FEER computation: a model based approach.

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Contents

Abstract

A large amount of research has already been produced on calculating fundamental equilibrium exchange rates (FEERs). In addition to purely statistical studies, more theoretical approaches have been suggested, mostly involving partial equilibrium models of trade flows. In this case, the FEER is computed by inverting econometrically estimated trade equations in which output is set at an exogenous potential value and the current account at an exogenous sustainable value. In this paper we describe an alternative methodology involving the use of a full-scale macroeconomic/ macroeconometric model. The adoption of a fully specified model allows reducing the number of exogenous independent assumptions required for the FEER computation. Moreover, within this approach the FEER is simultaneously computed alongside the other endogenous variables in the model. This implies that any possible interaction between the FEER and the rest of the economy is fully accounted for. In this paper, the model based approach to the FEER computation is described in the context of the NIESR's Nigem. This is a multicountry model with separated blocs describing most of the world economies. We consider five blocs only, the US, the UK, Germany (used as a proxy for the Euro Area), Japan and the Visegrad economies bloc. The proposed methodology produces estimates of the FEER for each of these economies; and medium term equilibrium estimates for the sterling/US dollar, euro/US dollar, yen/US dollar and a synthetic Visegrad currency/US dollar bilateral exchange rate.

Key words: medium term, FEER, macroeconometric models

JEL classification: F32, F47

1 Introduction

The concept of "equilibrium exchange rate" is still controversial. A number of possible definitions exist and there is already a vast literature discussing them. Given the timing of monetary policy pass-through, the most relevant definition for policy discussions is perhaps the exchange rate which would prevail if the economy were at its medium term equilibrium[1]. Various possible definitions of medium term equilibrium exchange rate have been formulated. As first introduced by Williamson (1983-1985) and recalled, among others, in Driver et al. (1998), a medium run equilibrium is essentially a flow equilibrium. As consumption and investment decisions tend to be implemented over long periods of time[2], assets dynamics tend to be much longer lived than price dynamics. Therefore while nominal rigidities can be ruled out in the medium run, assets accumulation cannot. A long run equilibrium can then be defined as a stock-flow equilibrium with the medium run equilibrium pictured as evolving towards it.

An analogous way of describing the medium run equilibrium exchange rate is the exchange rate consistent with the economy being at both internal and external balance. Prices and wages flexibility ensures that the condition of internal balance (demand equal to supply) is satisfied. External balance is usually identified with the current account balance being at a "sustainable" level as given by the medium term equilibrium level of foreign asset accumulation.[3] In a world where consumers' assets consist of equities, government bonds and foreign assets, while equities are pinned down by capital accumulation and bonds by the government budget constraint, external balance is required to control foreign asset accumulation.

The concept of medium term equilibrium exchange rate we adopt in this paper as definition of the FEER is analogous to what is known in the literature as NATREX (NATural Real EXchange)[4]. The main difference between Williamson's concept and the NATREX is that while Williamson assigns to his FEER concept a normative value, the NATREX is only a positive concept. The normative value of the FEER predicated by Williamson obtains from the observation that, while independent of monetary policy, the FEER is affected by public savings and investment decisions (as they are components of the current account). For Williamson, therefore, sustainable current accounts are only those implied by an optimal fiscal policy, i.e. those consistent with public savings and investment decisions derived from an optimising behaviour. However, because of the difficulty the quantification of an optimal fiscal policy involves (not least because such a policy would require some sort of international coordination), Williamson reverts to the use of underlying capital flows in his FEER's computations[5]. The NATREX concept, on the other hand, does not foresee the necessity of assuming an underlying optimal fiscal policy. Consequently, our medium term equilibrium exchange rate is more a NATREX than a FEER in Williamson's terms, as it sets fiscal policy (identified by public consumption, investment and revenues) at its historical trend. But, if we argue

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[1] An additional reason for why only medium term movements should be considered, when looking at a fundamentals based explanation of exchange rate movements, is that in the short run exchange markets participants are believed to base their decisions on short run trends rather than fundamentals.

[2] Permanent consumption theory suggests that consumption variability is considerably lower than disposable income variability. On the investment side, adjustment costs are one of the driving factors of the frequency at which investment decisions are taken.

[3] See below for a discussion about the normative value sometimes attributed to the concept of sustainability.

[4] See Stein, J. and al (1995).

[5] Driver and Wren Lewis (op. cit.), on the other hand, provide a methodology for computing sustainable current accounts, involving the use of "likely" and optimal fiscal policies.

that these trends do indeed represent the sustainable fiscal policy, then our medium term equilibrium exchange rate is also a FEER.[6]

Section 2 contains a brief discussion on the computation of FEERs as implied by the definition provided in this introduction. Section 3 recalls some of the theoretical approaches already implemented in the literature to date. Section 4 introduces, discusses and presents some results obtained with the model-based approach proposed in this paper, in the context of NiGEM, the NIESR multicountry model. Section 5 concludes.

