SENSITIVITY OF EXPORTS OF NON-OIL DEVELOPING COUNTRIES TO EXCHANGE RATE VOLATILITY^[1]

Fuad A. Abdullah, Finance, University of Nebraska - Omaha

I. Introduction

The breakdown of the Bretton Woods fixed-exchange rate system in 1971, and the subsequent floating of major currencies have presented participants in international trade and investment markets with a volatile and highly unpredictable exchange rate environment. This volatility of currency rates, which has intensified in recent years, has forced multinational firms to adjust their cash and exchange rate exposure management policies. Substantial changes in the structure and flow of world trade have taken place in the last decade, reflecting changing patterns of comparative cost advantage, and relocation of manufacturing and assembly operations in the areas and countries favored by the emerging patterns. The development of the export-oriented electronics industry in Hong Kong and Taiwan, the automobile industry in South Korea, and the steel industry in Brazil, among others, are striking examples of these shifts.

The highly variable exchange markets have also caused a sharp increase in hedging operations by international traders and investors. These operations have been conducted in the forward and future exchange markets, as well as by the use of other hedging techniques developed to manage the currency risk.

Non-oil developing countries have (LDCs) experienced serious export and balance of payments problems during the period 1973-1984 [2]. These problems had resulted in part from the need to finance sharp increases in the prices

of oil imports during the 1970s. Exports of LDCs were also adversely affected by the recession in the major industrial countries during the period 1980-1982. These developments contributed to the emergence of serious debt servicing problems experienced by a number of these countries, particularly since 1982.

Exporting firms in LDCs have not been able to adapt to the new exchange rate regime as well as their counterparts in industrial countries. For one thing, most of these firms are relatively small and lack the resources and versatility of large multinational firms which dominate foreign trade in industrial countries. They are, therefore, less experienced in hedging techniques that are designed to eliminate or reduce the exchange rate risk. Consequently, currency exposure management capabilities of the exporting firms in these countries are much more limited and circumscribed than firms operating in industrial countries.

This argument has been frequently stressed by representatives of LDCs in international monetary conferences. The report of the Deputies of the Intergovernmental group of 24 (which officially speaks for LDCs within the configuration of the IMF) released in August, 1985, stated that exchange rate variability "especially hurt the developing countries. Exporters and importers in these countries are exposed to high exchange risks in the absence of well-developed financial markets, especially forward cover arrangements" [3]. The

absence of a forward market in the currencies of most of these countries is clearly a serious limitation to the ability of exporting firms to hedge their currency exposure.

II. The Hypothesis and Review of Literature

The hypothesis to be tested is that export performance by non-oil LDCs has been adversely affected by volatility in the exchange market, particularly during the period 1973-1985. Exchange rate variability can impact trade flows either directly, by altering the relationship between costs and expected returns, or indirectly, through changing the pattern of output and investment in the exporting countries.

Empirical investigation of the relationship between exchange rate variability and trade flows has been sparse due mainly to the relatively short experience with floating exchange rates. Earlier studies by Clark [4] and Hooper and Kohlhausen [5] covered primarily time-series dating prior to the onset of the floating rate regime and were generally inconclusive.

Among recent studies, Cushman [6] claimed some measure of success in relating the volume of trade flows to exchange rate variability using 14 sets of bilateral trade flows between the United States and Germany. Cushman's study differed from the earlier ones cited above in two respects. He covered a greater portion of the floating rate period (up to 1977), and he employed a measure of real rather than nominal exchange rate variability. Of the 14 regressions, Cushman found six cases in which his measure of exchange rate variability had a negative sign (i.e., expected), and were significant at the 0.05 level.

A more recent study undertaken by an IMF research group attempted to investigate the impact of recent exchange rate variability on trade flows,

using a bilateral model similar to Cushman's [7]. The study covered exports from seven industrial countries (the United States, the United Kingdom, Japan, Germany, France, Canada, and Italy) to each of the other six during the period 1965-1982. The variable measuring exchange rate variability has the correct sign (i.e., negative) in 16 out of 42 equations, but the coefficient is statistically significant in only two cases. Overall, the outcome of this study was inconclusive, and evidence presented does not seem to support the hypothesis "that exchange rate volatility of a relatively short-term character has a serious adverse impact on international trade" [8].

III. Research Design and Methodology

The study will attempt to relate exchange rate volatility to the volume of exports by non-oil LDCs to industrial countries using a multivariate regression model as follows:

$$X_{ij} = a_0 + a_1 \text{GNP}_j + a_2 P_j + a_3 \text{ERV}_j$$

where:

X_{ij} = exports from country i (or countries i) to country j (or countries j) in volume terms. Exports in value terms derived from the IMF's *Direction of Trade Statistics* were deflated by the export price index for all trade.

