Appendix I

Measurement of Exchange Rate Variability

The tables and charts in this Appendix provide the means to assess exchange rate variability over the period 1962–83, using a number of different measures of variability. Tables 4–7 provide information on month-to-month and quarter-to-quarter changes in nominal and real exchange rates, respectively. The figures cited are annual averages of absolute percentage changes in period average (i.e., monthly or quarterly) indices of effective exchange rates (Line am.x in the Fund's *International Financial Statistics*) deflated where appropriate by indices of relative prices. For monthly series, the consumer price index was used as the deflator, while for the quarterly series, relative normalized unit labor costs were used. Tests were also run using other price indices to adjust for inflation; none of the results were sufficiently different from those reported here to warrant separate presentation. Table 8 presents information on the effective variation in exchange rates, defined as the weighted average of variability in bilateral (nominal) rates. It will be seen that trends in effective variation are similar to those in the variability of the effective exchange rate, but, as expected, the level of variability under this measure is somewhat greater.

Table 4. Major Industrial Countries: Month-to-Month Changes in Nominal Effective Exchange Rates, 1961–83[1]

	United States	United Kingdom	France	Federal Republic of Germany	Japan	Canada	Italy	Weighted Average[2]
1961	0.20	0.26	0.23	0.48	0.20	0.66	0.19	0.27
1962	0.10	0.07	0.04	0.12	0.13	0.45	0.04	0.13
1963	0.04	0.05	0.02	0.12	0.15	0.12	0.06	0.08
1964	0.04	0.08	0.02	0.05	0.11	0.09	0.06	0.06
1965	0.06	0.09	0.04	0.11	0.17	0.18	0.06	0.10
1966	0.06	0.10	0.13	0.15	0.07	0.11	0.08	0.10
1967	0.17	1.24	0.25	0.29	0.16	0.14	0.17	0.35
1968	0.08	0.21	0.17	0.30	0.13	0.18	0.15	0.17
1969	0.26	0.27	1.21	1.01	0.27	0.15	0.36	0.53
1970	0.13	0.17	0.10	0.18	0.11	0.56	0.16	0.20
1971	0.56	0.25	0.51	0.58	0.80	0.36	0.39	0.50
1972	0.47	1.03	0.61	0.34	0.54	0.58	0.27	0.53
1973	2.09	1.53	1.07	2.03	1.64	0.63	2.10	1.67
1974	1.66	0.56	1.82	1.54	1.50	0.55	1.50	1.37
1975	1.22	0.97	1.20	0.83	0.98	0.74	0.33	0.94
1976	0.40	2.18	1.05	1.39	0.99	1.05	3.07	1.28
1977	0.72	0.75	0.37	0.75	1.66	1.09	0.91	0.83
1978	1.40	1.22	1.11	1.07	2.66	1.53	0.80	1.34
1979	0.93	1.68	0.50	0.64	2.06	0.86	0.40	0.94
1980	1.78	1.18	0.73	0.86	2.50	0.55	0.83	1.20
1981	2.14	1.81	1.26	1.37	1.83	0.55	1.30	1.55
1982	2.03	1.11	1.16	0.65	2.03	1.06	0.64	1.28
1983	1.25	1.73	0.95	0.79	1.22	0.34	0.80	1.04
Averages								
1961–70	0.11	0.26	0.22	0.27	0.15	0.26	0.13	0.20
1974–83	1.35	1.32	1.01	1.00	1.74	0.82	1.06	1.18
1961–83	0.78	0.81	0.64	0.67	0.95	0.61	0.64	0.71

[1]The average percentage change, ignoring sign, in the monthly average nominal effective exchange rate index (weights derived from the Fund's multilateral exchange rate model).

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

Charts 7 and 8 show deviations of effective exchange rates from their medium-term trend, with the medium-term trend defined as a 19-quarter (or 57-month) moving average of the effective exchange rate (real or nominal). For periods for which calculation of the moving average requires exchange rate data extending beyond the end of 1983, the missing data are assumed to be equal to the average of the data available for the calculation. In Tables 9 and 10, changes in nominal and real effective exchange rates relative to their medium-term trend are set out. These figures are also annual averages of absolute percentage changes in period average indices.

Table 5. Major Industrial Countries: Month-to-Month Changes in Real Effective Exchange Rates, 1961–83[1]

	United States	United Kingdom	France	Federal Republic of Germany	Japan	Canada	Italy	Weighted Average[2]
1961	0.38	0.46	0.52	0.70	0.94	0.73	0.28	0.50
1962	0.35	0.31	0.28	0.35	0.53	0.63	0.32	0.38
1963	0.31	0.20	0.27	0.27	0.72	0.17	0.30	0.29
1964	0.23	0.32	0.19	0.29	0.70	0.15	0.31	0.28
1965	0.23	0.27	0.33	0.25	0.89	0.19	0.25	0.29
1966	0.21	0.35	0.21	0.22	0.55	0.15	0.28	0.25
1967	0.31	1.43	0.32	0.45	0.75	0.34	0.27	0.52
1968	0.20	0.45	0.26	0.33	0.52	0.23	0.25	0.30
1969	0.38	0.36	1.21	1.04	0.61	0.27	0.43	0.63
1970	0.18	0.31	0.22	0.27	0.67	0.67	0.31	0.34
1971	0.78	0.47	0.53	0.61	1.21	0.55	0.44	0.66
1972	0.48	1.02	0.63	0.43	0.59	0.60	0.38	0.56
1973	2.18	1.75	1.19	2.12	2.35	0.50	1.90	1.79
1974	1.76	0.98	1.82	1.54	1.66	0.57	1.79	1.50
1975	1.30	0.82	1.09	1.03	1.16	0.89	0.42	1.02
1976	0.49	2.07	0.96	1.08	1.31	1.06	2.37	1.16
1977	0.78	1.09	0.42	0.70	1.57	1.01	0.84	0.87
1978	1.33	1.23	1.19	1.05	2.68	1.67	0.75	1.35
1979	1.07	2.13	0.55	0.58	2.43	0.96	0.84	1.10
1980	1.91	1.53	0.67	1.25	2.45	0.60	0.69	1.37
1981	2.26	1.99	1.16	1.47	1.67	0.69	0.83	1.57
1982	1.85	0.93	1.19	0.56	2.15	1.13	0.79	1.23
1983	1.24	1.84	0.73	0.77	1.36	0.52	0.64	1.04
Averages								
1961–70	0.28	0.45	0.38	0.42	0.68	0.35	0.30	0.38
1974–83	1.41	1.46	0.98	1.00	1.85	0.91	1.00	1.22
1961–83	0.87	0.97	0.69	0.76	1.27	0.63	0.68	0.83

[1]The average percentage change, ignoring sign, in the monthly average real effective exchange rate index (based on weights derived from the Fund's multilateral exchange rate model and consumer price indices).
[2]Weighted according to current trade shares (exports plus imports).

Table 6. Major Industrial Countries: Quarter-to-Quarter Changes in Nominal Effective Exchange Rates, 1962–83[1]

	United States	United Kingdom	France	Federal Republic of Germany	Japan	Canada	Italy	Weighted Average[2]
1962	0.19	0.11	0.05	0.09	0.29	1.01	0.03	0.23
1963	0.07	0.05	0.02	0.23	0.32	0.16	0.07	0.13
1964	0.05	0.12	0.04	0.41	0.15	0.21	0.14	0.09
1965	0.13	0.20	0.13	0.23	0.27	0.25	0.16	0.19
1966	0.11	0.16	0.33	0.34	0.13	0.19	0.13	0.20
1967	0.21	1.69	0.48	0.51	0.20	0.25	0.30	0.52
1968	0.35	2.10	0.46	0.58	0.53	0.43	0.43	0.66
1969	0.48	0.44	3.58	2.86	0.30	0.11	0.65	1.28
1970	0.38	0.35	0.14	0.49	0.22	1.33	0.48	0.48
1971	1.33	0.53	1.32	1.47	1.72	0.71	0.90	1.19
1972	1.44	2.48	1.58	0.25	1.55	0.80	0.38	1.16
1973	4.15	2.48	1.47	5.37	2.70	1.78	4.23	3.49
1974	3.28	1.22	4.31	2.93	2.09	1.40	3.03	2.74
1975	2.87	3.07	2.44	1.70	1.37	1.87	0.61	2.14
1976	0.71	3.09	2.44	3.44	2.28	1.63	6.91	2.85
1977	1.00	1.65	0.63	1.01	3.76	2.98	2.03	1.60
1978	2.83	2.46	2.01	2.53	5.42	2.56	2.03	2.75
1979	1.44	3.96	1.14	1.67	6.13	1.36	7.24	2.11
1980	1.56	3.30	1.16	1.64	5.08	0.77	2.04	2.05
1981	5.75	3.57	2.38	2.42	2.27	0.93	3.34	3.26
1982	3.43	1.66	2.59	1.32	1.88	1.39	1.50	2.10
1983	2.44	4.30	2.57	1.08	4.18	0.41	1.91	2.33
Averages								
1962–70	0.22	0.58	0.58	0.64	0.27	0.44	0.28	0.42
1974–83	2.53	2.81	2.13	1.97	3.44	1.53	3.06	2.39
1962–83	1.55	1.77	1.41	1.48	1.95	1.02	1.76	1.53

[1]The average percentage change, ignoring sign, in the quarterly average nominal effective exchange rate index (weights derived from the Fund's multilateral exchange rate model).

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

Table 7. Major Industrial Countries: Quarter-to-Quarter Changes in Real Effective Exchange Rates, 1962–83[1]

	United States	United Kingdom	France	Federal Republic of Germany	Japan	Canada	Italy	Weighted Average[2]
1962	0.41	0.91	0.45	0.33	1.51	1.57	2.40	0.84
1963	0.40	0.67	0.42	0.93	0.64	0.31	2.03	0.69
1964	0.71	1.08	0.90	1.35	0.58	0.54	2.04	1.00
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	2.27	1.50	1.30	2.16
1983	1.73	4.95	2.42	0.94	3.34	0.85	1.97	2.12
Averages								
1962–70	0.65	1.33	1.04	1.22	0.99	0.69	1.99	1.04
1974–83	2.50	3.46	2.06	2.02	3.47	1.99	2.75	2.51
1962–83	1.77	2.42	1.60	1.75	2.34	1.38	2.41	1.87

