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EXCHANGE RATES AND U.S. EXTERNAL ADJUSTMENT IN THE SHORT RUN AND THE LONG RUN

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ABSTRACT

The objective of this paper attempts to reconcile PPP-based views and model-based views about prospects for U.S. external adjustment in the medium term. Projections based on conventional models of the current account do not fully capture ongoing adjustments to exchange rate changes that are implicit in long-run PPP theory. In particular, the model-based projections fail to capture longer-run shifts in relative output capacity in response to sustained cost differentials (or deviations from absolute purchasing power parity) across countries. Such supply-side adjustments appear to have been quantitatively important in the past. With U.S. labor costs in manufacturing now noticeably below those in some other major industrial countries, these supply-side adjustments are potentially important in the period ahead. Nevertheless, when the model extrapolations are revised to factor in such longer-run adjustments, the projected deficit remains sizable.

Exchange Rates and U.S. External Adjustment in the Short Run and the Long Run

Peter Hooper[1]

I. Introduction and Summary

As the U.S. external deficit began to respond in 1988 to the decline in the dollar over the preceding three years, sharply differing views emerged about prospects for the dollar and the deficit in the years ahead. One view is that a sustainable external balance would not be achieved without a substantial further decline in the dollar.[2] This view is based soundly on the extrapolations of conventional econometric models of the current account, which suggest that if the dollar remains at its current level, the deficit may narrow somewhat further, but will remain large, and eventually will begin to widen again. Another view, which appears to be have been held more widely in foreign exchange markets during much of 1988, is that the dollar has already fallen to (or even below) a level that is consistent with sustainable external balance in the longer run. This second view is bolstered by purchasing power parity (PPP) calculations, which indicate that U.S. prices and costs are

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1. The author is Assistant Director of the Division of Intenational Finance, Federal Reserve Board, and was a guest scholar at the Brookings Institution when this paper was written. The views expressed here are my own and do not necessarily reflect the views of the Brookings Institution, the Federal Reserve Board or other members of their staffs. I have benefitted from comments and suggestions by Barry Bosworth, William L. Helkie, Robert Z. Lawrence, Jaime R. Marquez, Ellen Meade, Edwin M. Truman, and participants in a seminar on global adjustment at the Institute for International Economics. I am also indebted to Kathryn A. Larin for her research assistance.

2. See Dornbusch (1988) and Krugman (1987 and 1988b). Also, New York Times (1988), for example, quotes Dornbusch, Feldstein and Summers on the need for a further decline in the dollar.

well below those in other industrial countries.[3]

The objective of this paper is to reconcile the PPP and model-based views, and to show that each contains a significant grain of truth. Projections based on conventional models of the current account do not fully capture ongoing adjustments to exchange rate changes that are implicit in long-run PPP theory. In particular, the model-based projections fail to capture longer-run shifts in relative output capacity in response to sustained cost differentials (or deviations from absolute purchasing power parity) across countries. While such supply-side adjustments appear to have been quantitatively important in the past, they are not captured adequately in the model projections. Nevertheless, we find that even when the model extrapolations are adjusted to factor in such longer-run adjustments, the projected deficit remains sizable.

The paper begins, in Section II, with a survey of extrapolations with conventional partial-equilibrium models of the U.S. current account, and a critique of the relatively short-run, demand-side orientation of those model-based extrapolations. Section III presents some data on absolute purchasing power parities, focusing on a comparison of absolute levels of unit labor costs in manufacturing across major industrial countries. Section IV then analyzes the empirical significance of longer-run supply-side adjustment (in response to cost differentials) that is not fully captured in the conventional models. The implications of such longer-run adjustment for medium-term extrapolations of the

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3. See, for example, Wall Street Journal (1988) for a PPP-based view from the market, and Goldman-Sachs (1988) for a discussion of PPP calculations and their implications. The debate between "model-based" dollar pessimists and "PPP-based" dollar optimists is also outlined in Krugman (1988b) and Economist (1988).

current account are also considered. Conclusions are presented in Section V.

II. Conventional Models of the U.S. Current Account

This section first reviews recent projections of U.S. current account models, and describes the basic structure of these models. It then presents a framework for considering the effects of a depreciation on the trade balance, and it analyzes the key elements of this framework that are not captured in the model-based extrapolations.

A. Model Extrapolations

Recent extrapolations with a number of conventional partial-equilibrium models of the U.S. current account are shown in Chart 1. The chart includes the average of a group of five models that participated in a January 1987 Brookings workshop on the U.S. current account, and whose updated extrapolations are reported in Bryant (1988).[4] Also shown are slightly more up-to-date extrapolations with two of the models reported in Bryant's average -- the MCM (labeled H-H) and DRI models -- and extrapolations reported in recent studies by Cline (1988) and Lawrence (1988).[5] These extrapolations were all run under the assumptions (shown

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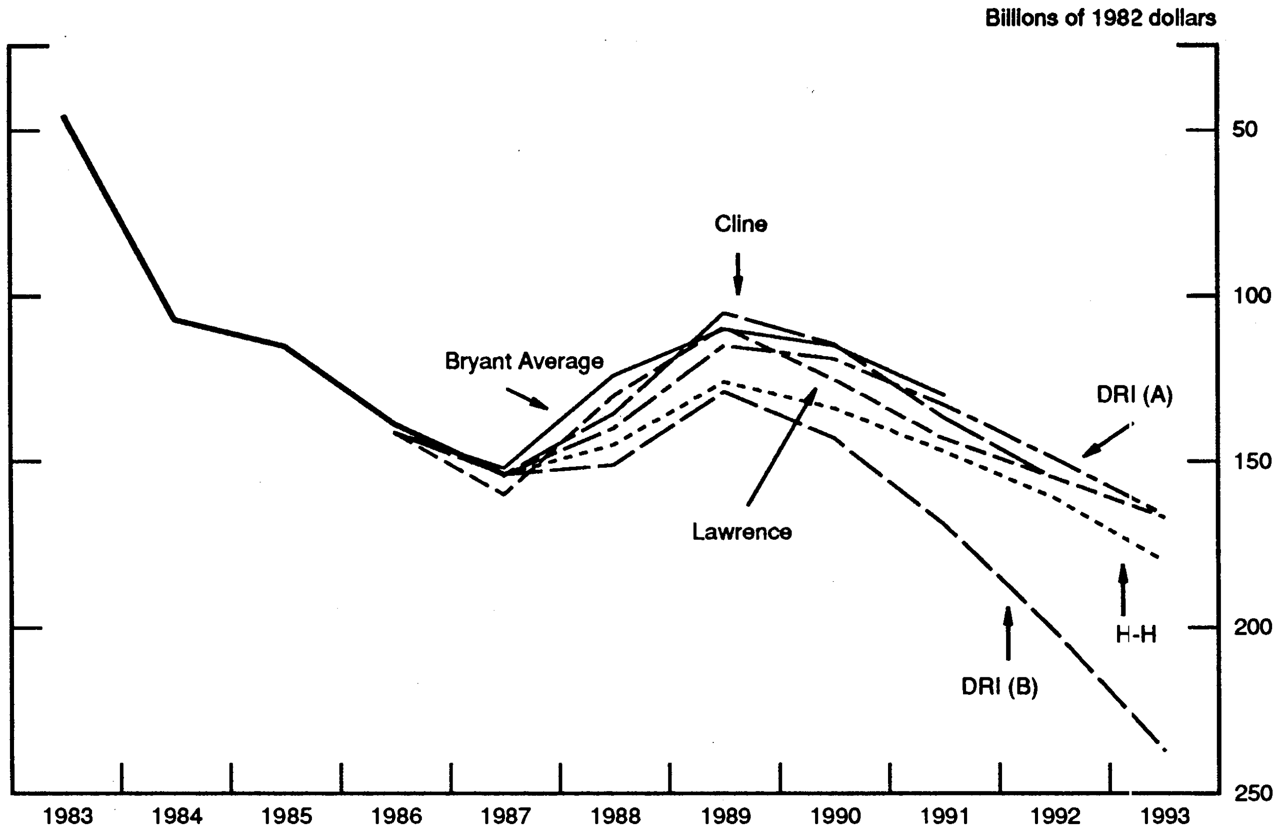
4. The models included in the Brookings workshop were the U.S. current account sectors of: the DRI model, the Japanese Economic Planning Agency's World Model, the FRB MCM, the OECD Interlink model, The Taylor Model, and the U.K. National Institute's model. See Bryant et al. (1988) for descriptions of these models.

