



Exchange Rate Volatility and Exports: The Case of Ireland

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1 Introduction

In recent years a significant volume of research has taken place in order to evaluate empirically the determinants of export demand in industrial countries. The literature can generally be divided into papers that use conventional estimation procedures and those that recognise the nonstationary nature of real exports and its determinants. Studies which can be grouped into the former category include Kenen and Rodrik (1986), Pozo (1992), Bailey, Tavlas, and Ulan (1986), while those included in the latter include Lastrapes and Koray (1990), Chowdhury (1993) and Arize (1995). Chowdhury (1993) and Arize (1995) also use cointegration and error-correction models (ECM) to estimate a long-run and a short-run export demand function.¹

The motivation for estimating the Irish export demand function derives from the recent extraordinary growth in the share of Irish exports in GDP. Most empirical studies of the determinants of Irish exports have used traditional estimation techniques (e.g., O'Connell (1978), Browne (1982), Lynch (1983) and Flynn (1984)) and, therefore, have not considered the integration properties of the time series involved in the analysis. Browne (1982) sees exports in a small open economy as being primarily driven by supply-side considerations, while Lynch (1983) includes both supply and demand side factors in order to get a more complete picture of exports. The general conclusion of the above papers is that factors such as world income and measures of competitiveness are major determinants of Ireland's exports. Studies which use more advanced estimation techniques include Caporale and Chui (1995) and McGettigan and Nugent (1995). As opposed to previous studies on Ireland, Caporale and Chui (1995) and McGettigan and Nugent (1995) recognise the non-stationary nature of exports and its determinants. Both papers obtain estimates of the income elasticity of exports between 1.7 and 3.6, and the relative price elasticity between -0.34 and -7.58 .

The present paper improves on previous studies that have estimated Irish export demand functions in several ways. First, we recognize that exports and its determinants are potentially non-stationary variables and estimate a demand function for Irish exports to the UK, the most important market for Irish exports, since the launch of the EMS (March 1979). Second, in contrast to all other studies, we include a measure of exchange rate volatility to investigate the effect of such movement on exports. This choice is justified by the increasing volatility in the sterling/Irish pound exchange rate following the break up of the one-to-one link between the two currencies at the outset of the EMS. Finally, both long-run and short-run export demand functions are estimated, through the use of the

¹A survey of the literature on exchange rate volatility and trade may be found in Cote (1994).

econometric techniques of cointegration and ECMs.

The paper is structured as follows: section 2 provides the theoretical background, section 3 discusses very briefly the econometric methodology and section 4 reports our results. Finally, section 5 concludes the paper.

2 Theory

Drawing on previous papers (Arize, 1995; Chowdhury, 1993), we can define the long-run demand function for exports as follows

$$\ln X_t = \beta_0 + \beta_1 \ln Y_t + \beta_2 \ln P_t + \beta_3 V_t \quad (1)$$

where X_t = real exports

Y_t = real foreign income

P_t = relative price (a measure of competitiveness)

V_t = exchange rate volatility

Economic theory would suggest that the income level of the trading partners of the domestic country and a measure of competitiveness between a particular country and its major trading partners should be included in an export demand function. Finally, a measure of exchange rate volatility would also be included in an export demand function. Traditional trade theory would suggest that exchange rate volatility would depress trade because exporters would view it as an increase in the uncertainty of profits on international transactions, under the assumption of risk aversion.² The theoretical arguments that exchange rate volatility actually might benefit trade are examined by DeGrauwe (1988), Franke (1991), Giovannini (1988), and Sercu and Vanhulle (1992). Hence, the sign of β_3 is ambiguous from a theoretical point of view.

²Although forward markets can be used for hedging purposes there are limitations and costs. For example, the size of contracts is large, the maturity is a multiple of 30 days, and it is difficult for trading firms to plan the magnitude and timing of all their international transactions to avail of the forward contracts.

