International Finance Discussion Papers

Number 160

April, 1980

EXPECTATIONS AND THE ADJUSTMENT OF TRADE FLOWS UNDER FLOATING EXCHANGE-RATES: LEADS, LAGS AND THE J-CURVE

by

John F. Wilson and Wendy E. Takacs

. . . I stress the need for paying more attention to leads and lags by means of delaying or putting forward imports and exports. . . . I point out that, in so far as a study of leads and lags is concerned with the effects of anticipations of changes in exchange rates on the supply-demand relationships in foreign exchanges arising from trade, such effects produced by changes in the timing of physical imports and exports are fully as relevant as those produced by changes in financial arrangements connected with imports and exports.

Paul Einzig,
<u>Leads and Lags: The Cause of Devaluation</u>, p.4

Expectations and the Adjustment of Trade Flows Under Floating Exchange Rates: Leads, Lags, and the J-Curve

by

John F. Wilson and Wendy E. Takacs*

I. Introduction

According to the standard textbook view of the adjustment of trade flows under floating exchange rates, currency depreciation or appreciation due to existing imbalances would fairly promptly set in motion adjustment in real goods and services flows. If this is so, the return toward equilibrium would be quicker than in a fixed-rate environment where national authorities may defend inappropriate exchange rates for too long.

The evidence from the floating period so far is less than fully persuasive that international imbalances are resolved more quickly by greater exchange-rate flexibility. During the last eight years large trade and current account surpluses and deficits have persisted in the major industrial countries despite substantial changes in exchange-rates. To be sure, some of these imbalances can be traced to energy developments and to divergence in economic performance across the major countries. At times during the 1972-79 period, however, swings in external balances appear to have been greater than such factors can account for, and movements in counterintuitive directions have been frequent. For instance,

* Division of International Finance, Board of Governors of the Federal Reserve System, and University of Maryland Baltimore County, respectively. The views expressed herein are solely those of the authors and do not represent those of their institutions. The authors are grateful to numerous colleagues, especially to Peter Isard and Peter Clark, for useful discussions and critique. Liz Christensen, Gail Grossman and Priscilla Baker provided excellent research assistance. We are also indebted to Patti Abell, Janice Fuqua and Josie Drecchio for their capable, patient, and cheerful typing assistance.

the German current surplus rose to record levels in 1974 despite the quadrupling of oil prices, and the Japanese surplus went through prolonged expansion in 1977-78 while the yen appreciated almost continuously. Although some perverse movements, attributable to J-curve effects, have come to be expected in international adjustment patterns, cases like the two cited go well beyond what might be predicted by conventional models. The deficiency may be, we suggest below, that such models ignore the role that expectations about future price and exchange-rate shifts may play in the adjustment profile.

The purpose of this paper is to add to the understanding of the adjustment of trade flows to price and exchange-rate stimuli by developing a simple model of how expectations might affect the time profile of real trade flows. When expectations are incorporated in such a model, "leads" as well as "lags" in the flows of physical goods become possible and a rationale for seemingly perverse behavior becomes apparent. The possibility of "leads" in trade flows has, to date, been neglected in the empirical literature but, as will be elaborated below, has important implications for adjustment of payments imbalances and, in particular, for the shape of the J-curve.

II. Analytical Framework

If we may suppose that current-period trade flows do respond to traders' expectations (or those of their customers) about the future, what form might such a response take? Consider the case of a U.S. importer during a period of rapid dollar depreciation, such as 1977 or 1978. Suppose that this importer deals in merchandise (e.g., cars or consumer electronic products) from a particular source, such as Japan, and that his ability or willingness to shift to other sources of supply is limited in the short-run. In the long run it would certainly be the case that dollar depreciation against the yen would bite into the importer's demand for Japanese products, probably because some of his customers would shift to domestic or third-country substitutes. In the short-run, however, the importer might temporarily accelerate his orders for Japanese goods, hoping to beat still higher exchange costs in the future. Alternatively, his customers may clamor for desired products sooner, essentially due to the same fears.[1/]

The result of this, assuming exchange rates move roughly as expected, may be a temporary increase in imports at about the same time the home currency in fact depreciates. Such a bulge would probably, but not necessarily, be associated with a disproportionate fall in imports in succeeding periods, both as an offset to the earlier acceleration and as reflection of real adjustment to the increase in import prices.

Somewhat the opposite behavior might characterize importers in a country whose currency is appreciating rapidly. Expecting the domestic currency cost of imports to be lower in the future, they may to some extent defer their own orders and imports. In such a case the initial bulge in the volume of imports will be downward, with a subsequent upward surge as the offset counterpart and in reflection of actual currency appreciation. If trade flows do react to exchange rate expectations in this way, it is evident that the volume balances of both appreciating and depreciating countries will, for a time, move perversely. An analogous argument can be made for expectations about foreign currency prices of traded goods. The case for anticipatory effects on trade flows arising from expected changes of domestic goods' prices is somewhat weaker, but one can be made for some circumstances.

Previous empirical work on anticipatory trade flows is scanty, but scattered references to the possiblity of hastening or postponing of orders can be found in the literature.[2/] The most extensive discussion appears in Einzig's Leads and Lags (1968). In his chapter on "The Timing of Imports and Exports," Einzig sketches examples of the kinds of import/export acceleration/deceleration mechanism outlined above, argues that changes in the timing of physical trade is as important as changes in trade financing arrangements, and notes that to some extent trade leads and lags may stem from customer pressures, rather than choices made by traders alone.[3/]

One objection sometimes raised against the trade leads and lags scenario is that traders can hedge their risks by payments leads and lags or spot and forward operations in the exchange markets. This may be true, but many traders might still elect to manipulate the time profile of their trade rather than their payments flows. Most of the fragmentary evidence on the behavior of traders, for instance, shows that only a small number hedge their risks in foreign exchange markets.[4/] And some traders may actually be obliged to alter the normal time-profile of their operations because of customer pressures. Customers cannot be assumed to have easy access to financial hedges.

III. The Model

Give the preceding discussion, it seems plausible to think of net orders for traded goods (new orders less cancellations) as depending on traders' views about the future, as well as the situation observed at a given point in time. Thus, consider such an <u>order's</u> <u>function</u> for imports:

$$O_t^M = O(Y_t, P_t^d, P_t^f, R_t, Z_t, Y_{t+1}^e, \ldots, Y_{t+h}^e, P_{t+1}^{de}, \ldots, P_{t+h}^{de}, P_{t+1}^{fe}, \ldots, P_{t+h}^{fe}, R_{t+1}^e, \ldots, R_{t+h}^e, Z_{t+1}^e, \ldots, Z_{t+h}^e) \quad (1)$$

where: Y = level of economic activity in the importing country;

P^d = level of domestic prices;

P^f = level of prices in the home country's trading partners;

R = exchange rate (cost of foreign currency in terms of the domestic currency);

Z = other cyclic variables, such as disequilibrium, inventory situation, etc., which may influence ordering behavior.5/

An "e" indicates the level of the variable expected by traders for the subscripted time period, and "h" is the expectation horizon. In this function it should be understood that net orders lodged in period "t" are for imports whose physical delivery will be distributed through time between periods "t" and "t + n", where n ($n \geq h$) may be thought of as the longest order-delivery lag. Therefore, actual imports (or exports) in a given period will be a function of present and past net orders.

$$M_t = M(O_t, O_{t-1}, \ldots, O_{t-n}) \quad (2)$$

Considering equations (1) and (2) together, observed imports in any time period will depend upon present and past observed levels of prices, income, and cyclical variables and present and past expectations as to the levels of the same variables.

$$M_t = M(Y_t, \ldots, Y_{t-n_o}, P^d_t, \ldots, P^d_{t-n_1}, P^f_t, \ldots, P^f_{t-n_2}, R_t, \ldots, R_{t-n_3},$$
$$Z_t, \ldots, Z_{t-n_4}, \{Y^e_{r,s}, P^{de}_{r,s}, P^{fe}_{r,s}, R^e_{r,s}, Z^e_{r,s}\}) \tag{3}$$

In equation (3) $\{X^e_{r,s}\}$ indicates the values of X expected for the period r in present or past period s over the relevant ranges, $r = t\text{-}n+1, \ldots, t+h$ and $s = t\text{-}n, \ldots, t$.