5. The two DRI extrapolations shown were reported in Gault (1988), and are discussed further below. The MCM simulation was based on the version of the U.S. current account sector of that model that is reported in Helkie and Hooper (1988) (hence referred to as the H-H model); the exchange rate simulation properties of a closely related version of this model are analyzed by Meade (1988). Cline's extrapolation was based on a (Footnote continues on next page)

Chart 1

Extrapolations of the U.S. Current Account



<u>Assumptions</u>

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.

in the table below the chart) that U.S. and foreign real growth would remain in the range of 2-1/2 to 3 percent per year, and that the dollar's average exchange rate and oil prices would remain unchanged in real terms from their average level at the end of 1987.[6]

The model extrapolations suggest that under these assumptions the deficit will continue to narrow through 1989, as the lagged effects of the depreciation of the dollar during 1985-87 stimulate net exports. Even at its low point, however the deficit still exceeds $100 billion in these model extrapolations. Absent further stimulus due to the exchange rate, the deficit then begins to widen again in 1990 and beyond, for three reasons. First, under the assumption that home and foreign incomes grow at the same rate (and assuming import and export elasticities are the same), imports and exports will grow at the same percentage rate. Since imports start at a substantially higher level than exports (i.e., at least $100 billion higher), the gap between imports and exports must continue to grow as well. Second, in all of the models, the income elasticity of demand for U.S. imports is somewhat higher than that for exports. This means that with similar income growth rates, imports will grow somewhat faster than exports in percentage terms and faster still in absolute terms. Third, rising net investment income payments associated with the growing U.S. net international indebtedness contribute further to the widening of the deficit.

(Footnote continued from previous page)

slightly different version of the same model. Lawrence's projection was based on a simulation model that was constructed to reflect existing conventional models.

6. This level of the dollar (against a weighted average of industrial country and developing country currencies) is roughly in line with its average for the first half of 1988, but nearly 5 percent below its level in the third quarter 1988.

B. Model Structure

The quantitative similarity of the projections obtained with the various models reflects basic similarities in the underlying model structures. The essential elements of these models are summarized in Table 1. Equations 1 and 2 are demand equations that specify export and import volumes as functions of incomes and relative prices (with a distributed lag). Some of the models also include nonprice rationing variables and time trends. The nonprice rationing variables capture short-run supply shifts that are not represented in price movements, while the time trends are included to capture capture longer-run supply-side shifts that also are not represented in relative prices, as will be discussed further below. Both the nonprice variables and the time trends are exogenous to the exchange rate in these partial-equilibrium models.

Equations 3 and 4 are "supply" equations (usually mark-up pricing equations) that determine export and import prices as functions of the exporting country's costs, competitors' prices, and the exchange rate. In these two supply equations, the exchange rate captures short-run "pass-through" dynamics and strategic pricing behavior on the part of exporters and importers. The current account balance is determined in Equation 5, as a function of trade volumes and prices plus net services and transfers. (Net services and transfers are generally specified in some detail as functions of other variables, including the exchange rate, but these details are not crucial to the discussion that follows.)

A key feature of the models is that the relative price elasticities in the demand equations are constant, generally in the neighborhood of -1.0, with distributed lags lasting about 8 to 10

Table 1

Simplified Current Account Model

(1) $X^d = \alpha_o + \alpha_1 Y^* + \alpha_2(L)\ E \cdot P^x/P^* + \alpha_3\ NP^x + \alpha_4\ T^x{}_1$

(2) $M^d = \beta_o + \beta_1 Y + \beta_2(L)\ P^m/P + \beta_3\ NP^m + \beta_4\ T^m$

(3) $P^x = \gamma_o + \gamma_1 C + \gamma_2\ P^*/E$

(4) $P^m = \delta_o + \delta_1(L)\ C^*/E + \delta_2 P$

(5) $CA = P^x \cdot X^d - P^m \cdot M^d + NST\ (....)$

Definitions:

C = Production Costs

CA = Current Account Balance

E = Exchange Rate (foreign currency/$)

M^d = Real Import Demand

NP^m = Nonprice Rationing of imports

NP^x = Nonprice Rationing of exports

NST = Net Services and Transfers

P = Domestic Price (in $)

P^* = Foreign Price (in foreign currency)

P^x = Export Price (in $)

P^m = Import Prices (in $)

T^m = Trend factors influencing imports

T^x = Trend factors influencing exports

X^d = Real Export Demand

Y = Domestic Real Income

Y^* = Foreign Real Income

(L) denotes lag operator

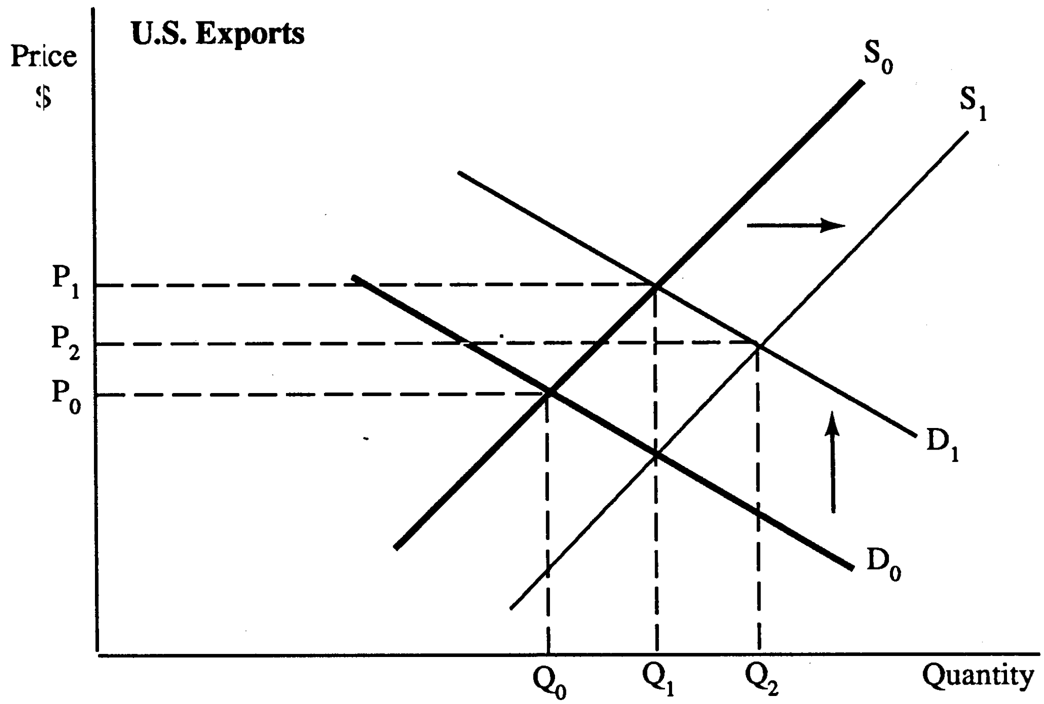
α, β, γ, δ are parameters quarters. In addition, import prices generally respond to exchange rate changes with a distributed lag of at most 2 to 4 quarters.[7] Thus, in model simulations involving exchange rate changes, a sustained depreciation of the dollar affects the current account through its impacts on both trade prices and trade volumes, over a period of about three years. Indeed, given the patterns of estimated lag distributions in the models, most of the impact takes place in well under two years. Once the adjustment lags have been worked through, the depreciation has no further effect, and the current account remains at its new level, ceteris paribus. We will argue below that these dynamics capture primarily the short-run price dynamics and shifts in demand resulting from exchange rate changes. They fail to capture potentially important longer-run shifts in supply that are induced by sustained changes in the exchange rate. As a result the full effects of a sustained depreciation may be significantly understated.