3 Econometric Methodology

In this paper cointegration analysis is used to test for a long-run export demand function of Irish exports to the UK. Tests for cointegration require nonstationary time series of the same order of integration. Therefore, we first test for the presence of a unit root in both the level and the first difference of the four variables in equation 1, using the Dickey-Fuller (DF) and the Augmented Dickey-Fuller (ADF) tests (Fuller, 1976 and Dickey and Fuller, 1979). The method used to test for cointegration is the Johansen procedure introduced in Johansen (1988) and extended in Johansen and Juselius (1990). Provided that cointegration exists among our variables, the cointegrating vector is normalised on exports to give the long-run elasticities for export demand.

We also test for the short-run export demand equation using the ECM:

$$\begin{aligned} \Delta \ln X_t = & \alpha_0 + \alpha_1 R_{t-1} + \sum_{i=1}^n \gamma_i \Delta \ln X_{t-i} + \\ & \sum_{i=1}^n \delta_i \Delta \ln Y_{t-i} + \sum_{i=1}^n \epsilon_i \Delta \ln P_{t-i} + \sum_{i=1}^n \theta_i \Delta V_{t-i} + e_t \end{aligned} \quad (2)$$

If our variables are cointegrated, then the ECM will be of the above form, where R_{t-1} is the error-correction term (i.e., the lagged residual from the cointegrating regression).

4 Data and Empirical Results

4.1 Data and the exchange rate volatility proxy

Our sample covers the period 1979Q2–1993Q3. We start the sample in the second quarter of 1979 since our objective is to estimate the long-run and short-run demand function for Ireland's exports to the UK since the beginning of the EMS (March 1979) that coincided with increasing volatility in the (sterling/Irish pound) exchange rate. The export variable is taken from the Trade Statistics series of the Central Statistics Office (CSO) publication, and was divided by Ireland's unit export value to obtain the real exports figure. Our first explanatory variable in the export demand function is foreign income. It is proxied by the quarterly GDP data of the UK that was obtained from the International Financial Statistics (IFS) tape, and was then converted to a common currency (Irish

pound). The exchange rate was obtained from the Bulletin of the Irish Central Bank. The second right-hand side variable in equation (1) is the measure of competitiveness. It is defined as the ratio of the Irish unit export value to that of the UK, denominated in Irish pounds. Data on the export unit value for both countries was again obtained from the IFS tape. Finally, as a measure of exchange rate volatility, we use the moving standard deviation of the growth rate of the real exchange rate:

$$V_t = \left[(1/m) \sum_{i=1}^m (\ln Z_{t+i-1} - \ln Z_{t+i-2})^2 \right]^{\frac{1}{2}} \quad (3)$$

where Z is the real exchange rate and m , the order of the moving average, is set equal to 8.³ The real exchange rate is calculated by the ratio of the relative prices (unit export values) multiplied by the sterling exchange rate. This measure of exchange rate volatility is adopted by Kenen and Rodrik (1986), Koray and Lastrapes (1989) and Chowdhury (1993).

4.2 Results

The first step in our analysis is to establish the order of integration of the variables in equation (1). This is done using the DF and the ADF tests including up to four lagged differences. The unit root test results, both with and without a trend, are shown in Table 1. We choose the order of the ADF test, k , as the minimum lag for white errors in the unit root regression. As can be seen all variables are integrated of order one, $I(1)$. We can now proceed to the cointegration tests. The results are shown in Table 2. The appropriate lag in the Vector Autoregression (VAR) was chosen on the basis of the minimum lag for robust results. Both tests, maximum eigenvalue and trace, indicate one cointegrating vector. The cointegrating vector (normalised on exports) and the likelihood ratio tests of the significance of the estimated coefficients are reported in Table 3. Both income and relative prices have the appropriate signs and are statistically significant, while the elasticities are larger than what previous studies found for overall Irish exports. The higher elasticities may be due to the fact that the UK is the most important trading partner for Ireland. Our measure of volatility has a positive sign, however, the likelihood ratio test indicates that this coefficient is statistically insignificant.

