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Does the Exchange Rate Regime Affect Export Volumes? Evidence from Bilateral Exports in the US-UK trade: 1900-1998

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Abstract

By utilizing the techniques of multivariate cointegration and error correction models, we investigate the impact of the different exchange-rate regimes that spanned the 20th century on the bilateral exports between the UK and the US over the last 98 years. Our results support two conclusions. First, fixed exchange-rate regimes and managed float exchange-rate regimes are equally conducive to trade. .Second, freely floating exchange-rate regimes are more conducive to trade than fixed exchange-rate regimes.

Keywords: exchange rate regime; exchange rate variability; trade volume

JEL Classification: F31, F33

Introduction

Even though the 20th century was marked by the adoption of a number of different exchange-rate regimes, the literature on the determinants of export demand focused almost exclusively on the relationship between exchange-rate volatility and volume of trade. In this voluminous literature the relationship between exchange-rate regime and trade volume has been practically ignored, with the exception of two studies, Brada and Mendez (1988) and Pozo (1992). This study attempts to remedy, at least partially, the imbalance in the existing literature by focusing on the impact of the different exchange-rate regimes that spanned the 20th century on the bilateral exports between the UK and the US. Specifically, by categorising the exchange-rate regimes of this century into three types, namely, fixed exchange-rate regime, managed-float exchange-rate regime, and freely-floating exchange-rate regime, we looked at how these regimes influenced the trade flows between the UK and the US over the last 98 years.

As already pointed out, the theoretical literature on the relationship between the exchange-rate regime and trade flows is rather limited. This literature is based on the impact of the regime on commercial policy and, therefore, trade flows. However, the direction of the link between the exchange-rate regime and trade flows is theoretically ambiguous. One strand that favours fixed-rate regimes argues that flexible exchange rates influence trade adversely on two grounds. First, flexible exchange-rate regimes lead to higher exchange-rate volatility which, in turn, depresses trade. Second, flexible exchange-rate regimes reduce the volume of trade by inducing governments to impose trade barriers in order to prevent the destabilising effects of volatile exchange rates. The second strand in the literature is identified with the proponents of flexible exchange rates and claims that a fixed-exchange rate regime also restricts

trade because it limits the available adjustment mechanisms to deal with balance-of-payments disequilibria and, hence, forces governments to resort to protectionism.

The above discussion indicates that the effect of a change in the exchange-rate regime on trade is, a priori, ambiguous and an empirical investigation is needed to resolve this ambiguity. To this end, we make use of a relatively recent approach to model the determinants of export volume in the UK and the US. The econometric methodology utilised applies developments in the econometrics of nonstationary time series in order to estimate long-run and short-run bilateral export functions. Our analysis covers a long period that includes all available relevant data for this century.

The remainder of the paper is organised as follows: Section 2 reviews the theoretical model and the relevant literature and section 3 discusses our econometric methodology. Section 4 describes the data used in the analysis and discusses and interprets our results. Finally, section 5 summarises our conclusions.

2. Theoretical Background and Literature

The modern empirical literature on the estimation of export functions uses the following long-run export function (see, e.g., Chowdhury, 1993, and Arize, 1995) which we have augmented with two dummy variables to take into account differences in the exchange rate regime across time:

$$\ln X_t = \beta_0 + \beta_1 \ln Y_t + \beta_2 \ln P_t + \beta_3 V_t + \beta_4 D_{1t} + \beta_5 D_{2t} + u_t \quad (1)$$

X_t stands for real exports, Y_t for real foreign income, P_t for relative prices (a measure of competitiveness), V_t for exchange rate volatility, D_{1t} and D_{2t} for two dummy variables, defined below, and u_t is the error term.

Equation (1) can be considered as the solution to a system of behavioural export demand and export supply equations. Economic theory suggests that the impact of real foreign income on real exports should be positive and the impact of relative price on real exports negative. Traditional trade theory suggests 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. On the other hand, a number of authors such as De Grauwe (1988), Giovannini (1988), Franke (1991), Sereu and Vanhulle (1992) and Viaene and de Vries (1992) illustrate, in the context of theoretical models, that exchange rate volatility might benefit trade. Hence, the sign of β_3 in equation (1) is ambiguous from a theoretical point of view.