Equation (3) is quite complicated and would be impossible to estimate without further assumptions and simplifications. Those noted below seem reasonable given that our goals are to suggest some methodological innovations, to obtain empirical evidence on trade adjustment, and to focus mainly on actual and expected changes in prices and exchange rates:

1. We eliminated the distributed lag structure on observed values of the income and cyclical terms ($Y_{t-1} \ldots Y_{t-n_o}$ and $Z_{t-1} \ldots Z_{t-n_4}$), so that only the current period values (Y_t and Z_t) remain in the equation. Likewise we dropped the expected levels of these variables $\{Y^e_{r,s}\}$ and $\{Z^e_{r,s}\}$ from the function.
2. For preliminary investigation, we included only one quarter ahead as the expectation horizon (that is, in this paper h=1), under the assumption that the expectation horizon is fairly short, even if the delivery lag may be longer.[6]
3. Lagged actual values of price and exchange rate variables were used in place of lagged forecast values.[7]

The above simplifications help reduce equation (3) to the following:

$$M = M(Y_t, P^{de}_{t+1}, P^{d}_{t}, \ldots, P^{d}_{t-n_1}, P^{fe}_{t+1}, P^{f}_{t}, \ldots, P^{f}_{t-n_2}, R^{e}_{t+1}, R_t, \ldots, R_{t-n_3}, Z_t) \quad \text{(3a)}$$

An obvious problem which survives these simplifications is that one-period-ahead price and exchange-rate expectations remain in the function to be estimated, and the trader's expectations about those variables cannot be observed. There are several ways this difficulty can be resolved. Actual future values of the variables could be used as proxies on the assumption that traders correctly anticipate future events, but such a solution somewhat begs the question. Alternatively, a variety of time series, auto regressive, or regression procedures could be used to generate series of expected values of the variables.[8/] But by far the likeliest scenario is that traders' expectations are typically formed by some simple "algorithm" involving recently observed data. Our (admittedly arbitrary) specification assumes that traders extrapolate current-period price and exchange-rate levels on the basis of a simple weighted average of recently observed rates of change. Price (P^f and P^d) and exchange rate (R) "forecasts" were generated as follows:

$$X_{t+1} = (0.7\ X_t/X_{t-1} + 0.3\ X_{t-1}/X_{t-2})X_t = \mu(t)\ X_t \quad (4)$$

The extrapolative factor, $\mu(t)$, is obviously a function of time because it is continuously updated through the sample.

While simple, equation (4) generates forecasts which in fact match outcomes reasonably well. This is important because, although it is unlikely traders could stumble on an algorithm with unbiased forecasting properties, it is also implausible they would stick with one which produces manifestly bad results through time.[9/] In our estimation procedure the algorithm given by (4) was used to generate the unobservable one-period-ahead forecasts of prices and exchange rates while, as noted, actual historical data (rather than lagged forecast data) were used for the "observable" present and past price and exchange rate levels.

After the above simplifications, and invoking the common assumption that the functional form of the original equation is exponential (except perhaps for the Z vector) taking logarithms yields the estimating function (5). The "e" superscript is omitted for convenience.

$$\ln M_t = k + \alpha \ln Y_t + \sum_{i=-1}^{n_1} \beta_i \ln P^d_{t-i} + \sum_{i=-1}^{n_2} \delta_i \ln P^f_{t-i} + \sum_{i=-1}^{n_3} \gamma_i \ln R^m_{t-i} + \eta Z_t + \varepsilon_t \quad (5)$$

As in our previous article, and for reasons given there, one simplification not undertaken here is the compression of price terms into the relative-price specification used in most of the trade literature.

The above derivation has been in terms of a country's demand for imports. The same basic formulation can also be applied to a country's exports, with the modification that the income and cyclical variables would then be those of the trading partners (Y^f and Z^f), the price of competing domestic goods would be the price level in the imporing countries (P^f), the price of the traded goods would be P^d, and the exchange rate (R^x) will be the price of the exporting country's currency in terms of foreign currency:

$$\ln X_t = k + \alpha \ln Y_t^f + \sum_{i=-1}^{n_1} \beta_i \ln P_{t-i}^f + \sum_{i=-1}^{n_2} \delta_i \ln P_{t-i}^d + \sum_{i=-1}^{n_3} \gamma_i \ln R_{t-i}^x + \eta Z_t + \varepsilon_t \qquad (6)$$

As is customary, sums of coefficients in equations (5) and (6) are interpreted as long-run responses of imports and exports to their several determinants. Sign expectations in both equations are as follows:

$$\hat{\alpha} > 0; \quad \Sigma\, \hat{\delta}_i, \quad \Sigma\, \hat{\gamma}_i < 0; \quad \Sigma\, \hat{\beta}_i > 0; \quad \hat{\eta} \gtrless 0 \qquad (7)$$

It should be noted, however, that because the hypothesis of this paper is that trade flows may initially or temporarily respond perversely to price-and exchange-rate stimuli, some individual coefficients are expected to be "wrong-signed." This should be especially the case at or near the lead end of the various lag distributions.

Two further modifications were made to the equations prior to estimation. First, prior reasoning suggests that the long-run impact of changes in export prices and exchange rates on trade flows should be about the same. This constraint was therefore imposed on the regressions and was implemented by a mixed estimation procedure.[10/] Second, since actual lag lengths $n_1 \ldots n_3$ are unknown, they must be searched out. To hold the number of equations to be estimated within manageable bounds, we assumed that the full adjustment horizon is the same for domestic and foreign prices. That is, $n_1 = n_2$ in equations (5) and (6).[11/]

The following information summarizes these restrictions and the lag-estimation technique used in obtaining empirical results:

Lag lengths: $n_1 = n_2 \gtrless n_3$

Lag sums: $E(\Sigma\hat{\delta}_i - \Sigma\hat{\gamma}_i) = 0$; $\Sigma\hat{\beta}_i$ unconstrained

Lag structures: (Shiller method) $E(\Delta^4\hat{\beta}_i) = E(\Delta^4\hat{\delta}_i) = E(\Delta^4\hat{\gamma}_i) = 0$ 12/

Before presenting empirical results, we might note the relationship of the approach used in this paper to some of the previous empirical work on trade flows. Somewhat surprisingly, almost all of the existing trade literature glosses over the orders/delivery mechanism we have incorporated here. With few exceptions, contributors to this literature treat trade flows solely as a function of current and past income and prices, ignoring both the role of expectations and the fact that recorded trade follows earlier orders (the true demand function). Implicit in this tradition is the assumption that trade volumes adjust only to price and exchange-rate changes which have _already_ materialized.

Among the few studies which take trade _orders_ as a starting point is Marston's study of British import demand (1971). As Marston correctly notes, "Current orders are determined by the level of aggregate demand and prices _expected_ in the period when imports are to be delivered." (p. 378) However, Marston continues that "... Expectations of future income ordinarily are based on the level of income recently experienced. Thus orders placed in the current period are a function of income in the current and previous periods. Similarly, recent price experience ordinarily determines expectations of future prices." Marston disposes of the expectations problem by writing orders as a function of past income and price _levels_, from which it follows that imports (which trail the orders) are likewise lagged linear functions of these observables. The assumptions in the present study about the way past experience is translated into expectations are somewhat broader than Marston's, mainly because recent rates of change are considered and expectational proxies cannot be avoided.

A much more complicated effort to give expectations a role in the existing literature is represented by the two studies by Isard, Lowrey and Swamy (1975) and (1978). In these studies of demand for imported consumer goods and imported foods, there is no explicit orders/delivery relationship, but the authors are cognizant of the role expectations play:

> In our multi-period framework the individual's demand for imports is related to his wealth or permanent income, rather than being a direct function of his current income. Current demands for imports also depend on the expected future prices of imports and domestic substitutes, which we express in terms of current prices and expected rates of inflation. (1975 p. 2).

As equation (6) in the cited study makes clear, Isard et al. regard current-period consumer goods imports as a distributed-lead function of future (expected) foreign and domestic prices. The particular proxies they adopt for expectational variables (see their equation (13)) involve geometrically weighted sums of past "inflation factors," which consumers are hypothesized to extrapolate forward over the relevant horizon. Making appropriate substitutions and a Koyck transformation (see their equation (32)), Isard et al. get a complicated import function which, however, includes only observables. Our own assumptions about expectations-formation are somewhat simpler, but lead to variable-proxies which cannot be purged from the estimating equation.

IV. Empirical Results

We applied equations (5) and (6) to the trade of six industrial countries among themselves. The countries included were Canada, France, West Germany, Japan, the United Kingdom and the United States. For each country we estimated equations explaining imports from and exports to the other five countries in the sample, using quarterly data for the period 1972.I to 1978.III. All lag structures were estimated using the Shiller procedure, and the long-run elasticities with respect to the export-price and exchange rate variables were constrained to be equal. In each case we explored various forms of the cyclical variables and all permutations of 4, 6, 8, 10, and 12 quarter lag lengths on the exchange rate and price variables, with the lag lengths on domestic and foreign price terms always the same. In the absence of undisputed econometric standards for choosing among alternative results with the same functional forms, we looked to the signs and significance levels of the coefficients, as well as to fit and serial correlation properties of the results, to select the best equations. Tables 1-6 present our results.

