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Edited by
Pavlos Karadeloglou and
Virginie Terraza

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Exchange Rates and Macroeconomic Dynamics

Edited by

Pavlos Karadeloglou

and

Virginie Terraza

Softcover reprint of the hardcover 1st edition 2008 978-0-230-50062-4

First published in 2008 by
PALGRAVE MACMILLAN
Houndmills, Basingstoke, Hampshire RG21 6XS and
175 Fifth Avenue, New York, N.Y. 10010
Companies and representatives throughout the world.

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ISBN 978-1-349-35283-8 ISBN 978-0-230-58269-9 (eBook)
DOI 10.1057/9780230582699

This book is printed on paper suitable for recycling and made from fully managed and sustained forest sources. Logging, pulping and manufacturing processes are expected to conform to the environmental regulations of the country of origin.

A catalogue record for this book is available from the British Library.

A catalog record for this book is available from the Library of Congress.

10 9 8 7 6 5 4 3 2 1
17 16 15 14 13 12 11 10 09 08

Transferred to Digital Printing 2011

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Introduction

Pavlos Karadeloglou[1] *and Virginie Terraza*[2]

The impact of exchange rate movements on prices and economic activity is in the core of international macroeconomic theory and policy. More recently, the interest in this issue has resurged following the rather strong exchange rate fluctuations, the unsustainability of the current account imbalances and the anticipated shifts in exchange rate regimes in some emerging economies. The classical international macroeconomic theory teaches that currency depreciations are expansionary while the opposite is true for domestic currency appreciations. However, factors like degree of trade openness, the market structure, the geographical composition of trade, the importance of intra-firm trade and the macroeconomic and institutional environment influence on the degree and intensity of the impacts.

Exchange rate models developed in the years following the fall of Bretton Woods were based on the assumption that exchange rate developments closely follow movements of fundamentals and that their movements matter. The price-competitiveness-channel together with import and consumer price developments are certainly obvious transmission mechanisms of the exchange rate developments to the macroeconomy, as swings in the nominal effective exchange rate affect relative costs and prices with a subsequent impact on export performance and thus activity. Recently the profession has made considerable progress, pursuing several new routes in an attempt to narrow down the still wide uncertainty about the size of the impacts. At the same time, one of the main directions in the empirical research in economics was to quantify the role of exchange rates in moderating the impact of economic disturbances.

When considering the factors determining exchange rate movements a familiar starting point is the theory of (relative) purchasing power parity (PPP), according to which the inflation differential at home and abroad is reflected in a corresponding change in the nominal exchange rate. Following the provocative paper by Obstfeld and Rogoff in 2000 about 'Risk and Exchange Rates' published in the NBER Working Paper No. 6694, where six key puzzles in International Finance related to transaction costs were identified, a large and vibrant literature seeking to establish if indeed transaction costs explain the puzzles was generated.

The first part of the book, deals with the PPP persistence puzzle, with econometric aspects of the exchange rates dynamics and its implications and the misalignment on equilibrium exchange rates. In chapter 1, **R. MacDonald** examines two of the puzzles addressed in Obstfeld and Rogoff, namely the PPP puzzle and the exchange rate disconnect. He argues that the latter actually has two puzzles subsumed within it, what he refers to as the levels and volatility puzzles. Hence, in total, he explores three puzzles in this paper, namely the PPP puzzle, and what we have referred to as the levels and volatility puzzles, and seeks to provide an explanation for these puzzles. He argues that the PPP Puzzle – the combination of a high volatility of real and nominal exchange rates with the slow mean reversion of real exchange rates – can be explained in a number of ways, from product and time aggregation biases to pricing to market, non-linear adjustment, real factors and imperfectly substitutable goods, with the preferred explanation for the PPP puzzle being a combination of pricing to market and real factors, such as the effects of productivity differentials on exchange rates. This conclusion has clear implications for the measurement of equilibrium values of currencies. The levels puzzle concerns the supposed poor out-of-sample forecasting properties of exchange rate models and, in particular, the findings of Meese and Rogoff (1983) that fundamentals-based models cannot outperform a random walk. He argues in this paper that the random walk paradigm can be convincingly overturned at horizons as short as two months, and this seems a robust result. The key to overturning this result is the use of econometric methods, which capture the underlying data dynamics and the long-run relationships. The volatility puzzle concerns the apparent excessive volatility of exchange rates in flexible rate regimes – intra regime volatility – and

the sharp rise in both real and nominal exchange rate volatility in the move from fixed to floating exchange rates – inter-regime volatility. In this paper he argues that excessive exchange rate volatility is entirely consistent with a number of forward-looking exchange rate models and in fact the empirical evidence suggests that intra-regime volatility may be something of a chimera. He also claims that the issue of inter regime volatility may also be overplayed since once the role of distortions are recognised in fixed rate regimes fundamentals become more volatile. He concludes that although there are still a number of puzzles in the exchange rate literature the three key puzzles considered in this paper have been resolved.

