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TRADE ELASTICITIES FOR THE G-7 COUNTRIES

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1 INTRODUCTION

One can hardly exaggerate the role played by trade elasticities in translating economic analysis into policy recommendations. No better example illustrates this proposition than the Marshall-Lerner condition, which states that, for a depreciation of the domestic currency to reduce the external deficit, the sum of export and import price elasticities (in absolute terms) must be greater than 1. That is,

$$\epsilon_x + \epsilon_m > 1,$$

where ϵ_x is the price elasticity of the demand for exports and ϵ_m is the price elasticity of the demand for imports. Knowledge of these elasticities thus allows policymakers to predict the effects of exchange-rate changes. The usefulness of the policymakers' predictions, however, hinges on the stability of the elasticities: conclusions based on one set of values can be contradicted if instability produces other values that violate the Marshall-Lerner condition. Such instability may arise from fundamental shifts in economic structure. For example, the adoption of the North American Free Trade Agreement (NAFTA) and the German reunification may have induced economic adjustments that undermine the usefulness of the existing estimates of trade elasticities. The only way to determine whether or not this is so is to test the proposition that elasticities are, indeed, constant.

The purpose of this study is to estimate and test the stability of income and price elasticities derived from conventional equations relating the foreign trade of the Group of Seven (G-7) countries to their respective incomes and relative prices.[1] The inquiry is also relevant to analyses of the sustainability of the U.S. current-account deficit. Such analyses find that either the U.S. external imbalance will widen indefinitely or relative prices will have to adjust over time to keep it from widening. These findings rest,

[0] An earlier version of this paper was presented at the spring 1998 Midwest International Economics Meetings at Michigan State University, and we are grateful to Anjit Bajwa and Priya Ranjan, the two discussants at those meetings. We also wish to thank Robert Amano, Edwin Truman, and Ralph Tryon for their comments on an earlier draft, Aaron Kechley and Molly Wetzel for their research assistance, and Peter Kenen and an anonymous referee for extensive comments. The calculations in this study use PcGive Professional 9.1 (Hendry and Doornik, 1996). The views expressed are solely the responsibility of the authors and should not be interpreted as reflecting those of the Board of Governors of the Federal Reserve System or of other members of its staff.

[1] For reviews of the literature, see Stern, Francis, and Schumacher (1976), Goldstein and Kahn (1985), Hooper and Marquez (1995), Sawyer and Sprinkle (1996), and Marquez (1999). The G-7 countries are Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States.

however, on the asymmetry of estimated income elasticities for U.S. trade.[2] We examine the robustness of this asymmetry and calculate the rate of depreciation consistent with external balance.

Our approach, described in Chapter 2, recognizes that movements in international trade may respond differently in the short and long run to movements in the key determinants of trade. Short-run fluctuations in trade may be influenced by order and delivery lags, as well as by factors such as bottlenecks, dock strikes, and transitory changes in trade policies. In large open economies, moreover, international trade can affect economic activity and relative prices. That is, income and prices are endogenous variables. To estimate long-run elasticities, we therefore use Johansen's (1988) cointegration method, which recognizes simultaneity among income, prices, and trade. To estimate short-run elasticities, we use estimation techniques from the error-correction model (ECM). Parameter estimation rests on quarterly observations through 1994 and uses trade data that include goods and services (but that exclude factor income).

Chapter 3 describes our parameter-stability tests: in-sample tests for 1990-1994 and out-of-sample tests for 1995-1996. Out-of-sample tests are important, because they help forecast policy design. Testing for stability of trade elasticities is not new, but the literature on the subject is dated and largely focused on U.S. imports.[3] We therefore apply our current tests to all of the G-7 countries and to exports as well as imports.

Chapter 4 reports the results from Chapter 3. These show that, with the exception of France and Germany, price elasticities for exports and imports satisfy the Marshall-Lerner condition; that the asymmetry in income elasticities for the United States is robust; and that there is no pronounced or chronic instability of elasticities during the 1990s. Elasticities for German trade, however, as well as elasticities for French and Italian exports, show substantial parameter instability around the time of German reunification.

Chapter 5 concludes the study. Three appendices provide supporting data.

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[2] Houthakker and Magee (1969) were the first to note this implication. Other studies examining this asymmetry include Cline (1989), Hooper and Marquez (1995), and Krugman (1995).

[3] For the United States, see Hooper (1978), Stern, Baum, and Green (1979), Maskus (1983), Deyak, Sawyer, and Sprinkle (1989), and Zietz and Pemberton (1993); for Japan, see Ceglowski (1997).

2 ECONOMETRIC FORMULATIONS

Our analysis uses the conventional treatment of trade flows as a function of real incomes and relative prices. This model assumes that domestic and foreign products are imperfect substitutes, that price homogeneity holds, and that trade elasticities with respect to income and relative prices are constant over time.

Long-Run Formulation

The system used to explain exports (x_t), foreign economic activity (fy_t), and relative export prices (rpx_t), all variables expressed in logarithms, is

$$\Delta z_{xt} = \kappa_x + \sum_{i=1}^{n} \Gamma_{xi} \Delta z_{x,t-i} + \Gamma_{xo} z_{x,t-1} + \epsilon_{xt}, \epsilon_{xt} \sim NI(0, \Omega_x), \quad (1)$$

where $z'_{xt} = (x_t \ fy_t \ rpx_t)$, κ_x is a 3x1 vector of intercepts, Γ_{xi} is a 3x3 matrix of coefficients for short-run interrelations; and

$$\Gamma_{xo} = \alpha_x \beta'_x = \begin{pmatrix} \alpha_{x11} & ... & \alpha_{x13} \\ ... & ... & ... \\ \alpha_{x31} & ... & \alpha_{x33} \end{pmatrix} \begin{pmatrix} \beta_{x11} & ... & \beta_{x31} \\ ... & ... & ... \\ \beta_{x13} & ... & \beta_{x33} \end{pmatrix}.$$

The elements of α_x measure the speed of adjustment and are known as loading coefficients; the vector $\beta'_{xi} = (\beta_{x1i} \ \beta_{x2i} \ \beta_{x3i})$ characterizes the ith long-run relation among x_t, fy_t, and rpx_t. For example, the relation associated with β'_{x1} is

$$x = -\left(\frac{\beta_{x21}}{\beta_{x11}}\right) fy - \left(\frac{\beta_{x31}}{\beta_{x11}}\right) rpx.$$

We measure rpx as the logarithm of the ratio between the export price index of the ith country and the foreign gross domestic product (GDP) deflator, both expressed in U.S. dollars: $\log(\frac{PX \cdot E_{\$/fx}}{PYF})$, where PX is the export price index denominated in local currency, $E_{\$/fx}$ is the price index of the ith foreign currency in terms of the U.S. dollar, and PYF is the foreign GDP deflator in U.S. dollars.[1] We measure PYF as

$$PYF = \prod_{j \neq i} (PY_j \cdot E_{\$/j})^{\omega_{ij}}, \sum_{j \neq i} \omega_{ij} = 1,$$

[1] Hooper, Johnson, and Marquez (1998, appendices E through K) study the sensitivity of the results by substituting the International Monetary Fund's (IMF's) real effective exchange rate for the relative price terms defined above .

where PY_j is the GDP deflator for the jth country in its own currency and ω_{ij} is the 1995 share of country j in i's nominal exports.[2] Reliance on 1995 shares means that changes in the country composition of world trade are not taken into account.

The system used to explain imports (m_t), domestic economic activity (y_t), and relative import prices (rpm_t), all variables expressed in logarithms, is

$$\Delta z_{mt} = \kappa_m + \sum_{i=1}^{n} \Gamma_{mi} \Delta z_{m,t-i} + \Gamma_{mo} z_{m,t-1} + \epsilon_{mt}, \epsilon_{mt} \sim NI(0, \Omega_m), \quad (2)$$

where $z'_{mt} = (m_t \; y_t \; rpm_t)$, κ_m is a 3x1 vector of intercepts, Γ_i is a 3x3 matrix of coefficients for short-run interrelations, and

$$\Gamma_{mo} = \alpha_m \beta'_m = \begin{pmatrix} \alpha_{m11} & ... & \alpha_{m13} \\ ... & ... & ... \\ \alpha_{m31} & ... & \alpha_{m33} \end{pmatrix} \begin{pmatrix} \beta_{m11} & ... & \beta_{m31} \\ ... & ... & ... \\ \beta_{m13} & ... & \beta_{mx33} \end{pmatrix}.$$

The elements of α_m measure the speed of adjustment and are known as loading coefficients; the vector $\beta'_{mi} = (\beta_{m1i} \; \beta_{m2i} \; \beta_{m3i})$ characterizes the ith long-run relation among m_t, y_t, and rpm_t. For example, the relation associated with β'_{m1} is

$$m = -\left(\frac{\beta_{m21}}{\beta_{m11}}\right) y - \left(\frac{\beta_{m31}}{\beta_{m11}}\right) rpm.$$

We measure rpm as $\log(\frac{PM}{PY})$, where PM is the import price and PY is the domestic GDP deflator, both in local currency.

Short-Run Formulation

Recognizing that movements in trade flows are influenced by transitory factors (bottlenecks, inventory adjustments, weather), we use error-correction formulations. Specifically, to explain fluctuations in the growth rate of exports, we postulate

$$\begin{aligned} \Delta x_t &= \mu_x + \sum_{j=1} \pi_{xj} \Delta x_{t-j} + \sum_{j=0} \tau_{xj} \Delta f y_{t-j} + \sum_{j=0} \rho_{xj} \Delta rpx_{t-j} \\ &\quad + \Phi_x \widehat{ECM}_{x,t-1} + e_{xt}, \end{aligned}$$

where a hat $\widehat{}$ denotes an estimate, and $\widehat{ECM}_x$ is the estimated gap between actual exports and the long-run value associated with $\widehat{\beta}'_{x1}$. That is,

$$\widehat{ECM}_x = x - \left(\widehat{\frac{\beta_{x21}}{\beta_{x11}}}\right) fy - \left(\widehat{\frac{\beta_{x31}}{\beta_{x11}}}\right) rpx,$$

[2] Data for fy also rest on a geometric average using the same weights as those of PYF; see Appendix A for a description of these weights.

Φ_x is the speed of adjustment of exports to their long relation, and $e_{xt} \sim N(0, \sigma_x)$.

Parameter Constancy

Testing for parameter constancy involves comparing the behavior of estimation residuals in alternative subsamples. If the parameters are stable, the properties of the residuals in the subsamples should be the same. We apply such tests to the cointegrating trade equations, to the cointegrating systems, and to the error-correction models.[3] We implement in-sample tests (for 1990-1994) and out-of-sample tests (for 1995-1996).

In-sample tests: 1990-1994. Our in-sample tests involve, in essence, four steps. First, we split the sample in 1989 and use it to obtain initial elasticity estimates. Second, we use these initial estimates to generate *ex post* predictions. Third, we test whether the associated prediction errors are, on average, statistically equal to zero; a rejection of this hypothesis means that trade elasticities cannot be treated as constants for that sample split. Fourth, we extend the first subsample by one quarter, update the elasticity estimates, and recompute the forecast tests. This process yields a collection of tests of parameter constancy for each quarter from 1990 through 1994.

There are different ways of generating *ex post* predictions. We consider three of them:

- One-step-ahead F-tests (*1* up): For given elasticity estimates, we generate a one-period-ahead prediction and apply an F-test to the hypothesis that the associated prediction residual is zero. The size of the estimation sample increases but the *ex post* sample is always one period (quarter) ahead.
- Break-point F-tests (Ndn): For given elasticity estimates, we generate *ex post* predictions N periods ahead and apply an F-test to the hypothesis that the vector of associated N-step-ahead residuals is zero. As the size of the estimation sample increases, the size of the sample *ex post* predictions (N) decreases *(*Ndn*)* from twenty quarters ($N = 20$) to one quarter ($N = 1$).
- Forecasts F-tests (Nup): The test retains the elasticities estimated with data through 1989 and applies an F-test to the hypothesis that the vector of N-step-ahead residuals is zero. The size of the estimation sample is fixed, but the size of the *ex post* sample size increases *(*Nup*)* from $N = 1$ to $N = 20$.

[3] Hooper, Johnson, and Marquez (1998) also report instability tests based on static formulations estimated with the Kalman filter technique. Their results corroborate those reported here.

Out-of-sample tests: 1995-1996. Out-of-sample tests of stability determine whether or not out-of-sample predictions differ significantly from actual trade values. To this end, we construct 95 percent confidence bands for the models' one-step-ahead predictions; the widths of these bands depend on the variance of the residual and on the variance-covariance matrix of the parameter estimates. A finding that actual trade values lie outside the confidence bands indicates parameter instability.

Sample starting dates for our analysis vary by country. We use the mid-1950s to early 1960s for Canada, Japan, the United Kingdom, and the United States, and the years around 1970 for Germany, France, and Italy.[1] Appendix A plots the historical series for each country.

Long-Run Elasticities

To estimate the long-run elasticities, we apply Johansen's (1988) maximum-likelihood cointegration technique to equations (1) and (2).[2] Because this technique is sensitive to the number of lags included, we consider lags ranging from two to nine quarters. To select the lag length, we seek coefficient estimates that have the right sign, that are as close as possible to unity, and that avoid serially correlated residuals. In addition, we exclude systems that have multiple cointegrating vectors, so as to avoid identification issues needing future research. Appendix B reports the details on lag selection.

According to our results, permanent increases in foreign income produce more than proportional increases in exports, except in the United States (Table 1). Similarly, permanent increases in domestic income produce more than proportional increases in imports, except in Japan, where the response is nearly proportional. In addition, the estimated income elasticities for both the United Kingdom and the United States exhibit the largest gaps between import and export elasticities. For Canada, the income elasticity for imports is 1.4, somewhat above the income elasticity for exports, at 1.1. The income-elasticity gaps for France, Germany, and Italy are small, with elasticity levels for both imports and exports generally being close to 1.5.

For Japan, estimates of the income elasticites are about equal (close to 1), and there is thus no elasticity gap. This result agrees with that found by Hooper and Marquez (1995) but disagrees with that found by Houthakker and Magee (1969), Cline (1989), and Marquez (1990), who report an income

[1] We use the longer sample period when available (rather than a standard shorter sample period across all countries) so as to maximize the power of parameter-stability tests. We also consider shorter samples for the noncontinental European countries in order to determine whether the choice of sample period affects the comparability of estimation results across countries. We find that the results for these shorter-period estimates are similar to those obtained for the full sample.

[2] As a first step, we use an augmented Dickey-Fuller test to identify the time-series properties of the data for estimation. In addition to using a constant term and a trend, we include four lags for the change of the variable being examined. The results suggest that the variables used in our regression analysis are all integrated of order one (see Appendix A).

TABLE 1
Long-Run Elasticities

	Income		Price	
	Exports	Imports	Exports	Imports
Canada	1.1*	1.4*	-0.9*	-0.9*
France	1.5*	1.6*	-0.2	-0.4*
Germany	1.4*	1.5*	-0.3	-0.06*
Italy	1.6*	1.4*	-0.9*	-0.4*
Japan	1.1*	0.9*	-1.0*	-0.3*
United Kingdom	1.1*	2.2*	-1.6*	-0.6
United States	0.8*	1.8*	-1.5*	-0.3*

Note: * denotes statistical significance at the 5 percent level.

elasticity for exports well in excess of that for imports. Previous estimates, however, use measures of foreign income and relative prices that neglect the importance of developing countries' markets for Japanese exports. Because these markets account for more than half of Japanese exports (see Appendix A), their exclusion from the measurement of foreign economic activity (fy_t) understates foreign growth, which causes the relatively high income elasticity for Japanese exports that is found by other studies.

With the exception of France and Germany, the price elasticities we find for exports and imports satisfy the Marshall-Lerner condition. Indeed, permanent declines in relative export prices induce proportional increases in exports, except for France and Germany. Permanent declines in relative import prices induce less than proportional increases in imports. These estimated price elasticities, particularly for imports, are lower than those generally found in the literature.

One factor that may help to account for these lower estimates is that our measure of trade volume includes both oil and services. One can see the effects of this aggregation by representing the aggregate price elasticity for imports as $\epsilon_m = \omega_{no}\epsilon_{m,no} + \omega_o\epsilon_{m,o} + (1 - \omega_{no} - \omega_o)\epsilon_{m,s}$, where ω_{no} is the share of nonoil imports in total imports, $\epsilon_{m,no}$ is the price elasticity for nonoil imports, ω_o is the share of oil imports, $\epsilon_{m,o}$ is the price elasticity for oil imports, and $\epsilon_{m,s}$ is the price elasticity for service imports. Given that oil consumption is highly price inelastic, the inclusion of oil in our measure of imports lowers the aggregate price elasticity relative to that of nonoil imports. Similarly, to the extent that tourism is country specific and lacks substitutes, one can expect a value of $\epsilon_{m,s}$ that is smaller than $\epsilon_{m,no}$. Hooper and Marquez (1995) find that the literature's average price elasticity is -1.23 for U.S. nonoil imports and -0.5 for U.S. total merchandise imports, a result suggesting that the inclusion of oil lowers the estimate of the aggregate price elasticity. Including both oil and services brings the U.S. import price elasticity to -0.3 (Table 1). For Japan, the average of import price elasticities excluding services is -0.97 and the corresponding average for Germany is -0.5 (Hooper and Marquez, 1995, table 4.2), figures that exceed (in absolute terms) those reported here.[3]

Short-Run Elasticities

Table 2 shows the short-run elasticities obtained by the error-correction formulations;[4] Appendix C reports the associated details. According to the results, the short-run income elasticity for exports is greater than 1 for all countries except Germany and Japan. For these two countries, the income elasticity is not significantly different from zero. For imports, the income elasticity is 1 for all countries except Canada, Germany, and the United States, where the income elasticity is greater than 1. The results also indicate that short-run price elasticities are, in all cases, less than 1 and often not significantly different from zero.[5]

TABLE 2
Short-Run Elasticities

	Income		Price	
	Exports	Imports	Exports	Imports
Canada	1.1*	1.3*	-0.5*	-0.1
France	1.8*	1.7*	-0.1	-0.1
Germany	0.5	1.0*	-0.1	-0.2*
Italy	2.3*	1.0*	-0.3*	-0.0
Japan	0.6	1.0*	-0.5*	-0.1
United Kingdom	1.1*	1.0*	-0.2*	-0.0
United States	1.8*	2.3*	-0.5*	-0.6

Note: * denotes statistical significance at the 5 percent level.

The evidence thus suggests that, in the short run, national economic developments are transmitted internationally largely through changes in income; changes in relative prices play a lesser role as a short-run international conduit.

[3] Hooper and Marquez (1995, table 4.1) survey merchandise price elasticities of G-7 countries after 1946 but find no studies that specifically examine trade in services.

[4] Owing to the presence of lagged endogenous variables in these equations, the period of adjustment is generally longer than the lag length used in estimating these systems. We therefore standardize the short-run income elasticity as $\sum \tau_j/(1-\sum \pi_j)$ and the short-run price elasticity as $\sum \rho_j/(1-\sum \pi_j)$.