In these equations, the income coefficients and the long-run price and exchange rate elasticities all have the expected signs. United Kingdom exports, and to a lesser extent, Canadian imports and exports, however, show only a small response to price and exchange rate variation. Cyclical influences appear to be particularly significant to Japanese trade.

The impact of expectations about price and exchange rate changes show up in the lag structures of these equations as "unexpected" signs on the coefficients of the leaded or near lagged variables. This sign pattern emerges, in the case of imports, as goods ordered early in an attempt to beat anticipated cost increases clear customs and, in the case of exports, due to temporary retardations as traders and their customers

TABLE 1: CANADA

IMPORTS

Long-run Estimates

constant	lnY	lnPf	lnR	lnP_d	t.lnY	$ln(Y/Y^T)$	ΔlnY	$\bar{R}^2$/SE	DW/DF
6.518 (0.86)	1.049 (1.40)	-0.739	-0.739	0.780	-0.002 (-0.46)			0.818 0.021	2.815 16

Lag Quarter	-1	0	1	2	3	4	5	6	7	8	9	10	11	12
lnP_f	0.893 (3.17)	0.130 (0.51)	-0.305 (-0.94)	-0.482 (-1.95)	-0.471 (-2.50)	-0.340 (-1.36)	-0.161 (-0.66)	-0.003 (-0.04)						
lnR	-0.033 (-0.17)	0.093 (0.92)	0.096 (0.81)	0.026 (0.27)	-0.069 (-0.75)	-0.150 (-1.39)	-0.195 (-1.60)	-0.196 (-1.56)	-0.162 (-1.25)	-0.106 (-0.78)	-0.046 (-0.39)	0.003 (0.05)		
lnP_d	-0.530 (-1.02)	-0.716 (-2.23)	-0.431 (-0.95)	0.093 (0.27)	0.627 (2.74)	0.940 (2.69)	0.804 (2.23)	-0.007 (-0.10)						

EXPORTS

Long-run Estimates

constant	lnYf	lnP_d	lnR	lnPf	t.lnYf	$ln(Yf/Y^Tf)$	$\Delta lnYf$	$\bar{R}^2$/ SE	DW/DF
5.301 (3.03)	1.385 (5.90)	-0.680	-0.680	0.610				0.932 0.027	2.747 17

Lag Quarter	-1	0	1	2	3	4	5	6	7	8	9	10	11	12
lnP_d	0.852 (1.38)	-0.813 (-1.85)	-1.220 (-2.01)	-0.820 (-1.98)	-0.060 (-0.26)	0.617 (1.38)	0.776 (1.62)	-0.012 (-0.14)						
lnR	-0.273 (-1.22)	-0.113 (-0.86)	-0.048 (-0.25)	-0.044 (-0.32)	-0.068 (-0.64)	-0.086 (-0.50)	-0.066 (-0.38)	0.018 (0.21)						
lnP_f	- 0.275 (-0.63)	0.539 (1.58)	0.707 (1.64)	0.457 (1.60)	0.017 (0.09)	-0.372 (-1.04)	-0.463 (-1.25)	-0.001 (-0.01)						

Notes to Tables 1-6: Variables and Sources are described in Wilson and Takacs (1979). $\bar{R}^2$ is adjusted for degrees of freedom; SE = standard error of estimate; DW = Durbin-Watson statistic; DF = degrees of freedom adjusted for prior restrictions. T-statistics are in parentheses beneath coefficients.

TABLE 2: FRANCE

IMPORTS

Long-run Estimates

constant	lnY	lnPf	lnR	lnP_d	t.lnY	$ln(Y/Y^T)$	Δ lnY	$\bar{R}^2$/SE	DW/DF
14.593 (1.53)	1.073 (1.916)	-2.218	-2.218	1.836	0.006 (1.46)			0.971 0.022	2.106 16

Lag Quarter	-1	0	1	2	3	4	5	6	7	8	9	10	11	12
lnP_f	-0.882 (-1.37)	-1.061 (1.67)	-0.965 (-1.23)	-0.681 (-1.01)	-0.293 (-0.74)	0.111 (0.55)	0.442 (1.08)	0.605 (1.05)	0.496 (1.03)	0.010 (0.13)				
lnR	0.007 (0.04)	-0.133 (-1.48)	-0.224 (-2.22)	-0.263 (-2.60)	-0.253 (-2.35)	-0.202 (-1.84)	-0.137 (-1.26)	-0.086 (-0.78)	-0.075 (-0.66)	-0.117 (-0.98)	-0.198 (-1.46)	-0.268 (-1.71)	-0.244 (-1.73)	-0.025 (-0.36)
lnP_d	0.337 (1.28)	0.459 (1.72)	0.459 (1.43)	0.374 (1.21)	0.243 (1.00)	0.101 (0.71)	-0.018 (-0.19)	-0.082 (-0.51)	-0.070 (-0.40)	0.034 (0.49)				

EXPORTS

Long-run Estimates

constant	lnYf	lnP_d	lnR	lnPf	t.lnYf	$ln(Yf/Y^Tf)$	Δ lnYf	$\bar{R}^2$/ SE	DW/DF
4.186 (0.65)	1.154 (2.02)	-0.834	-0.834	1.218	-0.001 (-0.18)			0.954 0.021	3.079 16

Lag Quarter	-1	0	1	2	3	4	5	6	7	8	9	10	11	12
lnP_d	0.029 (0.13)	-0.035 (-0.23)	-0.114 (-0.56)	-0.182 (-1.43)	-0.217 (-2.70)	-0.200 (-1.22)	-0.125 (-0.73)	0.010 (0.14)						
lnR	-0.246 (-1.42)	0.034 (0.30)	0.082 (0.53)	-0.015 (-0.15)	-0.166 (-2.37)	-0.279 (-2.06)	-0.256 (-1.76)	0.011 (0.17)						
lnP_f	-0.001 (-0.00)	0.400 (1.42)	0.484 (1.26)	0.363 (1.18)	0.147 (0.64)	-0.054 (-0.18)	-0.133 (-0.46)	0.012 (0.17)						

TABLE 3: GERMANY

IMPORTS

Long-run Estimates

constant	lnY	lnPf	lnR	lnP_d	t.lnY	$ln(Y/Y^T)$	Δ lnY	$\bar{R}^2$/SE	DW/DF
9.470 (1.01)	0.763 (2.27)	-1.388	-1.389	1.634				0.935 0.027	2.504 17

Lag Quarter	-1	0	1	2	3	4	5	6	7	8	9	10	11	12
lnP_f	0.375 (0.83)	-0.243 (-0.32)	-0.562 (-0.61)	-0.637 (-0.80)	-0.525 (-1.09)	-0.292 (-1.78)	-0.017 (-0.05)	0.204 (0.37)	0.263 (0.54)	0.046 (0.56)				
lnR	-0.259 (-2.16)	-0.135 (-1.40)	-0.097 (-0.60)	-0.110 (-0.40)	-0.140 (-0.38)	-0.167 (-0.42)	-0.177 (-0.52)	-0.164 (-0.72)	-0.117 (-0.95)	-0.022 (-0.25)				
lnP_d	-0.759 (- 1.32)	0.087 (0.09)	0.541 (0.39)	0.690 (0.57)	0.620 (0.87)	0.417 (2.06)	0.168 (0.26)	-0.040 (-0.04)	-0.117 (-0.14)	0.028 (0.32)				

EXPORTS

Long-run Estimates

constant	lnYf	lnP_d	lnR	lnPf	t.lnYf	$ln(Yf/Y^T f)$	Δ lnYf	$\bar{R}^2$/ SE	DW/DF
3.205 (0.29)	1.896 (2.23)	-1.329	-1.329	1.764	-0.001 (-0.19)			0.953 0.024	2.703 16

Lag Quarter	-1	0	1	2	3	4	5	6	7	8	9	10	11	12
lnP_d	-0.090 (-0.16)	-0.031 (-0.06)	-0.084 (-0.14)	-0.194 (-0.45)	-0.306 (-0.56)	-0.357 (-0.46)	-0.277 (-0.40)	0.009 (0.12)						
lnR	0.025 (0.20)	-0.006 (-0.06)	0.019 (0.14)	0.050 (0.36)	0.046 (0.32)	-0.010 (-0.06)	-0.106 (-0.66)	-0.211 (-1.23)	-0.286 (-1.63)	-0.304 (-1.76)	-0.261 (-1.61)	-0.180 (-1.22)	-0.089 (-0.77)	-0.017 (-0.23)
lnP_f	0.836 (1.93)	-0.2 46 (-0.73)	-0.479 (-1.34)	-0.182 (-0.52)	0.329 (0.69)	0.741 (1.24)	0.743 (1.49)	0.022 (0.28)						