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

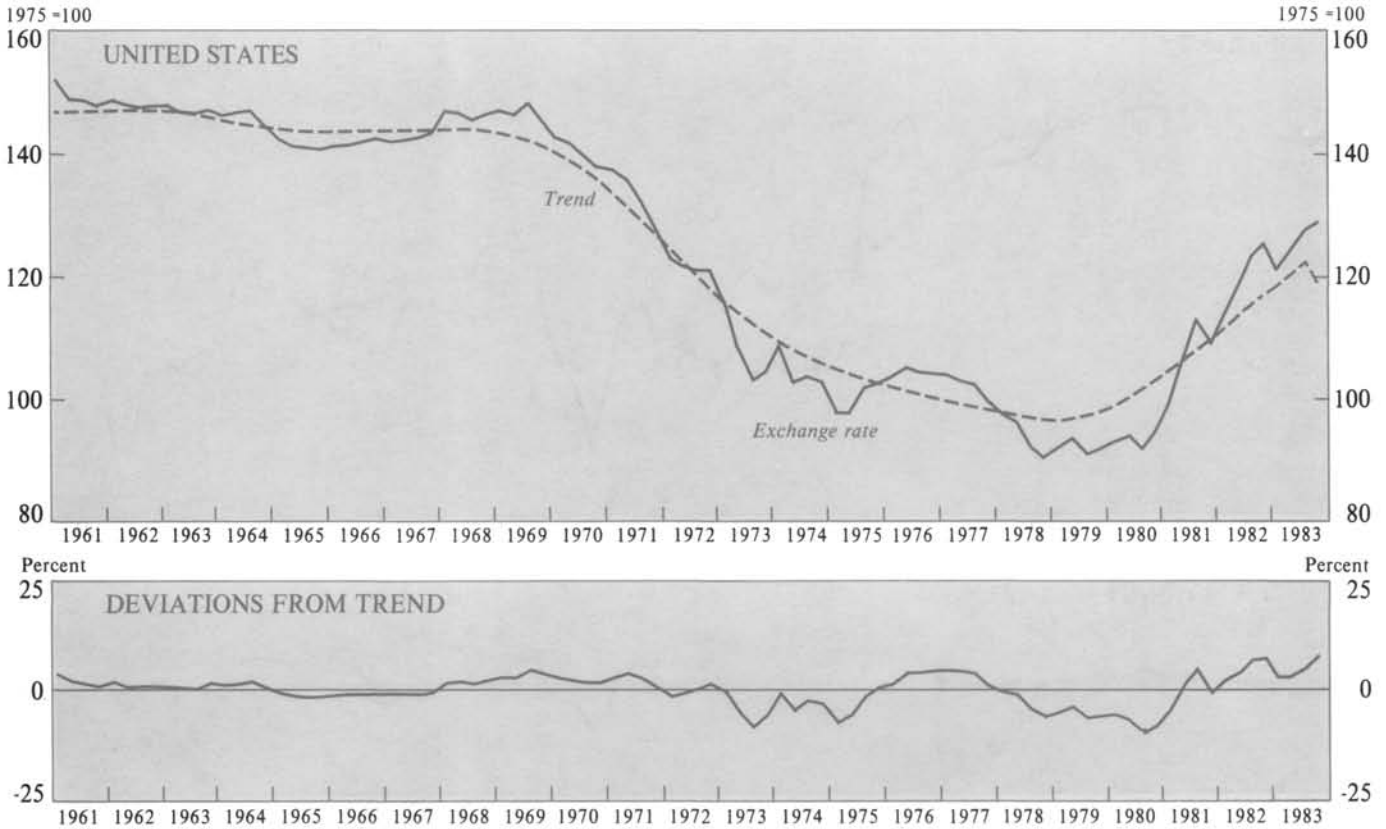
[2]Weighted according to current trade shares (exports plus imports).

Table 8. Major Industrial Countries: Effective Variation[1] of Nominal Exchange Rates, 1961–83

	United States	United Kingdom	France	Federal Republic of Germany	Japan	Canada	Italy
1961	0.63	0.55	0.60	1.11	0.35	0.99	0.51
1962	0.42	0.24	0.11	0.19	0.30	0.95	0.11
1963	0.13	0.10	0.08	0.13	0.24	0.16	0.10
1964	0.11	0.14	0.07	0.10	0.18	0.13	0.10
1965	0.17	0.14	0.10	0.17	0.23	0.25	0.10
1966	0.15	0.19	0.28	0.25	0.10	0.15	0.17
1967	0.46	2.99	0.43	0.44	0.26	0.46	0.40
1968	0.22	0.31	0.34	0.45	0.17	0.25	0.29
1969	0.42	0.54	2.59	1.85	0.31	0.23	1.10
1970	0.48	0.32	0.23	0.34	0.24	0.96	0.31
1971	0.86	0.69	0.85	0.87	1.53	0.64	0.70
1972	0.89	1.84	1.09	0.66	0.98	0.91	0.68
1973	2.33	2.87	2.07	2.65	3.02	0.94	3.40
1974	1.95	1.67	2.38	1.69	2.48	1.09	1.90
1975	1.47	1.57	1.36	1.04	1.41	1.03	1.22
1976	1.35	2.88	1.89	1.38	1.21	1.51	3.98
1977	1.32	1.46	1.04	1.09	1.75	1.27	1.16
1978	2.26	2.29	2.23	1.56	3.55	1.57	1.71
1979	1.64	2.24	0.82	0.85	2.26	1.37	1.03
1980	2.34	1.45	0.87	0.84	3.27	1.28	0.93
1981	2.31	2.95	1.77	1.71	2.55	1.16	1.76
1982	2.58	2.34	1.94	1.41	3.50	1.68	1.34
1983	1.40	2.45	1.30	1.42	1.83	0.65	1.08
Averages							
1961–70	0.32	0.55	0.48	0.50	0.24	0.45	0.32
1974–83	1.86	2.13	1.56	1.27	2.38	1.26	1.61
1961–83	1.12	1.40	1.06	0.95	1.38	0.85	1.05

[1]Weighted average of monthly variability of bilateral nominal exchange rates.

Chart 7. Major Industrial Countries: Quarterly Real Effective Exchange Rates, 1961–83



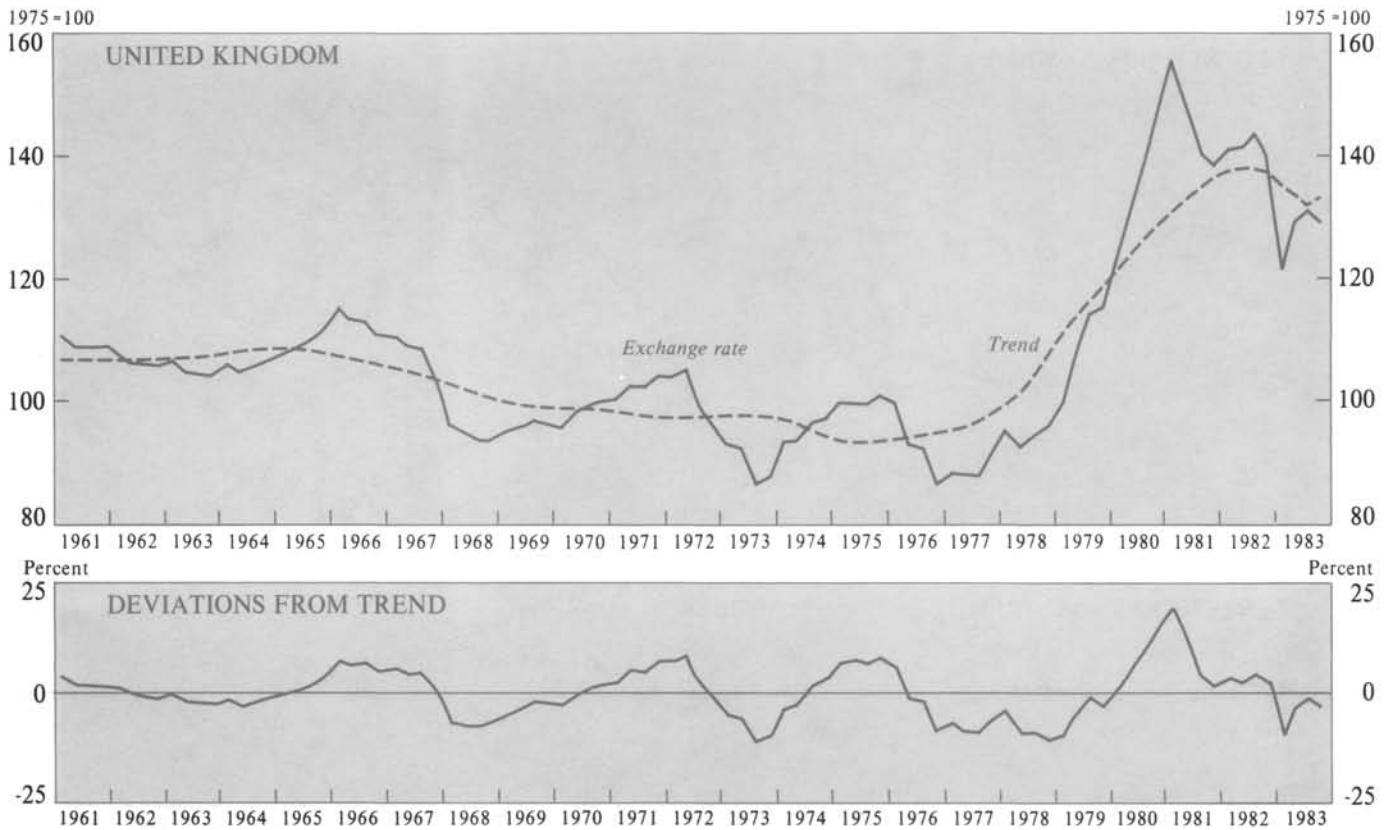
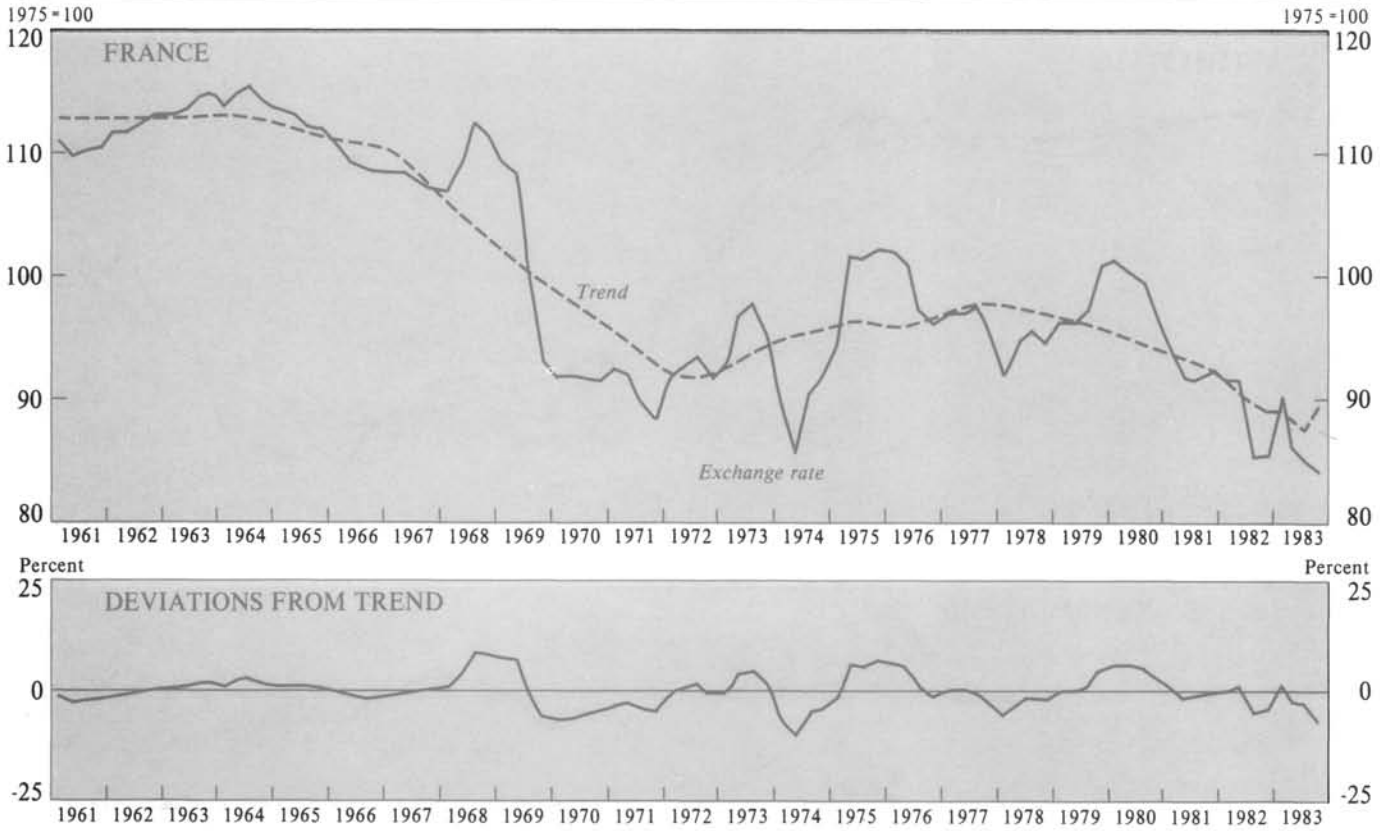