GNP_j = real GNP in the importing country or countries.

P_j = inflation rate in the importing country or countries.

ERV_j = a measure of exchange rate volatility of the importing country's currency (or a combined measure of volatility of the importing countries' currencies). For individual importing countries, the measure is the average percentage change, ignoring sign, in the quarterly average real effective exchange rate index of the importing country's currency (based on weights

derived from IMF's multilateral exchange rate model). The combined measure of variability of the currencies of the seven major industrial countries (United States, United Kingdom, France, Germany, Japan, Canada, and Italy) is an average of the measure of variability of the individual currencies weighted according to current trade shares (exports plus imports). This combined measure is used as a proxy for exchange rate variability in the currencies of all industrial countries. The measure of exchange rate volatility is given in Table 1.

All variables were expressed in logarithmic form. Time series used for testing the model are annual data for the period 1965-1985 obtained primarily from IMF published sources.

This study differs from the studies referred to earlier in this paper in at least two respects: 1) The model is capable of accommodating not only bilateral trade flows, but also aggregate exports by non-oil LDCs to all industrial countries as a group, or by any one non-oil LDC to all industrial countries as a group. 2) The measure of exchange rate variability centers around the fluctuations in the real exchange rates of the importing industrial country or countries, since export transactions are predominantly denominated in either the U.S. dollar or in the currency of the importing industrial country or countries. Variability in the exchange rate of LDCs' currencies vis-a-vis the currencies of the major industrial countries is not a significant variable in the design of this model. Exporting firms in LDCs are presumed in the model to measure returns against costs primarily in major convertible currencies rather than their own.

A total of 30 regressions were performed relating exports of all non-oil LDCs to all industrial countries, and exports of selected non-oil LDCs to all industrial countries, as well as each of these to its major trading partner.

Each of the regressions was performed twice: first without lagging the independent variables and second with these variables lagged one year. The coefficients were tested for significance using appropriate statistical techniques. The results are summarized in Table 2.

The model appears to have a satisfactory explanatory capacity with a coefficient of determination (R^2) ranging from 0.52 to 0.81. The best results were obtained by the multilateral regressions relating exports of all non-oil LDCs to all industrial countries which yielded a coefficient of determination of about 0.80. The explanatory capacity of the model improved slightly when the independent variables were lagged one period. Thirteen of the 15 original regressions registered a small improvement when so lagged.

As expected, trade flows in real terms from non-oil developing countries to industrial countries are strongly and positively correlated to changes in the real GNP in the importing country or countries. With the exception of exports of the Ivory Coast to all industrial countries and to France, its major trading partner, the coefficients for changes in real GNP are positive and statistically significant in all cases at the 0.05 level.

Exports in real terms also appear positively correlated, albeit less strongly, to the rate of inflation in the importing country or countries. Twenty-four of the regressions show positive coefficients for this variable all of which are statistically significant either at the 0.05 or 0.10 levels of significance.

The coefficients for the measure of exchange rate variability presents a mixed picture. While the coefficients of both global regressions, relating exports of all non-oil developing countries to all industrial countries, are negative (the right or expected sign) and statis-

tically significant, 15 of the remaining 28 regressions (relating exports of selected non-oil developing countries to all industrial countries and to their respective major trading partner) have a negative sign and only four of these are statistically significant. Two of the 13 coefficients with perverse or positive signs are statistically significant. The model design appears to favor the correlation of global non-oil LDCs' exports to all industrial countries, as against bilateral trade flows. Overall, the outcome shows some degree of sensitivity of exports to exchange rate variability, particularly for the global or aggregate regressions.

The Durbin-Watson test reveals some amount of serial correlation, or autocorrelation among error terms for different observations, which multivariate regression models are often prone to. In 17 of the 30 regressions the Durbin-Watson statistic is inconclusive, while 12 point to rejection of the null hypothesis that there is no significant serial correlation in the data. Overall, and considering that most researchers interpret the inconclusive outcome as an acceptance of the null hypothesis of no autocorrelation, the Durbin-Watson test does not appear to seriously compromise the conclusions derived from this study.