[5] With a few exceptions, the empirical distributions of the residuals satisfy the assumptions maintained for estimation (serial independence, homoscedasticity, normality). We include dummy variables for Canada to account for NAFTA and dummy variables for France and Germany to control for German reunification (see Appendix C).

Parameter Constancy

In-sample tests: 1990-1994. The first three columns of Table 3 summarize the frequency of violations of parameter stability for the three types of equations. The entries under these columns indicate whether the evidence of equation instability appears to be strong (numerous failures of the Chow test, indicated by "+++"), moderate (occasional failures, indicated by "++"), weak (one or two failures at most, indicated by "+"), or absent altogether (indicated by "0"). The fourth column shows the periods of greatest instability. The details are presented in Appendices B and C.

TABLE 3
Frequency of Violations of Parameter Stability

	Cointegration			
Exports	Exports Only	System	ECM	Dates
Canada	++	++	0	1993-94
France	+++	+++	+	1990-93
Germany	+++	+++	+	1990-94
Italy	0	++	+	1990-94
Japan	0	0	0	-
United Kingdom	0	+	+	1991
United States	+	0	+	1991, 1993
Imports	Cointegration			
	Imports Only	System	ECM	Dates
Canada	0	0	0	-
France	0	0	0	-
Germany	+++	+++	+	1990-94
Italy	0	+	0	1992
Japan	0	0	0	-
United Kingdom	0	0	0	-
United States	0	++	0	1991

According to the results, instability is more frequent in export elasticities than in import elasticities.[6] One reason for this result is that the data for the relative price of exports do not allow for changes in a country's openness, whereas the data for imports do allow for changes. The countries showing signs of instability in export elasticities are Canada, France, and Germany. For Canada, this instability stems from the introduction of

[6] Hooper (1978), however, finds elasticity estimates for U.S. exports to be much more stable than estimates for imports during the 1960s and 1970s.

NAFTA early in 1994; otherwise, the elasticities are stable. For Germany, the parameter instability in import elasticities for 1990-1994 points to the effects of German reunification.[7]

Out-of-sample tests: 1995-1996. Table 4 summarizes the frequency with which actual trade realizations differ from the models' predictions. Inspection of the results suggests that, with a few exceptions, the 95 percent confidence intervals around the models' predictions include the actual values. Although this evidence rules out obvious model misspecifications, we find cases in which the models underpredict the actual values.

TABLE 4
Violations of Parameter Stability, 1995-1996

Cointegration Relations				
	Exports	Dates	Imports	Dates
Canada	0	-	+	1996:3
France	0	-	0	-
Germany	0	-	0	-
Italy	+	1995:1	+	1995:1
Japan	0	-	0	-
United Kingdom	0	-	0	-
United States	0	-	0	-
Error-Correction Formulations				
	Exports	Dates	Imports	Dates
Canada	0	-	0	-
France	0	-	0	-
Germany	0	-	0	-
Italy	+	1995:1	0	-
Japan	0	-	0	-
United Kingdom	0	-	0	-
United States	+	1995:2	0	-

[7] Ceglowski (1997) finds evidence of instability in Japanese trade during the mid-1980s.

To emphasize the practical implications of trade elasticities, we compute the depreciation path of the real exchange rate consistent with external balance:[1]

$$r = \frac{-\left(\zeta_x \cdot \Delta fy - \zeta_m \cdot \Delta y\right)}{\left(\epsilon_x + \epsilon_m - 1\right)},$$

where ζ_x is the income elasticity of exports, ζ_m is the income elasticity of imports, and $r > 0$ means a real depreciation of the domestic currency.

Using average annual growth rates for 1976 through 1996 and the elasticity estimates from Table 1, we find that the rates of depreciation that offset trend-income effects are comparable to the IMF's rate of real depreciation (Table 5); the exceptions are the rates for Italy and the United Kingdom.[2] In addition, differences in trade elasticities may cause different rates of depreciation in countries that have comparable growth of domestic and foreign markets. For example, growth rates for domestic and foreign GDPs are similar for Canada, Germany, and Italy, but the real-exchange-rate paths needed to offset trend-income influences differ: for Canada, the path is depreciation; for Italy and Germany, the path is appreciation. Finally, the rate of real depreciation of the U.S. dollar that offsets income effects is 2.8 percent per year, whereas the actual rate of depreciation has been slightly above 1 percent per year. Thus, unless there are shifts in the elasticities and in the trend growth rates, or unless the rate of real depreciation of the dollar accelerates, the U.S. external imbalance will widen.

TABLE 5
Growth, Elasticities, and Real Exchange Rates

	Annual Growth (%)		Annual Real Depreciation (%)	
	Domestic (Δy)	Foreign (Δfy)	Required ($\widehat{r}$)	Actual (IMF)
Canada	2.6	2.7	0.8	1.5
France	2.1	2.4	0.6	0.6
Germany	2.7	2.4	-1.2	-1.9
Italy	2.3	2.5	-2.6	0.7
Japan	3.3	3.7	-3.7	-2.3
United Kingdom	1.9	2.5	1.2	-0.6
United States	2.6	3.1	2.8	1.1

Sources: Appendix A, Table A-1, and IMF, *International Financial Statistics.*

[1] This equation is derived by Krugman (1989, eq. 7). The minus sign in front of the brackets of the numerator, however, is not in Krugman's equation, which has a typographical error.

[2] Using the IMF's data, instead of ours, serves as an independent check on our results.

5 CONCLUSIONS

Our analysis suggests three main conclusions. First, we find that conventional trade elasticities are stable enough, in most cases, to help translate economic analysis into policy recommendations. Elasticities for German trade, as well as for Italian and French exports, are an exception, reflecting, in all likelihood, the effects of the German reunification. Second, our elasticity estimates suggest that the price channel is weak, if not wholly ineffective, with respect to continental European countries. Nevertheless, with the exception of France and Germany, price elasticities for exports and imports satisfy the Marshall-Lerner condition. Finally, we find that income elasticities of U.S. trade have not been shifting in a direction that is likely to ease the trend toward deterioration in the U.S. trade position. We therefore conclude that a trend real depreciation of the dollar will be needed to keep the U.S. external deficit from growing ever wider

APPENDIX A: DATA

Trade Shares.

TABLE A-1
Bilateral Export Shares

From/to	Can	Fra	Ger	Ita	Jap	U.K.	U.S.
Canada		0.009	0.008	0.012	0.023	0.020	0.201
France	0.007		0.116	0.118	0.014	0.095	0.023
Germany	0.012	0.167		0.160	0.045	0.123	0.036
Italy	0.007	0.096	0.075		0.009	0.049	0.014
Japan	0.045	0.024	0.027	0.028		0.031	0.103
United Kingdom	0.014	0.083	0.080	0.05	0.032		0.046
United States	0.778	0.063	0.074	0.075	0.285	0.120	
Other OECD	0.053	0.325	0.367	0.282	0.066	0.337	0.111
Mexico	0.004	0.003	0.005	0.003	0.008	0.002	0.072
NIEs	0.028	0.034	0.039	0.039	0.249	0.049	0.118
OPEC	0.012	0.034	0.023	0.033	0.041	0.039	0.031
ROW	0.040	0.163	0.187	0.200	0.229	0.134	0.245
Total	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Source: IMF, *Direction of Trade* (1995).

Note: OECD = Organisation for Economic Co-operation and Development; OPEC = Organization of Petroleum Exporting Countries; NIEs = newly industrialized economies; ROW = rest of world.

Historical series. Figures A-1 through A-7 show the series used for estimation: real imports of goods and service, real GDP, the price of imports relative to domestic products; real exports of goods and services; foreign income; and the price of exports relative to the price of foreign products, expressed in local currency. The figures reveal two features common to all of the G-7 countries. First, foreign trade grows over time in conjunction with foreign and domestic income. Second, relative prices for trade flows in both directions show downward trends, but the decline in the relative price of imports is more pronounced than the decline in the relative price of exports, except for the United States where the opposite is true.

Order of integration. To determine the time-series properties of the variables, we employ an augmented Dickey-Fuller test using a constant, a trend, and four lags. Because the test results are below their corresponding critical values, we cannot reject the hypothesis that these variables are integrated of order one (Table A-2).

TABLE A-2
Augmented Dickey-Fuller-Test Results

	x	rpx	fy	m	rpm	y
Canada	-1.92	-3.33	-2.48	-2.92	-2.12	-1.45
France	-1.93	-2.13	-2.04	-3.15	-1.58	-2.30
Germany	-1.93	-1.56	-1.69	-3.15	-2.59	-2.92
Italy	-1.72	-2.10	-2.64	-2.74	-2.43	-1.42
Japan	-2.51	-2.73	-2.43	-1.96	-2.52	-1.10
United Kingdom	-1.43	-2.26	-2.22	-3.17	-2.39	-2.12
United States	-1.74	-1.88	-2.47	-2.82	-1.13	-2.96

Note: Critical Values are 5 percent = -3.468; 1 percent = -4.08.

FIGURE A-1: Canada: Trade, Income, and Prices

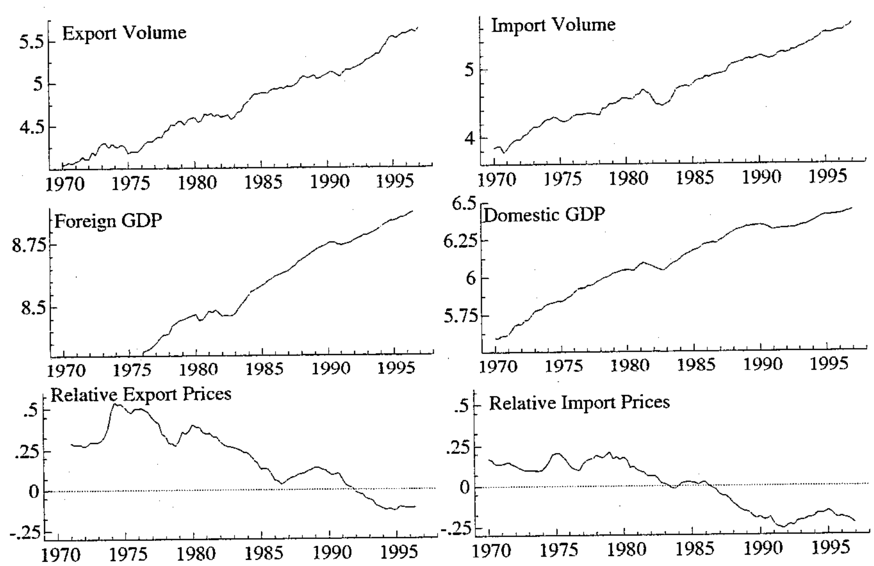


FIGURE A-2: France: Trade, Income, and Prices

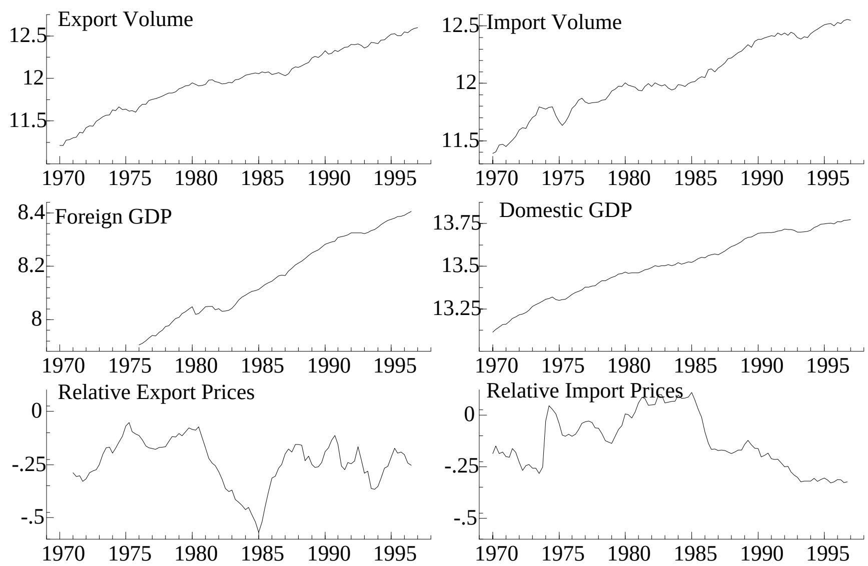


FIGURE A-3: Germany: Trade, Income, and Prices

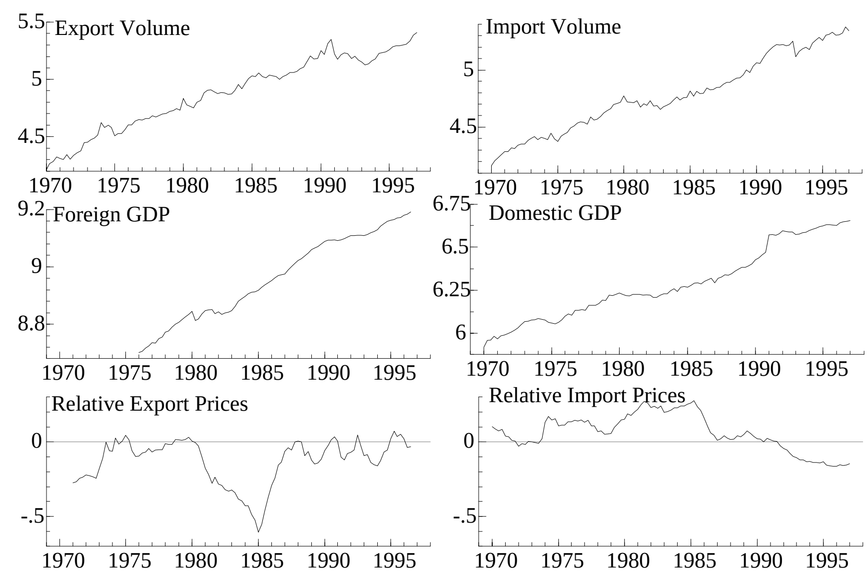


FIGURE A-4: Italy: Trade, Income, and Prices

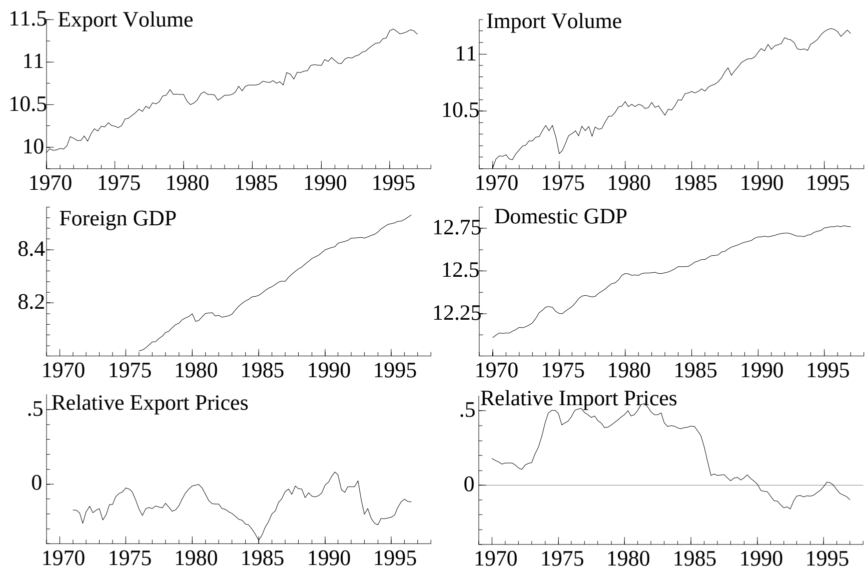


FIGURE A-5: Japan: Trade, Income. and Prices

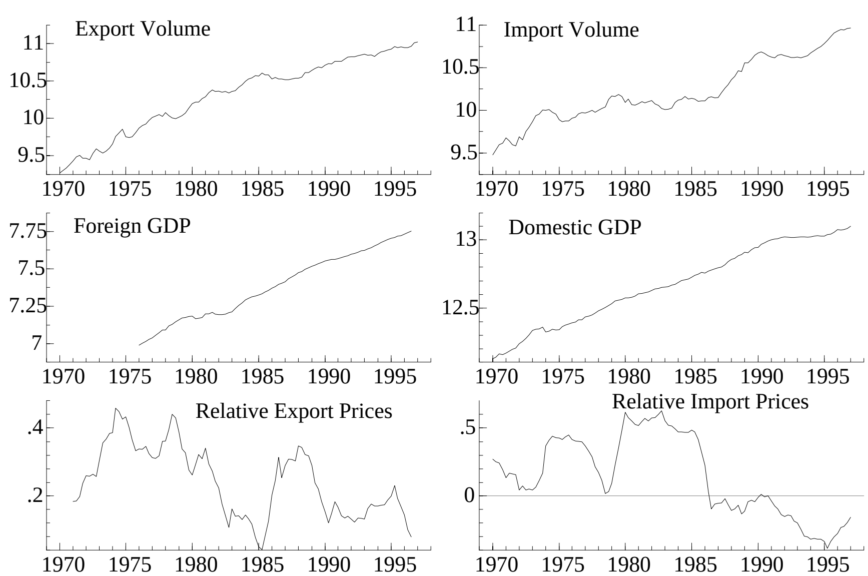


FIGURE A-6: United Kingdom: Trade, Income, and Prices

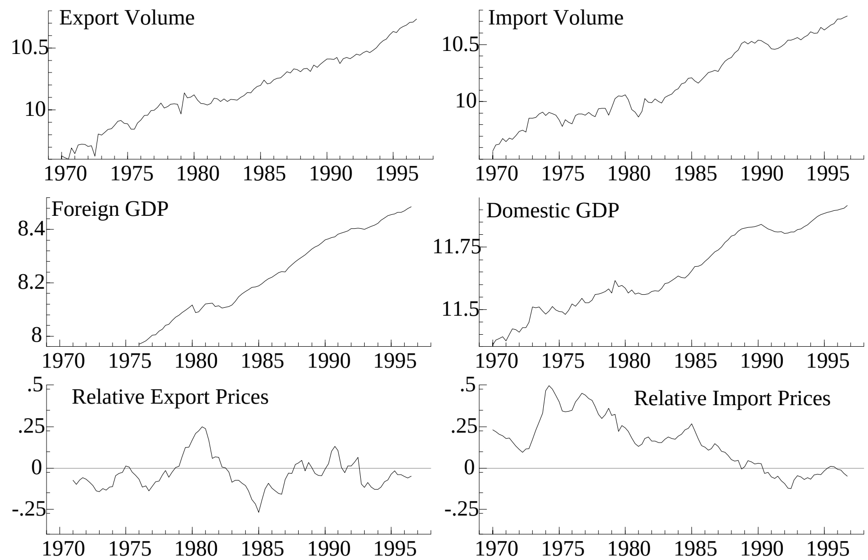
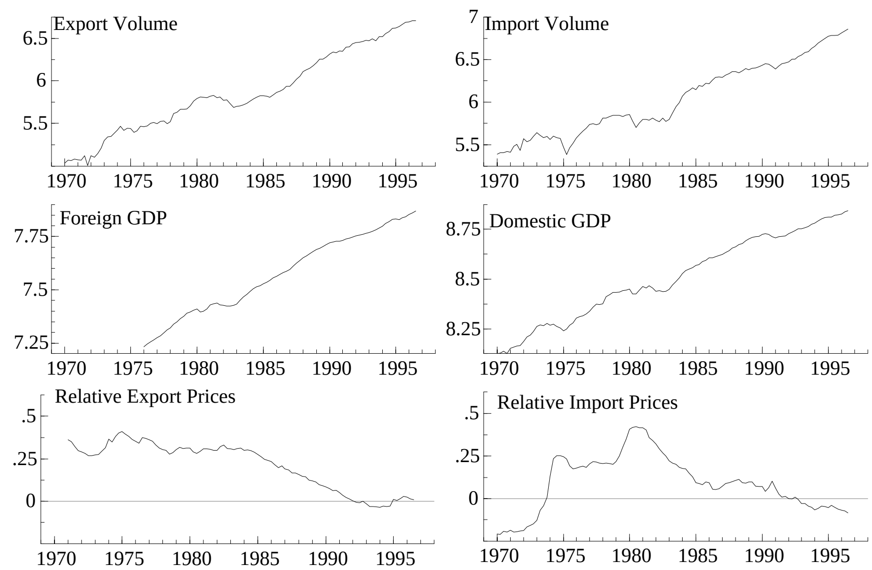


FIGURE A-7: United States: Trade, Income, and Prices



APPENDIX B: LONG-RUN ELASTICITIES

Exports

Estimation. Table B-1 shows, for exports, the effects that changing the lag length (from two to nine quarters) has on the number of cointegration vectors, the parameter estimates, and the tests of serial correlation of the residuals based on a test of whether the coefficients of a VAR(5) on each system's residuals are jointly zero. A dagger (†) beside an entry in the first row shows the lag length selected; "ni" indicates that the elasticities are not identified; an asterisk ($*$) denotes a rejection of serial independence. For France, we select two lags; otherwise, the loading coefficient is not significant. For Germany, we select two lags. For the United Kingdom, we select four lags, despite serial correlation, because the elasticity estimates are close to one.