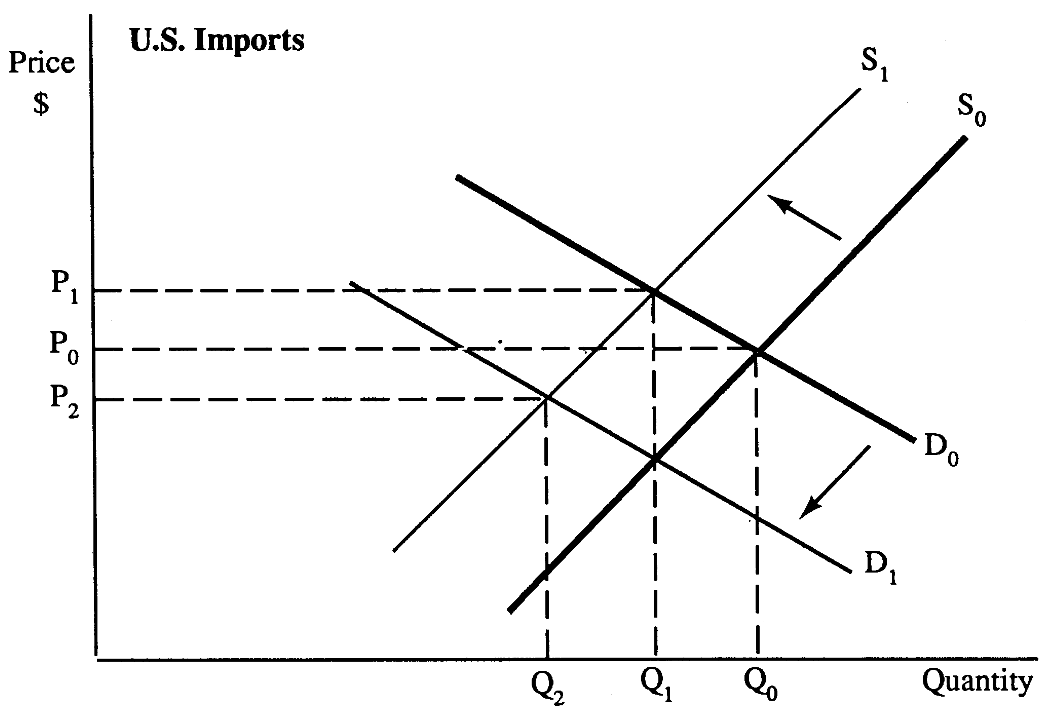
C. The Effects of Exchange Rate Changes: Theory

The effects of a depreciation of the dollar on the markets for U.S. exports and imports are shown schematically in Chart 2. In the top panel, the heavy lines show an initial market equilibrium for exports, with foreign demand equal to U.S. supply at a quantity Q_0 and a dollar price P_0. The curve labeled S_0 is the short run supply schedule conditioned on the capital stock (or U.S. output capacity) in period 0. When the dollar depreciates, the price of U.S. exports falls in terms of foreign currency, and stimulates foreign demand. This results in a shift

7. See Bryant et al (1988) for more details on the parameter estimates and lag lengths of most of these models.

Adjustment of U.S. Trade in Response to a Decline in the Dollar





in the foreign demand curve expressed in dollars from D_0 to D_1, with the quantity of exports gradually rising to Q_1, and the dollar price rising to P_1. These demand-side effects are captured reasonably well in the empirical models.

At the same time, a sustained decline in the dollar will reduce the cost of producing in the United States relative to other countries. This shift in relative production costs, if sustained, will eventually stimulate the growth of U.S. output capacity relative to that in other countries (and relative to what U.S. output growth would otherwise have been), ceteris paribus. This effect on U.S. output capacity is illustrated in the chart as a shift in the short-run U.S. supply curve from S_0 to S_1. This supply shift reduces the price of exports and stimulates the quantity demanded, with the equilibrium price declining to P_2, and the quantity exported increasing to Q_2.[8] The net impact of this shift in domestic supply on export value is ambiguous, and depends on the price elasticity of demand.[9]

Meanwhile, foreign output capacity is depressed relative to what it would otherwise have been. This shift in foreign supply tends to raise the foreign competitor's price and reduce the relative price of the home country's export, thereby stimulating foreign demand.[10] This effect

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8. In the context of a mark-up price model, an increase in output capacity (in response to an exchange-rate-induced labor cost differential) would tend to reduce export prices by lowering domestic production costs through an increase in labor productivity.

9. With the demand elasticity at unity, the U.S. supply shift leaves nominal exports unchanged. If it were greater than unity, nominal exports would rise, as volume would rise proportionately more than prices fell.

10. Of course, a reduction of foreign output capacity could also reduce foreign income, which would tend to depress foreign import demand and offset at least some of the relative price effect of the foreign supply shift.

is not shown in the chart, but could be illustrated by a further shift to the right in the foreign demand curve for U.S. exports, resulting in a higher quantity <u>and</u> price of exports.

In the case of imports (the bottom panel), a decline in the dollar tends to raise import prices, shifting the import supply curve expressed in dollars up from S_0 to S_1. As demand responds to the higher price, the quantity imported falls from Q_0 to Q_1. With quantity lower and prices higher at the new equilibrium defined by Q_1 and P_1, the value of imports remains little changed. This is what the conventional empirical models tend to predict, given their import price elasticities of about unity.

A longer-run supply response in this case would be reflected in a shift to the left in the U.S. import demand curve. That is, increases in U.S. output capacity stimulated by the lower dollar would tend to reduce the relative price of domestic substitutes and thereby depress U.S. demand for imports. Thus, both the quantity and price of imports fall (to Q_2 and P_2), resulting in a net decline in the <u>value</u> of imports. At the same time, foreign output capacity would be depressed, resulting in a further shift to the left (not shown in the chart) in the import supply curve. This shift would reduce the quantity of imports further, but it would also raise the price and therefore may have little additional impact on nominal imports.

In brief, sustained changes in exchange rates affect nominal and real net exports through both their short to medium-term direct impacts on prices and demand, and their longer-term impacts through changes in relative output capacities.[11]

D. What's Missing in the Models and Model Simulations

The demand-side orientation of empirical trade models and difficulties involved in modeling the supply side have long been recognized in the literature.[12] Over the years efforts have been made to improve the modeling of supply-side effects, with the specification of price equations and the ad-hoc inclusion of short-run nonprice rationing and longer-run secular supply variables in the demand equations. At present, however, the models are not well equipped to capture the longer-run supply side effects of changes in exchange rates.

To the extent that trade prices and quantities have been influenced in the past by exchange-rate-induced shifts in supply, one could reasonably expect these influences to be captured in the models' estimated parameters. In principle, impacts on trade prices should be captured in the supply or price equations, and impacts on quantities, should be captured in the distributed lag on the relative price term in the demand equations. In practice, however, these effects probably are not fully captured, due to various empirical problems. More importantly, because of the partial-equilibrium nature of the models, supply-side effects are captured much less completely in model simulations and extrapolations.

11. The supply-side effects of changes in exchange rates are thought of as being "longer-term" effects, because a) shifts in relative production costs probably do not influence investment decisions unless those shifts are sizeable and are viewed as likely to be sustained, and b) establishing new plant and equipment takes time.
12. See, for example, Orcutt (1950), Harberger (1953), Lawrence (1979).