The international empirical evidence on the influence of volatility on exports is also mixed. IMF (1984), Cote (1994) and McKenzie (1999) provide comprehensive reviews of the empirical literature. However, all existing studies, with the exception of Pozo (1992), do not consider the impact of the exchange-rate regime on trade flows. Pozo's (1992) approach is unsatisfactory for a number of reasons: First, by choosing the Gold Standard (1900-1914) to be the reference period, she does not take into account other periods of fixed exchange rate regimes included in her sample (i.e., 1926-1931) in her comparison with the managed float period. Second, she concentrates on the early part of this century, thus, not including in her analysis two very interesting periods associated with the Bretton Woods system and the more recent managed float regime. Third, she does not consider the potential nonstationarity of the involved time-series variables when performing the econometric analysis. Brada and Mendez (1988) also purport to analyse empirically the impact of the exchange rate regime on bilateral trade flows among 30 countries using cross-sectional data from the mid 1970s. The authors, using a gravity model, find that bilateral trade flows among countries with floating exchange rates are higher than those among countries with fixed rates.

In order to be able to define the exchange-rate regime dummy variables in our model, we need to appeal to the history of the international monetary system. Grilli and Kaminsky (1991) discuss the chronology¹ of the exchange rate regimes since the beginning of the Gold Standard period. The Gold Standard period lasted from 1879 to 1914. This was a period of a fixed dollar/sterling exchange rate. Following the start of the first world war, the exchange rate became managed floating. In March 1919, foreign exchange market intervention stopped and the dollar/sterling rate fluctuated freely. Between May 1925 and August 1931 we had a return to a fixed rate regime, the so-called Gold Exchange Standard. Following this, and until August 1939, the exchange rate fluctuated but remained subject to intervention. During the war, and until September 1949, we had a return to a fixed rate regime which was followed by the launch of the Bretton Woods system that remained in effect until May 1972. This system was replaced by the present managed float regime.

On the basis of the above classification of exchange rate regimes, we define the dummy variables in equation (1) as follows: D_1 takes the value 1 during the managed float regimes, i.e., 1915-18, 1931-39 and 1973-1998. The second dummy D_2 takes the value 1 during the free float period 1919-1924. Therefore, the reference exchange-rate system is the fixed exchange rate regime that applied during the following periods: 1900-14, 1925-30, and 1940-72. Our definition of the two dummies allows us to test for the differential effect on exports between the fixed exchange-rate regimes and, on the one hand, the managed float period that includes the post-Bretton Woods period and, on the other hand, the free float period starting at the end of WWI.

¹ Our chronology is slightly different from that in Grilli and Kaminsky (1991) since our use of annual data made it necessary to modify the time periods classified by these authors.

3. Econometric methodology

In agreement with developments in the econometrics of non-stationary time series, we start by estimating a long-run relationship between exports and its determinants implied by equation (1) using the Johansen multivariate cointegration approach. In the Johansen framework, all first-difference stationary variables are treated as endogenous. The two exchange rate regime dummies are the only exogenous variables.²

According to the Granger representation theorem (Engle and Granger, 1987), if the variables in equation (1) are cointegrated, then it can be shown that the error-correction model (ECM) for exports will be of the following form:

$$\Delta \ln X_t = \alpha_0 + \alpha_1 R_{t-1} + \alpha_2 D1_t + \alpha_3 D2_t + \sum_{i=1}^n \gamma_i \Delta \ln X_{t-i} + \sum_{i=1}^n \delta_i \Delta \ln Y_{t-i} + \sum_{i=1}^n \varepsilon_i \Delta \ln P_{t-i} + \sum_{i=1}^n \zeta_i \Delta V_{t-i} + e_t \quad (2)$$

where Δ is the first-difference operator, R_{t-1} is the error-correction term (ECT), i.e., the one-period lagged error term in the cointegration regression, $D1_t$, $D2_t$, X_t , Y_t , P_t and V_t are as defined earlier, and e_t is an error term. The rest of the equations in the ECM (not given) are analogous to equation (2) with the only difference being in the left-hand side variable of the equation. This ECM allows us to estimate the short-run relationships between exports and its determinants. It includes both the short-run dynamics and the long-run relation between the series. The parameter α_1 measures the response of real exports in each period to departures from the long-run equilibrium. With the cointegration equation normalised on exports, α_1 is expected to have a negative sign and be statistically significant.

² We have also included a war dummy that takes the value 1 during the two world wars.