Parameter stability. Figures B-1 through B-7 show Chow-test results of parameter stability of the cointegration model for exports. The tests for the export equation are shown on the left; the tests for the full system are shown on the right and are labeled "CHOW." A crossing of the horizontal line at a given date denotes a rejection of the hypothesis of parameter constancy at the 5 percent level for that date. For Canada, the tests suggest stable elasticities through 1993, with a significant change in those elasticities starting in 1994. For France, Germany, and Italy, the tests suggest parameter instability starting in 1993, at the time of the German reunification. For Japan, the United Kingdom, and the United States, the tests support parameter constancy.

Ex post predictions. Figures B-8 through B-14 show the 95 percent confidence intervals for the models' one-step-ahead predictions for exports for 1995-1996. Except for Italy in 1995:1, none of the actual values is outside the confidence intervals. Predictions for Italy, the United Kingdom, and the United States, however, are one-sided, and prediction errors for the United Kingdom are close to being significant.

Imports

Estimation. Table B-2 shows, for imports, the effects that changing the lag length (from two to nine quarters) has on the number of cointegration vectors, the parameter estimates, and tests of serial correlation of the residuals based on a test of whether the coefficients of a VAR(5) on each system's residuals are jointly zero. A dagger (†) beside an entry in the first row shows the lag length selected; "ni" indicates that the elasticities are not identified; an asterisk ($*$) denotes a rejection of serial independence.

For Canada, we select eight lags because the elasticity estimates are virtually equal to 1. For Italy, we select four lags, instead of five, because the loading coefficient is significant. For the United States, we select nine lags, instead of eight, to accommodate differences in the estimated price elasticities.

Parameter stability. Figures B-15 through B-21 show Chow-test results of parameter stability of the cointegration system for imports. The tests for the import equation are shown on the left; the tests for the full system are shown on the right and are labeled "CHOW." For Canada, the tests suggest stable elasticities through 1993 and a temporary instability starting in 1994. For Germany, the tests reject parameter constancy. For France, Italy, Japan, the United Kingdom, and the United States, the tests suggest stable elasticities.

Ex post predictions. Figures B-22 through B-28 show the 95 percent confidence intervals for the models' one-step-ahead predictions for imports for 1995-1996. Except for Italy in 1995:1 and Canada in 1996:3, these intervals include the actual values. Predictions for Canada, Italy, the United Kingdom, and the United States, however, understate actual imports.

TABLE B-1

Exports: Sensitivity to Lag Length

				Canada (1978:2 to 1994:4)				
Lags included	9†	8	7	6	5	4	3	2
Coin. vectors	1	0	0	0	0	0	0	0
Price elas'ty	-1.08 (0.10)	ni	ni	ni	ni	ni	ni	ni
Income elas'ty	0.82 (0.11)	ni	ni	ni	ni	ni	ni	ni
Loading coef.	-0.27 (0.21)	ni	ni	ni	ni	ni	ni	ni
Ser. corr. exp.	0.16	0.00	0.15	0.11	0.18	0.49	0.51	0.78
Ser. corr. sys.	0.07	0.01*	0.01*	0.00*	0.08	0.11	0.02*	0.02*
				France (1976:2 to 1994:4)				
Lags included	9	8	7	6	5	4	3	2†
Coin. vectors	1	1	1	1	1	2	1	1
Price elas'ty	0.62	0.65	0.43	0.58	4.12	ni	-0.30	-0.21 (0.09)
Income elas'ty	1.80	1.80	1.72	1.78	3.16	ni	1.47	1.49 (0.08)
Loading coef.	-0.19	-0.15	-0.24	-0.14	-0.01	ni	-0.01	-0.07 (0.04)
Ser. corr. exp.	0.55	0.13	0.48	0.40	0.05	0.11	0.07	0.01*
Ser. corr. sys.	0.17	0.11	0.17	0.24	0.31	0.74	0.48	0.17

TABLE B-1 *continued*

Germany (1978:2 to 1994:4)								
Lags included	9	8	7	6	5	4	3	2†
Coin. vectors	1	1	0	0	0	0	0	1
Price elas'ty	-0.27	-0.22	ni	ni	ni	ni	ni	-0.26 (0.09)
Income elas'ty	1.62	1.64	ni	ni	ni	ni	ni	1.43 (0.14)
Loading coef.	-0.38	-0.36	ni	ni	ni	ni	ni	-0.10 (0.05)
Ser. corr. exp.	0.58	0.70	0.64	0.11	0.46	0.45	0.73	0.28
Ser. corr. sys.	0.99	0.93	0.84	0.37	0.57	0.86	0.99	0.99

Italy (1976:3 to 1994:4)								
Lags included	9	8	7	6	5	4	3	2†
Coin. vectors	0	0	0	0	0	0	0	1
Price elas'ty	ni	ni	ni	ni	ni	ni	ni	-0.88 (0.57)
Income elas'ty	ni	ni	ni	ni	ni	ni	ni	1.62 (0.42)
Loading coef.	ni	ni	ni	ni	ni	ni	ni	-0.01 (0.01)
Ser. corr. exp.	0.09	0.04*	0.73	0.93	0.76	0.73	0.51	0.66
Ser. corr. sys.	0.30	0.14	0.30	0.34	0.53	0.83	0.88	0.97

Japan (1977:2 to 1994:4)								
Lags included	9	8	7	6	5†	4	3	2
Coin. vectors	1	0	0	0	1	1	1	0
Price elas'ty	1.31	ni	ni	ni	-1.01 (0.12)	-1.51	-1.32	ni
Income elas'ty	1.21	ni	ni	ni	1.12 (0.06)	0.66	0.94	ni
Loading coef.	-0.04	ni	ni	ni	-0.13 (0.08)	-0.00	-0.02	ni
Ser. corr. exp.	0.00*	0.00*	0.02*	0.81	0.16	0.21	0.25	0.04*
Ser. corr. sys.	0.01*	0.00*	0.00*	0.27	0.51	0.70	0.73	0.14

United Kingdom (1977:1 to 1994:4)								
Lags included	9	8	7	6	5	4†	3	2
Coin. vectors	1	1	1	1	1	1	1	1
Price elas'ty	1.17	0.60	0.49	0.88	1.06	-1.55 (0.51)	-3.41	-1.02
Income elas'ty	0.96	1.11	1.18	1.16	1.16	1.11 (0.32)	1.18	2.28
Loading coef.	0.18	0.30	0.25	0.04	0.03	-0.02 (0.02)	-0.08	-0.06
Ser. corr. exp.	0.84	0.55	0.12	0.05	0.27	0.00*	0.18	0.37
Ser. corr. sys.	0.90	0.74	0.50	0.16	0.17	0.00*	0.00*	0.00*

United States (1976:3 to 1994:4)								
Lags included	9	8	7	6	5	4	3	2†
Coin. vectors	2	2	1	1	1	0	0	1
Price elas'ty	ni	ni	-1.38	-1.44	-1.51	ni	ni	-1.47 (0.24)
Income elas'ty	ni	ni	0.89	0.73	0.74	ni	ni	0.83 (0.19)
Loading coef.	ni	ni	-0.15	0.03	-0.05	ni	ni	-0.06 (0.05)
Ser. corr. exp.	0.50	0.28	0.09	0.14	0.06	0.64	0.97	0.81
Ser. corr. sys.	0.27	0.01*	0.00*	0.00*	0.01*	0.05	0.84	0.71

TABLE B-2

Imports: Sensitivity to Lag Length

Canada (1963:1 to 1994:4)								
Lags included	9	8†	7	6	5	4	3	2
Coin. vectors	0	1	0	1	1	1	1	1
Price elas'ty	ni	-1.01 (0.17)	ni	-0.83	3.35	-2.83	-17.33	0.33
Income elas'ty	ni	-1.36 (0.07)	ni	1.24	0.74	1.60	4.02	1.17
Loading coef.	ni	-0.20 (0.05)	ni	-0.06	-0.00	-0.01	0.00	-0.01
Ser. corr. imp.	0.25	0.04*	0.16	0.15	0.36	0.11	0.08	0.55
Ser. corr. sys.	0.60	0.14	0.30	0.53	0.58	0.51	0.25	0.13
France (1972:2 to 1994:4)								
Lags included	9	8	7	6	5	4	3†	2
Coin. vectors	0	0	0	0	0	1	1	1
Price elas'ty	ni	ni	ni	ni	ni	-0.35	-0.37 (0.03)	-0.38
Income elas'ty	ni	ni	ni	ni	ni	1.61	1.59 (0.03)	1.59
Loading coef.	ni	ni	ni	ni	ni	-0.61	-0.60 (0.03)	-0.47
Ser. corr. imp.	0.00*	0.02*	0.08*	0.32	0.16	0.18	0.08	0.03
Ser. corr. sys.	0.09	0.17	0.07	0.00*	0.10	0.02*	0.12	0.01*
Germany (1968:3 to 1994:4)								
Lags included	9	8	7	6	5	4	3	2†
Coin. vectors	2	0	1	0	0	0	1	1
Price elas'ty	ni	ni	0.25	ni	ni	ni	0.31	-0.06 (0.23)
Income elas'ty	ni	ni	1.65	ni	ni	ni	1.63	1.47 (0.13)
Loading coef.	ni	ni	-0.10	ni	ni	ni	0.07	-0.13 (0.02)
Ser. corr. imp.	0.31	0.01*	0.18	0.05	0.31	0.02*	0.03*	0.05
Ser. corr. sys.	0.74	0.31	0.29	0.27	0.31	0.18	0.17	0.00*
Italy (1972:2 to 1994:4)								
Lags included	9	8	7	6	5	4†	3	2
Coin. vectors	2	2	2	2	1	1	1	1
Price elas'ty	ni	ni	ni	ni	-0.63	-0.40 (0.04)	-0.39	-0.39
Income elas'ty	ni	ni	ni	ni	0.78	1.40 (0.05)	1.42	1.42
Loading coef.	ni	ni	ni	ni	-0.06	-0.50 (0.12)	-0.53	-0.48
Ser. corr. imp.	0.46	0.54	0.83	0.77	0.17	0.82	0.88	0.73
Ser. corr. sys.	0.16	0.07	0.22	0.48	0.17	0.11	0.02*	0.02*
Japan (1956:4 to 1994:4)								
Lags included	9	8	7	6†	5	4	3	2
Coin. vectors	2	2	2	1	2	2	2	2
Price elas'ty	ni	ni	ni	-0.33 (0.21)	ni	ni	ni	ni
Income elas'ty	ni	ni	ni	0.92 (0.12)	ni	ni	ni	ni
Loading coef.	ni	ni	ni	-0.03 (0.01)	ni	ni	ni	ni
Ser. corr. imp.	0.60	0.36	0.63	0.22	0.10	0.00*	0.00*	0.01*
Ser. corr. sys.	0.22	0.12	0.27	0.03*	0.26	0.00*	0.00*	0.00*

TABLE B-2 *continued*

United Kingdom (1956:2 to 1994:4)								
Lags included	9	8	7	6	5†	4	3	2
Coin. vectors	0	0	0	0	1	2	2	2
Price elas'ty	ni	ni	ni	ni	-0.58 (1.50)	ni	ni	ni
Income elas'ty	ni	ni	ni	ni	2.21 (0.82)	ni	ni	ni
Loading coef.	ni	ni	ni	ni	0.01 (0.01)	ni	ni	ni
Ser. corr. imp.	0.31	0.63	0.72	0.20	0.33	0.44	0.67	0.90
Ser. corr. sys.	0.41	0.16	0.41	0.05	0.13	0.06	0.46	0.35

United States (1961:4 to 1994:4)								
Lags included	9†	8	7	6	5	4	3	2
Coin. vectors	1	1	1	1	1	1	1	1
Price elas'ty	-0.31 (0.09)	-0.21	-0.37	-0.36	-0.41	-0.43	ni	ni
Income elas'ty	1.79 (0.15)	1.72	2.76	2.12	2.10	2.10	ni	ni
Loading coef.	-0.10 (0.03)	-0.08	0.01	0.01	-0.03	-0.03	ni	ni
Ser. corr. imp.	0.12	0.37	0.11	0.03*	0.31	0.37	0.06	0.81
Ser. corr. sys.	0.26	0.12	0.02*	0.02*	0.03*	0.02*	0.00*	0.00*