TABLE 4: JAPAN

IMPORTS

Long-run Estimates

constant	lnY	$\ln P_f$	lnR	$\ln P_d$	t.lnY	$\ln(Y/Y^T)$	$\Delta \ln Y$	$\bar{R}^2$/SE	DW/DF
2.796 (1.08)	2.120 (6.80)	-1.575	-1.575	2.068		1.240 (2.51)	-1.513 (-3.64)	0.961 0.027	2.078 15

Lag Quarter	-1	0	1	2	3	4	5	6	7	8	9	10	11	12
$\ln P_f$	0.896 (1.76)	0.332 (1.01)	-0.172 (-0.49)	-0.560 (-2.16)	-0.778 (-4.46)	-0.778 (-3.33)	-0.525 (-2.20)	0.010 (0.11)						
lnR	-0.219 (-1.63)	0.330 (2.32)	0.317 (2.07)	-0.025 (-0.21)	-0.465 (-3.30)	-0.771 (-4.10)	-0.708 (-3.98)	-0.034 (-0.38)						
$\ln P_d$	0.583 (2.77)	-1.043 (-4.74)	-1.145 (-4.52)	-0.330 (-1.64)	0.798 (3.49)	1.632 (5.32)	1.568 (5.70)	0.004 (0.04)						

EXPORTS

Long-run Estimates

constant	lnYf	$\ln P_d$	lnR	lnPf	t.lnYf	$\ln(Yf/Y^T f)$	Δ lnYf	$\bar{R}^2$/ SE	DW/DF
-22.194 (-1.55)	1.970 (1.87)	-1.877	-1.877	8.192	-0.029 (-1.99)			0.910 0.057	1.577 16

lag Quarter	-1	0	1	2	3	4	5	6	7	8	9	10	11	12
$\ln P_d$	-1.066 (-2.23)	0.388 (0.97)	0.726 (1.32)	0.350 (0.78)	-0.336 (-0.83)	-0.921 (-1.79)	-0.972 (-2.03)	-0.046 (-0.24)						
lnR	-0.255 (-0.86)	0.597 (1.80)	0.890 (2.37)	0.735 (2.55)	0.248 (0.99)	-0.419 (-1.26)	-1.057 (-2.34)	-1.400 (-2.66)	-1.161 (-2.60)	-0.054 (-0.29)				
$\ln P_f$	0.370 (0.38)	1.780 (1.37)	2.210 (1.44)	1.950 (1.65)	1.295 (2.13)	0.546 (1.11)	0.017 (0.03)	0.023 (0.12)						

TABLE 5: UNITED KINGDOM

IMPORTS

Long-run Estimates

constant	lnY	lnPf	lnR	lnP_d	t.lnY	$ln(Y/Y^T)$	ΔlnY	$\bar{R}^2$/SE	DW/DF
0.614 (0.41)	1.353 (4.92)	-0.169	-0.170	0.473				0.935 0.029	2.200 17

Lag Quarter	-1	0	1	2	3	4	5	6	7	8	9	10	11	12
lnP_f	0.335 (1.13)	0.096 (0.52)	-0.042 (-0.17)	-0.112 (-0.59)	-0.140 (-1.07)	-0.143 (-0.75)	-0.116 (-0.60)	-0.046 (-0.49)						
lnR	-0.014 (-0.07)	-0.278 (-1.41)	-0.177 (-1.08)	0.061 (0.51)	0.207 (0.98)	0.032 (0.34)								
lnP_d	0.648 (1.94)	-0.191 (-1.25)	-0.429 (-2.02)	-0.278 (-1.66)	0.047 (0.46)	0.335 (2.61)	0.377 (2.72)	-0.034 (-0.36)						

EXPORTS

Long-run Estimates

constant	lnYf	lnP_d	lnR	lnPf	t.lnYf	$ln(Yf/Y^Tf)$	$\Delta lnYf$	$\bar{R}^2$/ SE	DW/DF
15.369 (0.49)	2.839 (2.09)	-4.304	-4.305	4.055	-0.001 (-0.03)			0.826 0.043	2.856 16

Lag Quarter	-1	0	1	2	3	4	5	6	7	8	9	10	11	12
lnP_d	0.006 (0.01)	-0.163 (-0.25)	-0.378 (-0.46)	-0.587 (-0.70)	-0.739 (-0.93)	-0.796 (-1.06)	-0.735 (-1.01)	-0.564 (-0.79)	-0.325 (-0.45)	-0.089 (-0.12)	0.055 (0.10)	0.011 (0.08)		
lnR	0.263 (1.25)	-0.137 (-0.50)	-0.329 (-0.98)	-0.377 (-1.23)	-0.343 (-1.20)	-0.290 (-0.97)	-0.270 (-0.79)	-0.306 (-0.76)	-0.391 (-0.86)	-0.500 (-1.06)	-0.589 (-1.28)	-0.594 (-1.42)	-0.433 (-1.38)	-0.009 (-0.07)
lnP_f	-1.072 (-1.56)	-0.174 (-0.41)	0.372 (0.54)	0.650 (0.72)	0.745 (0.74)	0.736 (0.74)	0.688 (0.79)	0.642 (0.92)	0.598 (1.02)	0.519 (0.90)	0.345 (0.73)	0.007 (0.05)		

IMPORTS

TABLE 6: UNITED STATES

Long-run Estimates

constant	lnY	lnPf	lnR	lnP_d	t.lnY	ln(Y/Y^T)	Δ lnY	$\bar{R}^2$/SE	DW/DF
27.441 (2.45)	1.284 (1.92)	-4.507	-4.507	3.670	0.009 (1.32)			0.942 (0.032)	1.941 16

Lag Quarter	-1	0	1	2	3	4	5	6	7	8	9	10	11	12
$\ln P_f$	0.109 (0.22)	-0.345 (-1.40)	-0.535 (-1.09)	-0.558 (-0.93)	-0.506 (-0.84)	-0.452 (-0.86)	-0.434 (-1.05)	-0.455 (-1.32)	-0.486 (-1.17)	-0.475 (-0.94)	-0.348 (-0.81)	-.023 (-0.22)		
lnR	0.052 (0.23)	-0.186 (-0.85)	-0.385 (-1.39)	-0.551 (-1.79)	-0.685 (-2.00)	-0.777 (-2.11)	-0.796 (-2.15)	-0.702 (-2.02)	-0.456 (-1.74)	-0.021 (-0.20)				
$\ln P_d$	0.749 (1.81)	0.601 (1.09)	0.531 (0.72)	0.507 (0.72)	0.497 (0.91)	0.470 (1.22)	0.393 (1.26)	0.249 (0.75)	0.053 (0.15)	-0.133 (-0.37)	-0.205 (-0.74)	-0.042 (-0.41)		

EXPORTS

Long-run Estimates

constant	lnYf	lnP_d	lnR	lnPf	t.lnYf	ln(Yf/Y^T f)	Δ lnYf	$\bar{R}^2$/ SE	DW/DF
17.133 (2.65)	1.216 (1.79)	-2.209	-2.209	1.313		-1.631 (-1.19)		0.877 0.024	2.149 16

Lag Quarter	-1	0	1	2	3	4	5	6	7	8	9	10	11	12
$\ln P_d$	0.702 (2.39)	-0.049 (-0.14)	-0.509 (-1.15)	-0.719 (-1.79)	-0.725 (-2.45)	-0.575 (-2.81)	-0.335 (-1.70)	-0.087 (-0.37)	0.068 (0.34)	0.019 (0.25)				
lnR	0.019 (0.11)	-0.198 (-0.93)	-0.365 (-1.35)	-0.459 (-1.82)	-0.466 (-2.22)	-0.385 (-2.20)	-0.248 (-1.41)	-0.100 (-0.51)	-0.001 (-0.00)	-0.007 (-0.09)				
$\ln P_f$	0.222 (0.74)	-0.280 (-1.41)	-0.410 (-1.26)	-0.280 (-0.84)	-0.003 (-0.01)	0.314 (1.58)	0.568 (2.64)	0.664 (2.40)	0.508 (2.03)	0.009 (0.11)				

respond to perceptions of cheaper merchandise in the future. Unexpected signs of this type do in fact appear for at least one of the variables in all equations, and appear to be particularly significant for Canadian and Japanese imports and exports, United Kingdom imports, and United States exports. The results therefore tend to confirm the existence of an import/export acceleration/deceleration phenomenon and indicate that the volume balances of major trading countries may move perversely in the short run in response to these influences.