Chart 7 (*continued*). Major Industrial Countries: Quarterly Real Effective Exchange Rates, 1961–83



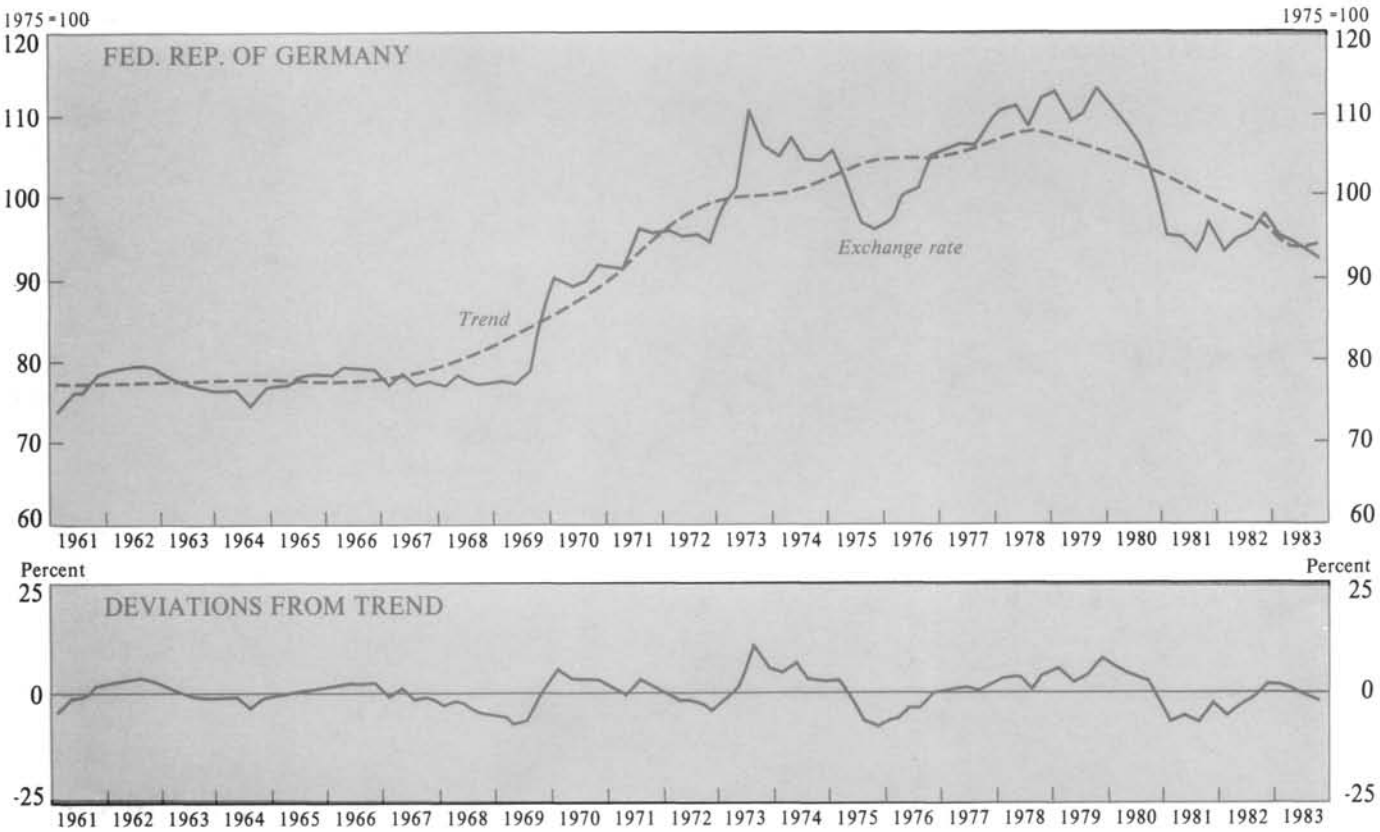


Chart 7 (*continued*). Major Industrial Countries: Quarterly Real Effective Exchange Rates, 1961–83

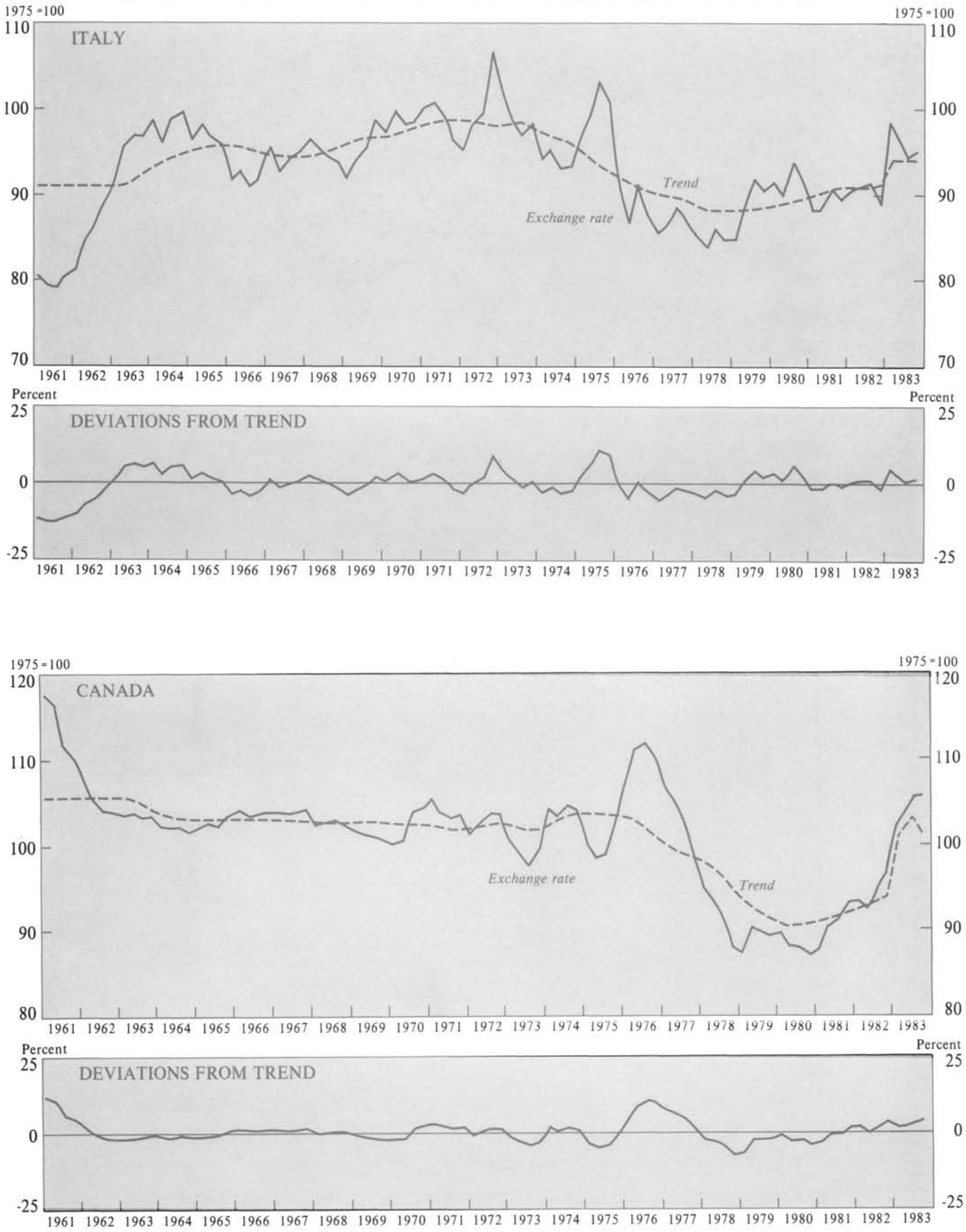


Chart 7 (*concluded*). Major Industrial Countries: Quarterly Real Effective Exchange Rates, 1961–83