One indication that the longer-run supply side effects of swings in exchange rates are not adequately captured in the models is the brevity of estimated relative price lags. As noted earlier, total lags are generally less than 3 years in duration, while mean lags (the point at which half of the full impact has taken place) are often less than 1 year. Goldstein and Kahn (1985) found much the same result in their more extensive survey of empirical trade models, particularly among models whose estimation sample periods had extended over the floating rate period. It seems plausible that a large shift in exchange rates (and therefore relative production costs) over time would induce shifts in the location of production facilities that would continue to influence trade volumes for more than two to three years.[13] The fact that longer lags generally have not been captured in the models could be explained in part by either data problems, or the tendency for exchange rate swings to reverse themselves within a period of several years over much of the floating rate period, or both.[14]

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13. Of course, some supply-related shifts may take place fairly quickly. For example, multinational firms that have plants located in different countries may be able to shift the location of production on fairly short notice. To the extent that such shorter-term responses have been prevalent in the past, they would presumably be picked up in the estimated price elasticities.

14. An important exception to this interpretation of Goldstein and Kahn's results was a study by Junz and Rhomberg (1973). Junz and Rhomberg found that during the 1960s country shares in world export markets responded to changes in relative prices over a period of up to 5 years. The authors hypothesized that such long lags could reflect what they called "production" lags, or the amount of time it takes for producers "to become convinced that a profit opportunity which they perceive in certain markets is sufficiently large and permanent to warrant the expense and effort of shifting from supplying one market to supplying another or of adding capacity in order to supply the additional market..." (Junz and Rhomberg, page 413.) A decision to relocate productive capacity to take advantage of perceived differences in production costs could be equally time consuming.

A potential problem with the data is that available time-series on import and export prices may not fully reflect longer-run shifts in supply, particularly in cases involving new products or countries that are new entrants into the world market. Supply shifts can only influence existing price indexes if there is an existing history of price observations, which is less likely when new products (or countries) are involved. As a case in point, Europe and Japan during the 1960s and early 1970s, and the Asian NICs more recently, entered the world market as major new exporters of a wide variety of new durable goods. These developments were reflected in a tremendous growth in the volume of U.S. imports of durable goods relative to total domestic consumption of those goods during the 1960s and 1970s. But, they were not reflected in any noticeable declines in the relative price of U.S. imports.

In estimated import demand equations, this surge in the growth of imports during the 1960s and 1970s tends not to be attributed to movements in relative prices, but rather to a high U.S. "income" elasticity. The fact that these apparent supply-related developments were more closely correlated with the trend growth in U.S. income than with movements in relative prices suggests at least some deficiency in the relative price data.[15]

As noted earlier, several of the models have attempted to compensate for this data inadequacy by introducing secular "supply" variables directly into the demand equations. The H-H model includes a crude measure of relative private fixed capital stocks, while the DRI model and other empirical studies have included time trends in their

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15. See Helkie and Hooper (1988) p. 20 for more discussion of this point.

trade equations to capture these effects.[16] The inclusion of these variables in the volume equations tends to result in a lower estimated income elasticity for U.S. imports, and in some cases a higher elasticity for exports. When time trends are used they generally imply a secular decline in the current account, as is illustrated by the extrapolations labeled DRI.A and DRI.B in Chart 1. With the time trend incorporated into the extrapolation the DRI model shows a much lower path for the current account (DRI.B) than it does when the trend has been extracted (DRI.A).

Even if the requisite price series could be constructed (and if demand lags were captured fully), simulations with partial-equilibrium models would still miss much of the supply-side effects of exchange rate changes. As we noted in the preceding subsection, supply shifts affect the quantity demanded by altering relative prices. Shifts in output capacity at home and abroad will alter export and import prices by changing labor productivity and (therefore) production costs C and C^* in the supply equations (3) and (4) in Table 1. Such changes in costs will also influence P and P^*, the denominators of the relative price terms in equations (1) and (2). However, since domestic costs and prices are treated exogenously in the models, the linkage from exchange rates to domestic costs and prices through shifts in output capacity is missing in

16. See Helkie and Hooper (1988) for a description of that model's supply proxy (which is also discussed further below). Gault (1988) discusses the DRI model's specification as well as its implications for the extrapolations in Chart 1. The use of the trend term is also considered by Krugman and Baldwin (1987) and in comments on their paper by both Bosworth (1987) and Hooper (1987).

simulations with those models.[17] The only endogenous "supply-side" effects of changes in exchange rates that are captured are the relatively short-run pass-through or strategic-pricing dynamics in equations (3) and (4).

In brief, what's missing in the models, or at least in extrapolations and simulations with the models involving exchange rate changes, is much of the longer-run supply-side effects of exchange rate changes. To some extent these effects may be missing altogether in the estimated models because of inadequacies in available price data. To a considerably greater extent they probably are captured in the models, but by variables that are exogenous to the exchange rate, namely, income variables, time trends (or other secular supply variables), and domestic prices and costs. In the next two sections we will consider the empirical significance of the relationship between exchange rates and longer-run shifts in supply.

III. PPP and Relative Labor Costs.

This section considers what is perhaps the most important linkage between the exchange rate and decisions concerning the location of output capacity, namely, movements in the levels of relative labor costs across countries.[18]

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17. Even if simulations were run with current account models linked to more complete macro models that determine domestic prices and costs endogenously, the potential longer run supply-side effects of exchange rate changes probably would be understated. Existing global econometric models generally do not contain direct linkages between exchange rates (or relative labor costs) and fixed capital formation.
18. The data presented in this section are described more fully by Hooper and Larin (1988).

Table 2 presents some rough estimates of the levels of labor costs in total manufacturing in the United States, in a group of 8 other industrial countries, and in a representative newly industrializing country -- Korea. As indicated in the top panel, in 1980, total compensation in U.S. manufacturing, at roughly $10 per hour, was slightly above that in other major industrial countries, on average.[19] By 1985, the difference had risen significantly, to more than $5 per hour, reflecting the sharp appreciation of the dollar over that period. Since 1985, U.S. compensation has fallen substantially relative to that abroad, due to the depreciation of the dollar. At average exchange rates for the first three quarters of 1988 the U.S. level was estimated to be slightly below that in other industrial countries, on average. (As indicated in the last column of the table, the relative levels were reversed slightly based on exchange rate data for the third quarter alone, as a result of the dollar's rise in mid-1988.) In contrast, Korean compensation, while rising relatively over time, remains well below U.S. compensation. Of course, differences in levels of compensation across countries reflect differences in levels of productivity to a significant degree, and a more complete assessment of labor costs must correct for these productivity differences.

The middle panel of the table presents estimates of levels of labor productivity in manufacturing, expressed as output per hour measured in 1980 dollars.[20] The productivity estimates suggest that U.S. productivity remains well above that in other countries. The bottom

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19. These data are BLS data for total compensation, where foreign data have been translated into dollars at current nominal exchange rates.
20. Foreign productivity data, measured in constant (1980) local currency units, have been translated into dollars at 1980 purchasing power parity exchange rates specific to manufacturing. See Hooper and Larin (1988).

Table 2

Comparative Levels of Hourly Compensation,
Productivity, and Unit Labor Costs in Manufacturing

	1975	1980	1985	1987	1988 P1	1988 P2
Total Compensation per hour (current dollars)						
United States	6.4	9.8	13.0	13.5	14.2	14.2
Foreign Industrial Countries*	4.5	8.4	7.7	12.8	14.6	13.3
Korea	0.3	1.0	1.3	1.7	2.1	2.2
Output per hour (1980 dollars)						
United States	13.7	15.0	18.4	19.9	20.3	20.3
Foreign Industrial Countries*	8.8	11.0	13.9	14.7	15.1	16.1
Korea	1.9	2.7	4.7	5.9	6.0	6.0
Unit Labor Costs (Ratio of compensation/hr to output/hr)						
United States	46	66	71	68	70	70
Foreign Industrial Countries*	51	76	55	87	97	88
Korea	18	37	28	29	35	36

P1/ Projections, based on exchange rates for January-June 1988, and projection of recent compensation and productivity trends.
P2/ Projections based on exchange rates for mid-August 1988.
*/ Canada, Japan, Germany, France, the United Kingdom, Italy, Belgium, the Netherlands, Denmark and Norway; weighted by shares in world GNP.

panel shows the ratios of compensation to productivity, or estimates of unit labor costs, that are at least roughly comparable across countries. On this basis, average manufacturing labor costs in other industrial countries were nerarly 40 percent above the U.S. level at average exchange rates in the first three quarters of 1988, whereas those in Korea were still less than half the U.S. level.