Two other facets of the estimates also are worth mentioning for comparison with results obtained with our earlier model applied to the same countries for the fixed-rate era. (See Wilson and Takacs (1979 - Tables 1-6.)) One is that the total response time to price and exchange-rate stimuli in the floating-rate environment appears shorter in most cases than it was earlier. Second, the results of our earlier study tended to confirm Orcutt's 1950 conjecture that adjustment to exchange-rate changes would be faster than to price changes. We questioned then whether the same would hold under floating exchange rates, and in fact, the results in Tables 1-6 tend to show full exchange rate lags as long as (or even slightly longer than) the corresponding price effects. A tentative conclusion from these aggregate results, therefore, is that trade adjusts to price and exchange rate movements over more equivalent horizons now than in the Bretton Woods interval.[13/]

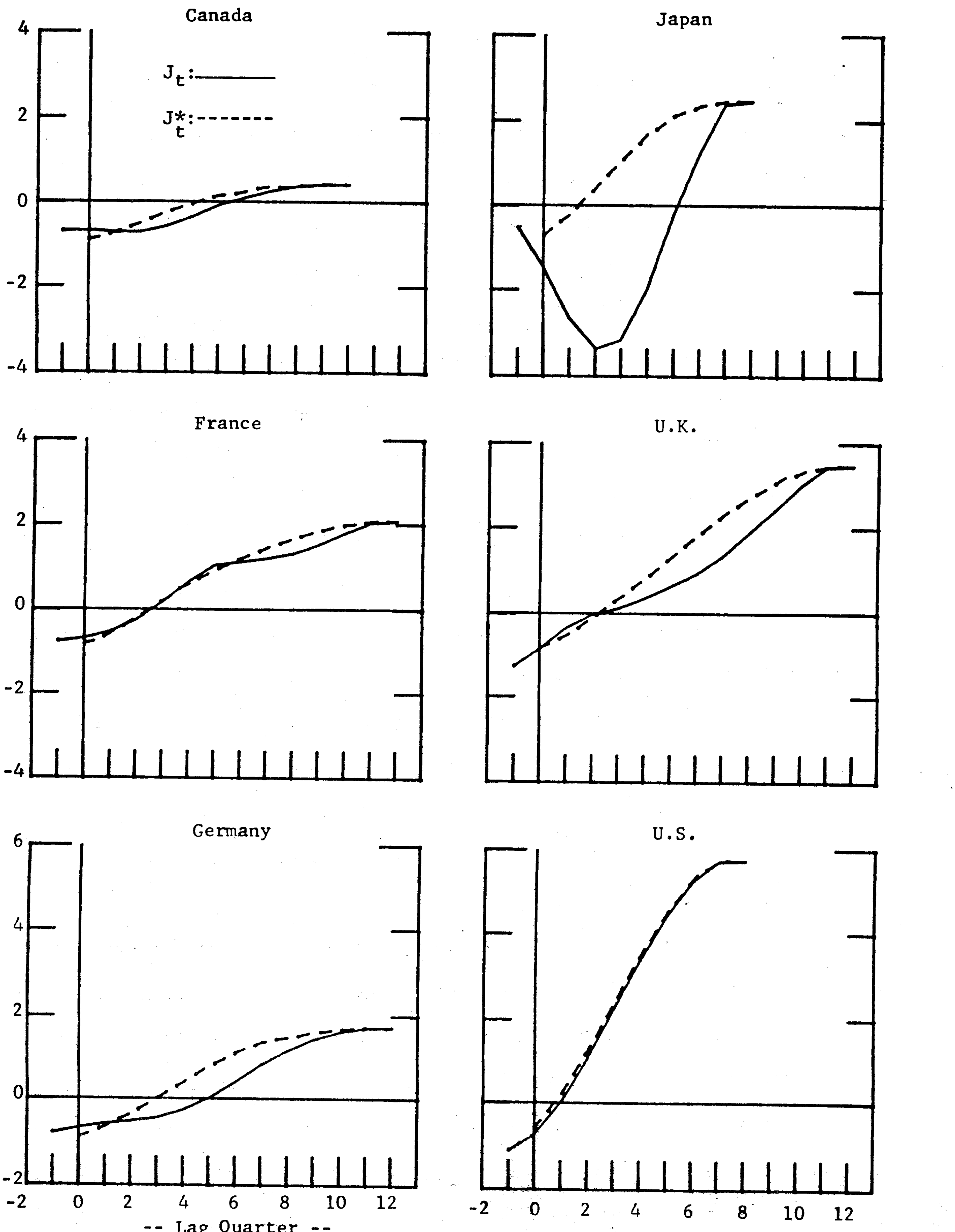
V. Implications of Trade Leads and Lags for the J-Curve

The pattern of leads and lags in trade flow behavior described and empirically confirmed above may initially reinforce the pure valuation effects of currency changes, and thereby exacerbate the J-curve for countries in trade or current account disequilibrium. If the currency of a given country depreciates, its trade balance may deteriorate sharply, not only due to the increased value of imports previously contracted for, but also due to the temporary surge in physical imports ordered in expectations of the depreciation. Export earnings may fall at the same time, because of a temporary downward shift in volumes.

To illustrate the way in which taking expectations into account can affect the J-curve, we have drawn in Figures 1-6 the J-curves implied by the estimated equations for each of the countries in this study. Also drawn, for comparison, are a set of stylized J-curves derived from the kind of trade-flow models which seem to predominate in the literature. In such models, import and export lag-coefficients are commonly assumed to follow second-degree polynominal curves, and there is no adjustment prior to an <u>actual</u> price or exchange rate impulse. To derive such stylized J-curves, therefore, we computed sets of pseudo-coefficients which trace second degree curves, but which have the same lag-lengths as our own estimates and likewise have the same coefficient sums. This latter condition assures that the final adjustment equilibrium will be the same in both cases, although the intermediate positions of the curves can differ noticeably. Details on construction of the pseudo-coefficients and derivation of the J-curves for both cases are found in the Appendix.

Several observations might be made relative to the J-curves displayed here, all of which relate to the "total" trade of each of the sample countries with the others as a group. First (assuming trade is initially balanced), all show an initial deterioration of the trade balance, although nothing in the estimation procedure required this to

Figures 1-6: Estimated (J_t) and Stylized (J_t^*) J-Curves for Major Countries under Floating Exchange Rates



Sources: Tables 1-6 and calculations of stylized coefficients outlined in Appendix.

be the case. This result by itself tends to confirm the view that the J-curve (in the sense of initial worsening of the balance) in reality works much as is often envisaged for these six countries, under floating as well as under fixed exchange-rates. Second, since the final trade equilibrium has improved after full adjustment in all cases, the evidence suggests the Marshall-Lerner condition is satisfied for these countries, i.e., that exchange-rate adjustments will ultimately be effective in bettering external performance. Third, it is apparent that the estimated J-curves lie beneath the stylized J-curves over most of the adjustment period for the countries concerned. That is, the model which takes expectations into account produces results in which the trade balance not only <u>deteriorates</u> earlier than in conventional models, but also in which the balance is generally <u>lower</u> as the full-adjustment horizon is approached. Consequently, the accumulated sum of trade balances -- measuring from the initial equilibrium -- need not be the same in the two cases, except that the final equilibrium is the same. In the results considered here, between the shock and the final adjustment the estimated model tends to accumulate trade balances for each country which are (algebraically) lower than those produced by the stylized model.

Taking note of an individual result, the adjustment path of the Japanese trade balance is especially striking. The estimated J-curve (alone among these estimates) not only continues to move in the "perverse" direction for several quarters, but for most of the adjustment period there is a considerable gap between the estimated and stylized J-curves. We are tempted to relate these findings to the 1977-78 historical experience, when the yen appreciated amost continuously, at the same time that political and economic observers (with, we think, the "conventional model" in mind,) searched the Japanese trade data fruitlessly for signs of external adjustment. A plausible interpretation of what happened during this episode is that expectations of further yen appreciation were regularly engendered by recent yen apprecation, giving rise to a series of "overlapping" J-curves, each exacerbated by anticipatory behavior, in which adjustment to past changes were, for a time, simply overwhelmed by traders' responses to recent and anticipated changes. Once a period of relative yen stability was achieved (from late 1978 through mid-1979), therefore, it should not be surprising that lagged effects caught up and the Japanese surplus plummeted late in 1979.[14/]

VI. Bilateral Trade Equations and J-Curves:

The model applied so far in this paper to aggregate trade of six industrial countries is also applicable to bilateral trade among them. To keep the study within reasonable bounds we have explored bilateral trade and J-curves only selectively, for the United States and Japan. Particular interest attaches to these cases because both countries are major factors in world trade, their bilateral exchange rates with other countries have changed sharply, and because of the persistent controversy over whether such changes can rectify bilateral imbalances at all between themselves and with other countries.