FIGURE B-1: Exports for Canada: Chow Tests for the Cointegration Model

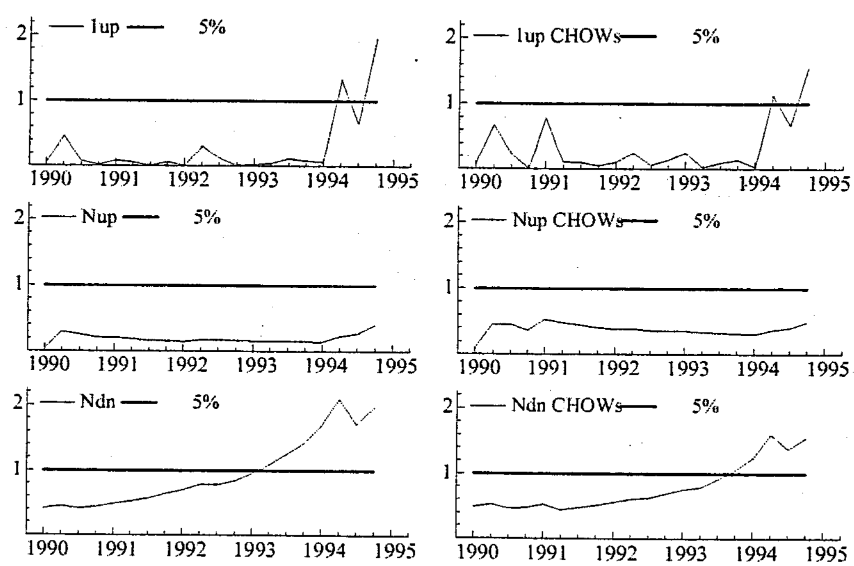


FIGURE B-2: Exports for France: Chow Tests for the Cointegration Model

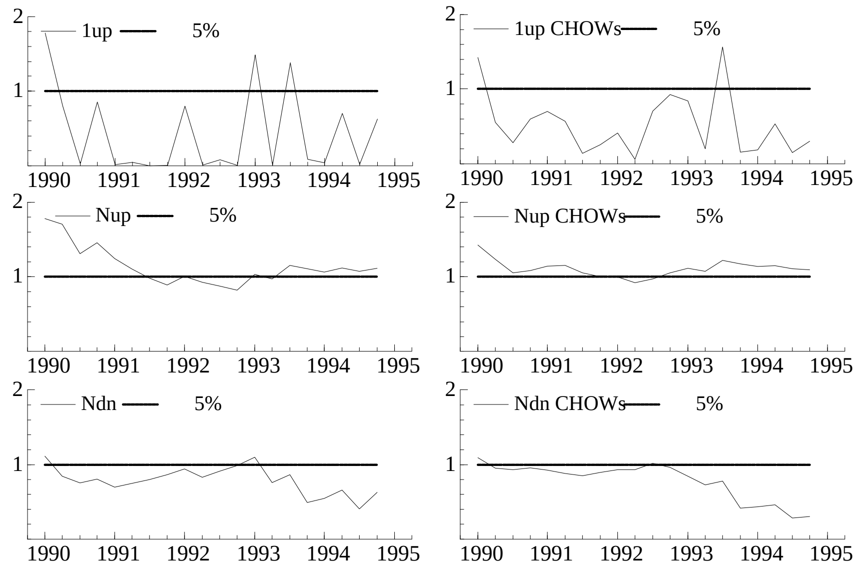


FIGURE B-3: Exports for Germany: Chow Tests for the Cointegration Model

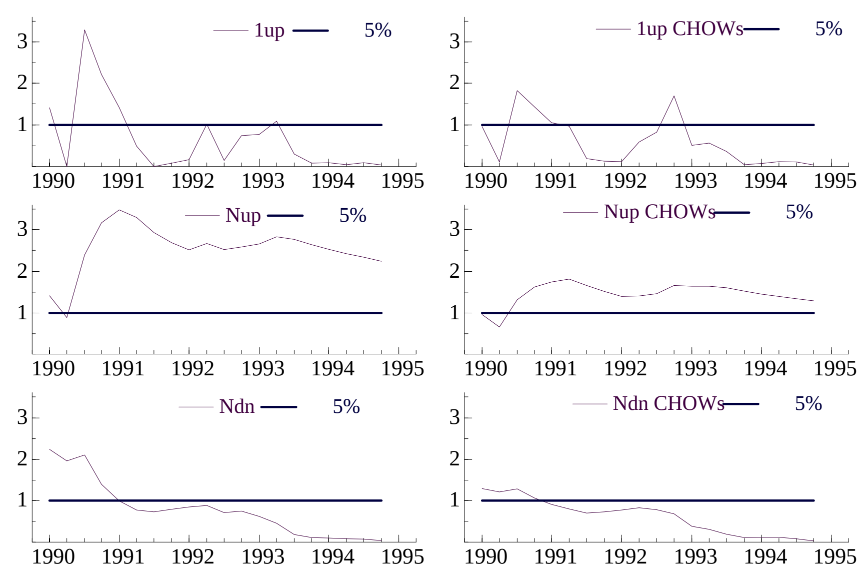


FIGURE B-4: Exports for Italy: Chow Tests for the Cointegration Model

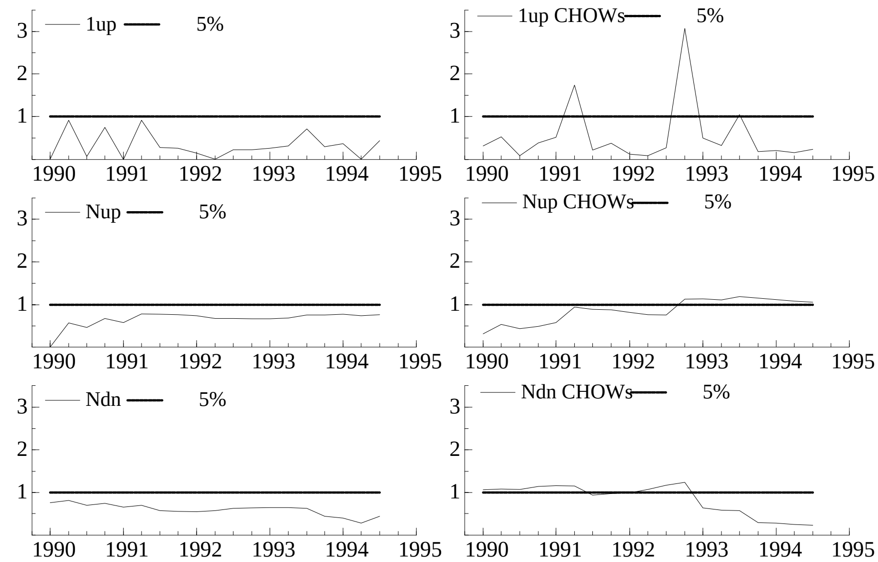


FIGURE B-5: Exports for Japan: Chow Tests for the Cointegration Model

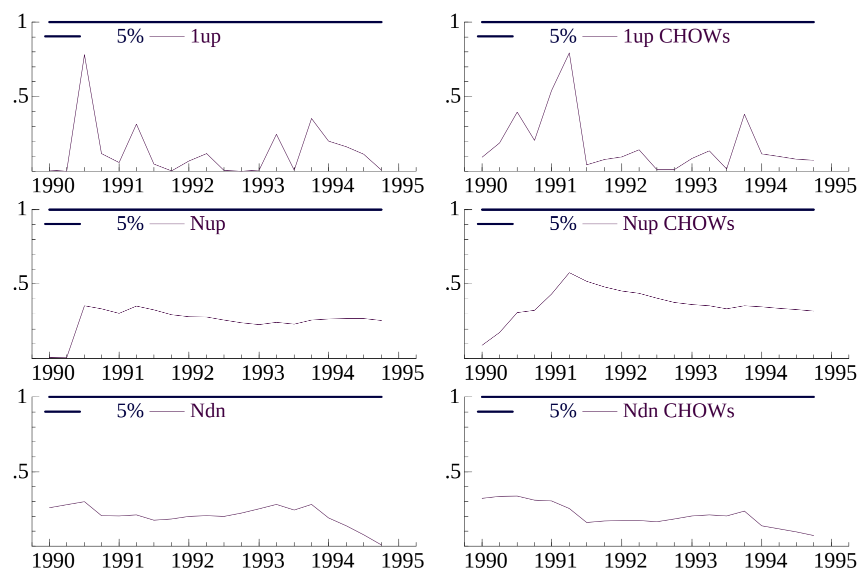


FIGURE B-6: Exports for the U.K.: Chow Tests for the Cointegration Model

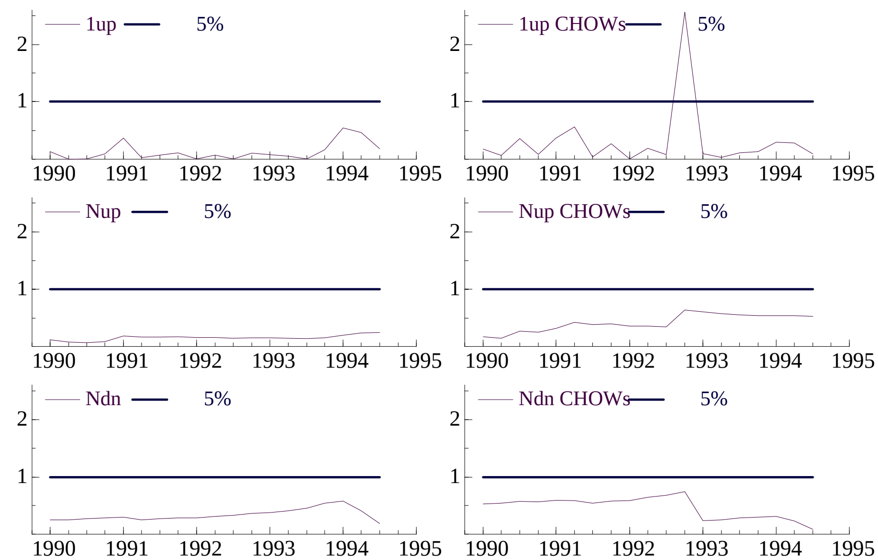


FIGURE B-7: Exports for the U.S.: Chow Tests for the Cointegration Model

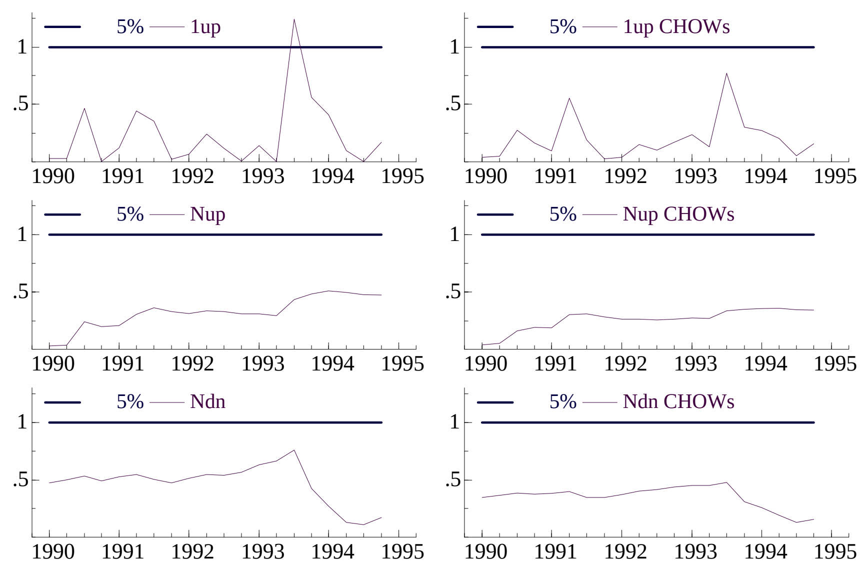


FIGURE B-8: Exports for Canada: Predictive Accuracy of the Cointegration

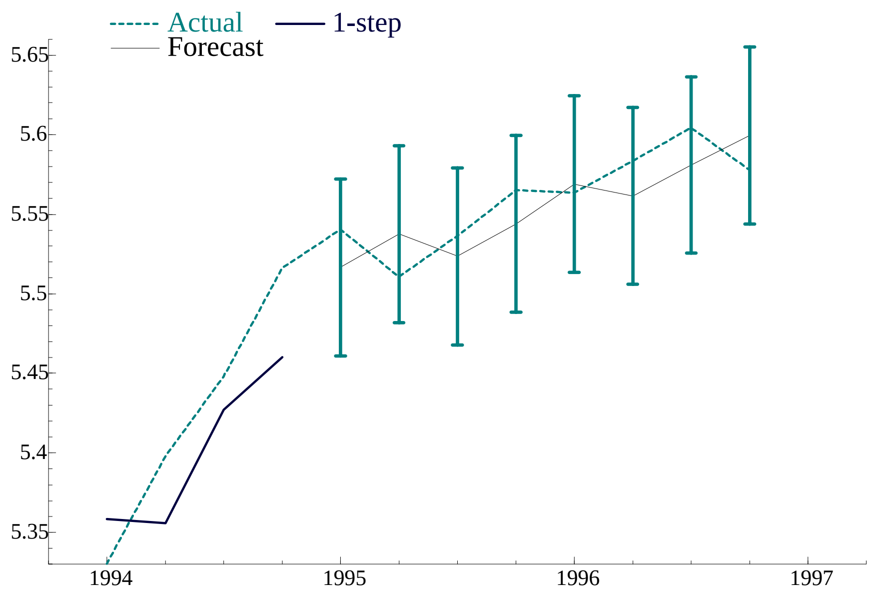


FIGURE B-9: Exports for France: Predictive Accuracy of the Cointegration Model

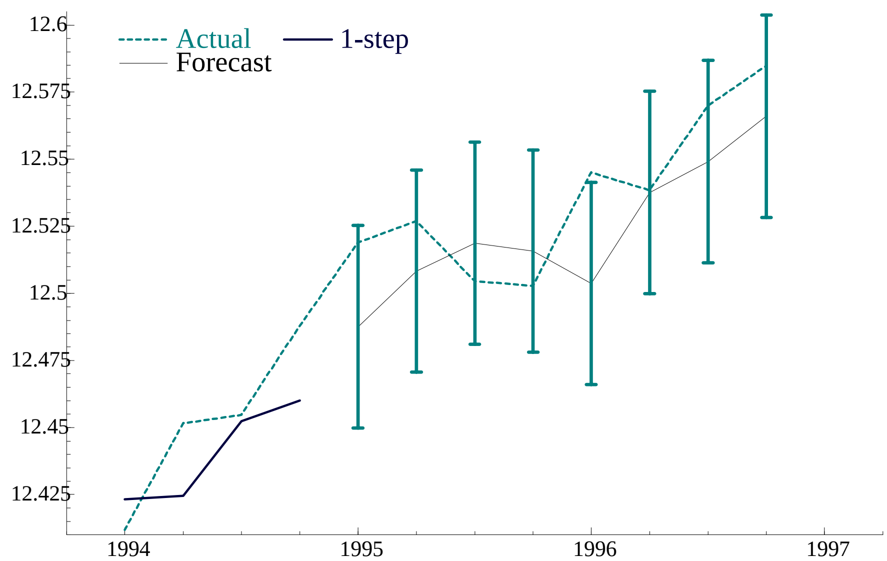


FIGURE B-10: Exports for Germany: Predictive Accuracy of the Cointegration

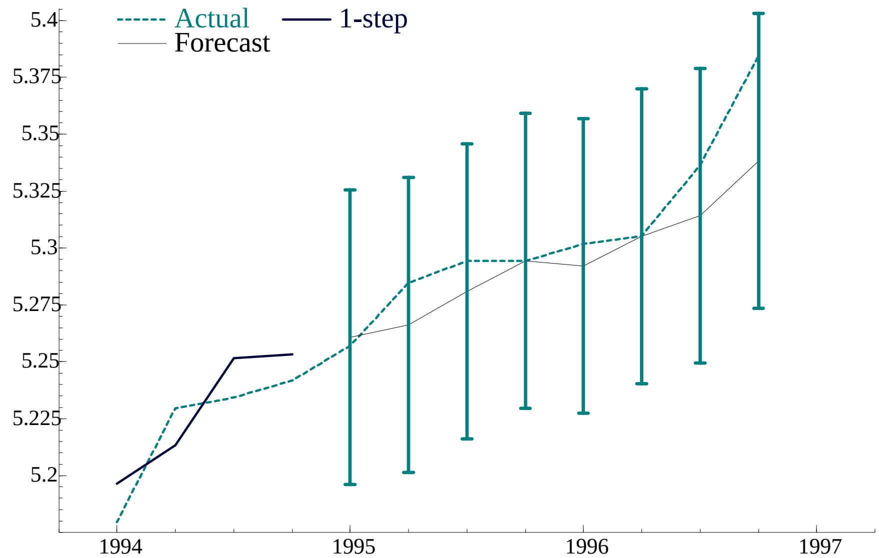


FIGURE B-11: Exports for Italy: Predictive Accuracy of the Cointegration Model

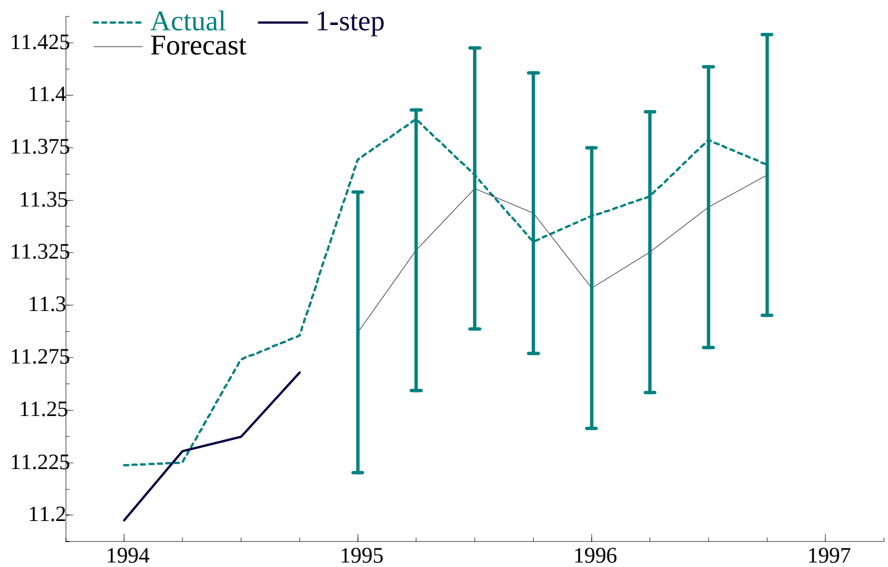


FIGURE B-12: Exports for Japan: Predictive Accuracy of the Cointegration

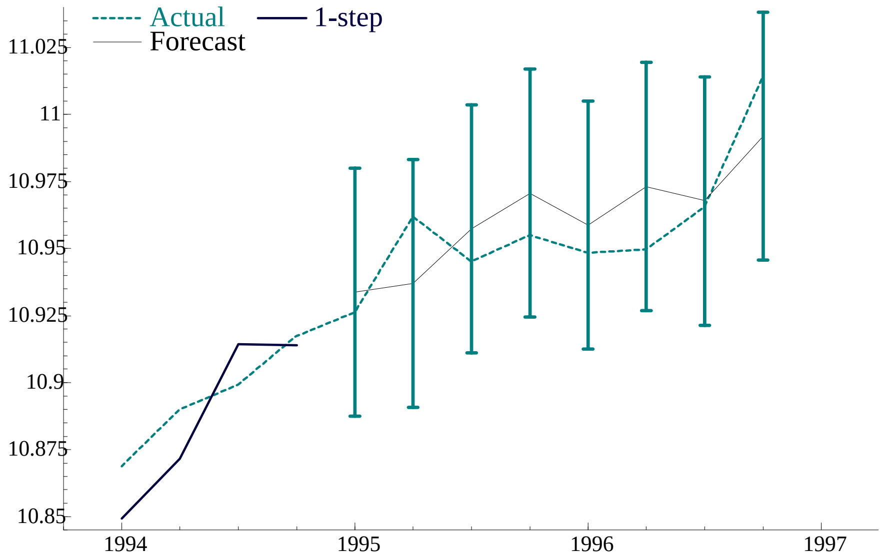


FIGURE B-13: Exports for the U.K.: Predictive Accuracy of the Cointegration

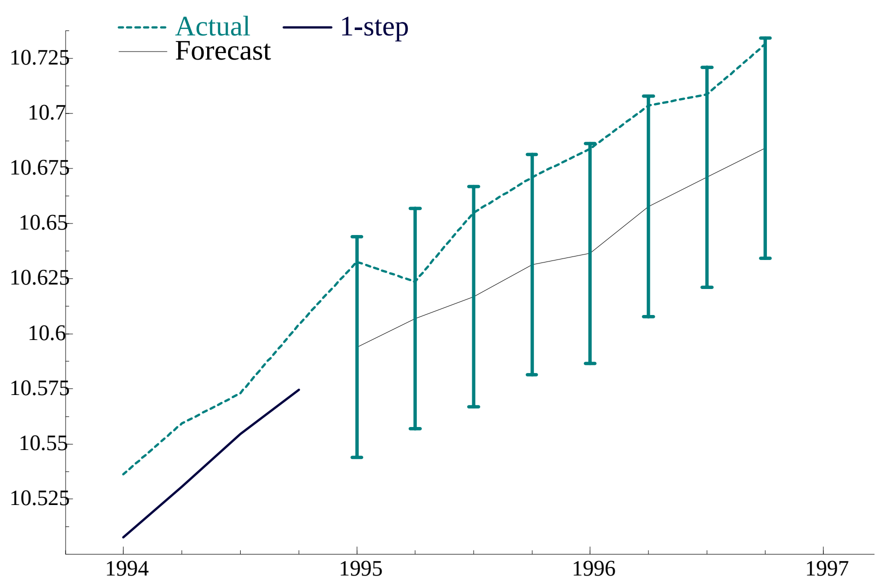


FIGURE B-14: Exports for the U.S.: Predictive Accuracy of the Cointegration

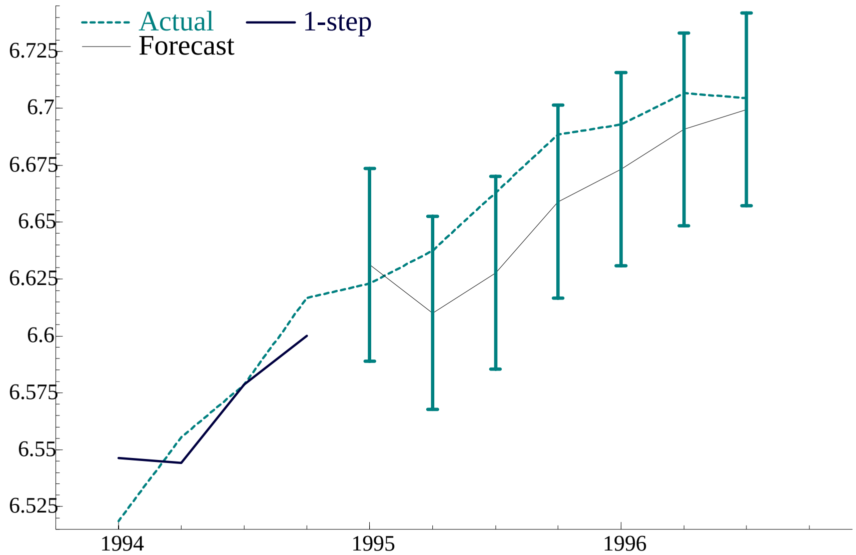


FIGURE B-15: Imports for Canada: Chow Tests for the Cointegration Model

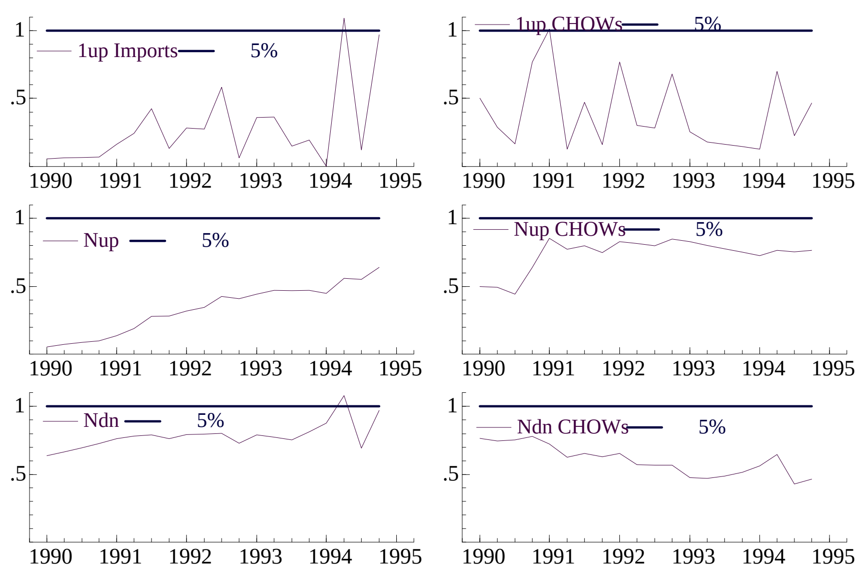


FIGURE B-16: Imports for France: Chow Tests for the Cointegration Model

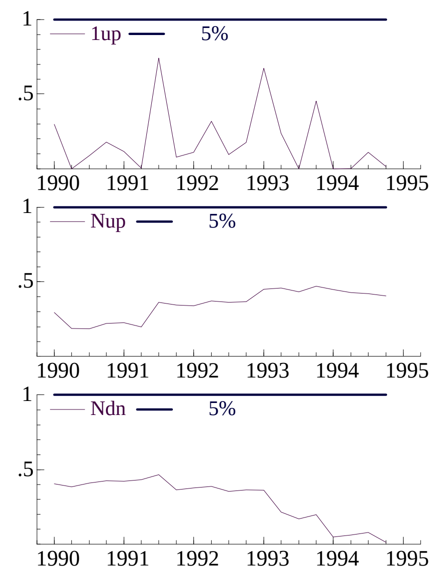


FIGURE B-17: Imports for Germany: Chow Tests for the Cointegration Model

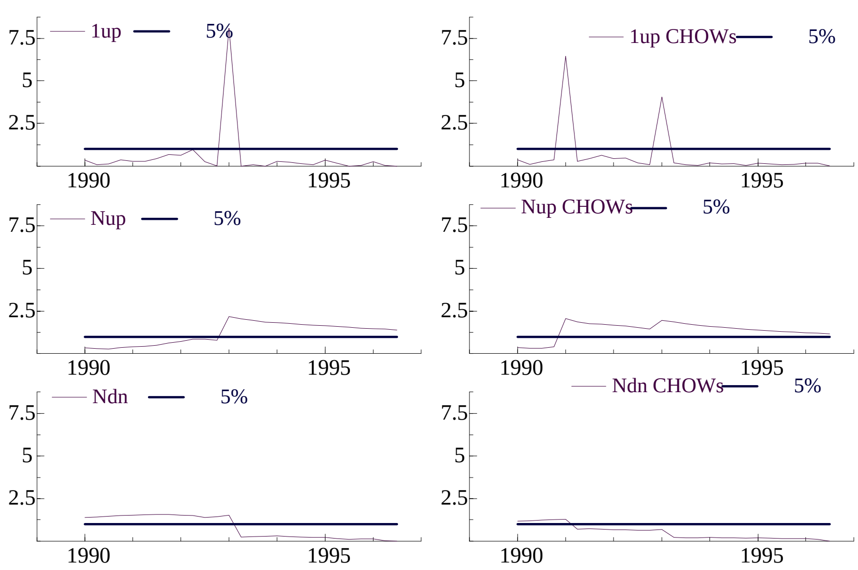


FIGURE B-18: Imports for Italy: Chow Tests for the Cointegration Model

