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Financial market integration in the early modern period in Spain: Results from a threshold error correction model

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ABSTRACT

The application of a threshold error correction model to the exchange rates of the Spanish Ducado and the Dutch Groat in Seville and Medina del Campo in the 16th century indicates that the band of arbitrage inactivity was 6%.

1. Introduction

The silver and gold currencies offered arbitrage opportunities between the markets for silver and gold as well as foreign exchange. However, transaction costs, which may have been rather substantial in the past, hindered arbitrage and led to a band of "arbitrage inactivity" for the exchange rate around its par value. This issue was analyzed empirically in some recent papers using threshold autoregressive or error correction models [Prakash and Taylor (1997), Canjels et al. (2004), Volckert and Wolf (2006), Kugler (2009)]. Prakash and Taylor (1997, Table 5) report that in subperiods of the classic gold standard deviations from par value of the Dollar/Pound rate were possible only in the range of 0.15–0.46% until arbitrage operations were triggered. This finding is not surprising since the introduction of the telegraph, the steamship and the railroad as well as improved safety of transport routes decreased significantly the transaction costs for exploiting arbitrage by shipping precious metals during the 19th century. Volckert and Wolf (2006) find larger bands of arbitrage inactivity in the range of 0.34 to 0.99% for the silver currencies of Flanders, Lübeck and Prussia in the years 1385 to 1450. This difference is surprisingly small since one would expect that the information and transport revolution in the second half of the 19th century led to a huge decrease in transaction costs. However, the application of a threshold error correction model to data relating the Basle Pound and the Rhinegulden and the market for gold and silver for the period 1365–1429 indicates that transaction costs prevented arbitrage when the difference of the gold–silver ratio and the real exchange rate was within a 7% band (Kugler, 2009). Such a large band of "arbitrage inactivity" is supported by information on other indicators for transaction costs, namely the up to 5% fees for money transfer by bills of exchange as well as the up to 10% difference between deposit and loan rates of banks in medieval and early modern times (Homer and Sylla, 2005, 76, 136). Nevertheless, it seems of some interest to explore financial market integration with other historical data sets. In this paper we consider the integration of the markets between the Spanish Ducado and the Dutch Groat in two Spanish towns, namely Seville and Medina del Campo. We use annual data from 1564 to 1603 and apply a threshold vector error correction model.

2. Historical background and data

We consider the exchange rate of the Dutch four pence silver coin Groat and the Spanish gold coin Ducado, which was issued by the Spanish kings since 1504 as a copy of the well established Venetian Ducat. It had a gold content of approximately 3.5 g. For the years 1564 to 1603 data are available for two exchange rates for theses two currency, one between Antwerp and Seville and the other between Antwerp and Medina del Campo.[1]

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[1] The data source is Denzel (1995).

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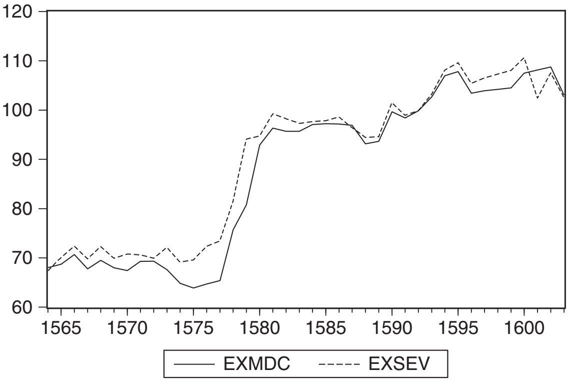

Fig. 1. Log of exchange rates in Seville (EXSEV) and Medina del Campo (EXMDC), Groat/Ducado 1564–1603.

Arbitrage should lead a tendency to equalize the two rates, except that transaction costs, which were sizable at that time, should prevent a strict equalization. Given gold or silver currencies there are always transaction costs present in the form of transportation and insurance costs for the transportation of the metal. Since they would not be the same from Antwerp to Medina del Campo and Seville the exchange rates might diverge from each other. Or expressed differently, the distance between the upper and lower gold or silver points in the two places was presumably different. However, if the difference among the two exchange rates quoted in the two places gets “large” we would expect arbitrage operation equalizing the two rates. The data plotted in Fig. 1 shows a rather persistent deviation between the two exchange rates. Moreover, we see a 50% depreciation of the Groat in the forty year period considered. In particular we note a very strong depreciation from 1575 to 1580.

