

Unanticipated Exchange Rate Risk And U. S. Imports

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Abstract

The effect of exchange rate risk on trade is one of the more controversial issues in international trade. This paper uses cointegration and error-correction approach to investigate the relationship between unanticipated exchange rate risk and U.S. imports over the period 1974:1-1992:4. The major finding of this study is that the exchange rate risk has a significant negative impact on U.S. imports.

Introduction

Exchange rates of industrial countries have been highly volatile since the move to flexible exchange rate in the early 1970s. The major concern about the exchange rate volatility is that it increases risk and uncertainty and thereby hampers trade and capital flows. However, despite a large body of literature, no consensus has been reached.

Hooper and Kohlhagen (1978) analyzed the bilateral trade among the major industrial countries during the 1955-1975 period and found that the exchange rate risk had a negative impact on export prices. Cushman (1983) studied the effect of real exchange rate risk on the U.S. and German bilateral trade. His results provide some support for the negative effect of real exchange rate risk on trade flows. Akhtar and Hilton (1984) examined the impact of exchange rate risk on manufacturing trade for the U.S. and Germany. They found that the exchange rate risk measured by the standard deviation of nominal effective exchange rate significantly reduced German imports and exports and U.S. exports. By modifying Akhtar and Hilton's model, and including more countries, Gotur (1985) found mixed results. His overall results, however, suggest that the exchange rate risk does not significantly influence trade. Similar results were also found by Bailey *et al* (1986). Maskus (1990) examined the sectoral effect of exchange rate risk across major sectors of international trade. His results show that the exchange rate risk has negative impact on trade. He also found that aggregate bilateral agricultural trade is more sensitive to exchange rate risk than the manufacturing sector.

More recent developments in economic theory challenge the common conclusion that the exchange rate risk causes reduction in trade volume. For example Giovannini (1988), Perce and Steinherr (1989), and De Grauwe (1988) argue that when financial markets do not

display any significant degree of risk aversion, exchange rate risk need not necessarily lead firms to restrict supply. In fact, an increase in uncertainty could be accompanied by an increase in expected return such that some individuals would prefer the more uncertain but also more rewarding situation. In this case an increase in exchange rate risk may increase the volume of exports. Some empirical evidence on the positive effect of exchange risk on trade is found in Cushman (1983) and Klein (1990).

Overall, the empirical results seem to be quite contradictory, but tend in general to point out there is no systematic significant relationship between exchange rate variability and trade flows. One possible reason for the inconsistent results is that a poorly specified international trade equation could yield, for example, spurious inferences on the underlying relationship between exchange rate risk and trade. It is common to specify trade model in log level form. The log level form has often been criticized on the grounds that the levels of many economic variables in trade models are non-stationary. Therefore, the regression equation that relates such variables could be subject to spurious regression, a phenomenon described in Granger and Newbold (1974), Nelson and Plosser (1982), Meese and Singleton (1982) and Blake (1991).

Since there are potential problems with models specified in log level form, some analysts suggest using the theories of error-correction and cointegration. In this approach, a long run equilibrium equation (cointegrating regression) is first fit to the levels of the variables, and the calculated residuals from that model are used in an error correction model which specify the systems short run dynamics.

In this paper we examine the relationship between

real exchange rate risk and U.S. imports. Because traders can insure against expected component of risk, we examined the effect of unanticipated component of risk. A simple autoregressive model is used to forecast the real exchange rate and the moving standard deviation of the forecast error is used as a proxy for exchange rate risk. Because real trade flows are presumably influenced by real exchange rate, we follow Cushman (1983) and Kenen and Rodrick (1986) in using real exchange rate risk as opposed to nominal. The remainder of the paper is outlined as follows: Section II discusses an empirical methodology, Section III presents estimation results and Section IV presents summary and conclusion.

The Model

Consider the long run relationship of import volume with real exchange rate, real income and real exchange rate risk posited in equation 1 below:

$$\ln M_t = \beta_0 + \beta_1 \ln y_t + \beta_2 \ln e_t + \beta_3 \ln s_t + u_t \tag{1}$$

Where M is imports volume, y = real income, e = real exchange rate, s = exchange rate risk and u is an error term. The symbol ln denotes the natural logarithm. Quarterly data over 1974:1-1992:4 are used to carry our investigation. All data comes from the International Monetary Fund, International Financial Statistics data base. Before we go into the estimation, the time series properties of the variables in equation 1 should be examined. We need to ensure that the macroeconomic variables used to estimate the equation are stationary, individually or jointly cointegrated. To determine whether macroeconomic time series is stationary, we use a unit root test developed by Fuller (1976) and Dickey and Fuller (1981). The Dickey-Fuller test (DF) entails the estimation of the following regression.

$$\Delta Z_t = \alpha_0 + \alpha_1 T + \alpha_2 Z_{t-1} + \epsilon_t \tag{2}$$

Where Z is the relevant time series D is the first difference operator, T is a linear trend and ϵ_t is normally distributed error term. If in equation 2, ϵ_t is not white noise and therefore serially correlated, Dickey-Fuller have suggested Augmented Dickey-Fuller test (ADF) given by:

$$\Delta Z_t = \alpha_0 + \alpha_1 T + \alpha_2 Z_{t-1} + \sum_{j=1}^k \delta_j \Delta Z_{t-j} + v_t \tag{3}$$

The absence of a unit root would imply that the estimated coefficient α_2 is significantly below zero.

After performing the unit root test for each time series, equation 1 should be estimated to test for a unit root in the residual u, in equation 1. If the DF or ADF tests confirm that the residual series does not have a unit root, while the dependent and the independent variables each in equation 1 have a unit root, then the variables are said to form cointegrated set. The findings of cointegration implies that these variables in the model do not wander far away from their long-run equilibrium path as implied by the economic theory.