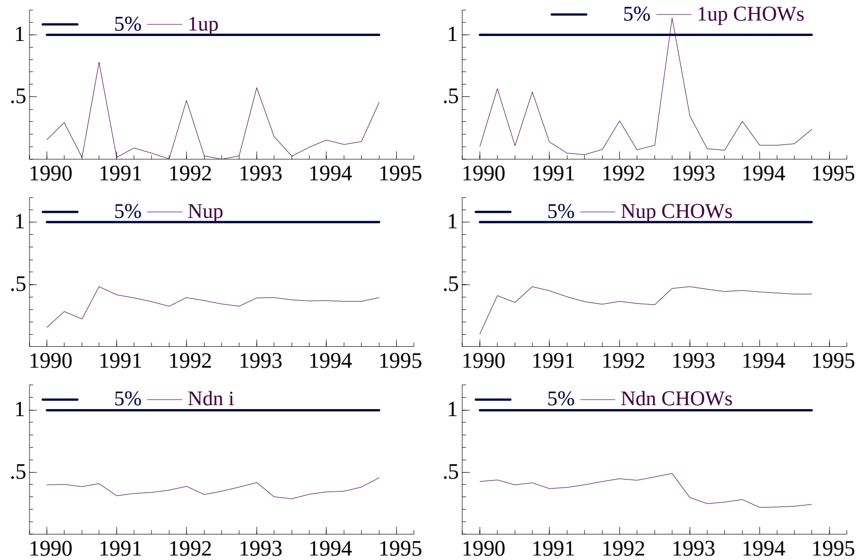


FIGURE B-19: Imports for Japan: Chow Tests for the Cointegration Model

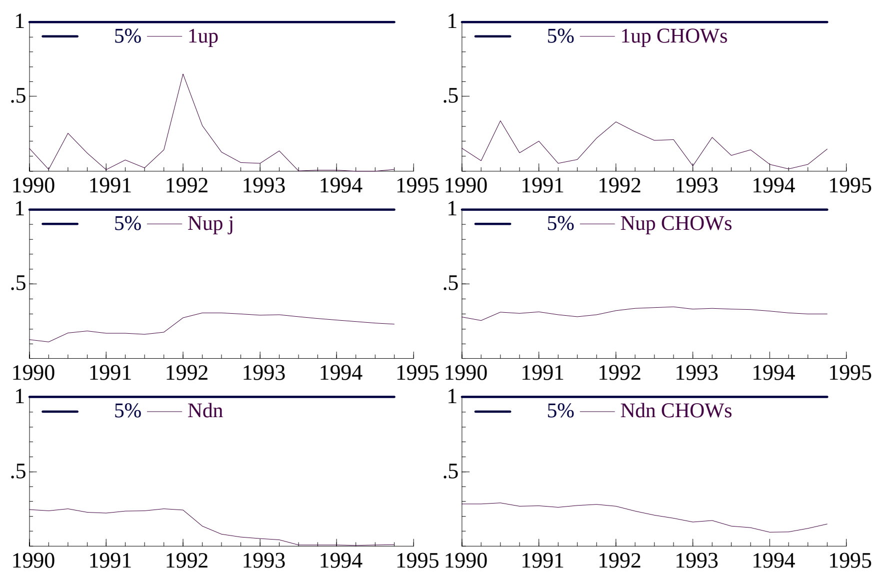


FIGURE B-20: Imports for the U.K.: Chow Tests for the Cointegration Model

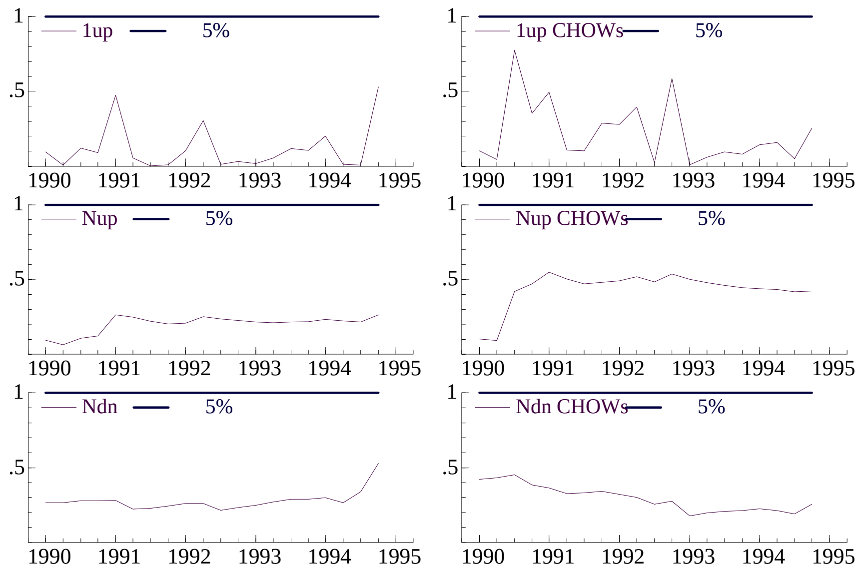


FIGURE B-21: Imports for the U.S.: Chow Tests for the Cointegration Model

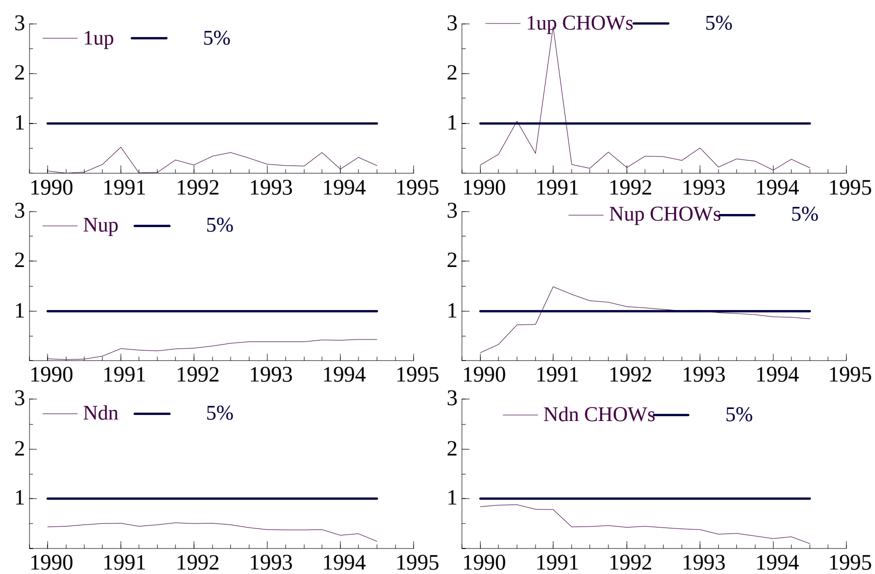


FIGURE B-22: Imports for Canada: Predictive Accuracy of the Cointegration

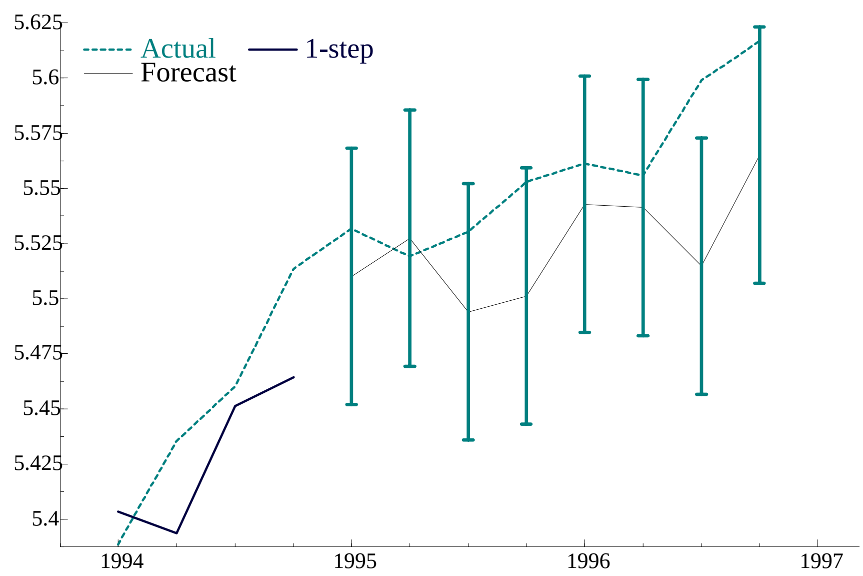


FIGURE B-23: Imports for France: Predictive Accuracy of the Cointegration

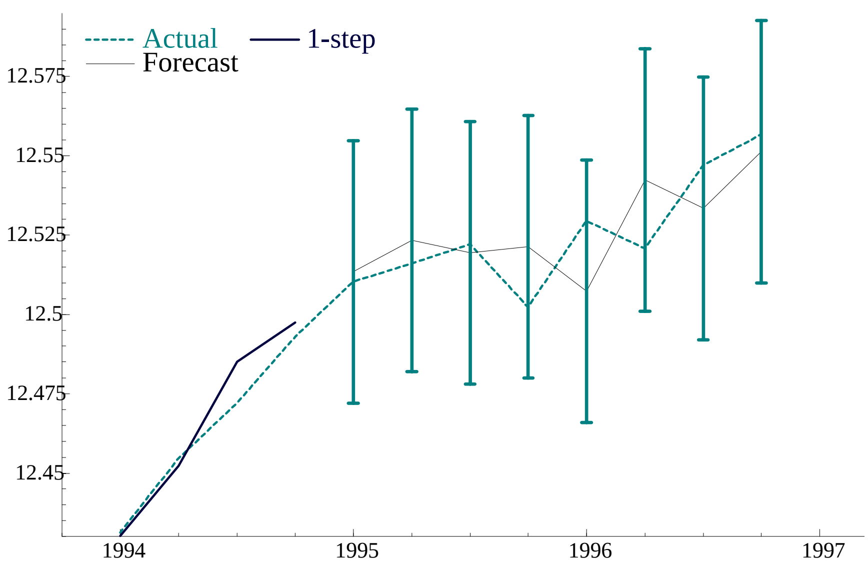


FIGURE B-24: Imports for Germany: Predictive Accuracy of the Cointegration

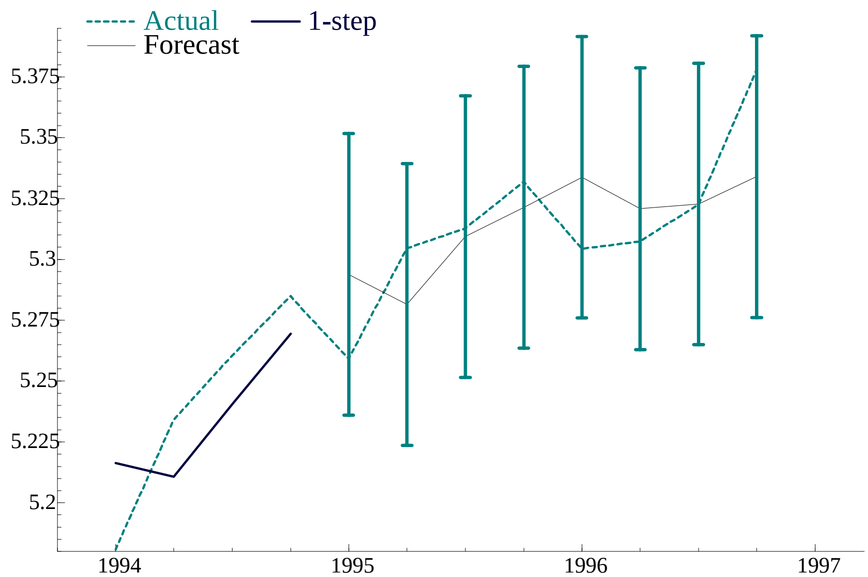


FIGURE B-25: Imports for Italy: Predictive Accuracy of the Cointegration Model

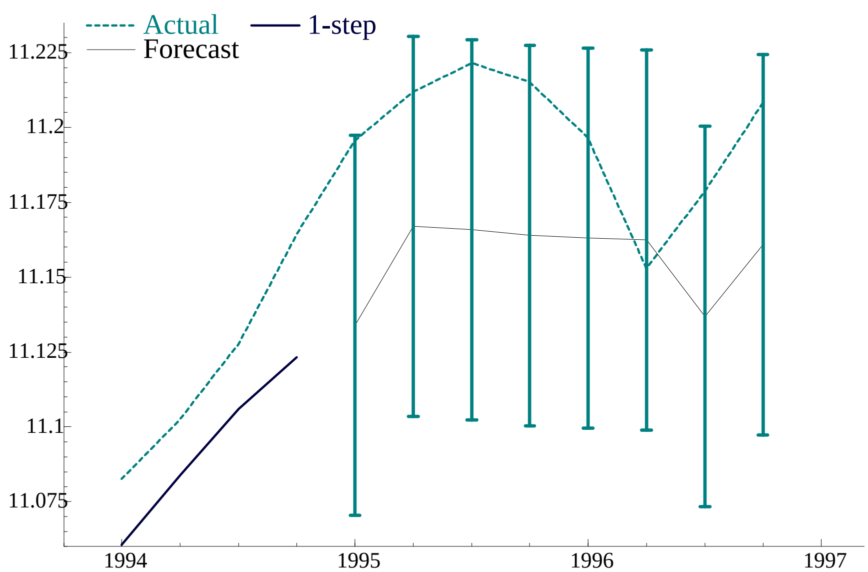


FIGURE B-26: Imports for Japan: Predictive Accuracy of the Cointegration

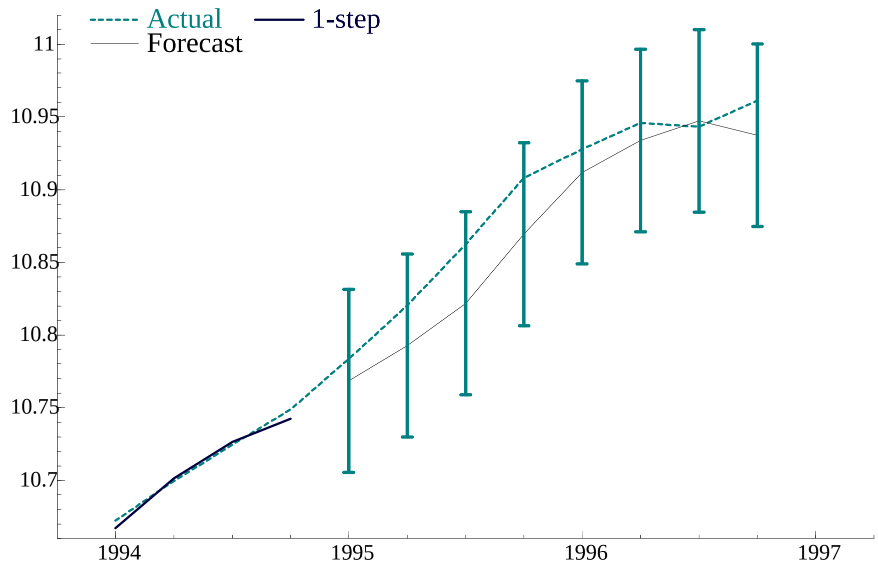


FIGURE B-27: Imports for the U.K.: Predictive Accuracy of the Cointegration

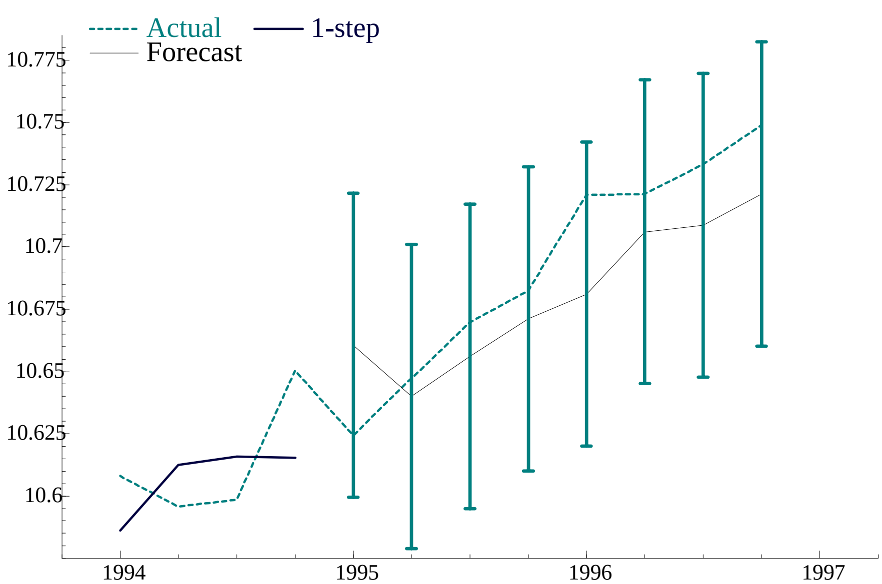
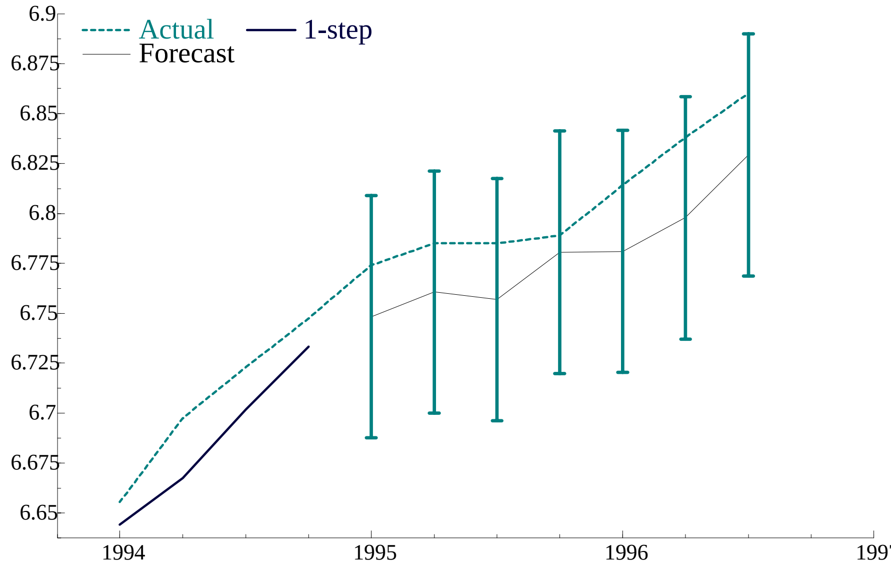


FIGURE B-28: Imports for the U.S.: Predictive Accuracy of the Cointegration



APPENDIX C: SHORT-RUN ELASTICITIES

Exports

Estimation. Table C-1 shows, for exports, that all of the coefficients have their expected signs and that countries differ markedly in their estimated adjustment speeds, ranging from 3 percent per quarter (United Kingdom) to 48 percent per quarter (Germany). The error-correction coefficient for France, Italy, and the United States is not significant, a finding that weakens the evidence on cointegration.

TABLE C-1
Exports: Parameter Estimates from the Error-Correction Model

	Can	Fra	Ger	Ita	Jap	U.K.	U.S.
Income	1.07	1.82	0.55	2.33	0.59	1.09	1.83
	(0.34)	(0.43)	(0.41)	(0.60)	(0.34)	(0.65)	(0.48)
Price	-0.48	-0.09	-0.05	-0.33	-0.45	-0.24	-0.53
	(0.15)	(0.06)	(0.06)	(0.13)	(0.12)	(0.10)	(0.23)
ECM	-0.20	-0.01	-0.48	-0.03	-0.17	-0.03	-0.05