Movements over time in the ratios of U.S. unit labor costs and its components to those in other industrial countries can be seen more clearly in Chart 3. As shown in the top panel, during the 1960s and early 1970s, foreign compensation and productivity were both rising substantially faster than their U.S. counterparts. Over the past 10 to 15 years, productivity growth differences have been much smaller, and movements in relative compensation have been dominated by swings in nominal exchange rates. The extent to which movements in nominal exchange rates have dictated movements in relative unit labor costs is illustrated vividly in the bottom panel of the chart. The simple correlation between quarterly movements in the exchange rate and the unit labor cost ratio between 1972 and 1988 is .95.

In brief, U.S. labor costs now appear to be significantly below the average level of costs in other industrial countries.[21] Even at the somewhat elevated level of the dollar as of the third quarter of 1988, the difference remains significant. Should this differential persist the

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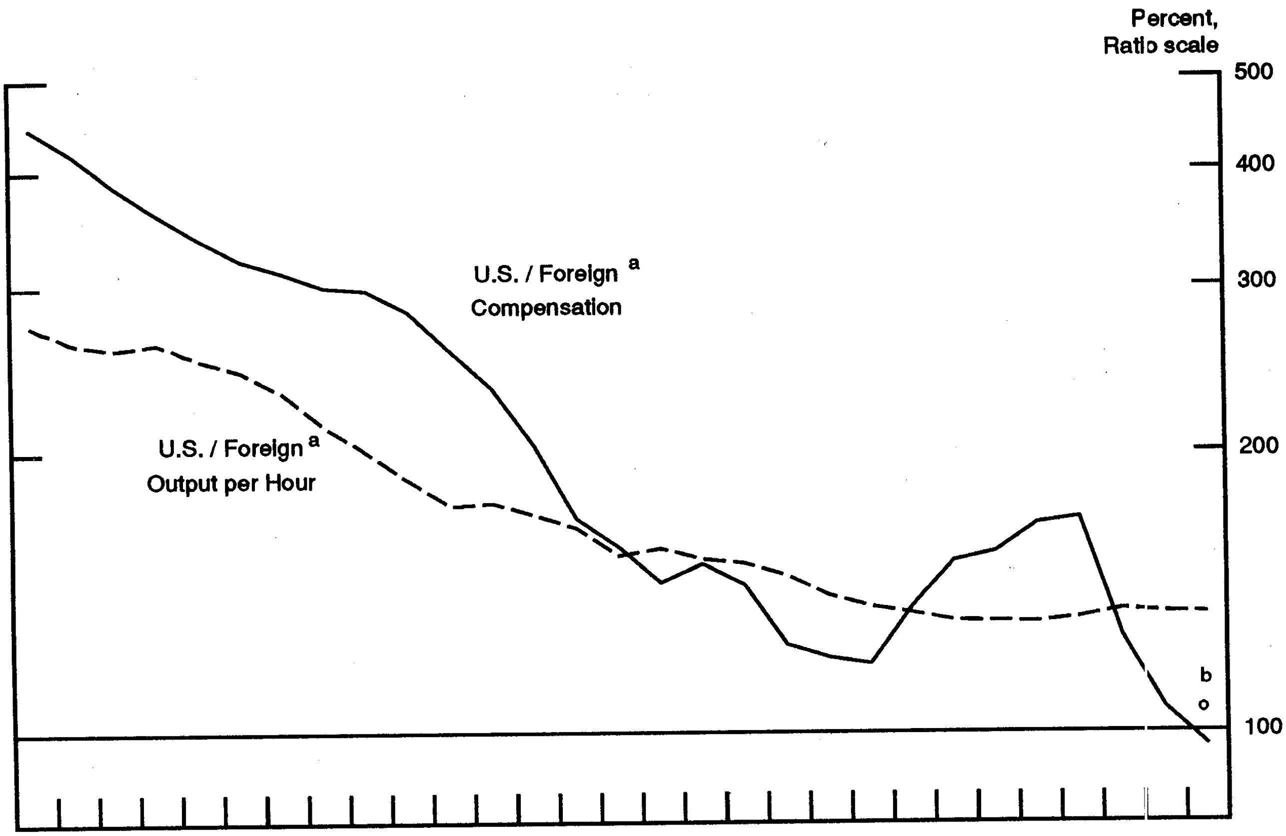
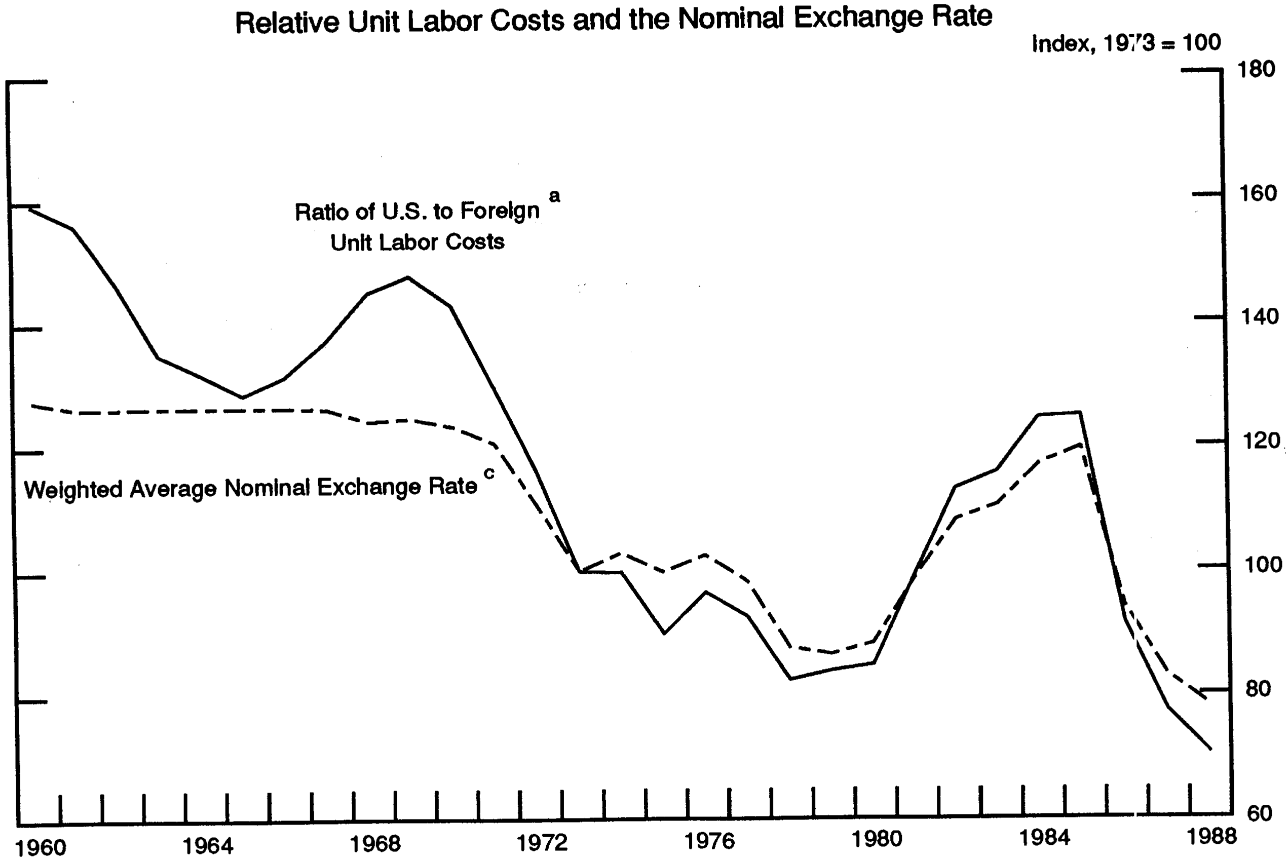
21. These estimates of unit labor costs and productivity should be interpreted with caution. The relative levels of productivity are at best crude estimates, as noted by Hooper and Larin (1988). Moreover, unit labor costs for total manufacturing may mask significant differences across across individual industries. Lawrence (1979), for example, found that in Japan unit labor costs tend to be lower than average in industries with a relatively high export content. (He did not find this to be the case for other industrial countries, however.)