Applying equations (5) and (6) to U.S. and Japanese trade yields a series of bilateral estimates similar to those tabulated in Tables 1-6. In Table 7 which follows, however, we have presented only the long-run price and exchange rate elasticities obtained, together with an indication of the full lag-lengths.[15/] While a few of the long-run parameter

Table 7:
Synopsis of Long-Run Price and Exchange Rate Estimates
for Bilateral Japanese and U.S. Trade, 1972-I - 1978-III

Trade Partners	Japan				United States			
	Exports		Imports		Exports		Imports	
	R, P_d	P_f	R, P_f	P_d	R,P_d	P_f	R, P_f	P_d
Canada	-1.13 (10, 10)	16.51 (10)	-1.73 (8, 6)	1.67 (6)	-1.33 (10, 6)	1.50 (6)	-0.97 (6, 6)	0.72 (6)
France	-1,21 (4, 8)	2.81 (8)	-0.80 (8, 4)	0.54 (4)	-1.11 (4, 6)	1.35 (6)	-3.14 (8, 10)	4.41 (10)
Germany	-1.18 (4, 10)	2.35 (10)	-2.45 (8, 8)	2.45 (8)	-1.39 (10, 4)	0.83 (4)	-3.63 (8, 8)	3.55 (8)
Japan					-1.66 (6, 6)	2.40 (6)	-2.80 (8, 6)	10.07 (6)
United Kingdom	-0.19 (6, 4)	0.33 (4)	-3,01 (10,6)	1.72 (6)	-0.23 (4, 4)	1.78 (4)	-0.18 (4, 6)	0.42 (6)
United States	-2.81 (8, 6)	10.07 (6)	-1.66 (6, 6)	2.40 (6)				

NOTES: Long-run elasticities on changes in exchange rates and traded-goods' prices are constrained to equality, and total lag lengths of domestic and foreign price effects are set equal. Figures in parentheses show number of lagged quarters of price and exchange-rate effects in best estimated equations. Full equation results are available from the authors.

estimates are outside plausible bounds, for the most part the elasticities are reasonable, and correct signs were obtained in every case. In addition, like the aggregate equations, the bilateral results show exchange rate lags frequently as long as or longer than the price lags for the floating rate period. Individual lag coefficients at or near the head of the estimated distributions in most of the bilateral equations also exhibit the temporary sign eccentricities found in the aggregate results, as hypothesized by the model.

Because of the considerable interest generated by bilateral trade balances involving the United States, Germany and Japan, Appendix Tables A1 and A2 reproduce the full estimation results for U.S. trade with these two countries.

The long-run coefficients shown in Table 7 can be used easily to calculate the terminal equilibrium, after the J-curve has traced out the full reaction to an exchange rate change. These results imply trade balance improvement in all bilateral cases. More interesting, however, is a comparison of the path followed by adjustment in the estimated model versus the one suggested by the stylized model. Differencing the J-curves derived from these two models (see Appendix equations (7) and (8)) yields the numerical results shown in Table 8, which again trace the relative trade balance response from one-period <u>ahead</u> of an actual exchange rate shift (i.e., t = -1) out to the end of the adjustment period. By assumption and construction, the differencies between the two J-curves reduce to near zero at the tail end of the adjustment period. The intermediate numbers can be interpreted as the percentage of the initial trade levels by which the stylized J-curve results, at time t, in a higher (i.e., more positive or less negative) trade balance than the estimated J-curve.

As the table shows, the estimated bilateral equations generally show more severe J-curves for Japan and the United States than the stylized model. The differences are especially pronounced for the Japanese adjustment pattern with Canada and the United States, but are also sizeable for adjustment of U.S. trade with Germany. The results imply that the counterintuitive movements in bilateral trade balances observed at times during recent years can be attributed to the temporary impact of expectations on trade flows rather than to any failure of the international price mechanism in the long-run sense. They also imply that policymakers tempted to despair at the "failure" of the international adjustment mechanism should beware of brute-force "solutions" to problems of trade imbalances.

VII. Summary and Conclusions

In this paper we have attempted to extend the methodology of trade-flow estimation into relatively uncharted terrain by explicitly accounting for price and exchange rate expectations. We have argued that traders react to these expectations in their import-export activities, either on their own initiative or responding to customer pressures, in addition to whatever financial operations they might undertake to protect their interests. The model resulting from these considerations begins with and underscores the importance of taking account of the order/delivery mechanism in international trade and leads to estimating equations in which expectations variables are still embedded and must be proxied.

We should stress again that we feel the expectations proxy used in the model reflects a plausible behavioral assumption and that the stylized J-curves used for comparions seem a fair summary of the conventional approach in this literature. But other alternatives might certainly be chosen which

Table 8:
Stylized vs. Estimated J-Curves for Bilateral U.S. and Japanese Trade

	Japan					United States				
Lag Period	Canada	France	Germany	U.K.	U.S.	Canada	France	Germany	Japan	U.K.
-1	-.22	.06	-.31	.26	-.65	-.12	-.70	-.06	-.65	.85
0	.67	-.04	-.25	-.08	.48	-.12	-.77	-.01	.48	.23
1	2.24	-.02	-.13	-.53	2.22	-.06	-.66	.24	2.22	-.48
2	4.03	.20	-.12	-.77	3.67	.02	-.60	.64	3.67	-.60
3	5.55	.51	-.21	-.71	4.24	.09	-.58	1.06	4.24	-.17
4	6.35	.53	-.24	-.41	3.74	.16	-.36	1.34	3.74	-.00
5	6.15	.35	-.25	.01	2.45	.23	-.14	1.33	2.45	
6	4.94	.15	-.18	.38	1.23	.29	.03	.98	1.23	
7	3.05	-.01	-.07	.48	.10	.25	.10	.47	.10	
8	1.20	.00	-.00	.32	.00	.12	.01	.20	.00	
9	-.09			.04		.01		-.00		
10	-.00			-.01		.00		-.00		

NOTE: Tabulated data are $J_t^* - J_t$, as shown in Appendix equation (8). Positive results obtain when the stylized model generates a less-severe J-curve than the estimated model; negative results when the opposite occurs.

could lead to other conclusions. For this reason, in the foregoing discussion we have tended to deemphasize particular coefficient results and lag-curve characterisitics, even though certain facets of the J-curve findings accord remarkably well with recent historical experience. The general empirical results in this paper, however, strongly suggest several conclusions. One is that, by accounting for the influence of expectations on trade flows, a model can be developed which leads to an adjustment pattern which may differ, perhaps sharply, from the conventional view. Second, the quantitative results at both aggregate and bilateral levels suggest that prices and exchange-rates, given time, remain effective determinants of long-run adjustment and that there are simple explanations for temporary paradoxical movements of trade volumes when these stimuli are applied. Finally, as hypothesized in our earlier paper, trade adjustment in the floating-rate world in fact seems to work out over a somewhat shorter horizon than in the fixed-rate era, and there are fewer grounds on which to distinguish price effects from exchange rate effects.

Appendix

1. Calculation of stylized lag-structures.

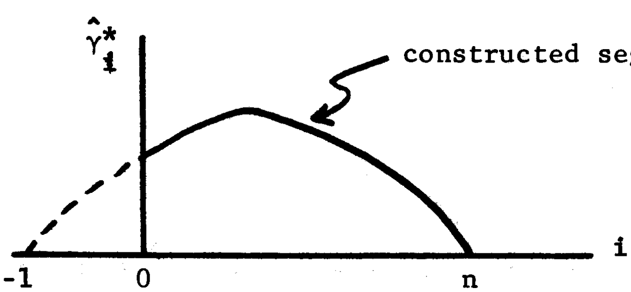
Many models of international trade flows hypothesize that lagged effects of price and exchange rate changes follow a polynominal curve, usually a second-order process, and use the Almon method to estimate these lag curves. If $\{\hat{\gamma}_i^*, i = 0, n\}$ is defined to be the resulting pseudo-coefficient vector on exchange-rate terms, the stylized model can be developed with the following three assumptions:

a) $\hat{\gamma}_i^* = a + bi + ci^2$ (second degree curve)

b) $\hat{\gamma}_{-1}^* = 0 = a-b+c$ (endpoint constraint, 1-period ahead)

c) $\hat{\gamma}_n^* = 0 = a+bn+cn^2$ (far endpoint constraint)

Graphically, the resulting estimates appear as follows:



Setting the lag-lengths of the stylized and actual estimates the same and likewise equating the long-run elasticity estimates (i.e., $\sum_{i=-1}^{n} \hat{\gamma}_i = \sum_{i=0}^{n} \hat{\gamma}_i^*$) the above information is sufficient to solve for a, b, and c and therefore the pseudo-coefficients $\hat{\gamma}_i^*$. This method was used to compute pseudo-coefficients corresponding to the exchange rate estimates on imports and exports for each of the six countries. The J-curves shown in Figures 1-6 were then derived as indicated below for both the actual, and pseudo-estimates.