In order to understand these developments a brief account of the historical background is helpful.[2] At the end of the 1560 ties the seven northern provinces of the seventeen that were under Spanish rule revolted against the oppressive rule of Philip II. The resistance against the king was on the one hand motivated economically because the booming economy of the Netherlands had to contribute very large amounts of taxes to the Spanish crown and thus to finance partly its attempt to obtain the hegemony and to restore the catholic religion in Europe. On the other hand many people in the Netherlands converted to Protestantism (Calvinism) and were not willing to return to the Catholic fold. In response to the union of Arras, which brought back the southern provinces under Spanish rule, they formed the Union of Utrecht in 1579 and declared independence of Spain in 1581. In 1585 the union of Utrecht lost Brabant and Flanders with Antwerp to Alexander Farnese, the representative of Philip II in the Netherlands. However, Farnese's military force had to intervene in the French religious war and the Northern provinces gained some territory back. Antwerp remained under Spanish control and lost its formerly paramount position as leading market place in Europe to Amsterdam since the river Scheldt was blocked by the Dutch. Moreover, many wealthy and skilled dissenters emigrated from the South to the North and thus weakened the economic base of the Southern Spanish Netherlands. The war ended by an armistice in 1609 and the independence of the Netherlands was finally internationally accepted in the peace treaty of the thirty years war in 1648. In sum the Dutch clearly “won the war”. They became the leading sea power and most prosperous trading nation in the 17th century and were able to replace the Portuguese who were under Spanish rule from 1580 to 1640. The Spanish attempt to restore European hegemony and the catholic orthodoxy and the religious intolerance of the crown ruined the economy and government finances in Spain which no longer played a dominating role in Europe.

Given this historical background is seems surprising to observe the strong depreciation of the Dutch against the Spanish currency. There are two main reasons: first, the Groat was strongly debased in several steps from 1575 to 1580 and lost 30% of its silver content. This was, of course, done for seigniorage reasons since the war against Spain had to be financed in a very difficult situation.[3] Second, the huge silver imports of Spain from its Latin American possessions with highly productive silver mines led to a marked rise in the price of gold relative to silver and to a tripling of the general price level in Europe where silver was the dominant monetary metal. This of course caused a general appreciation of all gold currencies like the Spanish Ducado.

3. Econometric model

Now let us turn to the econometric model used in this study. Let x and y be the log of exchange rates in Seville and Medina del Campo, respectively, and define the log difference as $z=x-y$. We apply the following threshold (vector) error correction model[4]:

$$\begin{aligned}
&\Delta x_t = a_1 + \lambda_1 z_{t-1} + \varepsilon_{1t}, \text{if } \mathrm{abs}(z_{t-1})<\tau \\
&\Delta x_t = a_1 + \lambda_2 z_{t-1} + \varepsilon_{1t}, \text{if } \mathrm{abs}(z_{t-1})\geq\tau \\
&\Delta y_t = a_2 + \lambda_3 z_{t-1} + \varepsilon_{2t}, \text{if } \mathrm{abs}(z_{t-1})<\tau \\
&\Delta y_t = a_2 + \lambda_4 z_{t-1} + \varepsilon_{2t}, \text{if } \mathrm{abs}(z_{t-1})\geq\tau \\
&\lambda_1, \lambda_2 \leq 0;\ \lambda_3, \lambda_4 \geq 0
\end{aligned} \tag{1}$$

If transaction costs are relevant we expect $\lambda_2=\lambda_3=0$ and at least one of the two other error correction coefficients to be different from zero. Defining a dummy variable d, which is one when $\mathrm{abs}(z_{t-1})<\tau$ holds and otherwise 0, we can rewrite our model in two equations:

$$\begin{aligned}
&\Delta x_t = a_1 + \lambda_1 z_{t-1} d_{t-1} + \lambda_2 z_{t-1}(1-d_{t-1}) + \varepsilon_{1t} \\
&\Delta y_t = a_2 + \lambda_3 z_{t-1} d_{t-1} + \lambda_4 z_{t-1}(1-d_{t-1}) + \varepsilon_{2t}
\end{aligned} \tag{2}$$

These two equations can be estimated by OLS when τ is known. In order to determine this parameter we use a grid search to get the value which minimizes the determinant of the residual covariance matrix of system (2). Of course the parameter τ is only identified if this nonlinearity is present. In order to test this we adopt the approach developed by Tsay (1989) for testing the appropriateness of a TAR specification based on “arranged” AR(1) models. This approach is applied twice, namely to both linear variants of the EC-model given in (1). In this framework the observations are ordered in ascending or descending order of the regressor (lagged z in our case) and then parameter stability is tested using the Chow or CUSUM test. The Chow test is applied with two breakpoints for absolutely large negative values and large positive values. The threshold structure implies that the model does not exhibit parameter stability. Moreover, Tsay suggested a test based on the recursive residuals of this arranged AR model: the recursive residual is regressed on the lagged regressor and the corresponding coefficient is tested to be zero as implied by linearity.

4. Empirical results

Before turning to the estimation results for the threshold EC-model we report some preliminary test results. Table 1 provides us with the findings of the Phillips–Perron unit root test and the Kwiatkowski–

[2] Compare Findlay and O'Rourke (2007, 175–187) for the political and economic developments in The Netherlands in the late 16th and early 17th century.

[3] In the later years of the conflict the Dutch provinces managed to finance their high expenditures in the Amsterdam capital market at decreasing interest rates (from 10% in 1600 to 4% in 1640) with funds provided by Dutch private savings.

[4] This modeling framework was developed by Balke and Fomby (1997) for non-stationary but co-integrated series with nonlinear adjustment dynamics. It is applied to analyze commodity market integration in the 19th century by Ejrnaes and Persson (2000) as well as Jacks (2005).