Chart 3

Relative Unit Labor Costs in Manufacturing and Their Components



Relative Unit Labor Costs and the Nominal Exchange Rate



a. Foreign includes average of Japan, Germany, France, Canada, the United Kingdom, Italy, the Netherlands, and Belgium, in dollars, weighted by manufacturing output.

b. Estimate based on levels of nominal exchange rates in mid-August 1988. Chart plotted using average exchange rate for 1988 H1.

c. Weighted by shares in world GNP.

result could be a shift in the location of manufacturing output capacity toward the United States. It is the empirical significance of this point that we consider next.

IV. Supply-Side Adjustment: Empirical Evidence

This section begins by reviewing available evidence about the empirical relationship between labor cost differentials across countries and movements in relative capital stocks (as a crude proxy for output capacity) in manufacturing. It then considers the performance in U.S. trade equations of a somewhat more refined measure of secular supply shifts than has been used in the past. Finally, it assesses the implications of endogenizing this relative capital stock variable for medium-term extrapolations of the current account.

A. Relative Labor Costs and Capital Formation in Manufacturing.

The OECD (1987) has recently published a fairly comprehensive and comparable (across countries) set of data on real net fixed capital stocks, by sector (including manufacturing), for the United States and five other major industrial countries.[22] The ratio of the combined capital stock of the foreign industrial countries to that of the United States is plotted in the bottom panel of Chart 4.[23] (The historical data

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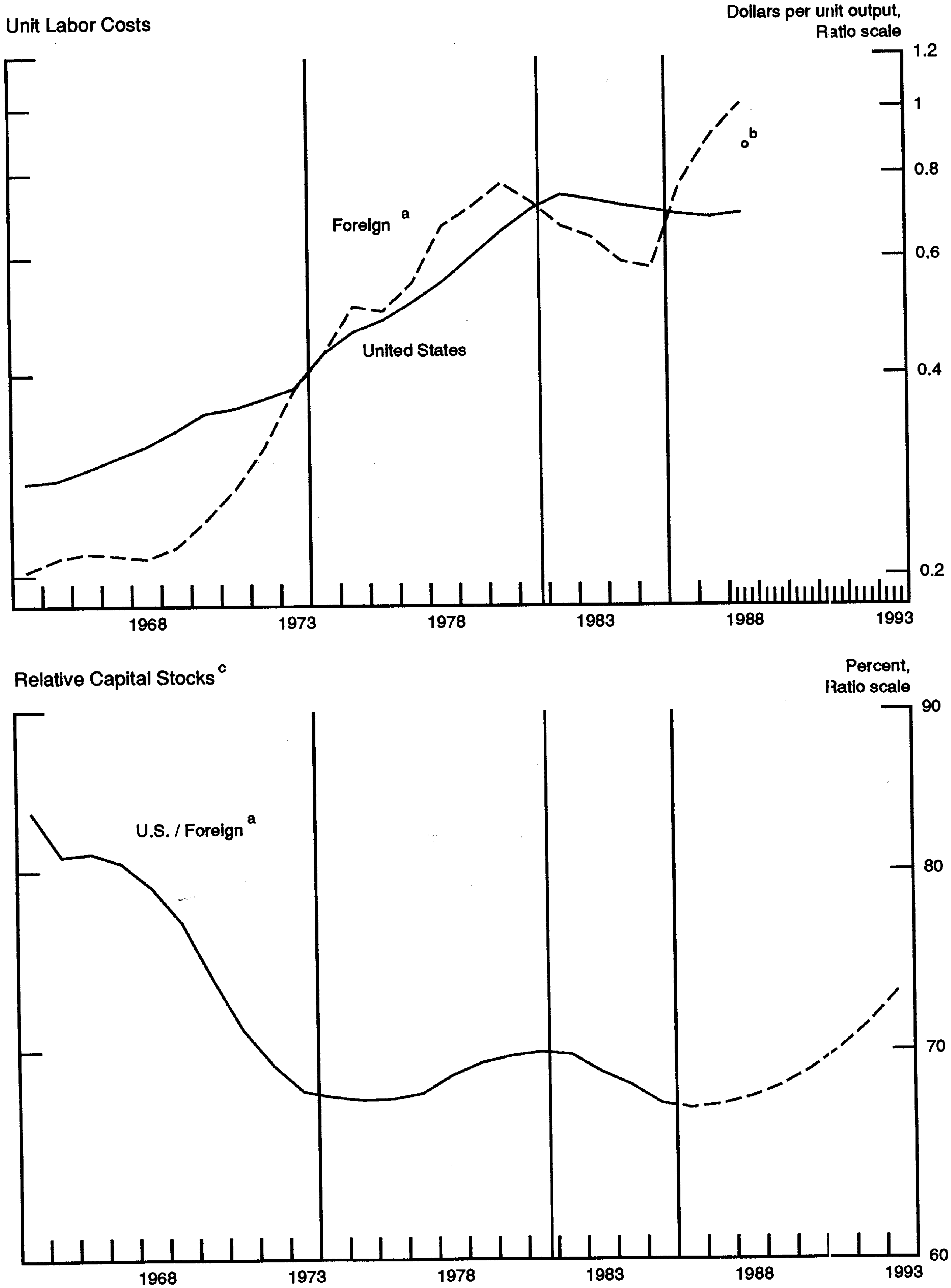
22. The foreign countries (and the shares of each in the combined capital stock of the five in 1984) are: Japan (40%), Germany (23%), France (17%), United Kingdom (16%), and Canada (4%). The U.S. data are consistent with data published by the Bureau of Economic Analysis for the capital stock in manufacturing. In all cases "gross" capital stocks are used, where the change in the gross stock is equal to gross fixed investment minus discards of old capital.
23. The OECD's data on foreign capital stocks have been translated into dollars using 1980 PPP exchange rates for investment goods obtained from the U.N. International Comparison Project.

Chart 4

Unit Labor Costs and Relative Capital Stocks in Manufacturing



a. Foreign includes average of Japan, Germany, France, Canada, and the United Kingdom, in dollars, weighted by manufacturing output.

b. Estimate based on levels of nominal exchange rates in mid-August 1988. Chart is plotted using averge exchange rate for 1988-H1.

c. Calculated from OECD estimates of U.S. and foreign real capital stocks in manufacturing, measured in 1980 dollars.

are available through 1985 in most cases, and through 1987 for the United States.) The top panel shows unit labor costs in dollars in the United States (the solid line) and in the same five other major industrial countries (the dashed line).

Movements in the labor cost differential and the capital stock ratio clearly were correlated over the period shown. During the 1960s and early 1970s, when U.S. labor costs were well above foreign costs, capital stocks in manufacturing were expanding much more rapidly abroad than in the United States. Of course, relative labor cost was only one of a number of factors that could have influenced the patterns of growth in manufacturing output capacity during this period. Nevertheless, when foreign labor costs rose above U.S. costs with the substantial decline in the dollar during the 1970s, the trend in relative capital stocks was reversed, as the U.S. stock began to expand more rapidly than that in other industrial countries. And, movement in the capital stock ratio was reversed again in the early 1980s, as U.S. labor costs rose above foreign costs with the sharp appreciation of the dollar.