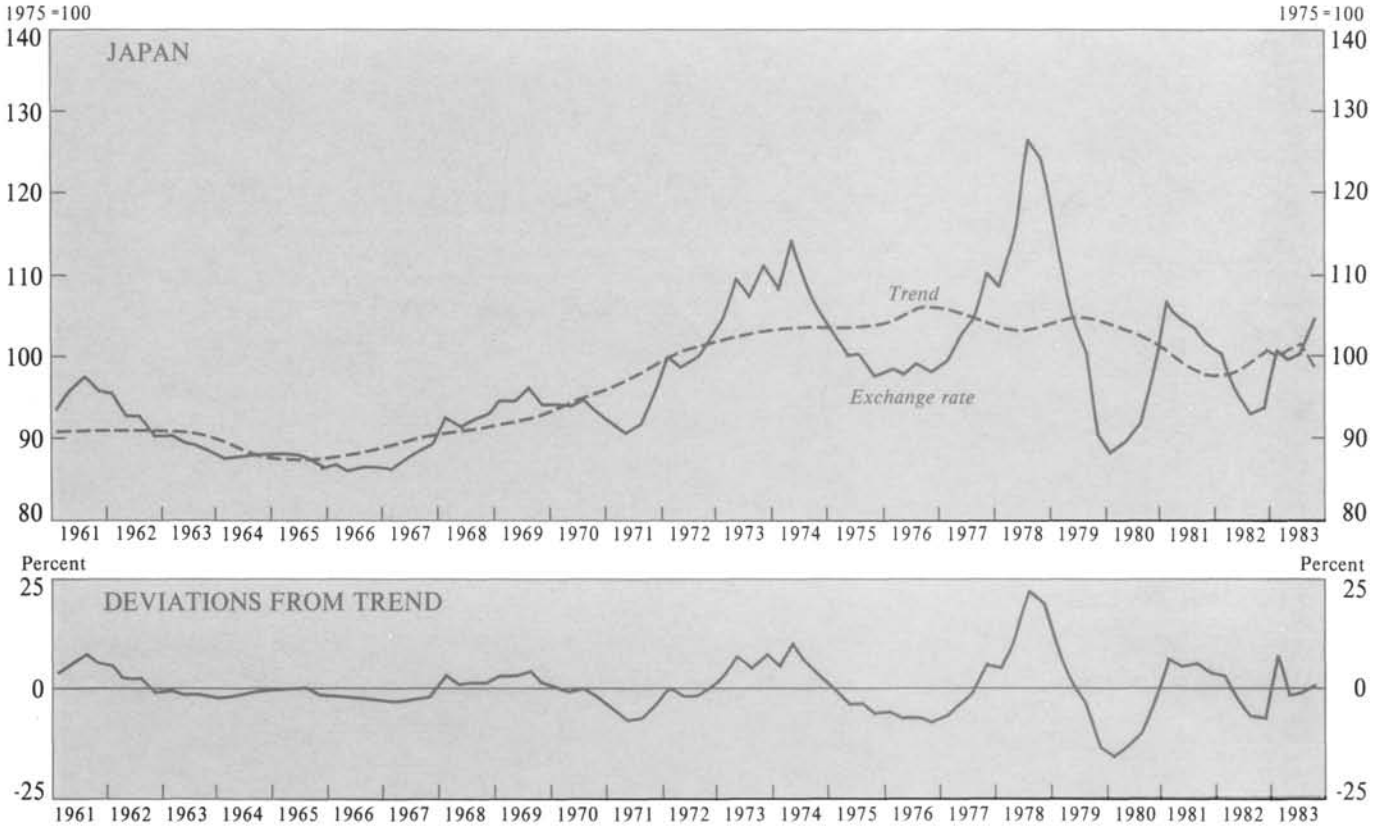
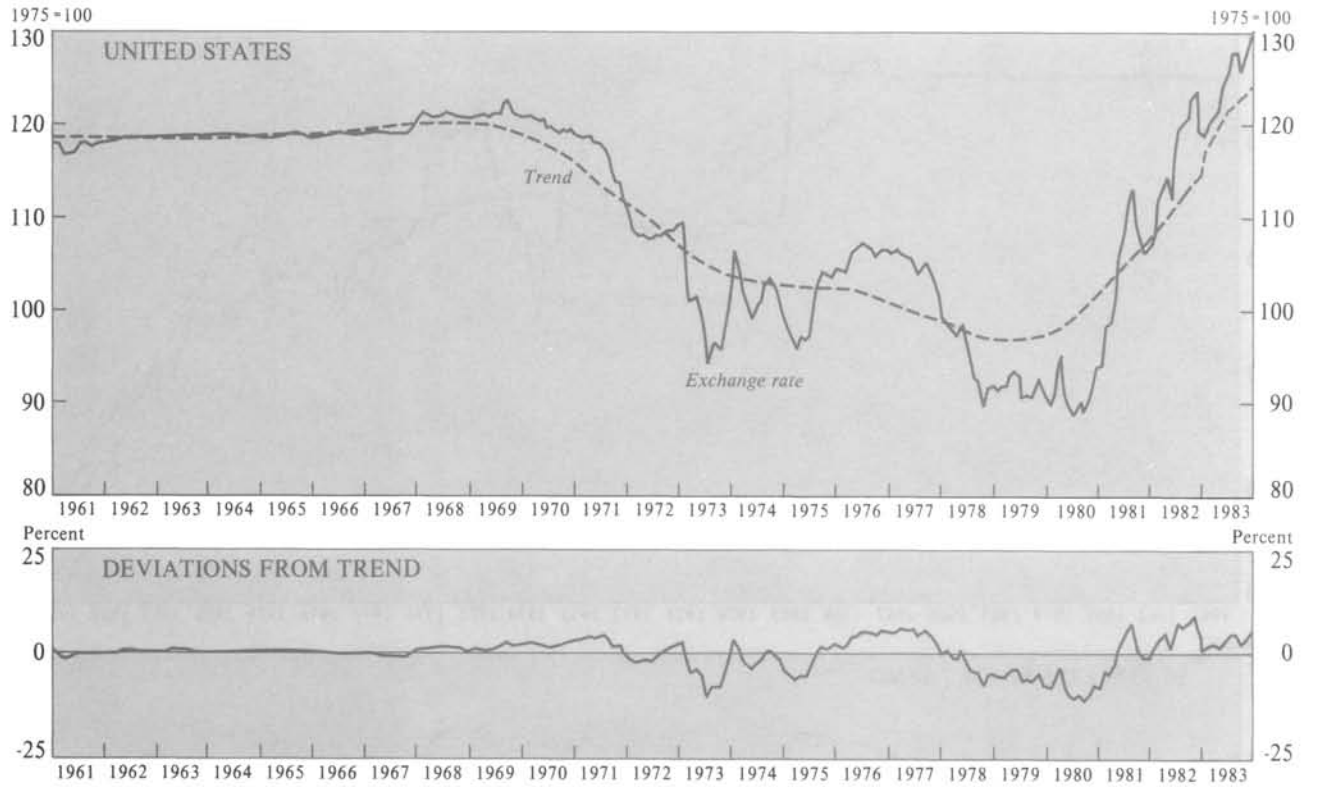


Chart 8. Major Industrial Countries: Monthly Nominal Effective Exchange Rates, 1961–83



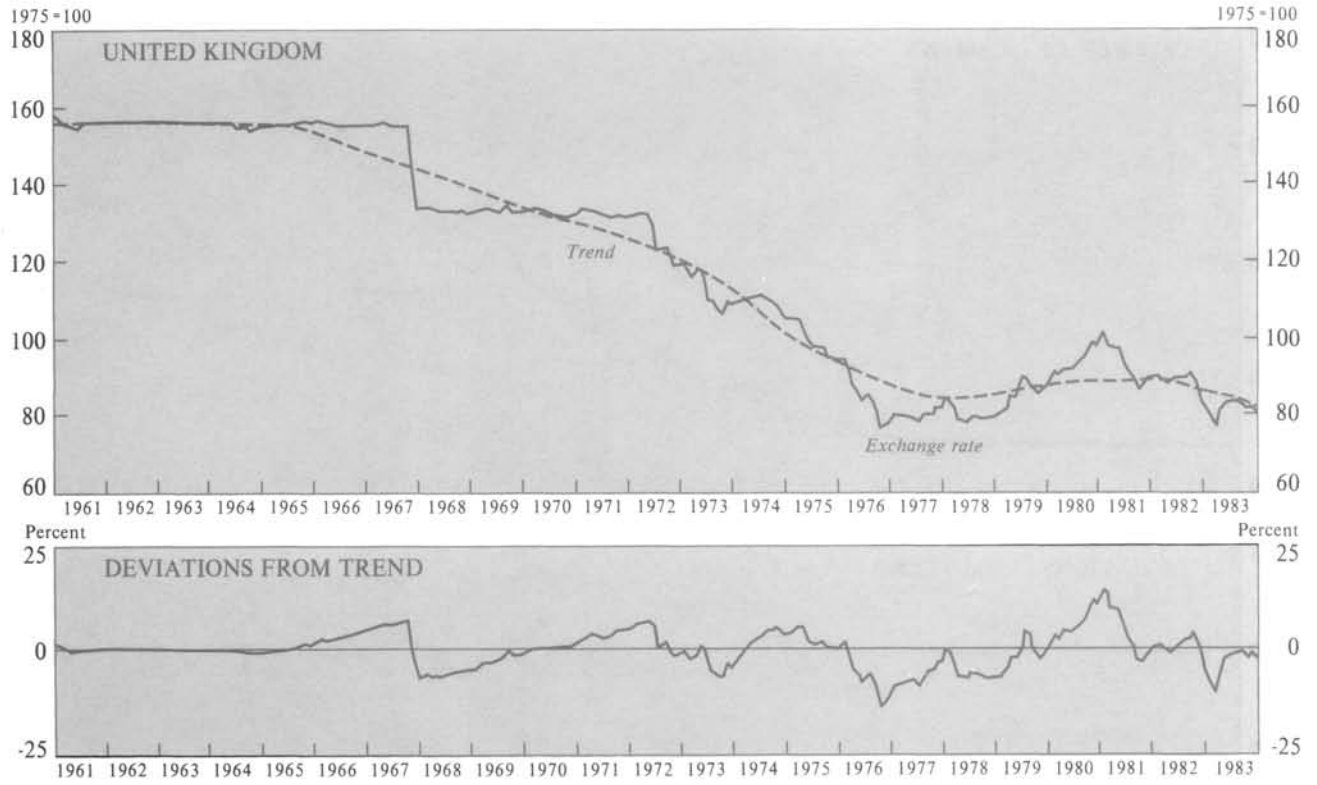
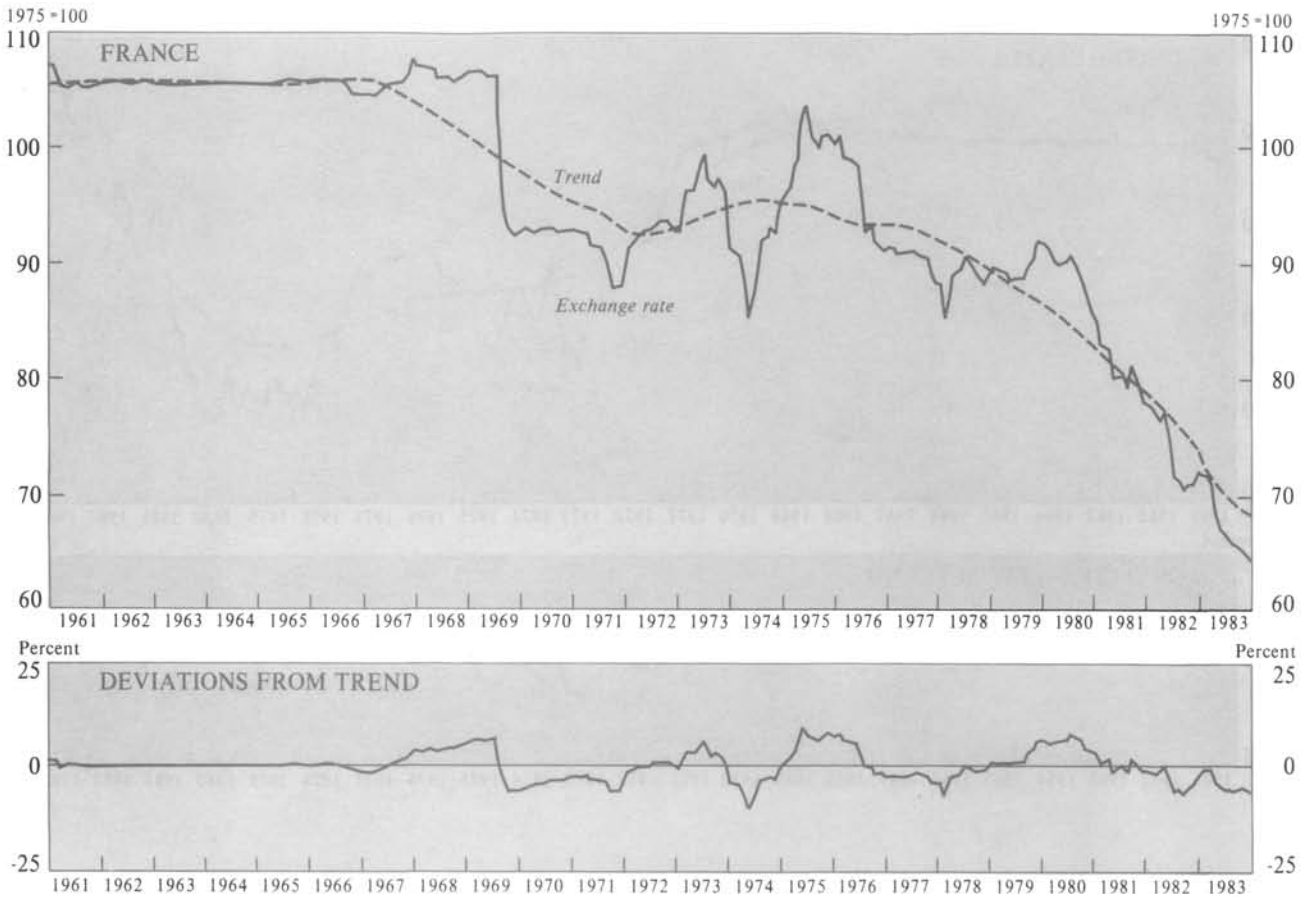