IV. Overall Conclusions

Exchange rate variability introduces an element of uncertainty in the degree of competitiveness of LDCs' exporting firms in industrial countries' markets. Lacking effective hedging mechanisms, or sufficient experience in developing and using such mechanisms, this variability over a prolonged period of time tends to act as a factor which may seriously inhibit these trade flows. While this hypothesis seems plausible a priori, it has been difficult to test empirically due mainly to conceptual and statistical problems related to the derivation of an adequate measure of volatility, and the fact that exchange

rate variability represents only one dimension of uncertainties associated with international transactions.

In addition, the currencies of most non-oil LDCs are pegged either to one of the major convertible currencies or to a basket of these currencies. For others, the rates are administratively determined. Some are experiencing hyperinflation rates accompanied by such a sharp depreciation of their currencies that bilateral rates against major convertible currencies are meaningless for gauging export competitiveness. As a result, comparison of costs and returns in local currency terms are often irrelevant for a typical exporting firm in a developing country. Competitiveness in world markets and the calculation of an acceptable rate of return to the exporting firm are determined primarily in terms of the U.S. dollar or other convertible currencies.

The majority of empirical studies on the impact of exchange rate variability on the volume of trade flows have failed to establish a systematically significant link between the two variables. Most of these studies attempted to establish this link for industrial countries on a bilateral basis. A common denominator in these studies is that they used both bilateral exchange rates and a measure of exchange rate variability among the independent variables.

This study attempted to overcome some of the conceptual and technical problems encountered in earlier studies by: (1) developing a model which is capable of accommodating global or aggregate trade flows as well as bilateral trade flows, (2) using a measure of exchange rate variability which centers around the fluctuations in the real exchange rates of the importing country or countries, rather than the bilateral exchange rates.

Overall, the arguments and evidence presented in this paper substan-

tiate to some extent that currency volatility tended to depress export of non-oil LDCs as a group to industrial countries as a group during the period under consideration (1965-1985). There is also some indication that bilateral trade flows have also been adversely impacted by exchange rate variability during this period. The study was somewhat hampered by the unavailability of quarterly data for some of the independent variables, which precluded regressing quarterly data. Further testing of this hypothesis using more refined models and quarterly instead of annual data, when feasible, seems warranted and may shed further light on the nature of the relationship between exchange rate variability and exports of nonoil LDCs to industrial countries.

Endnotes and References

- [1] Using the classification adopted by the International Monetary Fund (IMF), this group includes all members of the IMF except those classified as industrial countries and the oil exporting countries. Industrial countries comprise Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland, United Kingdom, and the United States. Oil exporting countries comprise Algeria, Indonesia, Iran, Iraq, Kuwait, Libya, Nigeria, Oman, Qatar, Saudi Arabia, United Arab Emirates, and Venezuela.
- [2] Abdullah, Fuad A., *Financial Management for the Multinational Firm*, Prentice-Hall (1987), pp. 562-64.
- [3] Report of the Deputies of the Intergovernmental Group of 24 on the International Monetary system released in August, 1985, for consideration by the Board of Governors of the IMF in the annual meetings held in Seoul, Korea (October 8-11, 1985). See International Monetary Fund, *IMF Survey*, (Washington, D.C.), (September 1985), pp. 7-10.
- [4] Clark, Peter B., "Uncertainty, Exchange Risk, and the Level of International Trade," *Western Economic Journal*, (Long Beach, California), Vol. 11 (September 1973), pp. 302-13.
- [5] Hooper, Peter, and Steven W. Kohlhagen, "The Effect of Exchange Rate Uncertainty on the Prices and Volume of International Trade," *Journal of International Economics* (Amsterdam), Vol. 8, (November 1978), pp. 483-511.
- [6] Cushman, David O., "The Effects of Real Exchange Rate Risk on International Trade," *Journal of International Economics* (Amsterdam), Vol. 15 (August 1983), pp. 44-63.
- [7] International Monetary Fund, *Exchange Rate Volatility and World Trade*, (Washington, D.C.), Occasional Paper No. 28, (July 1984), pp. 57-59.
- [8] *Ibid*, p. 37.