To determine whether the real exchange rate is misaligned with respect to its long-run equilibrium is an important issue for policy makers. In particular, the potential misalignment (which is the difference between the 'equilibrium exchange rate' consistent with macroeconomic fundamentals and the observed exchange rates) is one of the most important policy issues faced by the new EU Member States in view of their future adoption of the euro and with the big challenge being the participation in the exchange rate mechanism. In chapter 2, **Jan Frait, Luboš Komárek and Martin Melecký** focus on the development of real exchange rates and its determinants in five new EU Member States namely the Czech Republic, Hungary, Poland, Slovakia, and Slovenia. They provide the long-term trends leading to real exchange rate appreciation, pointing to the differences in the individual countries as well as a survey of existing empirical literature on the real exchange rates in transitional countries. Using the purely statistical (Hodrick-Prescott and Band-Pass filter) as well as the BEER-like approaches, which were estimated by two single equation techniques (Engle-Granger and ARDL), they conclude that the real exchange rates have generally evolved in line with the determinants that are believed to be fundamental. The differences among the individual countries can sometimes be explained by different development of their fundamentals.

The question related to the misalignment or not of the Chinese exchange rate has been a topical issue in the discussion of international fora as many analysts argue that this may be a solution for the correction of global imbalances. **Virginie Coudert and Cécile Couharde** (Chapter 3) investigate the size of a possible misalignment in the Chinese real exchange rate. To do so they investigate the trend

of several economic indicators that show some signs of undervaluation of the real exchange rate of the renminbi during the recent years: real effective exchange rate depreciation, surging foreign exchange reserves, current account surpluses. Second, they use cross-section regressions relating the real exchange rate to a 'Balassa effect', on different samples of countries. Third they address the issue of the 'Balassa effect' in the framework of a BEER approach using panel-data estimations. The econometric estimates confirm the trend of the stylised facts about the undervaluation for the Chinese renminbi.

In the second part of the book the importance of exchange rates dynamics in the pass-through effects (PTE) is examined. In chapter 4, **Victoria V. Dobrynskaya and Dmitry V. Levando** propose an analysis of PTE on consumer prices of different categories of goods and producer prices in different industries in Russia taking into account links between monetary policy and exchange rate regimes. They address the question whether the monetary policy in Russia counteracts exchange rate changes and reduces pass-through. Using an empirical approach, they test if PTE: 1) is incomplete in the short run and long run; 2) is different for consumer and producer prices; 3) is different for the components of CPI (food, goods and services) and the components of PPI (export- and domestic market-oriented industries) and if monetary policy decreases PTE. They conclude that PTE on all prices is incomplete even in the long run and that PTE on consumer prices is higher than PTE in developed countries. Furthermore, prices of food and goods are highly exchange rate elastic while prices of services do not react to exchange rate changes. This characterises Russia as a small economy, which is highly dependent on shocks in the world markets.

In chapter 5, the importance of exchange rate analysis and its impact on the economy is demonstrated in an inflation-targeting context adopted by the Hungarian Central Bank since June 2001. The main important issue in such a policy context is the exchange rate pass-through. This is a major focus of interest for policymakers and academics. The former are primarily interested in the extent and timing of ERPT as a key ingredient of their forecasting models of prices and of the trade balance. Along with academics, they are also interested in the role of ERPT in understanding the mechanisms of international price adjustment, e.g. in reconciling the observation that the relative stability of import prices does not reflect the high

volatility of nominal exchange rates with economic theory. Evidence of 'disconnect' between exchange rates and prices would also imply a greater degree of insulation and thus greater effectiveness of monetary policy. **V. Varpalotai** presents an inflation-forecasting model using an approach which is new not only in Hungary but also in the relevant literature. This model is based on disaggregated econometric estimates with special interest on slow price adjustment which are complemented by expert assumptions in a unified framework. The model delivers forecasts of the prices of marketed goods included in the CPI basket by describing the gradual process when costs gradually pass-through to consumer prices. Actually, it is the empirical estimation of this slow cost pass-through process that provides the novelty of the model in terms of economics and econometrics. By considering wages, foreign prices, exchange rate, transportation costs and energy prices the model contributes in answering two questions: (1) How do prices change following changes in the prices of their cost factors? (2) What happens during the transitory period when changes in costs and prices separate?