Chart 8 (*continued*). Major Industrial Countries: Monthly Nominal Effective Exchange Rates, 1961–83



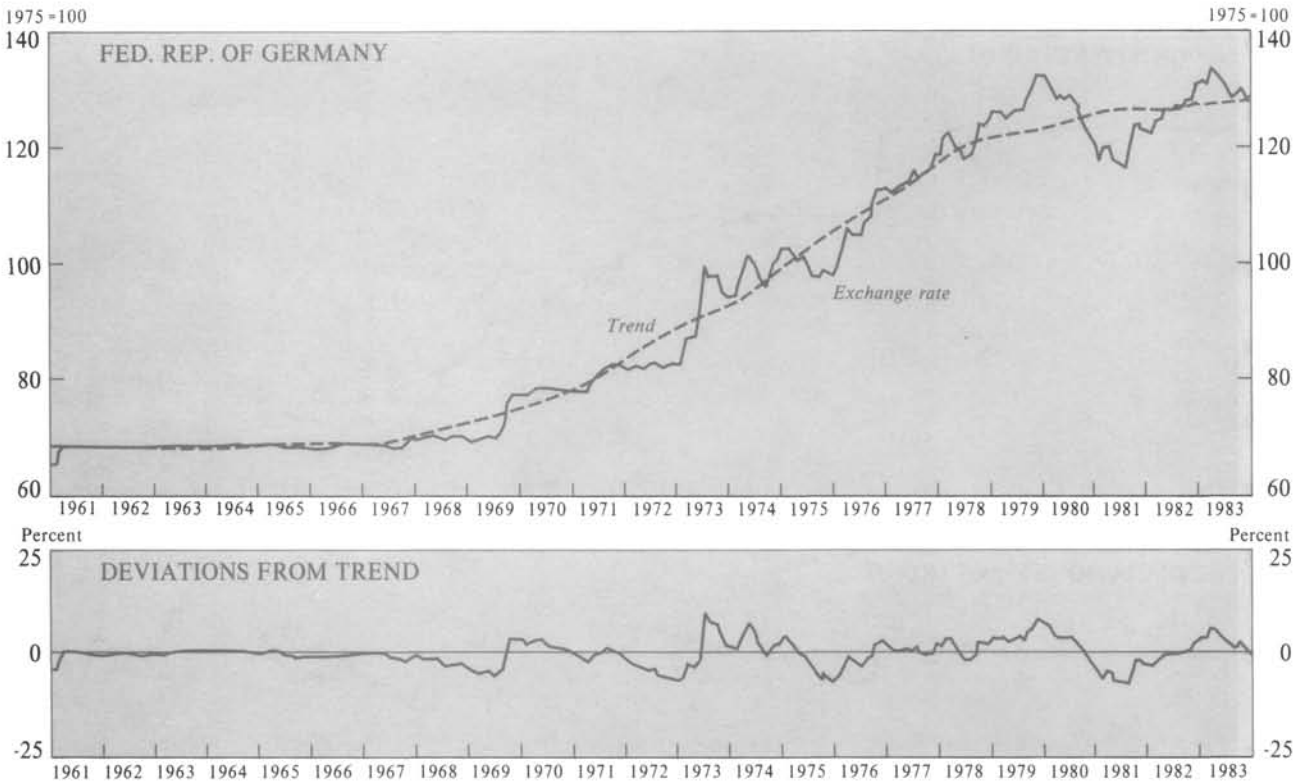
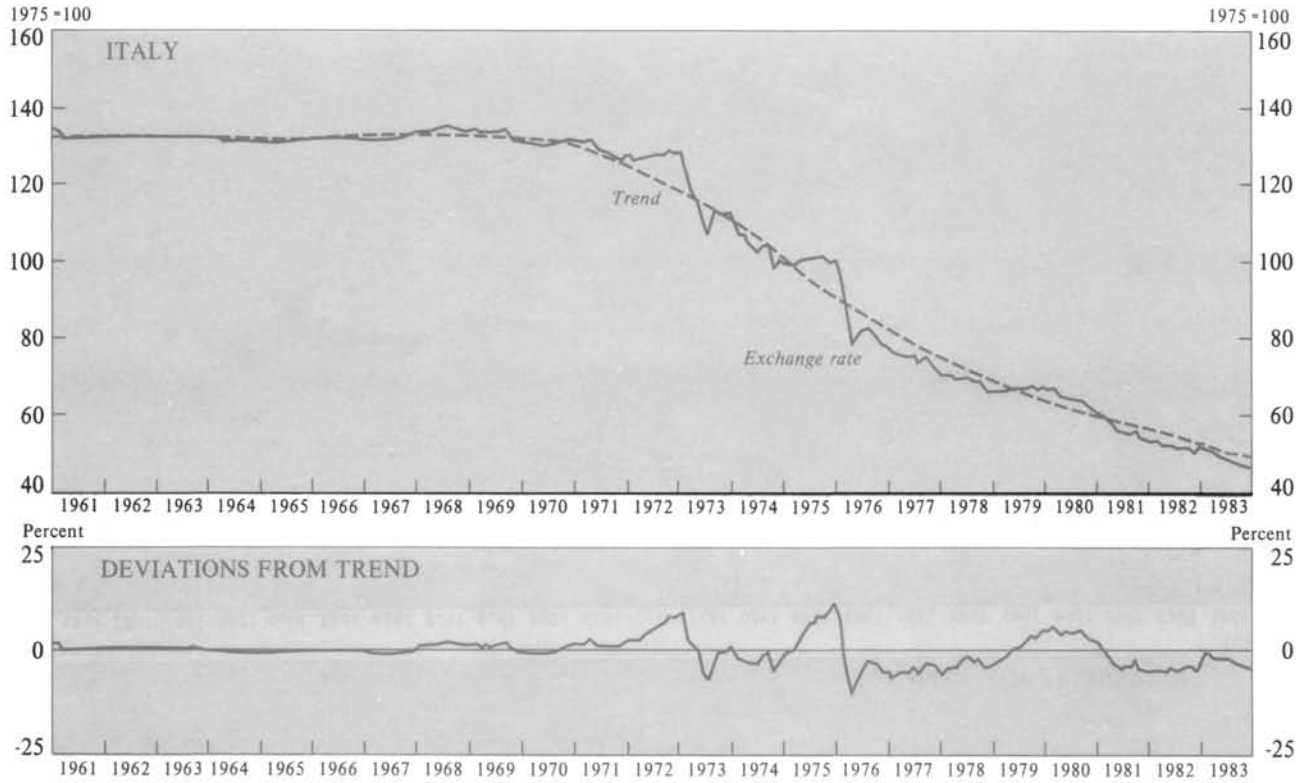


Chart 8 (*continued*). Major Industrial Countries: Monthly Nominal Effective Exchange Rates, 1961–83



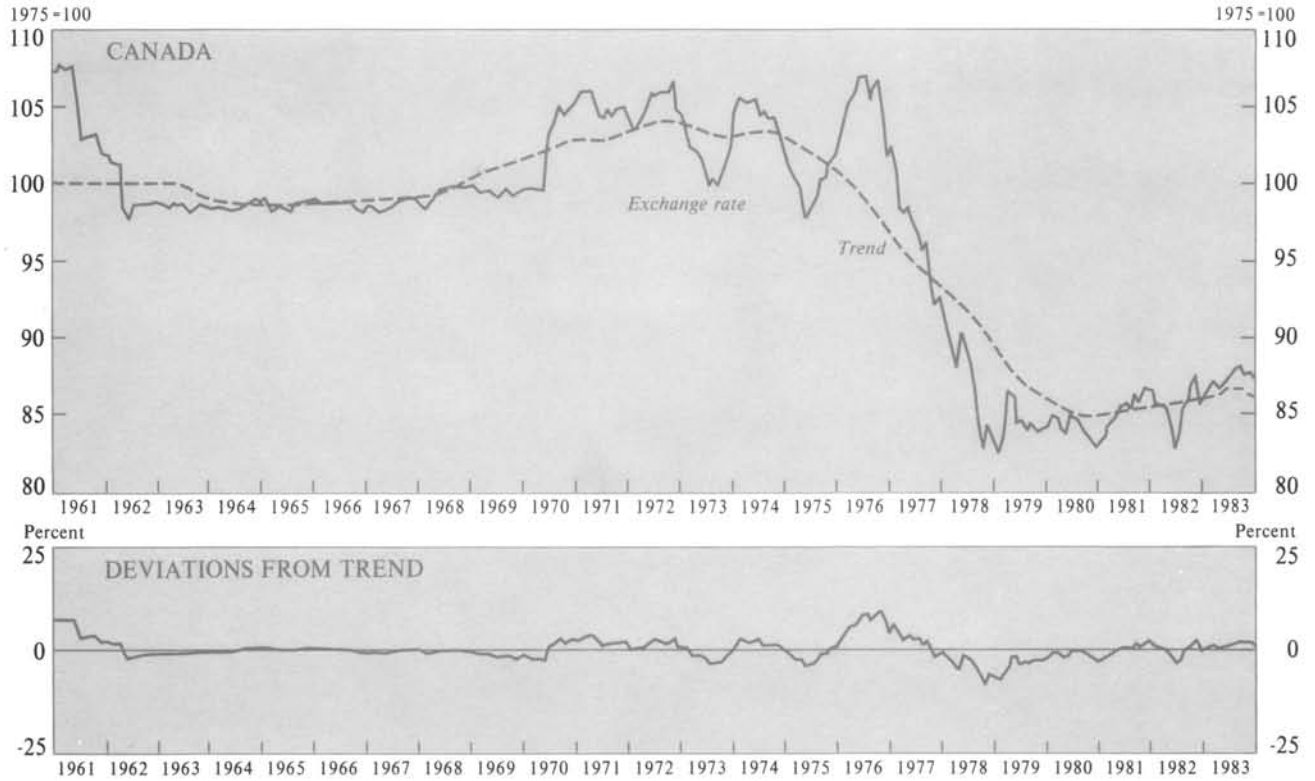


Chart 8 (*concluded*). Major Industrial Countries: Monthly Nominal Effective Exchange Rates, 1961–83