Causal relationships between the top and bottom panels of Chart 4 could well run in both directions. A labor cost advantage will induce capital formation that will, in turn raise productivity and tend to reinforce the labor cost advantage. The rapid increase in foreign labor productivity relative to U.S. productivity during the 1960s and early 1970s must be attributed in part to the substantially faster rate of capital formation abroad during that period. Nevertheless, as was illustrated in Chart 3, since the early 1970s, movements in relative labor costs have resulted primarily from swings in nominal exchange rates. Thus, in more recent years, any causal connection between the variables in Chart 4 probably has run predominantly from the labor cost differential to the capital stock ratio.

B. Supply Shifts and U.S. Trade Equations

As we noted earlier, some of the current account models incorporate secular supply shift variables in the trade volume equations. The H-H model, in particular, includes the ratio of U.S. to foreign gross private fixed capital stocks. This variable is very crude, inasmuch as it includes all nonmanufacturing and residential capital, in addition to the manufacturing capital stock. In this section we test the somewhat more refined manufacturing capital stock ratio in the H-H model.

Estimated equations for non-oil imports and nonagricultural export volumes are shown in Table 3. The original H-H equations are shown in columns 1 and 4. The same equations with an alternative capital stock variable (line 6) are shown in columns 2 and 5. Equations with the capital stock variable excluded are shown in columns 3 and 6. The "alternative" capital stock variable is the ratio of the U.S. manufacturing capital stock to a combination of the manufacturing capital stock for the 5 major foreign industrial countries and the aggregate capital stock of 10 major developing countries.[24] The coefficient estimates are elasticities, as the equations were estimated in double-log form.

The results for the import equation suggest that both the original and the alternative capital stock variables have a significant impact on import volume. Moreover, the inclusion of the capital stock

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24. The developing countries included are Brazil, India, Israel, Korea, Malaysia, Mexico, Singapore, Philippines, Taiwan, and Thailand.

Table 3

Impact of Relative Capital Stock Variable on Non-Oil Import and Nonagricultural Export Equations
(t-ratios in parentheses)

	Non-Oil Imports			Nonagricultural Exports		
	H-H model (1)	Alternative KS variable (2)	Without KS variable (3)	H-H model (4)	Alternative KS variable (5)	Without KS variable (6)
1. Constant	-2.23 (-0.48)	-5.75 (-1.69)	-12.40 (-17.64)	-6.63 (-1.47)	0.25 (0.61)	3.75 (4.25)
2. Real GNP a/	1.11 (2.84)	1.22 (3.23)	1.47 (4.06)	2.16 (5.60)	1.15 (5.35)	1.28 (15.79)
3. Real GNP (1)	0.97 (2.41)	1.12 (2.92)	1.29 (3.43)	-- --	-- --	-- --
4. Relative Prices (0-7) b/	-1.14 (-10.15)	-1.03 (-10.95)	-0.98 (-9.25)	-0.91 (-7.03)	-0.91 (-6.20)	-.93 (-6.19)
5. Relative Capacity Utilization (-1)	-0.29 (-1.39)	-0.19 (-1.01)	-0.03 (-0.17)	-- --	-- --	-- --
6. Relative Capital Stocks	-0.84 (2.22)	-0.66 (-2.02)	-- --	1.35 (2.33)	0.51 (0.87)	-- --
7. Dock Strike Dummy	0.81 (5.68)	0.82 (5.78)	0.80 (5.91)	0.77 (8.28)	0.78 (8.21)	0.79 (8.54)
8. Rho	0.46 (4.13)	0.48 (4.35)	0.55 (5.51)	0.68 (7.05)	0.72 (7.57)	0.73 (7.99)
9. Durbin Watson	1.91	1.91	1.95	2.10	2.04	2.05
10. R^2	0.9880	0.9878	0.9870	0.9897	0.9889	0.9888
11. Standard Error %	0.03	0.03	0.03	0.03	0.03	0.03

a. U.S. real GNP in import equation, total foreign GNP in export equation.
b. Denotes 8-quarter distributed lag for both imports and exports; sum of lagged coefficients is reported.

variables results in a noticeably lower income elasticity (shown in lines 2 and 3 of the table). The alternative capital stock variable has a somewhat smaller coefficient than the original one. In the export equation, while the original capital stock variable is significant and raises the income elasticity, the alternative one is not and has minimal impact on the income elasticity.

C. Adjusted Model Extrapolation

To illustrate the possible effect of a supply shift in response to the decline in the dollar since 1985, the H-H model extrapolation was adjusted for an assumed shift in the capital stock ratio. We first describe the assumed path for the manufacturing capital stock ratio through 1993, and then adjust the H-H model extrapolation using the estimated coefficients discussed above.

The hypothetical path of the capital stock ratio is shown in the bottom panel of Chart 4, based on the assumption that relative labor costs remain unchanged between 1988 and 1993. This path shows a continued decline in the ratio to 1988, based on capital stock data through 1987 and BEA's investment intention survey for U.S. investment in manufacturing for 1988. Beyond 1988, U.S. real gross investment in manufacturing is assumed to grow at 12 percent per year (i.e, exceeding the rapid 10.5 percent rate planned for 1988).[25] The growth of manufacturing investment abroad (including developing countries) was

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25. Maintaining this rate of growth of manufacturing investment implies that the combined total of real government and private consumption, plus investment outside the manufacturing sector, would have to grow slightly less than the assumed 2-1/2 to 3 percent annual rate for total GNP, assuming real net exports level off. In recent years, investment in manufacturing accounted for about 13 percent of total private fixed investment and 2-1/2 percent of real GNP.

for either the original or the "alternative" capital stock variable, the variance in the adjustment by 1993 would be plus or minus $25 billion for a 5 percent shift in the capital stock, or $45 billion for a 9 percent shift. At a most optimistic extreme, with unit elasticities, a 9 percent shift in relative capital stocks, plus one standard deviation of the elasticity estimates, the adjustment would be as large as $160 billion, or enough to eliminate most of the deficit by 1993. At a pessimistic extreme, with elasticities of 0.5, a 5 percent shift in capital stocks, minus one standard deviation, the adjustment would be negligible, leaving the current account deficit large and expanding in 1993.

The adjustment we have considered should also be viewed with caution because it is based on an ad hoc specification of supply influences, with the capital stock ratio acting largely as a proxy for longer-run supply shifts that are not captured in movements in relative prices. In order to develop more reliable estimates, the supply sides of existing trade models need to be specified more completely, and the shortcomings of available price series understood better.

V. Conclusions

Several conclusions can be drawn from this empirical analysis. First, conventional models of the U.S. current account predict a significant widening of the U.S. current account deficit after 1989 if the dollar stays where it is now (and if incomes at home and abroad continue to grow at similar rates). However, these model extrapolations may be overly pessimistic inasmuch as they fail to capture potentially significant longer-run adjustments on the supply side. That is, shifts in output capacity in response to cost differentials that have emerged as difference between the two paths shown, is small for the first two or three years of the extrapolation. However, it grows significantly thereafter. By 1993 the adjustment reaches nearly $60 billion, or enough to keep the deficit about unchanged from its extrapolated level in 1989. Thus, while supply-side effects appear to be quantitatively significant, they do not in themselves to comprise an "answer" to the deficit problem, at least over the time horizon we have considered.

Of course, a considerable degree of uncertainty must be attached to this estimate. On the one hand, it may be wildly optimistic to assume that U.S. investment in manufacturing will continue for another 5 years to grow faster than the rapid rates expected for 1988. It may be equally optimistic to assume that investment abroad (particularly in developing countries) will grow well below its recent historical average for such a prolonged period. Factors other than relative labor costs undoubtedly will influence relative rates of capital formation through 1993. A shift in the capital stock ratio closer to half the magnitude shown in Chart 4 (i.e., by less than 5 percent by 1993) might be more realistic.