The existence of cointegrated relationship in the long run also implies that the residuals from equation 1 can be used as an error correction model (Engel and Granger, 1987; Hall, 1986). If the random disturbance term, u_t in the long run equation is stationary then the import model can be estimated in two steps: In the first step, a prior level regression is estimated which allows the hypothesis of cointegration to be tested. In the second step, the residual from this regression are entered into a dynamic error specification of the form: Where all the variables are defined above and e_t is a short run random disturbance term and u_{t-1} is the lagged value of the long run random disturbance from equation 1 and the parameter λ that appear on u_{t-1} in equation 4

$$\Delta M_t = a_1 + \sum_{i=1}^n \beta \Delta M_{t-i} + \sum_{i=0}^n \delta_i \Delta y_{t-1} + \sum_{i=0}^n \gamma_i \Delta e_{t-i} + \sum_{i=0}^n \omega_i \Delta s_{t-i} + \lambda u_{t-1} + \epsilon_t \tag{4}$$

is the error correction coefficient.

Empirical Results

Before we go into detail we check the time series properties of the variables of the model based on (Engel and Granger, 1987). This is necessary because if the variables are nonstationary (i.e.; they have unit roots) as well as cointegrated, model one would be misspecified resulting in misleading values of R², F and t-statistics in OLS regression of M_t on the explanatory variables. ADF test is carried out to see if M_t, Y_t, e_t and S_t are I(1) against the alternative that they are I(0). The relevant test estimates are in Table 1. The critical values at 1% and 5% level are -3.51 and -2.89, respectively (Fuller, 1976). Thus the null hypothesis that M, Y, e and s are I(1) are accepted.

Next we test whether M_t, Y_t, e_t, and s_t are cointegrated. We consider ADF and CRDW (Cointegrating Regression Durbin Watson) test. The estimated cointe-

Table 1
Unit Root Tests

Variable	ADF
M_t	-1.777
Y_t	-2.067
e_t	-0.178
st	-2.765
ΔM_t	-4.378
ΔY_t	-5.438
Δe_t	-5.572
ΔS_t	-7.242

gration regression is

$$M_t = -53.00 + 3.60 \ln Y_t + 0.319 \ln e_t + 0.0224 s_t \\ (-24.62) \quad (32.35) \quad (4.29) \quad (1.01)$$

$$\bar{R}^2 = 0.95 \quad CRDW = 0.336 \quad ADF = -3.1 \quad (5)$$

shown in equation 5. The relevant estimated test statistics are -3.1 and 0.336. The critical values for ADF at 5 and 10% are -3.13 and -2.82, and for the CRDW the critical values are 0.367 and 0.308 (Granger and Newbold, 1986). Thus we reject the null hypothesis of no cointegratedness between M , Y , e , and s . This implies that there exists an error correction model to which we now turn.

The results of an error correction model is reported in Table 2. The major decision in the ECM is the choice of lag length. Because of the complexity of dynamic relationships, the order of the lag structure of the ECM's may be complicated (Engel and Granger, 1987). To find the lag length, we follow Hendry (1991) in using general to specific modeling strategy is followed. Since the data are quarterly, four lags of each variable were included in the first version of the model first, and then simplified the representation by eliminating the lags with insignificant parameters. An encouraging aspect of our result is that the error correction term (u_{t-1}) in ECM appears with the expected negative coefficient which is significantly different from zero at 5 percent level. This is an important finding and supports the acceptance of cointegration established above. Therefore, our empirical result suggests that an underlying

stationary relationship exists between real imports and the variables most often considered to be its most important determinants. In addition, our empirical results suggest that first differencing of all variables is not merely warranted but also necessary for establishing reliable hypothesis tests.

All estimated coefficients are statistically significant and have the expected theoretical signs. While the coefficients indicate large immediate response to income and exchange rate, the negative coefficient of ECT ensures the long run equilibrium. The adjustment towards equilibrium is not instantaneous. Only 17 percent of any quarter deviation from equilibrium is incorporated into the next quarter growth rates.

Conclusion

Most of the previous time series attempts which test the effect of exchange rate risk on trade have used log levels of variables. In most cases, however, the studies have tended to ignore recent specification suggestions such as testing for data stationarity. The recent evidence has shown that estimating regression using non-stationary variables yield spurious economic relationships and the variables of the model do not return to their original trend following a shock to the system.

This paper presents evidence to support the findings that the relevant macroeconomic variables used in testing are individually non-stationary, together these variables form a cointegrating set and hence they do not wander far from their long run equilibrium path.

Further, the results presented in this paper are consistent with the view that an increase in income and appreciation of the dollar tend to raise imports. The effect of an increase in exchange rate risk on trade, however, is negative, consistent with the view that exchange rate volatility adversely affects trade by raising risk and uncertainty.

Suggestions for Future Research

Evidence presented in this paper shows that exchange rate risk has a negative effect on U.S. imports. A future research might examine the relationship between exchange rate risk and trade for a number of countries in the context of cointegration and error-correction modelling. It would also be interesting to see if various proxies of exchange rate risk make any difference in the results.

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Table 2
Error Correction Model

Variable	Lag	Coefficient	t-Value
Constant	0	0.0145	2.219
$\Delta \ln M_t$	1	-0.213	-1.861
$\Delta \ln Y_t$	0-1	2.475	2.64
$\Delta \ln e_t$	1	0.313	2.25
$\Delta \ln S_t$	1	-0.017	-1.96
u_{t-1}	1	-0.169	-2.251
R ² =0.318 DW = 1.988			

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