	(0.08)	(0.04)	(0.07)	(0.04)	(0.06)	(0.01)	(0.05)
R^2	0.51	0.52	0.57	0.33	0.49	0.74	0.49
SER	2.51	1.69	2.30	3.34	2.04	1.18	1.79
Serial indep'nce	0.25	0.21	0.19	0.48	0.06	0.06	0.18
Homoscedas'ty	0.07	0.84	0.50	0.19	0.99	0.69	0.50
Normality	0.53	0.78	0.09	0.23	0.93	0.41	0.49
Functional form	0.90	0.82	0.06	0.76	0.87	0.87	0.06
Start sample	76.2	76.3	76.2	76.3	77.3	77.3	76.3

Note: Standard errors are in parentheses.

The formulations explain at least one-half of the variability of the growth rate of exports, except for Italy, where they explain about one-third. Finally, the empirical distributions of the residuals satisfy the assumptions maintained for estimation (serial independence, homoscedasticity, normality) in all cases. For homoscedasticity, we use a t-test of the null hypothesis that the variance of the residuals is constant. For normality, we use a χ^2 test of the null hypothesis that the distribution of the residuals is normal. For functional form, we use a reset test of the null hypothesis that the specification does not omit combinations of the predetermined variables.

Some formulations include dummy variables: Canada (1994:1) includes a variable for NAFTA; France (1990:1&2) and Germany (1990:1,3,4) include a variable for the effects of German reunification; the United Kingdom (1979:1&2) and the United States (1978:2; 1977:4) include a variable for oil-price shocks.

Parameter stability. Figures C-1 through C-7 show Chow tests of parameter stability for exports. For Canada, France, Japan, and the United Kingdom, the tests support parameter constancy. For Germany and the United States, they show evidence of some instability.

Ex post predictions. Figures C-8 through C-14 show the 95 percent confidence intervals for the models' one-step-ahead predictions for exports for 1995-1996. Except for Italy in 1995:1 and the United States in 1995:2, the actual values are in the 95 percent confidence intervals. Predictions for Germany, the United Kingdom, and the United States, however, are one-sided.