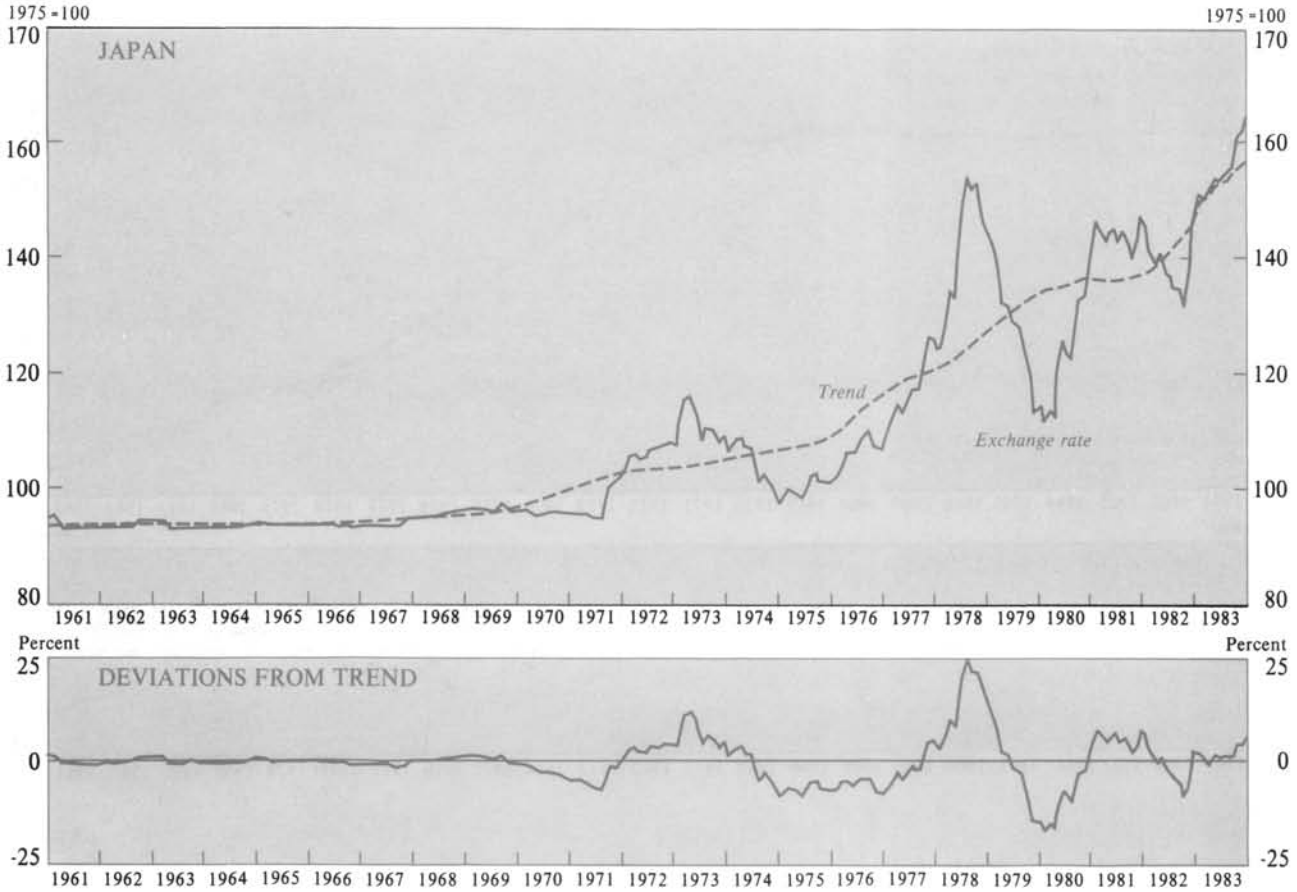


Table 9. Major Industrial Countries: Month-to-Month Changes in Nominal Effective Exchange Rates Relative to Trend, 1964–83[1]

	United States	United Kingdom	France	Federal Republic of Germany	Japan	Canada	Italy	Weighted Average[2]
1964	0.04	0.08	0.03	0.06	0.11	0.10	0.06	0.06
1965	0.07	0.19	0.05	0.12	0.16	0.18	0.07	0.12
1966	0.05	0.24	0.13	0.14	0.09	0.11	0.08	0.12
1967	0.19	1.37	0.40	0.35	0.16	0.13	0.18	0.40
1968	0.08	0.29	0.24	0.38	0.11	0.18	0.15	0.20
1969	0.28	0.45	1.27	0.95	0.33	0.18	0.34	0.55
1970	0.17	0.23	0.25	0.36	0.29	0.54	0.20	0.29
1971	0.51	0.35	0.47	0.56	0.84	0.38	0.37	0.50
1972	0.57	1.06	0.63	0.49	0.49	0.58	0.61	0.62
1973	1.99	1.40	1.09	2.05	1.76	0.57	1.94	1.63
1974	1.62	0.94	1.79	1.52	1.52	0.54	1.37	1.39
1975	1.17	0.71	1.26	1.05	0.97	0.77	1.02	1.02
1976	0.45	1.94	1.06	1.15	0.75	1.26	2.68	1.18
1977	0.75	0.84	0.30	0.66	1.44	1.06	0.69	0.77
1978	1.26	1.13	1.10	1.11	3.00	1.23	0.69	1.30
1979	0.87	1.61	0.63	0.59	2.47	0.79	0.76	0.99
1980	1.59	1.19	0.60	1.00	2.19	0.53	0.62	1.12
1981	2.03	1.99	1.11	1.32	1.90	0.51	0.94	1.50
1982	1.76	1.18	1.05	0.64	2.16	1.06	0.49	1.22
1983	1.10	1.65	0.67	0.87	1.03	0.31	0.47	0.93
Averages								
1964–70	0.13	0.41	0.34	0.34	0.18	0.20	0.15	0.25
1974–83	1.26	1.32	0.96	1.00	1.75	1.03	0.97	1.15
1964–83	0.75	0.95	0.71	0.77	0.98	0.55	0.69	0.80

[1]The trend exchange rate is defined as a 57-month moving average.
[2]Weighted according to current trade shares (exports plus imports).

Table 10. Major Industrial Countries: Quarter-to-Quarter Changes in Real Effective Exchange Rates Relative to Trend, 1964–83[1]

	United States	United Kingdom	France	Federal Republic of Germany	Japan	Canada	Italy	Weighted Average[2]
1964	0.72	0.99	0.93	1.34	0.58	0.39	1.74	0.95
1965	0.48	1.31	0.24	0.70	0.69	0.69	1.99	0.78
1966	0.24	1.62	0.57	0.42	0.36	0.36	2.22	0.69
1967	0.25	1.37	0.47	1.62	0.64	0.18	2.32	0.89
1968	1.21	2.24	2.09	1.30	1.45	0.74	1.32	1.42
1969	0.78	1.20	3.60	2.27	1.54	0.46	2.23	1.61
1970	0.68	1.28	0.67	1.95	1.05	1.11	1.56	1.18
1971	1.24	1.30	1.07	2.39	1.93	0.79	1.73	1.53
1972	1.36	2.73	2.09	1.36	2.08	1.26	3.41	1.84
1973	3.57	2.92	1.99	5.02	3.29	1.67	3.06	3.33
1974	3.08	3.20	4.59	1.94	4.37	1.91	2.08	2.95
1975	3.01	1.36	2.73	2.88	1.87	2.43	3.77	2.64
1976	0.98	4.22	1.75	1.97	0.75	2.84	5.93	2.30
1977	0.85	1.74	0.84	0.59	3.25	2.26	1.79	1.36
1978	1.90	2.24	2.09	2.02	5.54	1.88	1.65	2.31
1979	1.61	2.70	1.85	2.17	8.15	1.27	2.45	2.53
1980	1.62	4.58	1.15	2.13	3.61	0.90	2.57	2.28
1981	4.54	5.40	1.54	3.05	3.07	1.32	2.01	3.25
1982	2.08	1.00	2.03	1.62	2.53	1.30	1.05	1.71
1983	2.12	5.51	2.84	1.13	4.05	1.02	2.16	2.53
Averages								
1964–70	0.62	1.43	1.22	1.37	0.90	0.56	1.91	1.07
1974–83	2.17	3.20	2.14	1.95	3.72	1.71	2.55	2.39
1964–83	1.62	2.45	1.76	1.89	2.54	1.75	2.35	1.91

[1]The trend exchange rate is defined as a 19-quarter moving average.
[2]Weighted according to current trade shares (exports plus imports).

Appendix II

Determination of Aggregate Trade Levels

In a recent paper, Bergsten and Cline (1983) investigate the aggregate relationship between the growth of trade and output over the period 1961–81. Their basic purpose is to ascertain whether there are any residuals from this observed relationship in recent years that could be explained as a consequence of increasing protectionism. However, the results they obtain could equally be used to assess whether there was any observable adverse impact from growing exchange rate uncertainty. The estimated relationship is as follows:

$$\dot{M} = \underset{(2.6)}{-4.6} + \underset{(7.9)}{3.14}\,\dot{Y} \qquad \bar{R}^2 = 0.77$$

where

$\dot{M}$ = Annual rate of growth of OECD real non-oil imports

$\dot{Y}$ = Annual rate of growth of real GDP in OECD countries

Several points about this equation are noteworthy. First, it explains more than three fourths of the year-to-year variations in the rate of growth of imports in member countries of the Organization for Economic Cooperation and Development (OECD), indicating that real income levels are by far the major determinant of overall trade levels. Second, the elasticity of trade growth with respect to real income growth is very high, above 3 in fact. This implies that an additional 1 percent of output growth in any year has typically been associated with an additional 3 percent of import growth. Third, the weak performance of trade in recent years is fully explained by the decline in the rate of growth of output. Chart 9 plots actual and predicted non-oil imports in OECD countries during the period 1962–81 on the basis of the relationship calculated by Bergsten and Cline (1983). As may be seen, there is no tendency for actual trade to fall below predicted levels in recent years. Output growth in OECD countries was about 1 percent in 1981 and was actually negative in 1982. From the relationships of the estimated equation, this would lead one to expect a cumulative decline of non-oil imports of some 6 percent over the two years 1981–82. The decline that actually occurred was some 2 percent. There is no negative "residual" in this period to be attributed to the impact of other factors, such as protectionism or exchange rate uncertainties.