Table 1

Measure of Exchange Rate Volatility

Quarter-to-Quarter Changes in Real Effective Exchange Rates 1965-85¹

	<u>United States</u>	<u>United Kingdom</u>	<u>France</u>	<u>Germany</u>	<u>Japan</u>	<u>Canada</u>	<u>Italy</u>	<u>Weighted² Average</u>
1965	0.53	1.13	0.29	0.60	0.65	0.62	1.82	0.73
1966	0.16	1.59	0.51	0.42	0.29	0.39	2.26	0.66
1967	0.19	1.48	0.22	1.53	0.91	0.19	2.35	0.87
1968	0.97	2.60	1.63	0.99	1.68	0.56	1.19	1.27
1969	0.92	1.05	4.34	2.56	1.77	0.29	2.22	1.77
1970	1.52	1.46	0.56	2.26	0.89	1.78	1.61	1.54
1971	1.84	1.15	1.31	1.60	2.04	0.78	1.65	1.51
1972	1.56	2.45	1.78	0.57	2.55	1.34	3.19	1.68
1973	4.56	3.08	2.20	5.18	3.29	1.84	2.85	3.65
1974	3.03	2.77	4.69	1.70	4.15	2.08	2.09	2.85
1975	2.74	1.18	2.87	2.65	2.06	2.49	3.18	2.50
1976	0.97	3.71	1.97	2.19	0.86	2.43	6.07	2.29
1977	0.87	2.02	0.77	0.81	2.79	3.05	1.90	1.49
1978	2.25	2.81	2.19	2.09	4.91	3.16	2.02	2.59
1979	2.00	4.76	1.55	1.95	7.79	1.61	2.51	2.80
1980	2.25	6.42	0.97	2.69	3.03	1.10	2.48	2.74
1981	5.87	4.08	1.38	3.30	3.48	1.68	1.98	3.50
1982	3.33	1.82	1.82	1.87	3.27	1.50	1.30	2.16
1983	1.73	4.95	2.42	0.94	3.34	0.85	1.97	2.12
1984	3.17	1.69	0.81	0.94	1.15	1.20	2.36	2.93
1985	5.19	5.51	1.61	2.40	2.61	2.06	1.77	3.96

¹The average percentage change, ignoring sign, in the quarterly average real effective exchange rate index (based on weights derived from the IMF's multilateral exchange rate model and relative normalized unit labor costs).

²Weighted according to current trade shares (exports plus imports).

Source: Based on data in International Monetary Fund, Exchange Rate Volatility and World Trade, (Washington, D.C.), Occasional Paper No. 28 (July 1985), and data provided to the author by the IMF.

Table 2
Coefficients of Determinants of Exports of Non-Oil
Developing Countries to Industrial Countries

<u>Exports</u>	<u>Constant</u>	<u>Real GNP</u>	<u>Inflation Rate</u>	<u>Exchange Rate Volatility</u>	<u>$\bar{R}^2$</u>	<u>D-W[†]</u>
<u>Exporter-Importer</u>						
<u>All Non-oil LDCs to all Industrial Countries</u>						
Not lagged	-14.95 (7.45)	2.68 (12.19)*	0.75 (1.79)**	-0.063 (3.56)*	0.79	1.05 (I)
Lagged one year	-20.07 (12.75)	3.77 (11.11)*	1.29 (2.11)**	-0.029 (2.32)*	0.81	1.16 (I)
<u>Mexico to all Industrial Countries</u>						
Not lagged	-11.32 (9.14)	3.42 (11.25)*	-0.59 (1.94)**	-0.011 (1.46)	0.64	0.95 (R)
Lagged one year	-10.74 (6.43)	4.14 (17.18)*	-0.79 (1.85)	-0.017 (0.95)	0.68	0.78 (R)
<u>Mexico-United States</u>						
Not lagged	-20.35 (7.64)	1.36 (7.07)*	0.34 (1.79)**	0.016 (2.69)*	0.78	0.99 (R)
Lagged one year	-25.19 (10.26)	1.92 (9.37)*	0.45 (2.10)**	0.013 (2.13)*	0.80	1.03 (I)
<u>Brazil to all Industrial Countries</u>						
Not lagged	-14.24 (3.03)	1.34 (4.07)*	0.84 (3.00)*	-0.003 (0.27)	0.75	0.67 (R)
Lagged one year	-12.95 (6.50)	2.35 (5.15)*	0.51 (1.79)**	-0.003 (0.31)	0.76	0.70 (R)