The third part of the book deals with econometric aspects of the exchange rates dynamics linked to structural shocks on different economies. The contribution of the dynamic stochastic general equilibrium (DSGE) model is used by **G. de Walque and R. Wouters** to analyse the existing linkages between the United States and the euro area. They try to empirically estimate a New Open Economy Model to analyse the behaviour of the exchange rate and the current account between the two economies. They use a Bayesian full information approach to estimate the model; the latter is used to evaluate the impulse response functions for different shocks (productivity shocks domestic demand and monetary policy shocks). Their results confirm that positive productivity shocks and declining mark-ups, or the typical characteristics of the new economy, are unable to explain a major appreciation of the exchange rate. Although in its present state, the model has clearly some problems to replicate the observed international synchronisation in the cyclical output and aggregate demand components, it remains a topic for further research to analyse how much of the observed correlation between the output of the two major economies can be explained once we allow for a positive correlation between the domestic shocks that hit the two economies (which are assumed to be orthogonal in the estimation approach up

to now). In particular, they can identify the major sources of exchange rate and current account developments. Finally the main findings suggest that shocks issued from the uncovered real interest parity seem to be important to explain the short run volatility in exchange rates, while fundamental shocks explain the long run swings.

In chapter 7, a dynamic macroeconomic model is used to study the impact of liberalisation on the behaviour of the real exchange rate in a representative transition economy operating under a flexible exchange rate regime. **Christos Papazoglou** identifies the role of liberalisation in the emergence of the stylised fact concerning the behaviour of the real exchange rate at the early stages of transformation of the transition economies. The analysis considers the impact of two specific shocks related to liberalisation. The first refers to an increase in the core inflation while the second analyses a shock on the financial sector, under a fall in the demand for money. The results are affected by two assumptions reflecting the particularity of transition economies: The particular shocks on domestic inflation are increased due to the observation that the private sector does not extend over the entire economy. The second concerns the underdevelopment of the domestic financial sector, which diminishes the impact of the two disturbances on the rate of exchange depreciation. As a result of these two specific features the possibility of real appreciation during the adjustment process increases. The particular disturbance impacts more on the inflation rate than on the exchange depreciation rate in the short run and generates the necessary adjustment mechanism that brings the system towards the new long run equilibrium.

Notes

1. European Central Bank.
2. LSF, University of Luxembourg.

Part I

The Purchasing Power Parity and its Implications for Equilibrium Exchanges Rates

1

Three Exchange Rate Puzzles: Fact or Fiction?

Ronald MacDonald

1.1 Introduction

In their provocative paper, Obstfeld and Rogoff (2000) advocated explaining six key puzzles in International Finance by appealing to transaction costs. Their paper has generated a large and vibrant literature which seeks to establish if indeed transaction costs explain the puzzles. In this paper we examine two of the puzzles addressed in Obstfeld and Rogoff, namely the PPP puzzle and the exchange rate disconnect. We argue that the latter actually has two puzzles subsumed within it, what we refer to as the levels and volatility puzzles. Hence, in total, we explore three puzzles in this paper. A common conclusion often expressed regarding the puzzles is that they cannot be understood in terms of a standard macroeconomic framework and therefore to understand exchange rate behaviour the profession has to move towards a market microstructure approach and effectively abandon macroeconomic fundamentals (see for example, Flood and Rose (1995)). The bottom line in this paper is, however, that macroeconomic fundamentals are useful for explaining exchange rate behaviour and indeed can be used to explain the exchange rate puzzles.

The so-called PPP puzzle (Rogoff (1995)) concerns the high volatility of real and nominal exchange rates and the slow mean reversion of real exchange rates. The ballpark figure for the latter is within a range of three – five years for CPI-based real exchange rates. The puzzle arises because the exchange rate volatility is consistent with a standard price stickiness story (i.e. liquidity effects in the presence of

sticky prices), but the slow mean reversion is not consistent with price stickiness (a half-life of one year would be consistent).

The levels puzzle relates back to the seminal paper of Meese and Rogoff (1983) in which they demonstrated that a standard set of macroeconomic fundamentals are unable to beat a simple random walk at horizons of less than three years. This conclusion has apparently been reaffirmed by many researchers in the period post-1983 (see, for example, Frankel and Rose (1995) and Rogoff (1999)). In this paper we argue that the levels puzzle is not really a puzzle and can be explained when proper account is taken of the interaction between the macroeconomic fundamentals and exchange rates.