FIGURE C-1: Exports for Canada: Chow Tests for the ECM Coefficients

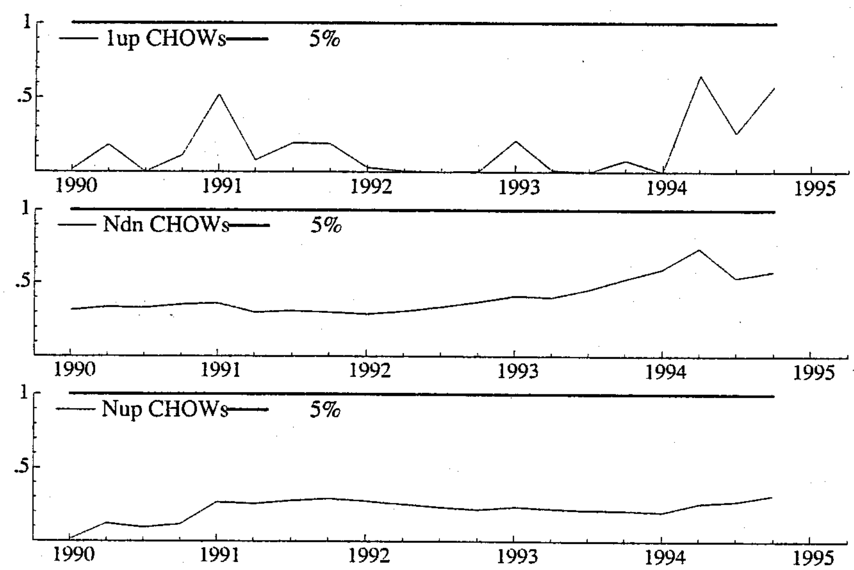


FIGURE C-2: Exports for France: Chow Tests for the ECM Coefficients

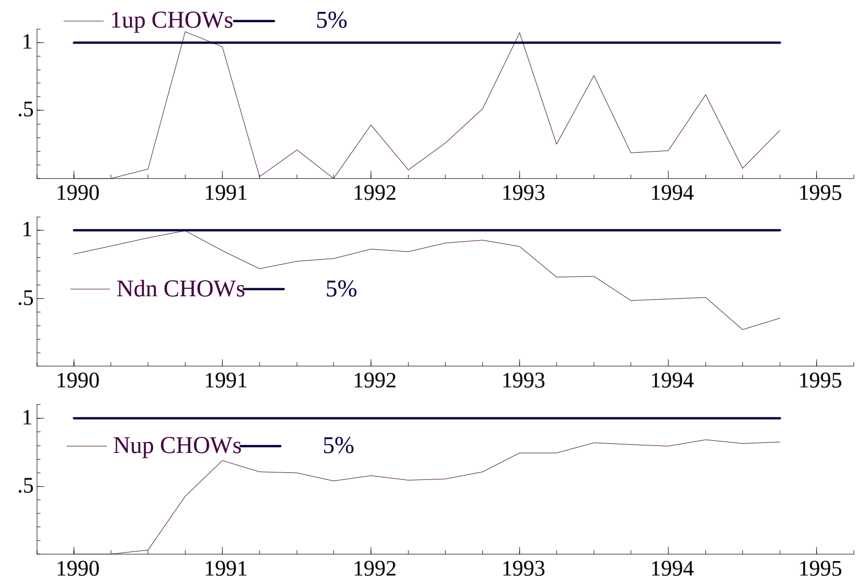


FIGURE C-3: Exports for Germany: Chow Tests for the ECM Coefficients

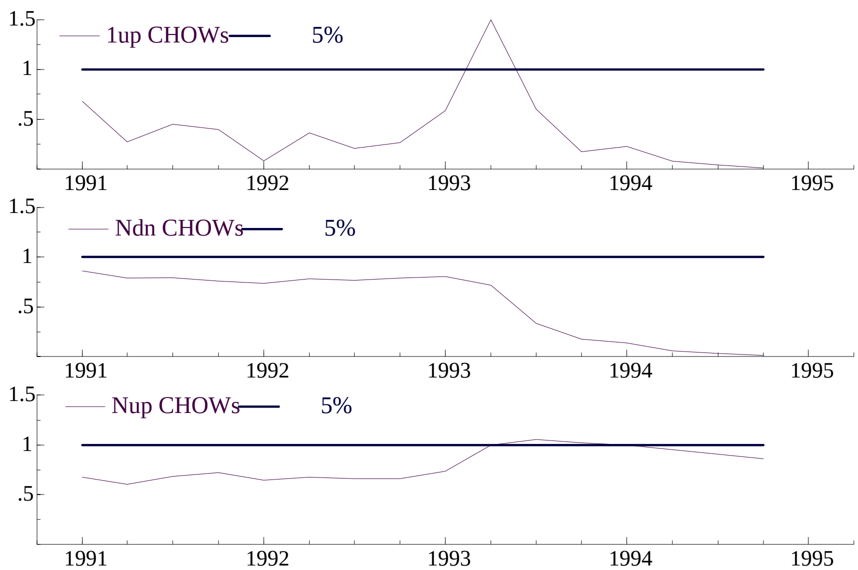


FIGURE C-4: Exports for Italy: Chow Tests for the ECM Coefficients

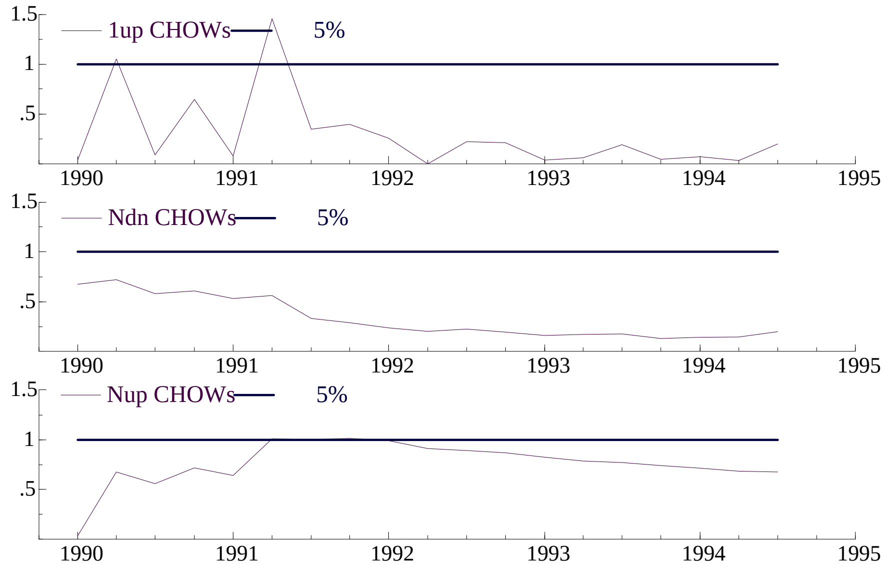


FIGURE C-5: Exports for Japan: Chow Tests for the ECM Coefficients

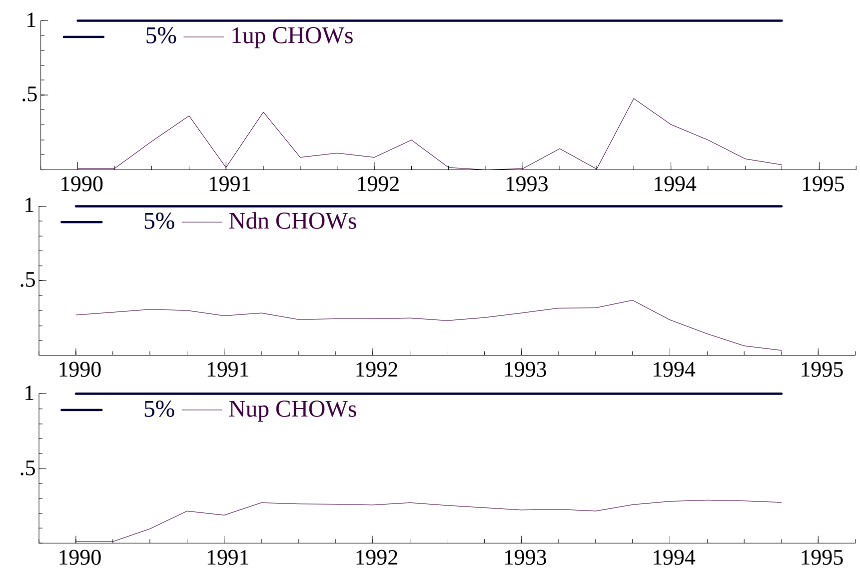


FIGURE C-6: Exports for the U.K.: Chow Tests for the ECM Coefficients

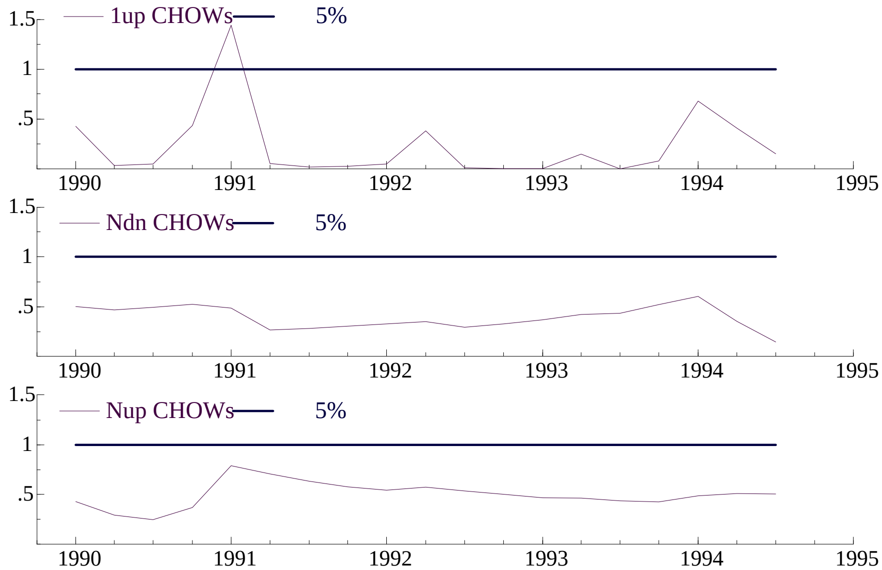


FIGURE C-7: Exports for the U.S.: Chow Tests for the ECM Coefficients

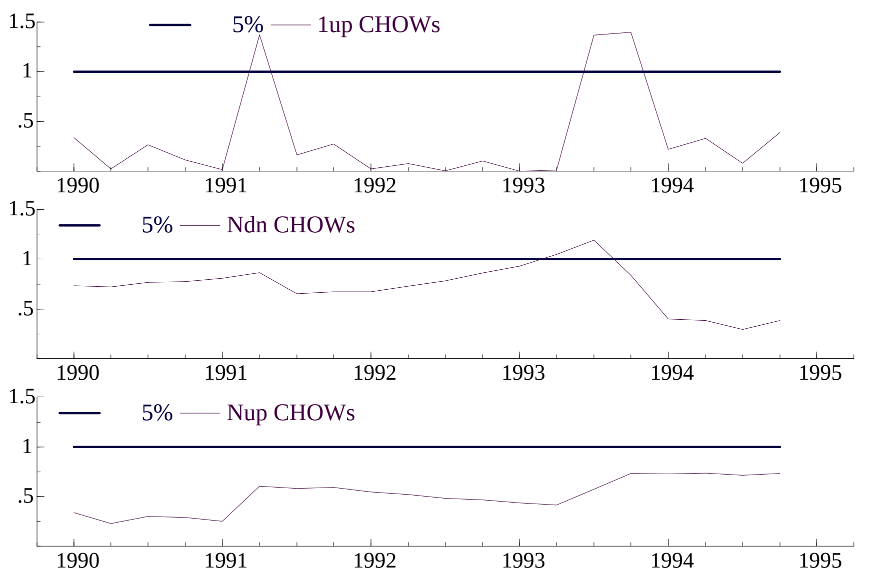


FIGURE C-8: Exports for Canada: Predictive Accuracy of the Error-Correction

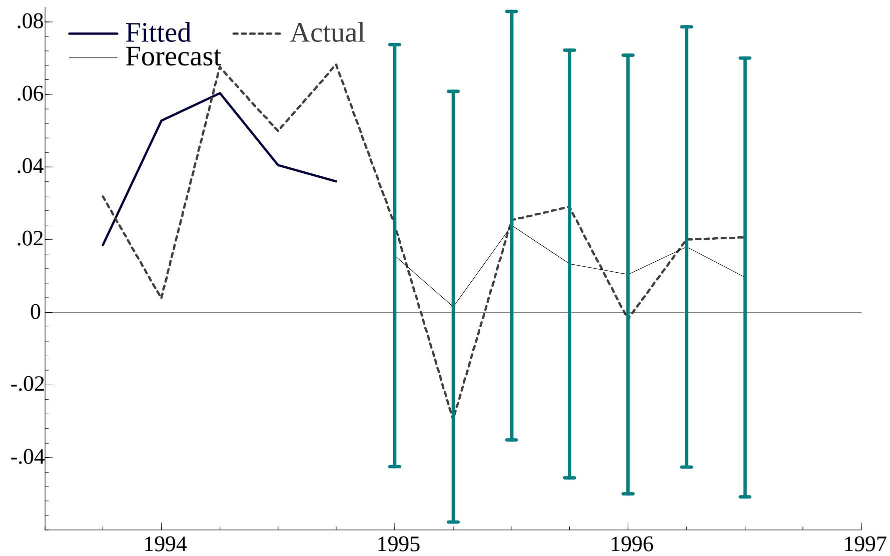


FIGURE C-9: Exports for France: Predictive Accuracy of the Error-Correction

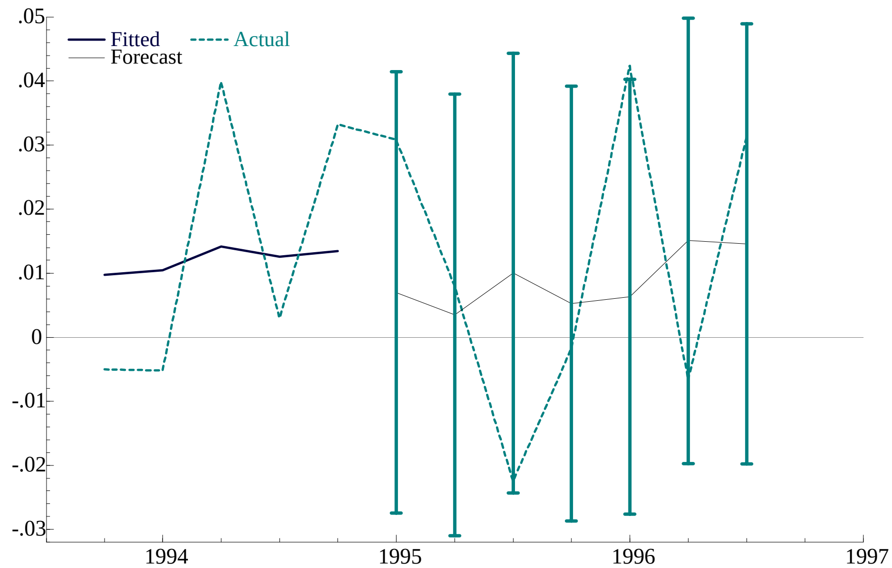


FIGURE C-10: Exports for Germany Predictive Accuracy of the Error-Correction Model

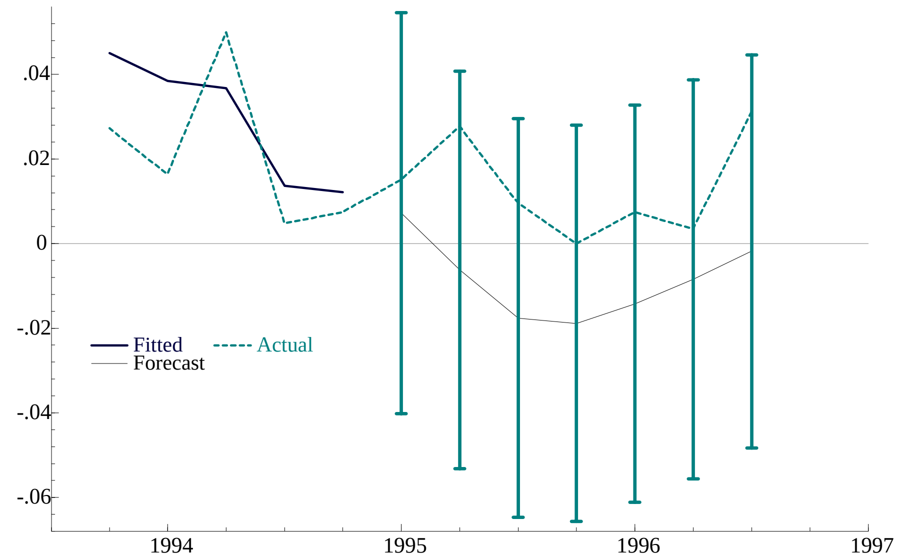


FIGURE C-11: Exports for Italy: Predictive Accuracy of the Error-Correction Model

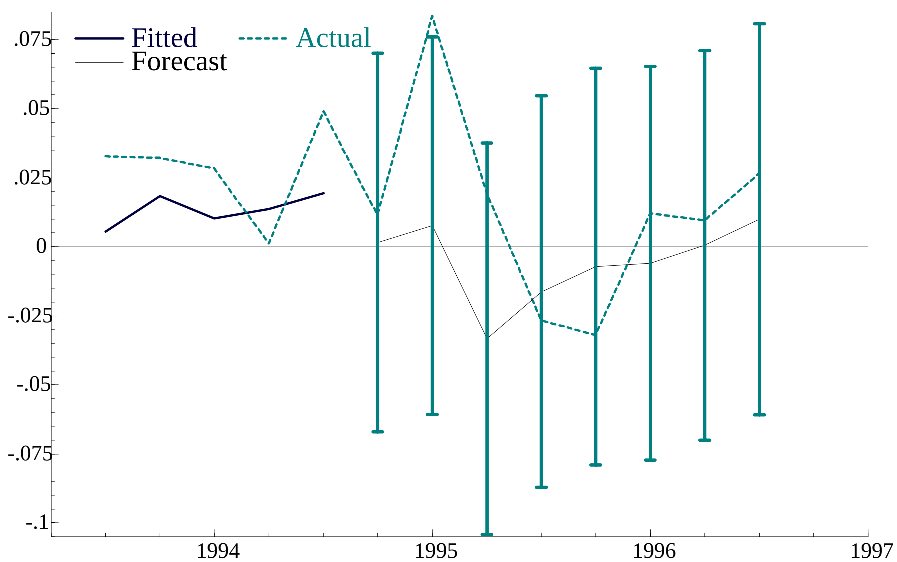


FIGURE C-12: Exports for Japan: Predictive Accuracy of the Error-Correction Model

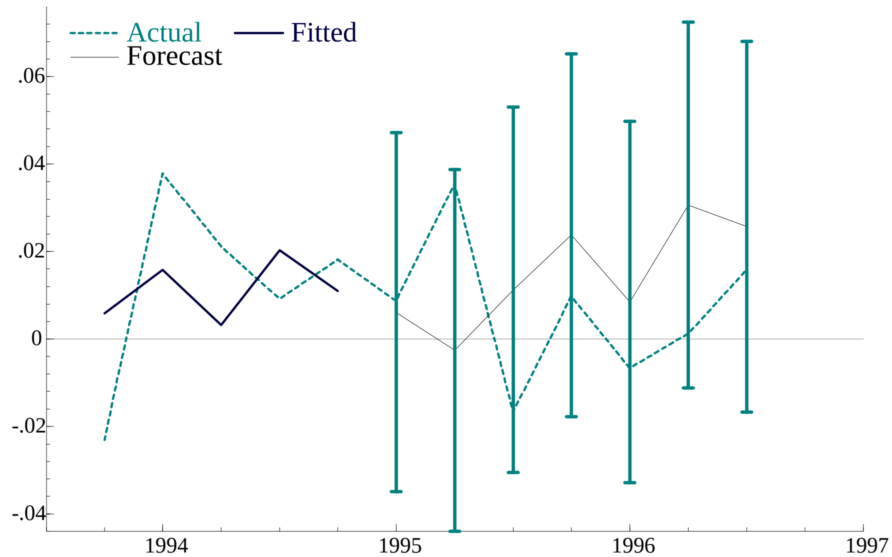


FIGURE C-13: Exports for the U.K.: Predictive Accuracy of the Error-Correction Model

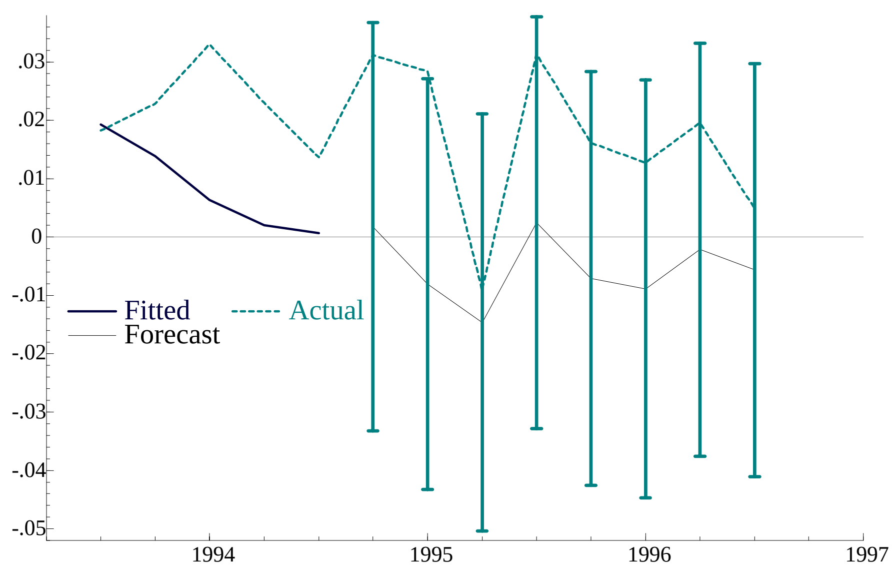
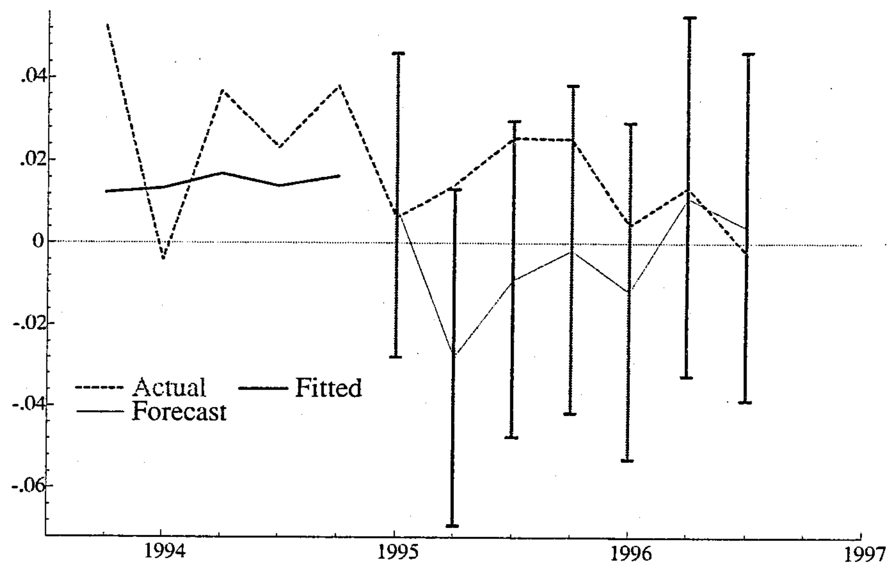


FIGURE C-14: Exports for the U.S. Predictive Accuracy of the Error-Correction Model



Imports

Estimation. Table C-2 shows, for imports, that all the coefficients have their expected signs and that countries differ markedly in their estimated adjustment speeds, which range from 2 percent per quarter (United Kingdom) to 36 percent per quarter (Italy). The error-correction coefficient is significant for all countries, except the United States, a finding that weakens the evidence on cointegration. The formulations differ in their ability to explain the variability of the growth rate of imports, which ranged from 23 percent for the United Kingdom to 67 percent for France. Finally, the empirical distributions of the residuals satisfy the assumptions maintained for estimation (serial independence, homoscedasticity, normality), except for Canada (normality) and the United Kingdom (homoscedasticity and normality).

Some formulations include dummy variables: Canada includes a dummy variable for NAFTA that takes a value of 1 starting in 1994:1; Germany (1993:1) includes a variable for the ERM crisis; Japan (1972:1; 1989:1) and the United Kingdom (1972:4; 1975:2; 1979:4) include a variable for oil-price shocks; and the United States (1969:1&2; 1972:1&2; 1974:2) includes variables for dock strikes and price controls.

price shocks; and the United States (1969:1&2; 1972:1&2; 1974:2) includes variables for dock strikes and price controls.

Parameter stability. Figures C-15 through C-21 show Chow tests for imports pointing to a remarkable degree of parameter constancy across countries.

Ex post predictions. Figures C-22 through C-28 show the 95 percent confidence intervals for the models' one-step-ahead predictions for imports for 1995-1996. Except for Japan in 1995:2, the actual values for these predictions fall within the 95 percent confidence intervals. Predictions for Canada and France, however, understate the growth rates for imports.

TABLE C-2

Imports: Parameter Estimates of the Error-Correction Model

	Can	Fra	Ger	Ita	Jap	U.K.	U.S.
Income	1.26	1.65	0.99	1.01	1.00	1.01	2.31
	(0.21)	(0.40)	(0.25)	(0.37)	(0.37)	(0.30)	(0.30)
Price	-0.14	-0.06	-0.17	-	-0.05	-	-0.55
	(0.16)	(0.14)	(0.08)		(0.09)		(0.14)
ECM	-0.11	-0.34	-0.10	-0.36	-0.04	-0.02	-0.04
	(0.04)	(0.07)	(0.02)	(0.06)	(0.02)	(0.01)	(0.03)
R^2	0.44	0.67	0.49	0.42	0.52	0.23	0.63
SER	2.77	1.63	2.32	3.02	2.91	2.91	2.48
Serial correl'tn	0.97	0.21	0.42	0.08	0.28	0.05	0.30
Homoscedas'ty	0.79	0.24	0.83	0.56	0.21	0.02*	0.08
Normality	0.01*	0.74	0.96	0.34	0.57	0.00*	0.12
Functonal form	0.38	0.51	0.02*	0.04*	0.09	0.78	0.35
Start sample	61.2	71.3	68.3	70.3	56.4	55.4	60.3

Note: Standard errors are in parentheses; * denotes statistical significance at the 5 percent level.