On the other hand, the estimated coefficients on the "alternative" capital stock variable may be on the low side. The original H-H coefficients were nearly twice as large, averaging roughly 1.0. A priori, it seems plausible to expect export volumes to expand (and import volumes to recede) in proportion to the growth in <u>relative</u> domestic output capacity, <u>ceteris paribus</u>. Elasticities of 1.0 combined with a 5 percent shift in the capital stock ratio would yield about the same adjustment as shown in Chart 5.

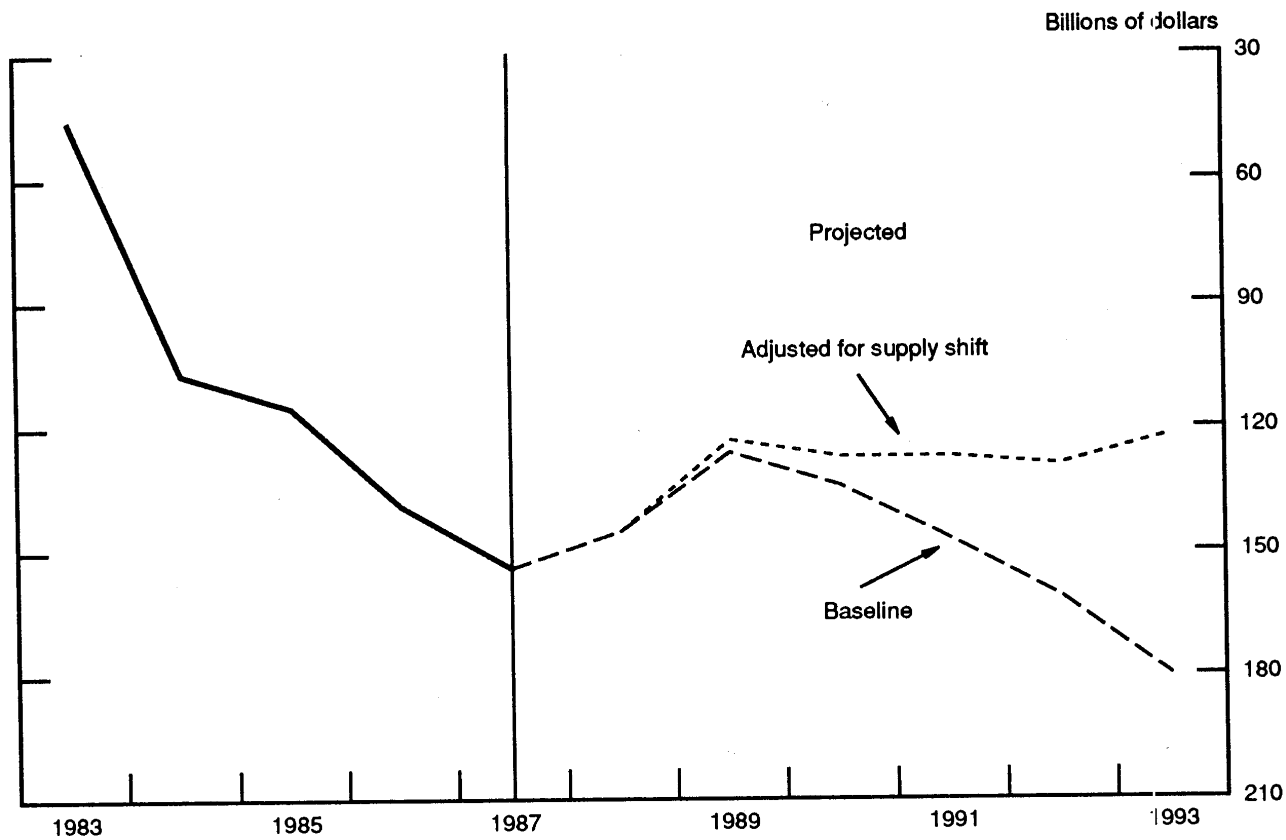
In any event, the range of uncertainty around these estimates is substantial. Within one standard deviation of the estimated coefficients assumed to slow substantially, to an average of about 2 percent per year during 1986-89 (well below the actual growth rate for total business fixed investment in most countries during 1986-87). That rate is then assumed to rise to 4 percent per year during 1990-93. The retirement of old capital, which has amounted to between two-thirds and three-fourths of gross investment in recent years, was assumed to continue to grow at a 5 percent rate both at home and abroad. Accordingly, the rate of capital formation in manufacturing (or gross investment net of discards) grows very rapidly in the United States, and declines somewhat abroad over the extrapolation horizon. Under these optimistic assumptions the ratio of U.S. to foreign capital rises by a total of nearly 9 percentage points between 1988 and 1993.

The baseline H-H model extrapolation shown in Chart 1 assumed no change in the capital stock ratio over the projection horizon; thus longer-run supply effects were neutral. To adjust this baseline, we use the estimated capital stock elasticities from the equations with the "alternative" capital stock ratio in Table 3 (-0.66 for imports and 0.51 for exports). These elasticities are smaller in magnitude and statistically less significant than those in the original H-H specification. The adjustment for both imports and exports was computed as the product of the elasticities times the baseline levels of non-oil import and nonagricultural export volumes respectively, times the cumulative percentage deviation of the capital stock ratio from its 1988 level. All other components of the current account were assumed to follow their baseline paths.

The H-H model's baseline and the adjusted path for the current account are shown in Chart 5. The adjustment, which is equal to the

Chart 5

H-H Model Extrapolation of the U.S. Current Account Deficit



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In any event, the range of uncertainty around these estimates is substantial. Within one standard deviation of the estimated coefficients for either the original or the "alternative" capital stock variable, the variance in the adjustment by 1993 would be plus or minus $25 billion for a 5 percent shift in the capital stock, or $45 billion for a 9 percent shift. At a most optimistic extreme, with unit elasticities, a 9 percent shift in relative capital stocks, plus one standard deviation of the elasticity estimates, the adjustment would be as large as $160 billion, or enough to eliminate most of the deficit by 1993. At a pessimistic extreme, with elasticities of 0.5, a 5 percent shift in capital stocks, minus one standard deviation, the adjustment would be negligible, leaving the current account deficit large and expanding in 1993.

The adjustment we have considered should also be viewed with caution because it is based on an ad hoc specification of supply influences, with the capital stock ratio acting largely as a proxy for longer-run supply shifts that are not captured in movements in relative prices. In order to develop more reliable estimates, the supply sides of existing trade models need to be specified more completely, and the shortcomings of available price series understood better.

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Second, over the floating rate period, movements in relative unit labor costs in manufacturing between the United States and other industrial countries have been determined predominantly by swings in nominal exchange rates. While estimation techniques are crude, the decline in the dollar since 1985 appears to have opened up a sizable manufacturing labor cost advantage in favor of the United States, at least vis a vis major industrial countries. The rise in the dollar in mid-1988 did not significantly reverse this cost advantage.

Third, over the past three decades, movements in the ratio of U.S. to foreign (industrial country) capital stocks in manufacturing appear to have been associated with shifts in labor cost differentials, suggesting that significant supply-side adjustments to exchange rate changes have occurred in the past.

Fourth, a very rough estimate of these supply-side effects (obtained by "endogenizing" secular supply shift variables in one of the models) indicates that they may be large enough to keep the deficit from widening again after 1989. This estimate also suggests the continuation of a sizable U.S. external deficit for a number of years to come (given the underlying assumptions of similar rates of growth of income and domestic demand at home and abroad, and no further change in U.S. international price competitiveness).

Finally, the range of uncertainty around the mean estimate of these supply effects is considerable. Given the variance of model coefficients and the range of plausible responses of capital stocks to cost differentials, the the supply-side adjustment could range from negligible to enough to narrow the deficit substantially further over the next 5 years.

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