Finally, the short-run export demand function was estimated using an ECM and

³The export demand function was also estimated when $m = 4$ in the construction of the volatility measure. The results were consistent with those outlined in the next section.

the results are shown in Table 4. Only the most significant lagged differenced terms are included in the model. The error-correction term has a positive sign, which indicates that exports do not restore the long-run equilibrium. A possible explanation for the positive sign is that multinational corporations (MNCs), which make up a large part of Irish exporters, are price setters and so the adjustment towards long-run equilibrium most likely takes place through the competitiveness measure and not exports.⁴ Both income and relative prices have the appropriate sign. The fact that the relative price coefficient is larger than the income coefficient indicates that Irish exports to the UK are more responsive to changes in relative prices than to changes in income in the UK. Finally, and most important, we find that our measure of volatility has a negative sign and is statistically significant. This shows that, in the short-run, exchange rate volatility has a negative effect on Irish exports to the UK. This result carries an important policy implication. A future European monetary union that would possibly include both Ireland and the UK would eliminate all uncertainty associated with bilateral exchange rate changes and, therefore, boost Irish exports to the UK.

5 Conclusion

The paper uses the modern econometric techniques of nonstationary time series to estimate short run and long-run export demand functions for Ireland. We concentrate on Irish exports to the UK as they represent the most important component of Irish export activity. We find that the export volume is very sensitive to income and relative price changes, in particular in the long run. With respect to the influence of exchange rate volatility on exports, our results indicate that in the long run the influence is insignificant, but in the short run, exchange rate volatility and the associated uncertainty has a negative effect on real exports.

⁴It has been shown by Murphy (1994) and Walsh (1996) that a large percentage of growth in output and exports may be traced to the activities of MNCs.

Table 1: ADF(k) tests

Levels				
	τ_μ	k	τ_τ	k
$\ln X$	0.99	1	-2.27	1
$\ln Y$	-2.27	0	-2.42	0
$\ln P$	-2.09	0	-2.20	0
V	-2.39	0	-2.17	0
Differences				
	τ_μ	k	τ_τ	k
$\Delta \ln X$	-14.67*	0	-15.06*	0
$\Delta \ln Y$	-6.32*	0	-6.29*	0
$\Delta \ln P$	-6.59*	0	-6.54*	0
ΔV	-6.80*	0	-6.89*	0

Note: * denotes significance at 5%. τ_μ and τ_τ stand for the Dickey-Fuller test statistics for the no trend and trend model, respectively. The critical values given by *Microfit*, for the no trend and trend models are -2.91 and -3.49, respectively.

Table 2: Cointegration Test Results

$H_0 :$	Maximum Eigenvalue Test	Trace Test
$r = 0$	38.72*	54.21*
$r = 1$	11.22	15.50
$r = 2$	4.02	4.27
$r = 3$	0.26	0.26

Note: * denotes significance at 5%.

Note: The test statistic for the null $H_0 : \beta_i = 0$ for the equation $\ln X_t = \beta_1 \ln Y_t + \beta_2 \ln P_t + \beta_3 V_t$ has a $\chi^2(1)$ distribution under the null hypothesis. * denotes significance at the 5% level

Table 3: Cointegrating Vector and Likelihood Ratio Tests

Normalised Cointegrating Vector:

$$\ln X_t = 5.75 \ln Y_t - 4.73 \ln P_t + 7.44 V_t$$

Likelihood Ratio Tests:

H₀ : Statistic: $\chi^2(1)$

$\beta_1 = 0$ 25.44*

$\beta_2 = 0$ 24.98*

$\beta_3 = 0$ 0.93

Table 4: Regression Results for the Error-Correction Model

lag	$R(-1)$	$\Delta \ln X$	$\Delta \ln Y$	$\Delta \ln P$	ΔV	Summary Statistics
1	0.06 (3.13*)	-0.73 (-8.12*)		-0.55 (-2.58*)		$\bar{R}^2 = 0.60$ AR = 1.74 ARCH = 1.05
2			0.28 (1.34)		-2.93 (-2.32*)	

Note: Figures in parentheses are the t-statistics. * denotes significance at the 5% level. The LM(4) test statistic for autocorrelation (AR) and the LM(4) test statistic for autoregressive conditional heteroskedasticity (ARCH) are also reported.

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