2. <u>J-Curve calculations</u>.

Let: B_i = trade balance in domestic currency (initially = 0) in period i (where i=0 is the moment of actual exchange-rate change);

P^x_i = local currency price of exports;

X_i = quantity of exports ($\bar{X}$ = initial level);

P^m_i = foreign currency price of imports;

M_i = quantity of imports ($\bar{M}$ = initial level);

R_i = exchange rate (cost of foreign currency).

Then

1) $B_i = P^x_i X_i = P^m_i M_i R_i$

1a) $0 = P^x_{-1}\bar{X} - P^m_{-1}\bar{M}R_{-1}$

Taking the total differential of 1), assuming that $P^x = P^x_{-1}$ and $P^m = P^m_{-1}$ to isolate the pure exchange-rate effect on the J-curve (alternatively, following a "small country" assumption), and summing the results to estimate the path traced by the J-curve, one gets

2) $J_t = \sum_{i=-1}^{t} dB_i = P^x \sum_{i=-1}^{t} dX_i - P^m M_o dR_o - P^m \sum_{i=-1}^{t} R_i dM_i \qquad (t=-1,\ n)$

This can be converted easily to elasticity form by noting that

$$3)\quad dM_i = \frac{\partial M_i}{\partial R_o} dR_o = \gamma_i^m \frac{\overline{M}}{R_o} dR_o$$

Making a similar calculation for exports, but noting that the exchange-rate used in the export equations is the foreign price of local currency (i.e., $R_i^x = R_i^{-1}$), yields

$$4)\quad dX_i = -\gamma_i^x \frac{\overline{X}}{R_o} dR_o$$

Substituting 3) and 4) into equation 2) leads to:

$$5)\quad J_t = [-P^m M_o R_o - P^x \overline{X} \sum_i \gamma_i^x - P^m \overline{M} \sum_i R_i \gamma_i^m] \frac{dR_o}{R_o}$$

Noting the initial level of trade ($= T = P^m \overline{M} R_{-1} = P^x \overline{X}$) and manipulating this expression results in :

$$6)\quad J_t = T[-\frac{M_o R_o}{\overline{M} R_{-1}} - \sum_i \hat{\gamma}_i^x - \sum_i \frac{R_i}{R_{-1}} \gamma_i^m] \frac{dR_o}{R_o}$$

Assuming that T=100, then 1 percent shift in exchange rates ($\frac{dR_o}{R_o} \simeq .01$ and $R_i/R_{-1} = 1.01$ for all $i \geq 0$) therefore gives:

$$7)\quad J_t = [-1.01\frac{M_o}{\overline{M}} - \sum_{i=-1}^{t} \hat{\gamma}_i^x - \sum_{i=-1}^{t} \frac{R_i}{R_{-1}} \hat{\gamma}_i^m]$$

The estimated coefficients can then be used to compute $\{J_t, t=-1, n\}$ where n is the longest lag length computed on either imports or exports for the given country. Given the empirical estimates, the first term of 7) always has a value very close to 1, from which the relation of J_t to the Marshall-Lerner condition is clear.

The same calculation can be carried out for the J-curves generated by the pseudo-coefficients $\{\hat{\gamma}_i^{x*}, \hat{\gamma}_i^{m*}\}$. Noting that the "lead" (i=-1) coefficients are equal to zero, the difference between the estimated and stylized J-curves can be calculated as:

$$8) \quad J_t^* - J_t \simeq \sum_{i=-1}^{t} (\hat{\gamma}_i^{x} - \hat{\gamma}_i^{x*}) + \sum_{i=-1}^{t} \left[\frac{R_i}{R_o}(\hat{\gamma}_i^{m} - \hat{\gamma}_i^{m*})\right]$$

The profile of these differences is implicit in Figures 1-6 for the aggregate equations and is shown explicitly in Table 8 for bilateral trade (with all partners in the sample) of the United States and Japan. In each case $(J_t^* - J_t) > 0$ means the stylized model generates a <u>less severe</u> J-effect at time t than the expectations model, the converse holding for $(J_t^* - J_t) < 0$. Finally, $J_n^* - J_n = 0$, reflecting the constructed condition that the terminal equilibrium be the same in the two models.

TABLE A-1: UNITED STATES BILATERAL TRADE WITH JAPAN

IMPORTS

Long-run Estimates

constant	lnY	lnPf	lnR	lnP	t.lnY	$\ln(Y/Y^T)$	Δ lnY	$\bar{R}^2$/SE	DW/DF
-24.651 (-1.4)	2.417 (1.8)	-2.805	-2.805	10.072	-.031 (-1.9)		-1.643 (-1.2)	0.887 (0.071)	1.51 15

Lag Quarter	-1	0	1	2	3	4	5	6	7	8	9	10	11	12
$\ln P_f$	-.982 (-1.6)	0.197 (0.4)	0.424 (0.7)	0.060 (0.1)	-0.536 (-0.8)	-0.998 (-1.2)	-0.951 (-1.4)	-0.018 (-0.1)						
lnR	-0.301 (-0.9)	0.386 (1.2)	0.695 (1.9)	0.634 (2.1)	0.234 (0.8)	-0.414 (-1.0)	-1.105 (-1.9)	-1.525 (-2.2)	-1.312 (-2.3)	-0.097 (0.4)				
lnP	1.436 (1.2)	2.065 (1.1)	2.160 (1.0)	1.877 (1.1)	1.372 (1.8)	0.800 (1.1)	0.311 (0.3)	0.051 (0.2)						

EXPORTS

Long-run Estimates

constant	lnYf	lnP	lnR	lnPf	t.lnYf	$\ln(Yf/Y^Tf)$	Δ lnYf	$\bar{R}^2$/SE	DW/DF
1.627 (0.6)	2.164 (7.0)	-1.661	-1.661	2.396			-2.155 (-4.7)	0.955 (0.029)	2.57 15

Lag Quarter	-1	0	1	2	3	4	5	6	7	8	9	10	11	12
lnP	0.540 (1.2)	0.222 (0.7)	-0.135 (-0.4)	-0.455 (-2.1)	-0.662 (-4.2)	-0.690 (-3.2)	-0.484 (-2.3)	0.004 (0.1)						
lnR	-0.351 (-2.7)	0.380 (3.1)	0.412 (3.2)	0.031 (0.3)	-0.480 (-3.6)	-0.844 (-4.9)	-0.786 (-4.8)	-0.024 (-0.3)						
$\ln P_f$	0.535 (2.1)	-1.144 (-5.2)	-1.201 (-4.5)	-0.290 (-1.3)	0.936 (3.8)	1.826 (5.6)	1.730 (5.9)	0.004 (0.0)						

t-statistics in parentheses beneath coefficients.