4. Data and results

(i) Data

In the analysis we use annual data for the period 1900-1998. Our sample includes the US and the UK, two countries for which a full series of relevant data for this century is available. The export variable measures each country's bilateral exports. Its real value is created through division by the unit export value. Our first explanatory variable in the export function is foreign income which is proxied by real GDP for the UK and real GNP for the US. The second right-hand side variable in equation (1) is a measure of competitiveness. It is defined as the ratio of the exchange rate-adjusted price of domestic country exports to the price of exports of the trading partner. The dollar/sterling exchange rate is measured in annual averages. The real exchange rate was constructed using the export price indexes in the two countries. The source of the nominal exchange rate data is Lee (1978). The source of the rest of the series is Liesner (1989) and the IFS database.³

The moving standard deviation of the growth rate of the real exchange rate is used as a measure of time-varying exchange rate volatility:

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

where Z is the real exchange rate and m , the order of the moving average, is set equal to 2.^{4,5} This measure of exchange rate volatility is adopted by several authors, including Lastrapes and Koray (1990) and Chowdhury (1993).

³ The unit export value data were missing for the period 1914-1918 for both countries. Therefore, we proxied the missing values by a price index that includes all commodities for each country. This choice seems legitimate as these price indexes were almost identical with the unit export value indexes for the first thirty years of the century.

⁴ Our main results turned out to be robust to alternative specifications of the order of the moving average.

⁵ Although we use real exchange rates to calculate our volatility measure, Chowdhury (1993), Lastrapes and Koray (1990) and Thursby and Thursby (1987) obtain similar results using nominal and real exchange rates.

(ii) Results

First, we employed Augmented Dickey Fuller (ADF) and Phillips-Perron unit root tests to determine the integration properties of each time series. The results of these tests, available upon request from the authors, imply that all series, except for the exchange rate volatility series, which is stationary, are $I(1)$. Then, we proceeded to test for cointegration following the Johansen maximum likelihood approach among the three first-difference stationary variables in equation (1). The dummy variables are included in the cointegration procedure as exogenous variables and the real exchange rate volatility variable is included as an endogenous stationary variable. We chose the lag length in the VAR using an adjusted likelihood ratio test. The results of the maximum eigenvalue tests, also available upon request from the authors, illustrate that there exists a unique cointegrating vector for the US export function. For the UK export function, the tests indicate that there exist two cointegration vectors. Following the convention, in the second case, we have chosen the most significant vector, i.e., the one that corresponds to the largest eigenvalue, in the analysis that follows.

In Table 1 we report the cointegration vectors. Based on these results, we can make a number of observations: First, real foreign income is positively signed and significant in both cases. Second, relative prices are statistically significant, but, in the case of the UK export function, enter with a positive sign. Third, the income elasticity is higher for the US exports to the UK, whereas the relative price elasticities appear quite large. Note though, that we have estimated bilateral long-run export functions for a long series of data that spans almost a century, in contrast to most of the existing literature that has focused on multilateral functions and used recent data.

Tables 2 and 3 report the short-run dynamics reflected in the estimated ECMs. Using the cointegration vectors

normalised on exports, we estimated the ECMs for exports. Table 2 reports the ECM for UK's exports to the US and Table 3 reports the ECM for US's exports to the UK. To decide the final forms of the ECMs, we started with the maximum lag suggested by the likelihood ratio test for each variable included in the VAR and eliminated insignificant lags unless this introduced serial correlation in the error term. This allowed us to derive a parsimonious model.

Before we discuss the results, we need to determine the acceptability of the ECMs. For that reason, we performed a number of tests which are reported in the last column of each table. These tests indicate that the ECMs are adequate for further analysis. The adjusted R^2 are 0.22 and 0.44 in Tables 2 and 3, respectively. Such values compare well with the adjusted R^2 values of other studies for regressions based on first differences in variables. The Breusch-Godfrey Serial Correlation LM test (F-statistic) indicates that there is no serial correlation in the residuals of the estimated equations at the 5% level. Moreover, autoregressive conditional heteroskedasticity (ARCH) does not seem to be a problem according to the ARCH LM test (F-statistic).

Since the above econometric tests support the adequacy of the estimated ECMs, we can make a number of observations regarding the findings presented in Tables 2-3.⁶ First, the ECM results show that changes in foreign income and relative prices have statistically significant short-run effects (in some cases at the 10% level of significance) on exports. Second, the dynamics of the ECM equations also indicate that real exchange rate variability does not have a significant short-run impact on export volume in either of the two cases. The error-correction coefficients are

⁶ The estimated ECMs include also a dummy variable that takes the value 1 during the two world wars. We find this dummy to be negative and significant in the case of UK exports to the US and positive and significant in the case of US exports to the UK. The signs for the war dummy are consistent with our a priori expectations.

correctly signed and highly significant in both cases verifying the existence of a long-run cointegration relationship.⁷

Finally, and perhaps most importantly, the statistical significance of the exchange rate regime dummy variables differs across the two ECM regressions considered in this study. The only statistically significant exchange regime dummy is the free float dummy for both export functions. It indicates an increase in UK's exports to the US and vice versa during the free float period 1919-1924 relative to the fixed exchange-rate regime periods. The insignificance of the managed float regime dummy D1 implies that there is no difference in bilateral exports of either country between fixed exchange rates and the managed float regimes.