The volatility puzzle has two aspects: inter- and intra-regime volatility. For example, a standard asset-pricing framework would imply

$$Var(s_t) \leq Var(\hat{s}_t) \tag{1.1}$$

where $(\hat{s}_t)$ is some measure of the fundamental based exchange rate, but in actuality what we observe in flexible rate regimes is:

$$Var(s_t) > Var(\hat{s}_t) \tag{1.2}$$

This is the intraregime puzzle – the stylised fact that exchange rates in floating regimes seem to be excessively volatile relative to macroeconomic fundamentals. However, as we shall see in this paper, a number of macroeconomic models predict that the direction of the variance inequality in (2) is correct. The concept of intra-regime volatility (Baxter and King (1989) and Flood and Rose (1999)) is that in moving from fixed to floating rates the volatility of macroeconomic fundamentals remains unchanged but the volatility of exchange rates – both real and nominal – increases dramatically. In this paper we show that recent empirical work suggests that the intraregime puzzle can be explained if care is taken to define the macro fundamentals.

1.2 The PPP puzzle

Central to the PPP puzzle is the slow mean reversion speeds of real exchange rates. Consider the following AR process for the real

exchange rate:

$$q_t = \rho q_{t-1} + \beta + \varepsilon_t, 0 < \rho < 1, \tag{1.3}$$

where q is the log of the real exchange rate, ρ is the parameter of mean reversion, ε_t is a random error term and β is a constant. If we write the log of the equilibrium exchange rate as $\bar{q}$ and if we define this as the unconditional expectation of the process in (3) then (assuming $\rho < 1$): $\bar{q} = \beta/(1 - \rho)$.

Long-run PPP is violated if $|\rho|=1$ and if ρ and/or β are not time-invariant constants (our discussion here follows Abuaf and Jorion (1990)). If long-run PPP holds, short-run PPP is violated whenever $q_t \neq \bar{q}$ and factors which would prevent a continuous equality between short- and long-run PPP would be non-zero interest differentials and foreign exchange market intervention.[1] Traditional PPP focuses on the existence of long-run PPP and, more specifically, how long it takes for a currency to settle at its long-run PPP value. In other words: how fast is mean reversion in expression (3)? To answer this question it is useful to introduce the concept of a half-life; that is, how long does it take for half of a shock to PPP to be extinguished? If a and b denote the initial and final deviations from equilibrium, respectively, the number of intervals from a to b will be given as $(lnb\text{-}lna)/\ln\rho$ and therefore the formula for a half-life is given as:

$$hl = \frac{\ln (0.5)}{\ln (\hat{\rho})}. \tag{1.4}$$

In the traditional form of PPP money neutrality probably suggests *hl* should be around one year, and this would imply a value for ρ of 0.5, with annual data. However, and as we shall see in more detail below, estimated half-lives are much higher than one year. For example, for the post Bretton Woods period when currencies are examined on an individual basis, ρ turns out to be statistically indistinguishable from unity. However, when data from prior to the post-Bretton Woods regime, or when panel data are used for the post-Bretton Woods, there is clear evidence of statistically significant mean reversion and the half-life falls within the range of three to five years (see MacDonald (1995) and Rogoff (1996)). Rogoff (1996) has labelled such mean reversion speeds, combined with the large volatility of

real exchange rates as the PPP puzzle:

> How can one reconcile the enormous short-term volatility of real exchange rates with the extremely slow rate at which shocks appear to damp out? Most explanations of short-term exchange rate volatility point to financial factors such as changes in portfolio preferences, short-term asset price bubbles and monetary shocks. Such shocks can have substantial effects on the real economy in the presence of sticky nominal prices. Consensus estimates for the rate at which PPP deviations damp, however, suggest a half-life of three to five years, seemingly far too long to be explained by nominal rigidities. It is not difficult to rationalize slow adjustment of real shocks if real shocks – shocks to tastes and technology – are predominant. But existing models based on real shocks cannot account for short-terms exchange-rate volatility. (Rogoff, 1996, pp. 647–8)