TABLE A-2: UNITED STATES BILATERAL TRADE WITH GERMANY

IMPORTS

Long-run Estimates

constant	lnY	lnPf	lnR	lnP	t.lnY	ln(Y/Y^T)	Δ lnY	$\bar{R}^2$/SE	DW/DF
17.481 (1.3)	1.388 (1.0)	-3.627	-3.627	3.547	0.004 (0.4)		-1.175 (-1.2)	0.888 (0.052)	2.73 15

Lag Quarter	-1	0	1	2	3	4	5	6	7	8	9	10	11	12
lnP_f	0.907 (0.9)	-0.926 (-2.0)	-1.723 (-1.9)	-1.748 (-1.7)	-1.265 (-1.4)	-0.527 (-0.8)	0.220 (0.5)	0.725 (1.4)	0.732 (1.5)	-0.022 (-0.1)				
lnR	0.032 (0.2)	-0.182 (-0.8)	-0.209 (-0.7)	-0.204 (-0.6)	-0.292 (-0.7)	-0.496 (-1.2)	-0.724 (-1.9)	-0.833 (-2.6)	-0.664 (-2.8)	-0.055 (-0.4)				
lnP	1.427 (1.8)	1.369 (1.4)	1.142 (0.8)	0.796 (0.6)	0.380 (0.4)	-0.048 (-0.1)	-0.407 (-1.0)	-0.597 (-0.8)	-0.504 (-0.7)	-0.010 (-0.1)				

EXPORTS

Long-run Estimates

constant	lnYf	lnP	lnR	lnPf	t.lnYf	ln(Yf/Y^T f)	Δ lnYf	$\bar{R}^2$/SE	DW/DF
9.850 (1.3)	1.201 (2.2)	-1.393	-1.393	0.835				0.563 (0.062)	2.33 17

Lag Quarter	-1	0	1	2	3	4	5	6	7	8	9	10	11	12
lnP	-0.399 (-0.4)	0.612 (0.5)	0.171 (0.2)	-0.730 (-1.9)	-1.099 (-1.4)	0.054 (0.3)								
lnR	-0.097 (-0.5)	-0.066 (-0.5)	-0.084 (-0.6)	-0.097 (-0.8)	-0.067 (-0.4)	-0.019 (-0.1)	-0.026 (-0.1(	-0.112 (-0.7)	-0.236 (-1.6)	-0.320 (2.1)	-0.272 (-1.6)	0.003 (0.0)		
lnP_f	1.514 (1.2)	-1.321 (-1.1)	-1.097 (-1.0)	0.392 (0.8)	1.353 (1.3)	-0.006 (-0.0)								

t-statistics in parentheses beneath coefficients.

FOOTNOTES

1/ Several colleagues, purchasers of Japanese cars, have graciously volunteered to let us cite their personal behavior as microeconomic confirmation of such a phenomenon. Whether the hypothesized accleration is due to the importer or his customers makes some difference analytically, as questions about use of the forward exchange market and inventory costs arise in the former case.

2/ Some mention of acceleration or deceleration of trade due to expectations can also be found in Hansen, Foreign Trade Credits and Exchange Reserves (1961), p. 107; Machlup, International Monetary Economics (1966), pp. 48-49; Yeager, International Monetary Relations (1966), p. 119; Grassman, Exchange Reserves and the Financial Structure of Foreign Trade (1973), pp. 9-18; and the comments by Samuelson on Magee's "Currency Contracts, Pass-through, and Devaluation," Brookings Papers on Economic Activity, (1973:I). At this meeting "... Samuelson noted that ... anticipatory behavior can result a reverse J-curve for an appreciating country, with its surplus exaggerated shortly before the change in exchange-rates, and the deterioration exaggerated for an interval thereafter" (p. 323). There have also been occasional comments from commercial or public sources. In its 1969 Annual Report, the Bundesbank comments (pp. 2-3) that foreign orders for German goods were speeded up during the year in anticipation of DM revaluation (the DM was revalued by 9.3 percent in late October). Analogous remarks can be found in various Japanese sources during the 1977-78 period, while the yen was under strong upward pressure.

3/ See especially comments on p. 4 and pp. 33-34.

4/ A broad-based recent study by Scharrer, Gehrmann and Wetter (1978) of the behavior of German traders is a case in point.

5/ For a more detailed description of the data base, adjustments, weighting and cyclic variables used, see our earlier study, pp. 269-270.

6/ Various arguments can be adduced for choosing a short horizon which is fairly uniform across countries and commodity groups. Principally, referring back to equations (2) and (3), one might expect traders to have fairly well-defined views about economic conditions only for a short period ahead, even though horizons longer than h=1 may be implied by the empirical regression results.

7/ While debatable, this step may be justified on both theoretical and empirical grounds. Since the orders' function is in net terms and contains actual, current-period prices and exchange rates in addition to expectations, it can be hypothesized that discrepancies between past expectations and actual outcomes are already captured in the orders' response to the actuals, so that lagged expectations can be dropped for the index range r=t,...,t-n. Alternatively, if the algorithm which generates expectations is fairly accurate with respect to outcomes, lagged expectations terms would be redundant in the equation. On the latter point see footnote 9.

8/ The major objection to these options is that they utilize full-sample information. In effect, they rely on historical data which are partly beyond the possible knowledge of the trader at any point in time. These approaches therefore lack in plausibility. Expectations proxies used in the present study resemble those developed in Hernandez-Catá (1976), pp. 709-12.

9/ Applying equation (4) to the data yields one-period-ahead exchange-rate proxies which have a mean error of less than 0.1 percent compared with actuals for all countries in the sample. Interestingly, the mean forecast error for the (weighted) U.S. rate was negligible. Foreign and domestic price forecasts produced by this algorithm had even lower mean percentage errors than the exchange-rate results.

10/ The rationale for expecting price and exchange rate movements to have the same long-run effect on trade flows (but not necessarily the same short-run influence) and a detailed description of the restricted-least-squares method used, can be found in Wilson and Takacs (1979), p. 268.

11/ For a discussion of the reasons for and implications of this simplification, see Wilson and Takacs (1979), p. 269.

12/ That is, in this application of the Shiller procedure, the expected value of the fourth differences of coefficients within a lag-structure is equal to zero. This is the same as assuming the coefficient path follows a polynomial of degree three or less, but higher-order curves can result if the data suggest them and the associated "tighteness prior" is set at low levels. After some experimentation, this prior was set at 0.3, a not very restrictive value, in the present study. In our previous study estimation was with second-degree polynomial-equivalent priors. A particular advantage of the Shiller lag-estimation method for the current paper is that it permits the augmentation of the data matrix by our expectational proxies. This would not be possible with conventional methods such as the Almon, which creates interpolators from a single series.

13/ In our earlier paper we also developed a statistic, C_t, to display the relative dominance of the price or exchange rate effect in causing trade adjustments in the expected (i.e., long-run) direction though the full lag period. Generally we found that exchange-rate changes tended to have greater initial impacts on trade flows than equivalent price changes, even though the total responses were the same in the long-run. The relevance of C_t is less clear in the current study because the hypothesis is that trade flows may initially move counterintuitively in response to these stimuli. They have been calculated, however, and are available on request.

14/ The rapid increase in oil prices in 1979 certainly played a role, also, but cannot account for all the deterioration. The implication of this kind of adjustment pattern for trade policy seems to be that, in an environment of volatile exchange-rates, policy-makers should have patience and exercise restraint. The model in effect says that artifical measures to beat back the Japanese trade surplus during this period (e.g., forced export restraints, import quotas, etc.) would have been premature.

15/ As in the aggregate model, the lag lengths on domestic and foreign price terms were constrained to be the same. No constraint relates the short- or long-run price responsiveness.

REFERENCES

Einzig, Paul, Leads and Lags: The Cause of Devaluation (London: St. Martins, 1968)

Grassman, Sven, Exchange Reserves and the Financial Structure of Foreign Trade (Lexington: D.C. Heath, 1973)

Hansen, Bent, Foreign Trade Credits and Exchange Reserves: A Contribution to the Theory of International Capital Movements (Amsterdam: North Holland, 1961)

Hernandez-Catá, Ernesto, "Trade Credit, Interest Rates and the Recent Behavior of External Lending by U.S. Banks," International Monetary Fund Staff Papers, XXIII (November, 1976), pp. 699-717.

Isard, Peter, Barbara Lowrey, and P.A.V.B. Swamy, "Theory and Estimation of the Demand for Imports of Consumer Goods," International Finance Discussion Paper No. 61, Board of Governors of the Federal Reserve System (May, 1975).

________, "U.S. Demand for Imported and Domestically Produced Foods: An Investigation of Intertemporal and Cross Substitution," International Finance Discussion Paper No. 116, Board of Governors of the Federal Reserve System (January, 1978).

Machlup, Fritz. International Monetary Economics. (London: George Allen and Unwin, Ltd., 1966).

Magee, Stephen P. "Currency Contracts, Pass-through, and Devaluation," Brookings Papers on Economic Activity, (1973:I), pp. 303-325.

Marston, Richard, "Income Effects and Delivery Lags in British Import Demand, 1955-1967", Journal of International Economics, 1(4), (1971), pp. 375-399.

Scharrer, Hans-Eckart, Dieter Gehrmann and Wolfgang Wetter, Währungsrisiko und Währungsverhalten deutscher Unternehmen im Assenhandel (Hamburg: Verlag Weltarchiv, 1978)

Wilson, John F. and Wendy E. Takacs, "Differential Responses to Price and Exchange Rate Influences in the Foreign Trade of Selected Industrial Countries," The Reveiw of Economics and Statistics, 61, (May, 1979) pp. 267-279.

Yeager, Leland B., International Monetary Relations, (New York: Harper and Row, 1966).