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Fractional cointegration and real exchange rates

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Abstract

This paper uses fractional integration and cointegration to model the DM–US dollar and the yen–US dollar real exchange rates in terms of both monetary and real factors, more specifically real interest rate and labour productivity differentials. We find that whilst the individual series may be integrated of order 1, their long-run relationship might have a fractionally cointegrated structure. This means that mean reversion occurs, consistently with the findings of other studies. However, it also indicates, in contrast to such studies, that the cointegrating relationship possesses long memory. In other words, the error correction term responds slowly to shocks, implying that deviations from equilibrium are long-lived. It appears that only a combination of real and monetary variables can accurately track down the movements of real exchange rates.

JEL classification: C22; C32; F30; F41
Keywords: Real exchange rates; Fractional integration; Fractional cointegration

1. Introduction

Long-run theories of the real exchange rate have alternatively focused on real or monetary factors as the main determinants of its equilibrium level (see Froot & Rogoff, 1994; MacDonald, 1995; Rogoff, 1996, for an extensive review of the literature). Caporale and Pittis (2001) argue that only a combination of the two can account for the actual behaviour of real exchange rates. In particular, in their view, monetary factors are responsible for the long-lived deviations from equilibrium, whilst real factors are the fundamentals determining the long-run level. In other words, ''sticky price'' open macro models (see, e.g., Dornbusch, 1976) can provide a rationale for the high persistence of the shocks and slow mean

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reversion, whilst productivity differentials can be seen as the driving force behind real exchange rates in the long run (see Balassa, 1964; Samuelson, 1964). A similar idea informs the model by Mussa (1982), where the movement of the real exchange rate is decomposed into an equilibrium component driven by real factors, and a transitory one, which is associated with changes in the nominal exchange rate regime.

Caporale and Pittis (2001) show that the cointegrating vector includes real exchange rates, real interest differentials, and productivity differentials, which are all found to be $I(1)$ variables. Treating interest rate differentials as $I(1)$ series might appear surprising, as the existence of long-run capital flows equalising real rates implies that they should be $I(0)$ (see Meese & Rogoff, 1988). The rationale for the inclusion in the cointegrating set is that they might be fractionally integrated variables. Such processes exhibit long memory and high persistence (see Granger & Joyeux, 1980), and it is therefore necessary to include them in the long-run specification to obtain a stable relationship.

A number of recent studies have been able to find mean reversion in real exchange rates (see the references in the survey by Edison, Gagnon, & Melick, 1997; Lothian, 1997; Rogoff, 1996). However, standard cointegration analysis restricts the error correction term to be an $I(0)$ process, which is not persistent. In this paper, we argue that a fractionally integrated and cointegrated structure might be more appropriate for modelling real exchange rates. Specifically, the error correction term might respond to shocks more slowly than implied by classical cointegration, and the equilibrium errors might behave as a fractionally integrated series displaying slow mean reversion. In other words, the error correction term might exhibit long memory so that deviations from equilibrium are highly persistent. Under these circumstances, a fractional cointegrating relationship provides a much better understanding of the behaviour of the series of interest. Using this methodology, we find that real exchange rates are in fact fractionally cointegrated with real interest rate and labour productivity differentials.

The structure of the paper is as follows. Section 2 briefly reviews the literature on real exchange rates. Section 3 defines the concepts of fractional integration and cointegration, summarising some of the techniques for estimating and testing the long-memory parameter. In Section 4, these techniques are applied to the DM–US dollar and yen–US dollar real exchange rates. Finally, Section 5 contains some concluding remarks.

2. A brief review of the literature on real exchange rates

Numerous empirical studies have tested for the existence of a long-run relationship between real exchange rates and real interest differentials. Most of them have been unsuccessful in finding such a relationship. For instance, Campbell and Clarida (1987) concluded that the innovation variance of real interest differentials is too small to account for the large swings in real exchange rates, which appear to be driven instead by other permanent shocks (see Huizinga, 1987), most likely of real nature (see Clarida & Galli, 1994). This raises the question whether the key relationship is between the temporary components of these two variables, as argued by Baxter (1994). Meese and Rogoff (1988) also failed to find cointegration, a result which they attributed to the omission of some relevant variables, such as the expected future real exchange rate. Blundell-Wignall and Browne (1991) argue that including the equilibrium rate results in cointegration. The opposite conclusion is reached by Edison and Pauls (1993). Lothian and Taylor (1996, 1997) point out that the problem might simply be one of low power in small samples of the test statistics used—mean reversion can be found over long time spans. Alternatively, panel unit root methods can be used, which again produce stronger evidence in favour of a long-run