochastic simulation techniques employed for this purpose are specified in Marquez (1988). In essence, the program creates a repeated sampling of residuals for each of the behavioral equations in the model. This is done by drawing new residuals from a set of independent normal residuals (IN(0,1)) that have the same mean and variance as the residuals in the corresponding behavioral equations. This method, usually referred to as bootstrapping, does not require prior knowledge of the distribution of the residuals. However, the hypothesis underlying the statistical tests performed in the estimation of the model assumed the residuals were normally distributed. Tests performed on the residuals of the equations supported the normality assumption for the four equations for which we performed the stochastic simulations.

The analysis performs 100 drawings of the residuals. For each drawing, the model is simulated from 1969Q2 to 1988Q3. The resulting confidence bands are shown in Chart 7. The left panel of the chart shows the band in the trade balance due to the uncertainty embedded in the price-equation residuals for nonoil imports and nonagricultural exports. The center panel depicts the band around the trade balance derived from the uncertainty due to the residuals in the two trade-volume equations. The right panel lists the error band based on uncertainty due to the residuals in both the volume and price equations.

Chart 7

U.S. Trade Account

95 % Confidence Intervals Of Residual Uncertainty



The within-sample error band due to the price residuals is quite narrow. Although the 95 percent confidence band varies from less than $4 billion in 1977Q3 to a high of nearly $22 billion in 1978Q3, the interval is nearly symmetric and averages about $12 billion. The error band due to the volume residuals is substantially wider. The 95 percent confidence band based on shocks to both the price and volume residuals is nearly the sum of the two bands. The error band due to the combined shocks ranges from a low of $6.5 billion in 1982Q4 to a high of nearly $75 billion in 1978Q1.

The post-sample error bands are substantially larger than those computed within the sample. This is due to the fact that the observed residuals are larger, post sample, than within the sample over which the parameters are estimated. This may be due, in part, to the preliminary nature of much of the data outside the sample period.

We have also performed a preliminary analysis of the error variance in the model predictions based on the uncertainty due to the model's parameters. The corresponding error bands are of the same order of magnitude as those computed for the uncertainty due to the residuals.

VI. Conclusions

This paper has presented an empirical analysis of the progress in U.S. external adjustment through 1988 and prospects for continued adjustment over the years ahead. Our analysis of the performance of a partial-equilibrium model of the U.S. current account, suggests that U.S. external adjustment was slower than "expected" during 1986-87, and faster than expected during the first half of 1988. The model was about "on

track' at mid-year 1988. Thereafter, some slowing of the pace of adjustment was anticipated, as the positive effects of the past depreciation began to wear off. But the model did not fully anticipate the net widening of the trade balance that took place in the second half of 1988. Extrapolations of the U.S. external balance with exchange rates and income growth rates held unchanged, using various models, indicate that the U.S. external balance could narrow somewhat further during 1989, but will begin to widen again thereafter. This view may be overly pessimistic, due to some limitations of the models and the possible longer-run effects of past exchange rate changes. In any event the range of uncertainty around these model projections leaves ample room for further adjustment, as well as for some further widening of the deficit.

Appendix

Trade Price Equations

Nonagricultural export and nonoil import prices are determined in markup equations. The markup over domestic production costs, proxied by domestic output prices, is a function of competing goods prices in the foreign market lagged one quarter. The import price equation also includes a world nonoil commodity price variable, since nearly 20 percent of these imports can be classified as basic commodities rather than manufactured goods.

The estimation results suggest that changes in domestic costs in the exporting country are passed through quickly to U.S. import and export prices. Costs are proxied by an average of domestic output prices by sector, weighted by each sector's share in U.S. nonagricultural exports, in the export price equation and by foreign consumer prices, weighted by bilateral nonoil import shares, in the import price equation. Markups or profit margins are assumed to vary, particularly in the short run, in response to changes in prices in the foreign market. On the import side, nonoil import prices respond with a lag to changes in the dollar's exchange rate. And on the export side, nonagricultural export prices respond with a lag to changes in the exchange rate times foreign prices. The coefficient estimates are shown in Table A-1.

The price equations differ from those reported in Helkie and Hooper (1988) for two reasons. First, the computer series that was used as an explanatory valuable in the nonagricultural export price equation was revised back through 1970 as was its relative share of nonagricultural

exports. Second, we wished to use wholesale rather than consumer prices for competitive prices for U.S. exports and explanatory variables for U.S. nonoil import prices.

Table A-1

Parameter Estimates for Trade Price Equation

Independent Variable	Nonagricultural Exports	Nonoil Imports
Intercept	0.36 (2.59)	3.81 (8.92)
Domestic prices	0.92	... (29.94)
Foreign prices[b]	0.13 (3.90)	0.80 (14.03)
Exchange prices[b]	-0.13 (3.90)	-0.82 (-8.88)
Commodity prices[c]	...	0.21 (3.45
Summary statistic		
Rho	0.60 (6.41	0.76 (8.61)
$\bar{R}^2$	0.99	0.99
Standard error of estimate	0.0008	0.014
Durbin-Watson	1.64	1.49
Estimation Sample	75Q1-84Q4	70Q1-84Q4

[a] Equations are expressed in logarithmic form. Numbers in parentheses are t-statistics.

[b] One-quarter lag on both price and exchange rate in nonagricultural exports; six-quarter distributed lag on exchange rate and four quarter lag on foreign and commodity prices in nonoil import equation.

[c] International Financial Statistics nonoil commodity price index.

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