The purpose of this Appendix is to replicate Bergsten and Cline's test, with certain modifications that are of interest for the subject of the present study.

(i) Overall world trade is considered, rather than just OECD non-oil imports. This is partly to test the robustness of Bergsten and Cline's results and partly because exchange rate uncertainty can (at least potentially) affect a broader cross-section of trade than is captured in the variable used by Bergsten and Cline.

(ii) The time period covered by the data is extended backward by two years (to include 1959 and 1960) and forward by one year (to include 1982).

(iii) A variable intended to capture exchange rate uncertainty is introduced. This is defined as the weighted average quarterly variation in the real effective exchange rate of the major industrial countries, and is explained in footnote 2 to Table 11. It is introduced both in unlagged and lagged form.

Table 11 presents the results of a selection of equations from a larger number that were in fact estimated. (The other equations mostly involved different specification of the exchange rate uncertainty variable, and produced broadly similar results.)

It may be seen from equations 1–3, covering the longer time period, that the results are similar to those obtained by Bergsten and Cline, and that the inclusion of exchange rate variability, whether in lagged or unlagged form, does not help the explanatory power of the equation. The coefficient on exchange rate variability is not significant, and it has a perverse sign. The only noteworthy difference from Bergsten and Cline's results is that the elasticity of trade growth with respect to income growth is somewhat lower (about 2 instead of 3).

Equations 1–3 do not provide support for the proposition that exchange rate variability has had a significant adverse effect on trade growth. However, firm conclusions cannot be reached on the basis of such relatively simple tests. One possibility that is not tested in equations 1–3 is that the impact of exchange rate uncertainty on trade accumulates gradually over time, and cannot easily be related to measured variability in a given time period, such as a year. To investigate this, equations 4 and 5 estimate the relationship between growth of world

output and trade over two subperiods, one of which (1959–71) was characterized by relative stability in exchange rates and the other (1974–83) by relative instability. It will be seen that there is a striking difference between the equations for the two subperiods. Moreover, Chart 10, which shows predicted and actual rates of growth of world trade over the past 20 years on the basis of the equation estimated for 1959–71, reveals a tendency toward negative residuals. This chart suggests that some unincluded factor has in the late 1970s and early 1980s reduced the growth of world trade relative to that of world output below what would have been expected on the basis of experience in the 1960s.

This having been said, it must be recognized that a number of fundamental changes have occurred in the world economy in the past ten years, and it is not possible on the basis of the evidence presented here to conclude that exchange rate variability is the one that has been responsible for the negative residuals shown in the chart. Also, it should be noted that the explanatory power of the equation used to extrapolate the "expected" values in the chart is very low.

Chart 9. OECD Member Countries: Growth Rate of Non-Oil Imports, 1962–81

(In percent)

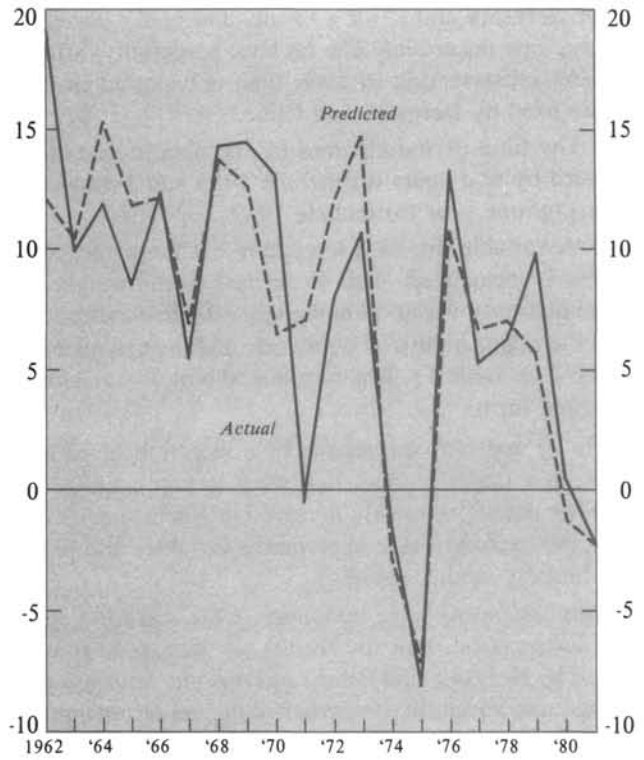
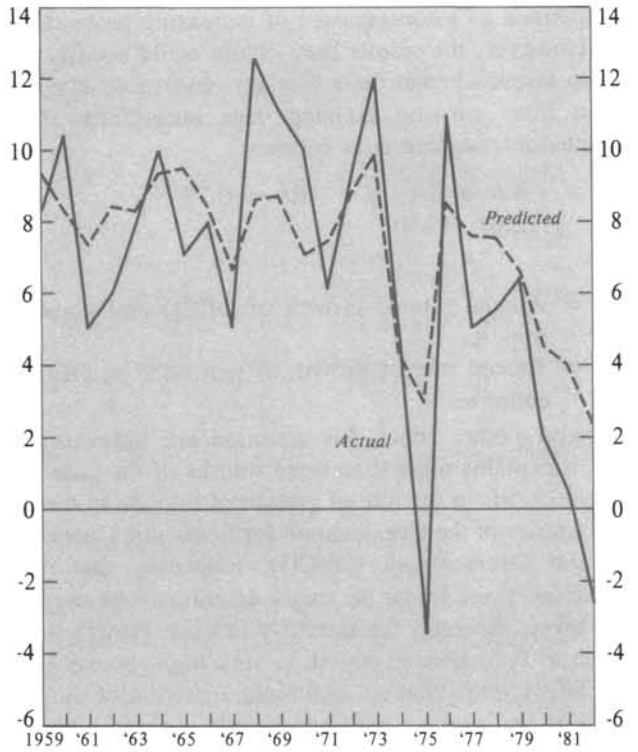


Chart 10. Rate of Growth of World Trade, 1959–82

(In percent)



Source: Based on equation 4 in Table 11.

Table 11. Equations Relating Growth of World Output and World Trade[1]

Time Period	Constant	Growth of World Output	Real Exchange Rate Variability[2]	Real Exchange Rate Variability (Lagged)[2]	$\overline{R}^2$	D-W	SEE
1959–82	−1.83	2.02			0.77	2.00	2.06
	(1.02)	(0.23)					
1962–82	−2.72	2.13	0.32		0.80	1.88	2.08
	(1.52)	(0.26)	(0.45)				
1963–83	−3.57	2.32		0.51	0.80	1.84	2.03
	(2.06)	(0.34)		(0.58)			
1959–71	2.63	1.12			0.08	1.82	2.31
	(3.99)	(0.79)					
1974–83	−2.31	2.18			0.82	2.36	1.96
	(1.09)	(0.36)					

[1]Coefficients of determination ($\overline{R}^2$); Durbin-Watson statistics (D-W); standard estimated errors (SEE); standard errors in parentheses.
[2]Seven-country trade-weighted average of quarterly variability in real effective exchange rates (based on the gross domestic product deflator).

Appendix III

Inflation and Exchange Rate Variability

A possible mechanism by which exchange rate variability could affect inflation is through a "ratchet" effect on the domestic price level. If increases in traded goods prices from exchange rate depreciations are passed on into consumer prices more rapidly or completely than are any reductions attributable to exchange rate appreciations, this could lead to a faster rate of price increase when exchange rates are volatile than when they are stable.

One way of testing the presence of such an effect is to estimate an equation explaining variations in the rate of inflation, including among the explanatory variables a measure of exchange rate variability. Table 12 presents the results of such a test for seven major industrial countries. The equation employed is based on that used by Spitäller (1978) with the only substantive difference being the extension of the estimation period by five years (to 1981) and the addition of a variable to capture exchange rate movements. Specifically, the estimating equation is as follows:

$$\dot{CP} = a_o + a_1\dot{M} + a_2\frac{\dot{Y}}{\overline{Y}} + a_3\dot{MP} + a_4\dot{CP}_{-1} + a_5XV$$

where

CP = consumer price index
M = money stock
Y = output
$\overline{Y}$ = an exponential growth trend of output
MP = import prices
XV = standard deviation of the effective exchange rate over the previous five quarters

A dot above a variable indicates a rate of change.

The results are broadly consistent with those obtained by Spitäller in his equations. The lagged dependent variable is highly significant in all cases except that of Japan, and has a value in the range 0.75–0.95. Both in the results reported here and those of Spitäller, import prices seem to have a dominant effect in Japan, with a given change in the import price index having an impact roughly one fourth the size on the consumer price index.

Changes in the pressure of demand (as measured by output growth relative to trend) are generally positively associated with inflation, though the results do not appear to be highly significant, or robust across countries. The rate of growth of the money supply is only significant (with the correct sign) in one country, as against three in Spitäller's results.

For present purposes, the greatest interest attaches to the estimates for the coefficient on exchange rate variability. Six out of the seven countries exhibit a positive relationship between inflation and exchange rate variability, but in no case is the coefficient significantly different from zero at the 95 percent confidence level. While these results do not, therefore, preclude the possibility of a systematic inflationary effect coming from exchange rate instability, they do not provide any strong support for it.

Table 12. Major Industrial Countries: Determinants of Inflation[1]

Country	Constant	$\dot{M}$	$\dot{Y}/\overline{Y}$	$\dot{MP}$	$\dot{CP}_{-1}$	XV	$\overline{R}^2$	D-W
Canada	1.67	0.01	−1.07	0.08	0.83	0.04	0.94	2.11
	(0.69)	(1.10)	(0.47)	(3.79)	(15.08)	(0.35)		
France	1.74	0.05	−1.47	0.05	0.86	0.02	0.95	2.19
	(0.84)	(2.80)	(0.72)	(6.09)	(26.59)	(0.29)		
Germany, Fed. Rep. of	−2.59	−0.01	3.09	0.02	0.84	0.04	0.90	1.91
	(2.12)	(0.19)	(2.46)	(1.55)	(14.97)	(0.79)		
Italy	1.62	0.04	−1.63	0.08	0.83	0.05	0.95	2.02
	(0.37)	(1.17)	(0.38)	(5.68)	(21.15)	(0.41)		
United Kingdom	−3.18	0.08	3.79	0.08	0.77	0.03	0.77	1.87
	(0.38)	(1.51)	(0.18)	(2.36)	(10.87)	(0.25)		
United States	−5.29	0.05	5.29	0.03	0.92	−0.09	0.96	2.02
	(2.14)	(1.27)	(2.29)	(3.12)	(24.67)	(1.89)		
Japan	−25.63	−0.01	25.37	0.21	0.23	0.27	0.80	1.19
	(2.94)	(0.09)	(3.12)	(10.07)	(3.33)	(1.75)		

[1]Coefficients of determination ($\overline{R}^2$); Durbin-Watson statistics (D-W); *t*-ratios in parentheses.