<u>Exports</u>	<u>Constant</u>	<u>Real GNP</u>	<u>Inflation Rate</u>	<u>Exchange Rate Volatility</u>	<u>$\bar{R}^2$</u>	<u>D-W[†]</u>
<u>Exporter-Importer</u>						
<u>Brazil to the United States</u>						
Not lagged	-15.17 (8.89)	2.25 (10.43)*	1.58 (4.95)*	-0.004 (0.67)	0.82	1.74 (A)
Lagged one year	-13.50 (7.14)	2.99 (13.05)*	0.75 (3.31)*	-0.004 (0.90)	0.75	1.23 (I)
<u>Korea to all Industrial Countries</u>						
Not lagged	-7.88 (3.28)	0.88 (9.85)*	0.18 (0.85)	-0.001 (0.0065)	0.58	0.75 (R)
Lagged one year	-5.33 (4.19)	1.01 (6.57)*	0.22 (1.10)	-0.002 (0.13)	0.65	0.90 (R)
<u>Korea to United States</u>						
Not lagged	-20.15 (9.85)	2.90 (17.48)*	0.86 (1.74)**	-0.052 (3.21)*	0.72	1.14 (I)
Lagged one year	-30.45 (15.78)	3.05 (16.90)*	1.05 (2.99)*	-0.061 (1.99)**	0.77	1.23 (I)
<u>Philippines to all Industrial Countries</u>						
Not lagged	-6.57 (5.03)	0.91 (3.82)*	0.63 (1.85)**	0.002 (0.075)	0.52	0.95 (R)
Lagged one year	-5.14 (3.81)	1.07 (4.00)*	0.50 (2.03)**	0.003 (0.032)	0.56	1.02 (R)
<u>Philippines to the United States</u>						
Not lagged	-10.05 (6.33)	1.69 (9.20)*	1.10 (3.15)*	0.002 (0.162)	0.60	1.01 (R)
Lagged one year	-14.90 (8.10)	1.72 (7.55)*	1.23 (5.42)*	0.004 (0.362)	0.62	1.15 (I)

<u>Exports</u>	<u>Constant</u>	<u>Real GNP</u>	<u>Inflation Rate</u>	<u>Exchange Rate Volatility</u>	<u>$\bar{R}^2$</u>	<u>D-W[†]</u>
<u>Exporter-Importer</u>						
<u>Egypt to all Industrial Countries</u>						
Not lagged	-31.03 (14.95)	1.80 (6.16)*	0.84 (3.09)*	0.003 (0.25)	0.50	0.89 (R)
Lagged one year	-34.95 (16.60)	2.01 (8.04)*	1.03 (1.84)**	0.003 (0.46)	0.54	0.95 (R)
<u>Egypt to Italy</u>						
Not lagged	-14.47 (9.03)	0.85 (3.16)*	-0.50 (1.50)	0.001 (0.59)	0.38	1.21 (I)
Lagged one year	-12.50 (10.07)	1.27 (2.15)*	-0.79 (2.10)**	-0.16 (1.42)	0.45	1.10 (I)
<u>Turkey to All Industrial Countries</u>						
Not lagged	-24.24 (15.59)	1.76 (15.40)*	0.88 (3.10)*	0.003 (0.47)	0.73	1.44 (I)
Lagged one year	-19.75 (13.07)	1.35 (12.95)*	0.91 (4.71)*	0.002 (0.35)	0.76	1.65 (I)
<u>Turkey to Germany</u>						
Not lagged	-22.07 (12.70)	1.80 (17.40)*	0.75 (3.75)*	0.003 (0.95)	0.65	1.35 (I)
Lagged one year	-13.05 (8.80)	0.85 (10.30)*	0.90 (2.95)*	0.002 (0.61)	0.69	1.51 (I)
<u>Ivory Coast to all Industrial Countries</u>						
Not lagged	-6.30 (2.17)	-2.25 (1.86)**	1.75 (4.95)*	-0.01 (2.88)*	0.61	1.34 (I)
Lagged one year	-4.55 (1.95)	-1.50 (1.04)	1.63 (4.05)*	-0.01 (2.73)*	0.63	1.45 (I)

<u>Exports</u>	<u>Constant</u>	<u>Real GNP</u>	<u>Inflation Rate</u>	<u>Exchange Rate Volatility</u>	<u>$\bar{R}^2$</u>	<u>D-W[†]</u>
<u>Exporter-Importer</u>						
<u>Ivory Coast to France</u>						
Not lagged	-4.14 (1.65)	-1.59 (2.04)**	1.55 (3.52)*	-0.005 (1.25)	0.65	1.08 (I)
Lagged one year	-3.15 (1.85)	-1.29 (1.87)**	1.42 (3.00)*	-0.005 (1.17)	0.63	1.19 (I)

*Statistically significant at the 0.05 level.

**Statistically significant at the 0.10 level.

†The critical values for the Durbin-Watson test at the 10-percent, two-sided level of significance are $d_L = 1.03$, $d_U = 1.67$.

(I) Inconclusive

(R) Reject the null hypothesis that there is no autocorrelation.

(A) Accept the null hypothesis.