FIGURE C-15: Imports for Canada: Chow Tests for the ECM Coefficients

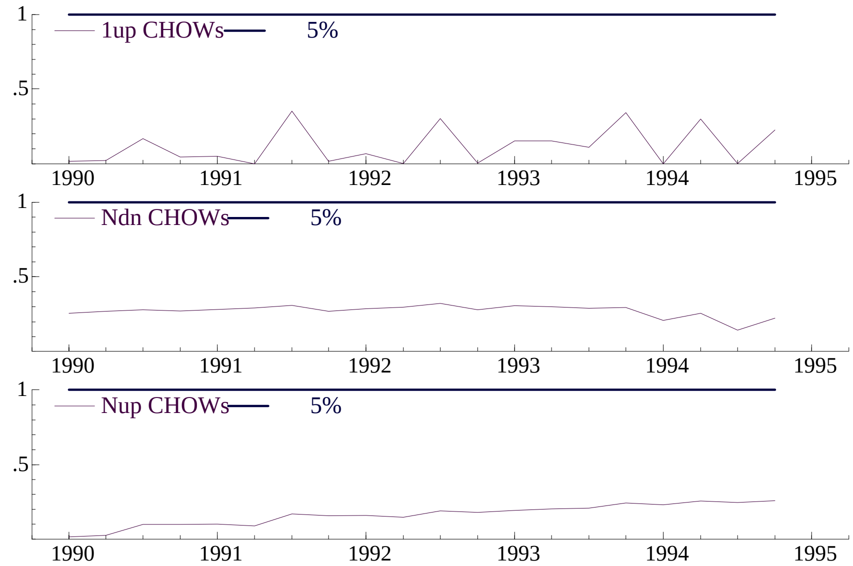


FIGURE C-16: Imports for France: Chow Tests for the ECM Coefficients

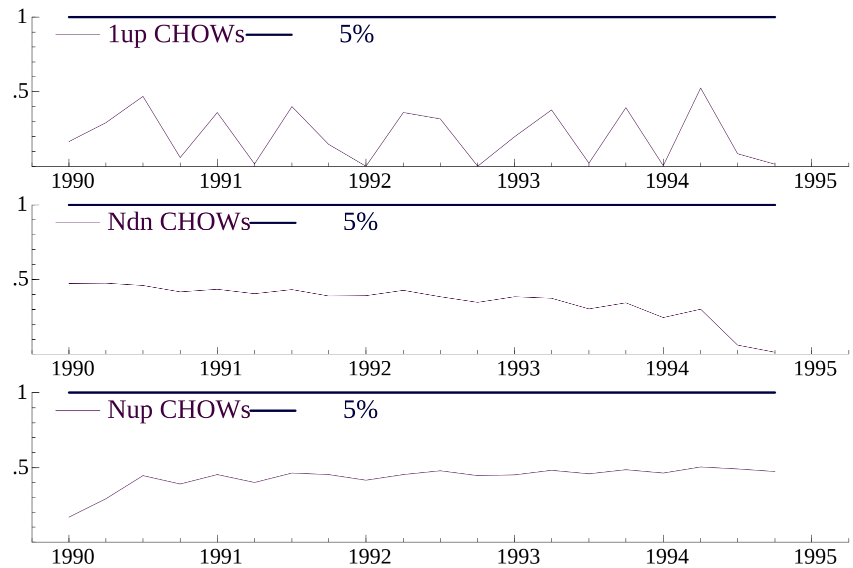


FIGURE C-17: Imports for Germany: Chow Tests for the ECM Coefficients

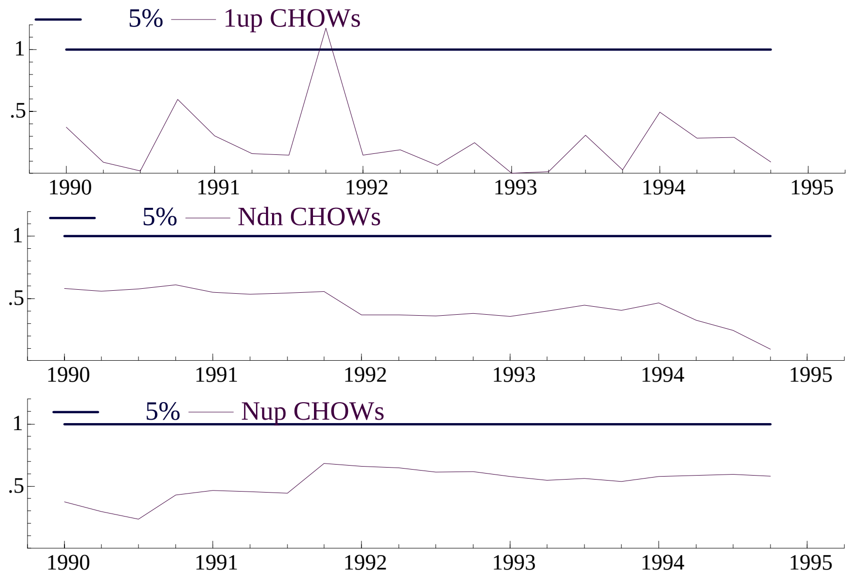


FIGURE C-18: Imports for Italy: Chow Tests for the ECM Coefficients

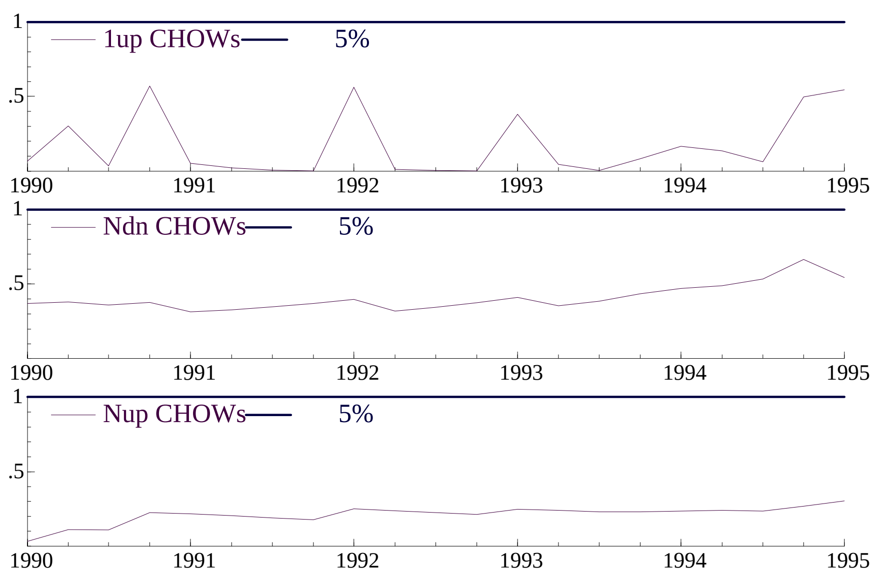


FIGURE C-19: Imports for Japan: Chow Tests for the ECM Coefficients

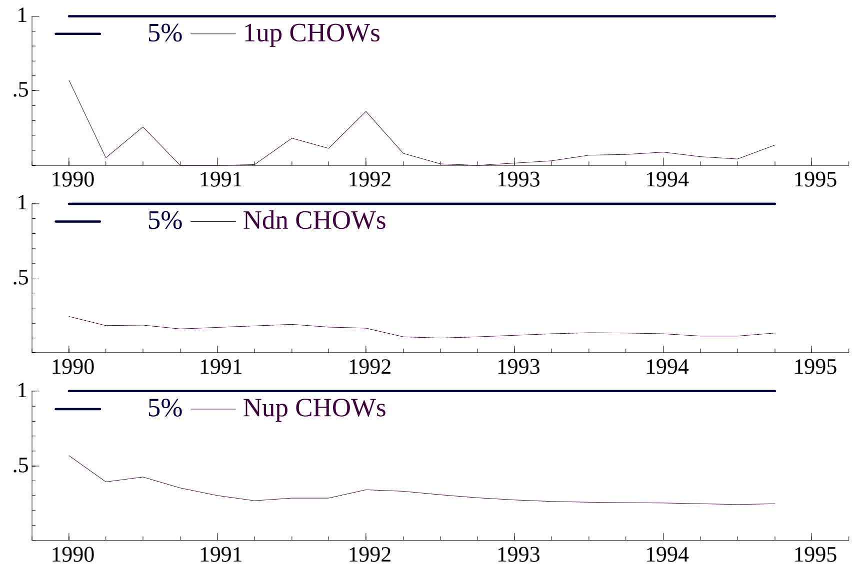


FIGURE C-20: Imports for the U.K.: Chow Tests for the ECM Coefficients

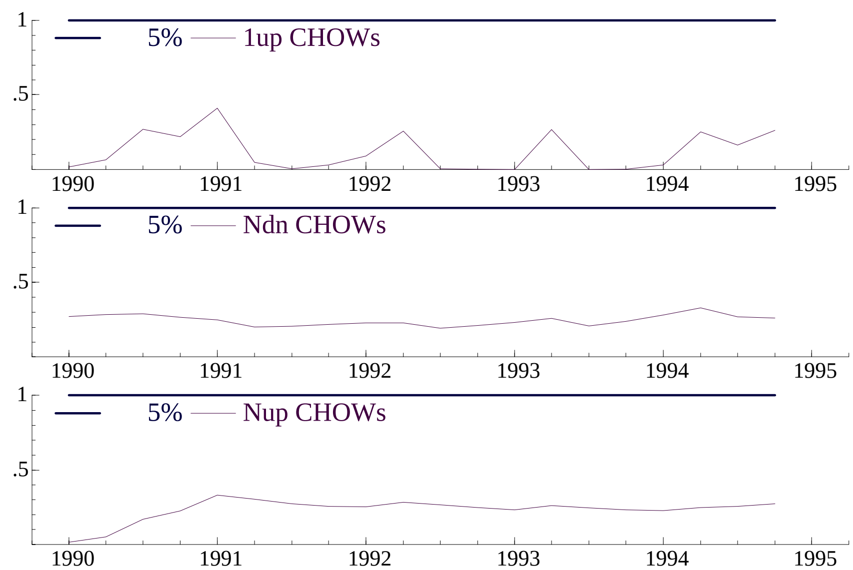


FIGURE C-21: Imports for the U.S.: Chow Tests for the ECM Coefficients

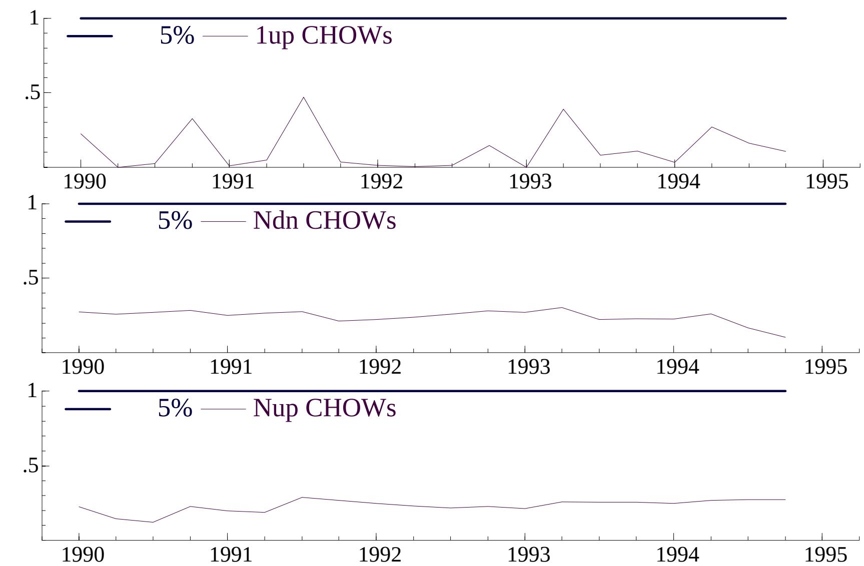


FIGURE C-22: Imports for Canada: Predictive Accuracy of the Error-Correction Model

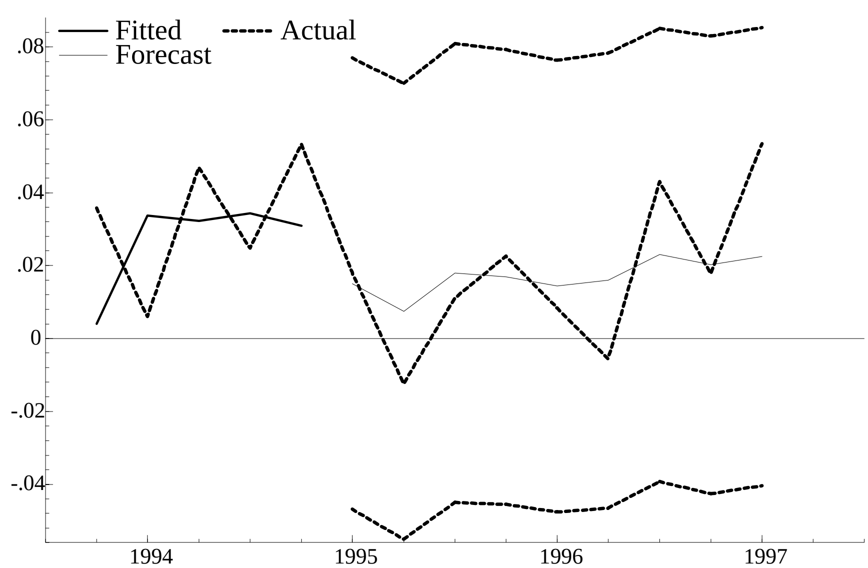


FIGURE C-23: Imports for France: Predictive Accuracy of the Error-Correction Model

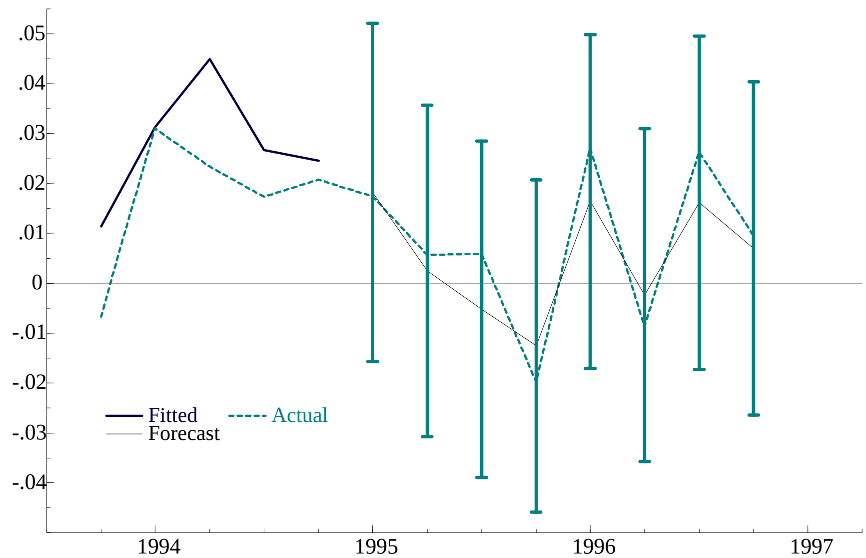


FIGURE C-24: Imports for Germany: Predictive Accuracy of the Error-Correction Model

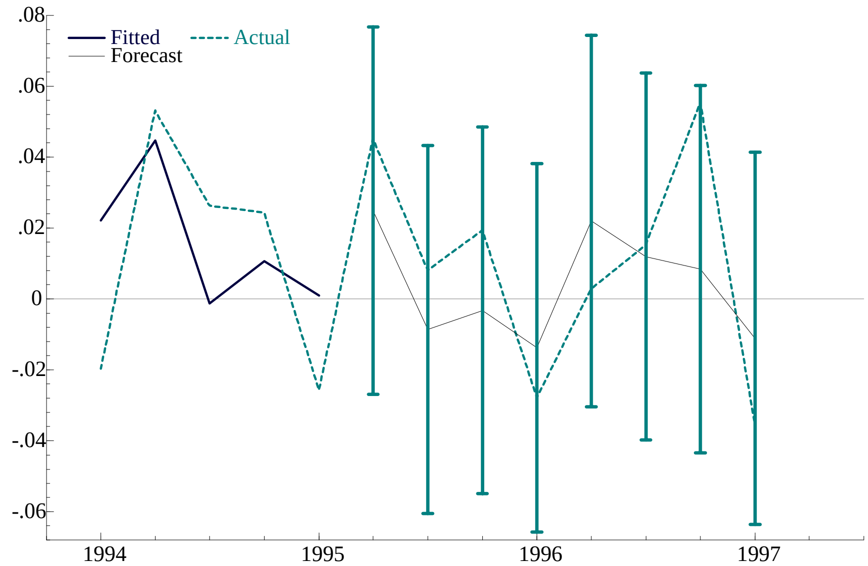


FIGURE C-25: Imports for Italy: Predictive Accuracy of the Error-Correction Model

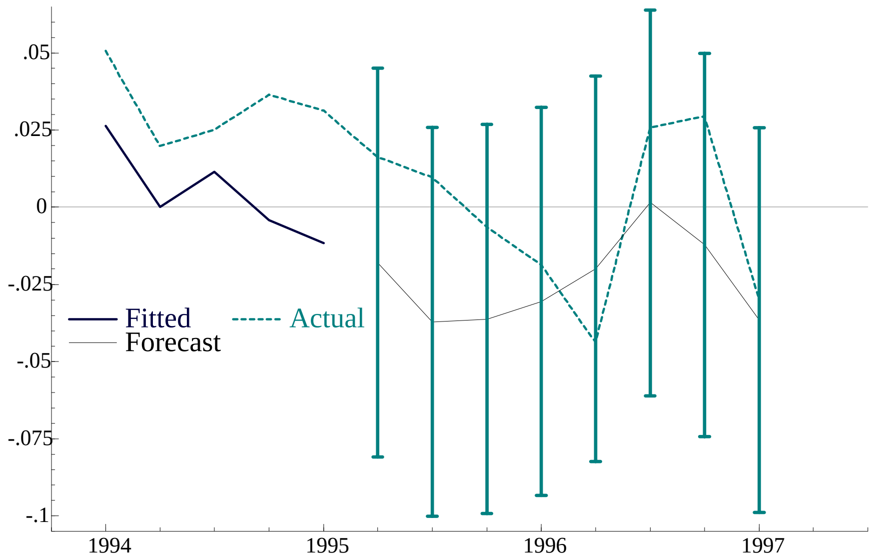


FIGURE C-26: Imports for Japan: Predictive Accuracy of the Error-Correction Model

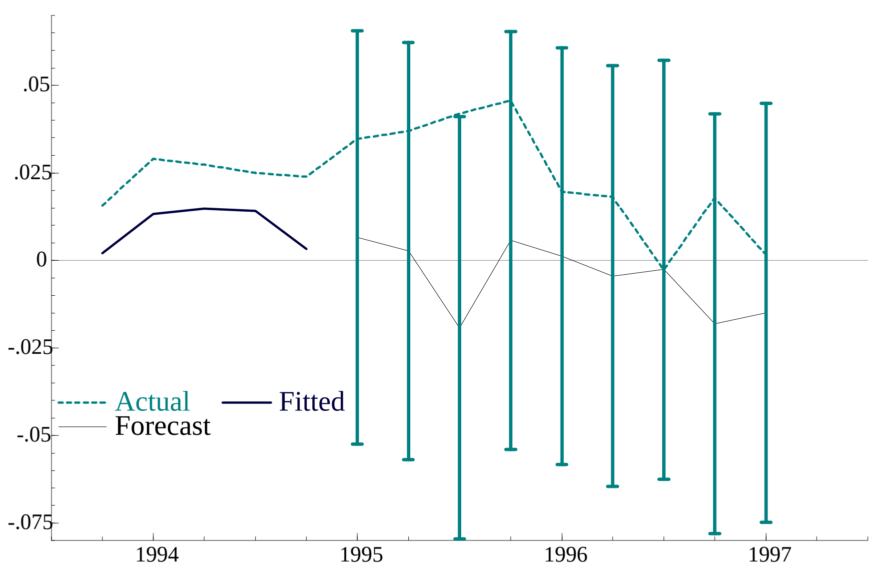


FIGURE C-27: Imports for the U.K.: Predictive Accuracy of the Error-Correction Model

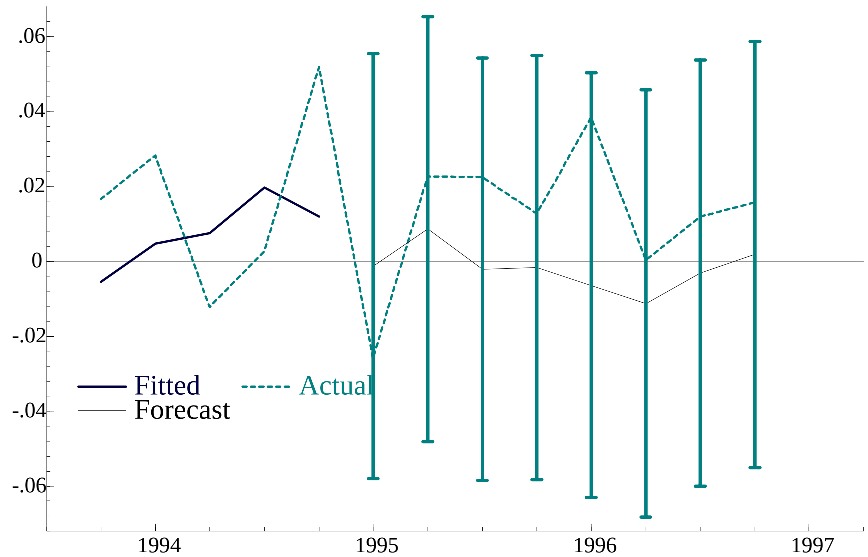
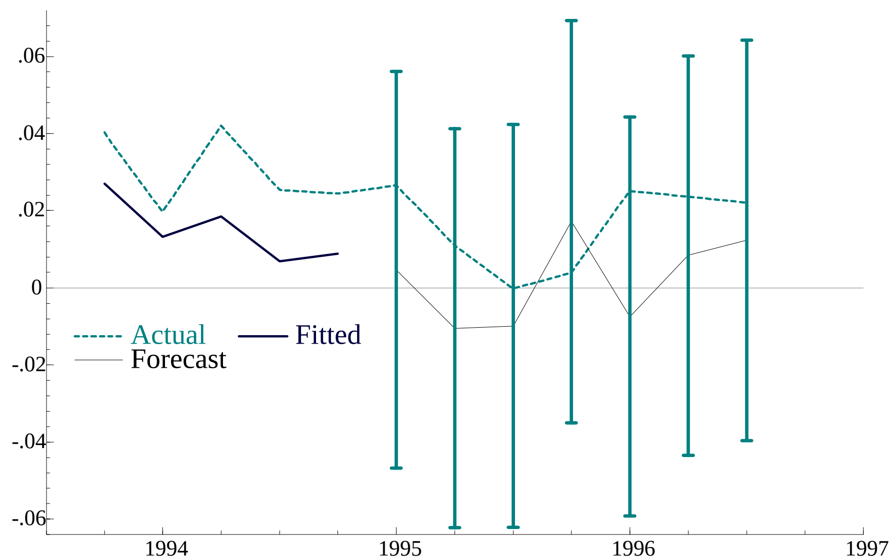


FIGURE C-28: Imports for the U.S.: Predictive Accuracy of the Error-Correction Model



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STUDIES are devoted to new research in international economics, with preference given to empirical work. They should be comparable in originality and technical proficiency to papers published in leading economic journals. They should be of medium length, longer than a journal article but shorter than a book.

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