A useful way of trying to understand and explain the PPP puzzle is to decompose the overall (CPI-based) real exchange rate into two relative price components, an internal and external component. Assume that the overall price level, p, is made up of a price level for traded goods, which, in turn, is the sum of the n traded goods produced in the home and foreign country, and the price level for non-traded goods, which is the sum of the m non-traded goods produced:

$$p_t = \beta_t p_t^T + (1 - \beta_t) p_t^{NT}, \; 0 < \beta < 1, \tag{1.5}$$

$$p_t^* = \beta_t^* p_t^{T^*} + (1 - \beta_t^*) p_t^{NT^*}, \; 0 < \beta^* < 1, \tag{1.5'}$$

where P_t^T denotes the price of traded goods, P_t^{NT} denotes the price of non-traded goods the βs denote the share of traded goods in the economy and lower case letters again indicate that a log transformation has been utilised. The existence of non-traded goods can impart an important bias into the determination of the equilibrium exchange rate. This may be seen in the following way. Consider the definition of the real exchange rate, defined with respect to overall prices:

$$q_t \equiv s_t - p_t + p_t^*, \tag{1.6}$$

and define a similar relationship for the price of traded goods as:

$$q_t^T \equiv s_t - p_t^T + p_t^{T*}. \tag{1.6'}$$

By substituting (1.5), (1.5′) and (1.6′) into (1.6) we can obtain:

$$q_t = q_t^T + (\beta_t - 1)[(p_t^{NT} - p_t^T) - (p_t^{NT*} - p_t^{T*})] \tag{1.7}$$

or

$$q_t = q_t^T + q_t^{T,NT}$$

where

$$q_t^{NT,T} = (\beta_t - 1)[(p_t^{NT} - p_t^T) - (p_t^{NT*} - p_t^{T*})],$$

the relative price of non-traded to traded goods in the home country relative to the foreign country is usually referred to as the relative internal price ratio.

From the perspective of trying to unravel the sources of deviations from PPP, expression (1.7) is quite neat because it indicates that there are two potential sources of systematic movements in real exchange rates (which is another way of thinking about deviations from PPP): one is through movements in the relative price of traded goods, captured in q^T, and the other is movements in the internal price ratio, $q^{NT,T}$. In a world where all macroeconomic shocks are nominal, the existence of non-traded goods would have no impact on the real exchange rate since all prices, both traded and non-traded, would move in proportion to, say, a monetary disturbance. However, in a world where there are both real and nominal disturbances, real shocks can lead to movements in $q^{NT,T}$ which are independent of q^T, thereby producing a violation of PPP. In this regard, perhaps the best known real shock is a total factor productivity shock which occurs in the traded sector and gets transmitted into p^{NT} and, ultimately, the CPI-based real exchange rate. This is the so-called Balassa–Samuelson hypothesis, which we discuss in the next chapter. We shall return to expression (1.7) below.

As Rogoff (1996) notes, and as we will demonstrate further below, the q^T term is highly volatile and its variance innovation dominates

the variance innovation of $q^{NT,T}$. Since $q^{NT,T}$ is usually taken to be driven by 'real shocks', such as taste and technology shocks, which are likely to be highly persistent, the variance behaviour of $q^{NT,T}$ makes it difficult to explain the behaviour of q in terms of $q^{NT,T}$. In sticky price models the volatility of the nominal exchange rate gets transferred on a one-to-one basis into the volatility of q^T. But how can the persistence of q^T be explained? We turn to some explanations after discussing the empirical evidence.

1.2.1 Testing PPP

Recent tests of PPP have focused on using unit root methods to determine if real exchange rates are mean-reverting and co-integration methods to test the relationship between the nominal exchange rate – relative price relationship. The latter tests of PPP focus on the following kind of relationship:

$$s_t = \beta + \alpha_0 p_t + \alpha_1 p_t^* + \varphi_t, \tag{1.8}$$

and on the properties of the residual term in (1.8). In particular, if s_t, p_t, and p_t^* are integrated of order one – I(1) – then so-called weak form PPP (MacDonald 1993) exists if the residual term from an estimated version of (1.8) is found to be stationary, or I(0). Strong-form PPP exists if, in addition to weak-form holding, homogeneity is also satisfied; that is, $\alpha_0 = 1$ and $\alpha_1 = -1$. If the estimated coefficients are equal and opposite then this implies relative prices affect the exchange rate in a symmetrical fashion; that is, $\alpha_0 = -\alpha_1$. The distinction between weak- and strong-form PPP is important because the existence of transportation costs and different price weights across countries means that 'there are no hypothesis regarding the specific values of α_0 and α_1 except that they are positive and negative' (Patel 1990).

The basic message from co-integration-based tests of (1.8) is that the estimator used matters. For example, the application of the two-step Engle–Granger method, in which symmetry is generally imposed, produces little or no evidence of co-integration – see, for example, Baillie and Selover (1987), Enders (1988), Mark (1990) and Patel (1990) for evidence for a variety of bilateral currencies from the recent floating period (see MacDonald (1995,2006)).