In summary, our ECM results point to two interesting conclusions regarding the impact of the exchange-rate regime on exports. First, we find that fixed exchange rates and the managed float regime are equally conducive to trade. Second, there is strong evidence suggesting that the freely floating exchange rates are more conducive to trade than fixed exchange rates. The latter conclusion seems to support the argument of the proponents of flexible exchange rates that fixed rates are accompanied by rising protectionism. The conclusion is also consistent with the insignificance of the exchange rate volatility proxy. Our result on the higher size of exports under free floating is in line with the conclusion of Brada and Mendez (1988), even though these authors did not distinguish between free floating and managed float.

⁷ We have also tested for the structural stability of each ECM using a CUSUM test. The results (not reported) indicate that both models are not subject to structural instability.

5. Summary and Conclusions

We have examined the impact of the exchange rate regime on bilateral export flows between the UK and the US using data from the 1900-1988 period. By treating the time series in this period as potentially nonstationary we determine the contribution of fixed exchange rates, freely floating rates and managed float in export flows. Using ECM analysis, we reach two main conclusions: First, fixed exchange rates and managed float are equally conducive to trade, and second, freely floating exchange rates are more conducive to trade than fixed exchange rates. The second conclusion seems to support the argument of the proponents of flexible exchange rates that fixed rates are accompanied by rising protectionism.

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**TABLE 1: Cointegration Vectors and Likelihood Ratio Tests
1900 - 1998**

Country	Normalized Cointegrating Vector	H ₀ : β ₁ =0	H ₀ : β ₂ =0
UK Exports	$\ln X_t = 29.94 + 1.86 \ln Y_t - 7.42 \ln P_t$	9.49**	6.76**
US Exports	$\ln X_t = -47.56 + 2.83 \ln Y_t + 8.93 \ln P_t$	5.70**	6.85**

Note: The tests H₀: β_i=0, i=1, 2, in the equation $\ln X_t = \beta_0 + \beta_1 \ln Y_t + \beta_2 \ln P_t + \beta_3 D_{1t} + \beta_4 D_{2t}$ have a $\chi^2(1)$ distribution under the null hypothesis. ** denotes significance at the 5% level.

**TABLE 2: Error-Correction Regression Results : UK Exports to the US
1900 - 1998**

lag	R	D ₁	D ₂	ΔlnX	ΔlnY	ΔlnP	ΔV	Summary Statistics
0		- 0.009 (0.18)	0.29** (2.78)				0.44 (0.99)	Adjusted R ² = 0.22 F-statistic=3.10 (0.00) AR F(1,78)=0.03 (0.86) ARCH F(1,78)=0.95 (0.33)
1	-0.15** (3.32)			-0.14 (1.15)	0.34 (0.75)	0.43 (1.14)		
2				-0.18 (1.46)	-1.07** (2.53)	0.58 (1.62)		
3				0.15 (1.36)				
4						0.43 (1.40)		

Note: The figures in parentheses are the absolute t-statistics. * and ** denote significance at the 10% and 5% levels, respectively. F statistics are followed by marginal significance levels in parentheses. This regression includes also a war dummy that takes the value 1 during the two World Wars. This dummy is negatively signed and statistically significant.

**TABLE 3: Error-Correction Regression Results : US Exports to the UK
1900 - 1998**

lag	R	D ₁	D ₂	_lnX	_lnY	_lnP	_V	Summary Statistics
0		0.03 (0.69)	0.20** (1.96)				0.71 (1.59)	Adjusted R ² = 0.44 F-statistic=6.99 (0.00) AR F(1,78)=2.14 (0.15) ARCH F(1,78)=1.36 (0.25)
1	-0.06** (4.44)			-0.20* (1.78)	3.72** (6.44)	-0.62** (2.72)		
2					0.80 (1.24)	-0.41* (1.83)		
3					0.75 (1.23)			
4								
5				-0.21** (2.37)				
6						-0.46** (1.99)		

Note: The figures in parentheses are the absolute t-statistics. * and ** denote significance at the 10% and 5% levels, respectively. F statistics are followed by marginal significance levels in parentheses. This regression includes also a war dummy that takes the value 1 during the two World Wars. This dummy is positively signed and statistically significant.

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