Appendix IV

Determination of Bilateral Trade Flows

Several recent papers have undertaken an empirical investigation of the relationship between exchange rate variability and bilateral trade flows using time-series data (Clark, 1973; Hooper and Kohlhagen, 1978; Cushman, 1983). Of these, only Cushman has claimed any success in relating the volume of trade to exchange rate variability. In a study of 14 sets of bilateral trade flows (all involving the United States or the Federal Republic of Germany as a partner country), he finds six cases in which his measure of exchange rate variability enters with a negative (i.e., expected) sign, and is significantly different from zero at the 95 percent confidence level. Cushman's study differed from the earlier ones cited above in covering a greater portion of the floating rate period (though still only until 1977), and in employing a measure of real rather than nominal exchange rate variability.

While Cushman's results are suggestive, closer examination reveals that they are by no means conclusive. Even in the six equations where the coefficient on exchange rate variablility was negative and significant, the level of significance was not high (the highest *t*-ratio being 3.45); the equations concerned employed five different lag structures (including two where trade levels were made to depend on future exchange rate variability); and there were two equations where the coefficient on exchange rate variability was positive (i.e., perverse) and significant. Moreover, in four of the six equations where the coefficient was not significant at the 95 percent level, it also had a perverse sign.

One purpose of this appendix is to present results of estimating a model similar to Cushman's (though somewhat simplified in structure) and applied uniformly across countries. This model is as follows:

$$X_{ij} = a_o + a_1 GNP_j + a_2 RCU_{ij} + a_3 RXR_{ij} + a_4 RXV_{ij}$$

where

X_{ij} = volume of exports from country i to country j
GNP_j = real GNP in country j
RCU_{ij} = relative capacity utilization
RXR_{ij} = real bilateral exchange rate
RXV_{ij} = variability in the real bilateral exchange rate

The equation is estimated in logarithmic form

As in Cushman's model, all independent variables were lagged by one quarter, and 42 equations were estimated, covering exports from seven industrial countries (the United States, the United Kingdom, Japan, the Federal Republic of Germany, France, Canada, and Italy) to each of the other six (Table 13). All the equations were estimated for first quarter 1965 to fourth quarter 1982. In the absence of specific information about bilateral trade flows in volume terms, the bilateral flows in value terms (derived from the Fund's *Direction of Trade Statistics*) were deflated by the export price index for all trade. The real bilateral exchange rate is the nominal bilateral rate (quarterly average obtained from the Fund's *International Financial Statistics*), adjusted for changes in relative normalized unit labor costs. Variability in this rate is the standard deviation of percentage changes during the five quarters ending with the observation period.

The variable measuring exchange rate variability has the correct (negative) sign in 16 out of 42 equations and the incorrect sign in the remaining 26. In only two cases where the coefficient is negative is it statistically significant, while positive coefficients are significant in several more cases.

The results reported in Table 13 have a number of similarities to, as well as differences from, those of Cushman. In nearly every equation, gross national product in the importing country is strongly and positively related to bilateral imports, as would be expected. The influence of relative capacity utilization (a measure of relative cyclical position) shows the expected negative sign in a majority of cases, although the tendency is not particularly striking. The real exchange rate variable is specified as the real price of the importer's currency in terms of the exporter's currency; since an increase in this variable increases the exporter's competitiveness, it is expected to exhibit a positive association with trade flows. (It should be noted that insofar as rising exports tend to pull up the exchange rate, the opposite association could also be justified.) In fact, there does appear to be a general positive association between exports and competitiveness that is statistically significant in more than half the cases considered.

Table 13. Major Industrial Countries: Determinants of Bilateral Trade Flows[1]

Trade Flow Exporter–Importer	Constant	Gross Domestic Product	Relative Capacity Utilization	Real Exchange Rate	Exchange Rate Variability	$\overline{R}^2$	D-W
United States–United Kingdom	−23.78 (7.96)	2.00 (8.13)	1.48 (3.36)	0.54 (3.72)	−0.01 (0.81)	0.80	0.99
United States–France	−6.19 (5.19)	0.43 (5.33)	−0.14 (0.38)	0.89 (5.34)	0.03 (3.01)	0.71	0.99
United States–Germany	−15.97 (8.36)	1.19 (8.74)	−0.49 (2.11)	0.24 (2.24)	−0.004 (0.67)	0.83	1.74
United States–Italy	−17.55 (9.28)	0.91 (9.27)	−0.16 (0.51)	0.76 (4.00)	0.002 (0.22)	0.75	1.91
United States–Canada	−11.73 (14.75)	1.11 (16.94)	0.15 (0.40)	0.89 (3.61)	−0.01 (0.58)	0.86	2.20
United States–Japan	−14.28 (8.33)	0.81 (9.03)	−0.36 (2.87)	0.23 (1.99)	0.03 (3.56)	0.93	0.81
United Kingdom–United States	−22.47 (8.23)	1.54 (8.16)	−0.60 (1.35)	0.40 (2.49)	0.001 (0.11)	0.69	0.88
United Kingdom–France	−14.39 (7.14)	0.92 (6.54)	−1.38 (1.65)	−0.33 (0.92)	0.81 (3.69)	0.64	0.60
United Kingdom–Germany	−42.45 (30.97)	2.99 (30.43)	1.58 (4.95)	−0.53 (5.42)	0.01 (1.88)	0.95	1.33
United Kingdom–Italy	−31.17 (17.89)	1.54 (16.93)	0.23 (0.90)	−0.39 (3.15)	0.02 (2.27)	0.93	1.67
United Kingdom–Canada	−1.19 (0.86)	−0.13 (0.11)	−0.94 (2.36)	0.73 (7.47)	−0.01 (0.86)	0.61	1.44
United Kingdom–Japan	−11.32 (9.85)	0.50 (8.21)	−1.16 (9.64)	0.61 (5.67)	−0.01 (1.01)	0.88	1.32
France–United States	−38.83 (22.78)	2.75 (23.59)	0.59 (0.29)	0.68 (5.88)	−0.01 (1.21)	0.93	2.07
France–United Kingdom	−64.42 (27.30)	5.39 (27.65)	0.28 (0.77)	0.42 (2.85)	0.01 (1.31)	0.96	1.39
France–Germany	−22.07 (15.59)	1.76 (17.48)	−0.87 (2.63)	0.88 (4.10)	0.003 (0.48)	0.93	1.29
France–Italy	−54.24 (26.43)	2.90 (27.44)	0.72 (2.59)	0.73 (3.37)	0.02 (2.32)	0.96	1.68
France–Canada	−23.77 (12.70)	1.88 (12.43)	−0.96 (1.96)	0.82 (5.09)	−0.00004 (0.01)	0.86	1.73
France–Japan	−34.47 (13.91)	1.79 (13.60)	−0.84 (4.34)	0.64 (0.26)	0.01 (1.26)	0.94	1.44
Germany–United States	−26.57 (8.85)	1.92 (9.37)	0.60 (1.79)	0.63 (3.94)	−0.003 (0.32)	0.64	0.78
Germany–United Kingdom	−64.55 (33.81)	5.36 (34.18)	−0.28 (0.92)	0.86 (8.68)	0.03 (3.33)	0.96	1.48
Germany–France	−10.13 (6.43)	0.84 (7.77)	0.99 (1.28)	1.41 (3.30)	−0.01 (0.75)	0.68	0.80
Germany–Italy	−45.76 (21.86)	2.43 (22.67)	0.09 (0.48)	0.88 (5.76)	0.02 (3.10)	0.94	0.92
Germany–Canada	−15.39 (7.12)	1.19 (6.82)	−0.18 (0.45)	0.47 (2.78)	−0.003 (0.33)	0.58	1.60
Germany–Japan	−17.55 (14.64)	0.91 (14.17)	−1.37 (9.32)	0.51 (2.99)	0.01 (2.27)	0.92	0.89
Italy–United States	−20.07 (9.14)	1.84 (12.19)	0.76 (1.94)	1.30 (5.18)	−0.05 (3.71)	0.71	1.14
Italy–United Kingdom	−39.87 (15.85)	3.77 (18.13)	−0.65 (1.94)	1.07 (6.89)	0.02 (1.99)	0.94	1.66
Italy–France	−4.95 (3.08)	0.85 (7.72)	−0.92 (1.58)	2.12 (5.63)	0.01 (0.68)	0.77	0.97
Italy–Germany	−15.68 (6.56)	1.67 (9.87)	−0.70 (2.77)	0.36 (1.74)	0.001 (0.13)	0.90	0.78

Table 13. (*concluded*). Major Industrial Countries: Determinants of Bilateral Trade Flows[1]

Trade Flow Exporter–Importer	Constant	Gross Domestic Product	Relative Capacity Utilization	Real Exchange Rate	Exchange Rate Variability	$\overline{R}^2$	D-W
Italy–Canada	−13.13 (10.26)	1.44 (13.74)	−0.59 (1.52)	1.07 (5.91)	−0.01 (1.46)	0.81	1.47
Italy–Japan	−21.81 (7.35)	1.39 (8.86)	−1.09 (4.29)	0.55 (2.38)	0.016 (1.42)	0.92	1.61
Canada–United States	−29.15 (18.42)	2.15 (19.58)	−0.24 (0.53)	−1.03 (3.50)	0.01 (0.42)	0.90	1.08
Canada–United Kingdom	6.30 (2.07)	−0.53 (2.09)	0.86 (1.89)	−0.14 (1.34)	−0.18 (1.57)	0.38	1.41
Canada–France	−8.23 (5.74)	0.43 (4.33)	−2.76 (4.54)	1.29 (7.57)	0.03 (2.92)	0.78	1.28
Canada–Germany	−19.21 (4.66)	1.27 (4.34)	−1.20 (2.15)	0.29 (1.33)	0.00003 (0.03)	0.70	1.52
Canada–Italy	−28.27 (7.64)	1.36 (7.07)	0.34 (0.52)	0.30 (1.04)	0.03 (2.02)	0.69	1.38
Canada–Japan	−18.42 (5.95)	0.95 (5.86)	0.62 (2.11)	0.40 (1.79)	0.02 (1.52)	0.89	0.94
Japan–United States	−56.32 (15.25)	4.34 (17.18)	0.55 (4.33)	0.59 (1.15)	−0.29 (2.96)	0.94	0.95
Japan–United Kingdom	−82.50 (14.85)	7.13 (15.70)	0.49 (1.94)	0.86 (3.57)	0.001 (0.08)	0.89	1.25
Japan–France	−8.40 (3.00)	0.81 (4.19)	−0.79 (1.85)	−2.72 (7.53)	0.07 (3.25)	0.85	0.68
Japan–Germany	−59.03 (31.76)	4.56 (34.10)	−0.23 (1.60)	−0.05 (0.31)	−0.01 (1.98)	0.98	1.53
Japan–Italy	−63.06 (10.57)	3.42 (11.11)	0.84 (3.09)	0.51 (2.10)	0.003 (0.27)	0.88	0.91
Japan–Canada	−28.48 (6.06)	2.68 (7.07)	0.64 (1.84)	0.68 (2.13)	−0.018 (0.95)	0.75	0.47

[1]Coefficients of determination ($\overline{R}^2$); Durbin-Watson statistics (D-W).

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