2 Equilibrium exchange rate computation.

Given the above definition of medium term equilibrium exchange rate as the exchange rate consistent with the economy being at its internal and external balance, any approach to its computation will reduce to a formalisation of the internal and external balance conditions. In other terms, the medium term equilibrium exchange rate can be computed as solution of the following schematic model:

$$X = Z + \alpha_1(px-wpx) \quad (1)$$

$$M = DD + \alpha_2(pm-p) \quad (2)$$

$$px = \alpha_3\, wpx + (1-\alpha_3)\, p \quad (3)$$

$$pm = (1-\alpha_4)\, wpx + \alpha_4\, p \quad (4)$$

$$X-M = Net\ Sav = Y_S(K,L,TFP) - DD \quad (5)$$

$$pY_d - p_d\, DD + r\, NA = CA_S \quad (6)$$

Eq. 1 defines export volumes as function of world demand and the relative export price. Eq. 2 defines import volumes as function of domestic demand and relative import price. Under the assumption of producer currency pricing, world export prices are defined in US dollar and then transformed in the same denomination as px via the bilateral exchange rate (US dollars per unit of domestic currency): $wpx=px*/e$. Eq. 3 and 4 define export and import prices as a weighted average of domestic prices (p) and world export prices. Notice that in this setting export and import volumes are modelled as function of exporters and importers real exchange rates, in turn proportional to a third independent measure of real exchange rate ($p-wpx$) with coefficient $(1-\alpha_3)$ and (α_4-1) (with α_3, $\alpha_4<1$). Eq. 5 and 6 express the internal and external balance conditions, respectively. Note that if price arbitrage holds, then the two equations represent the real and nominal version of the same balance condition. The above system consists of 5 equations in 5 unknowns (X, M, $(px-wpx)$, $(pm-p)$ and $(p-wpx)$) and its solution provides the medium term equilibrium exchange rate. As this

[6] In Nigem, the model we are going to use for our FEER derivation, fiscal policy is identified by a tax rule which aims at stabilising the deficit to GDP ratio around a target level. Consequently, it can be argued that fiscal policy is indeed optimal in this model in the sense of minimising the public authority loss function.

methodology eventually relates the exchange rate to the fundamentals of the economy, the FEER denomination follows.[7,8]

3 Existing approaches to the FEER computation: a review

"*the shift in emphasis has been in the direction of relying less on ad hoc judgements about equilibrium capital flows, which are difficult to make in an environment of high and rising capital mobility, and more on models of the behaviour of the saving-investment balance over the medium run*".

The above consideration, reported in a recent IMF paper[9], provides a justification to the analysis conducted in this paper. A large number of studies producing FEER estimations are already available in the literature. With reference to the simplified model described at the previous section, these studies can be classified in two groups: those using a partial equilibrium approach (based on a calibrated or estimated version of the above model) and those using a "general" equilibrium approach (based on a detailed description of all the sectors of the economy, in addition to the external sector represented by the model in the previous section).[10] A brief description of the two methodologies and how they compare to each other follows.

3.1 Partial equilibrium approach.

This is the approach used in most of the studies adopting non statistical methods to compute FEERs. It involves computing "off models" estimates of potential output and medium term current account and using them in econometrically estimated static trade equations to produce a path for the FEER. While potential output estimates can be obtained using either a production function approach or purely statistical methods, there are no standard techniques for computing medium term current accounts. One methodology often used is the one first engineered by Williamson (1994) and based on the Blanchard-Fisher intertemporal model of saving and investment. These estimates are inserted into the trade equations, which are then inverted to provide the real exchange rate consistent with internal and external balance.

The major advantage of this methodology is its simplicity and clarity, as it provides a direct relationship between the FEER and the fundamentals of the economy. The methodology, therefore, allows to easily ascertain the causes of the exchange rate over or undervaluation. Given its simplicity, it can also be extended to a multicountry framework, so that, once the estimated FEERs

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[7] Although, for those more close to Williamson's thinking, this requires also the assumption that the medium term fiscal policy included in the domestic demand term DD is optimal (sustainable).

[8] Notice that this model does not necessarely exclude PPP. In other terms, the CPI based real exchange rate can well be assumed to be stationary (i.e. p*=e p, with p* denoting foreign prices), without restraining the importers and exporters based real exchange rate from moving.

[9] Isard P. et al. (2001).

[10] The denomination "general equilibrium approach" can be controversial, depending on the judgement about the degree of specificity accruing the models in use. Alternatively, the approach could be denominated "large model based approach". In addition to these structural methods, reduced form methods should also be mentioned. They rely on cointegration or other purely statistic techniques to find a relationship between the FEER and a set of fundamentals.

for the set of countries in consideration have been computed, it is possible to derive bilateral "equilibrium" exchange rates (using the arbitrage condition). This approach has however a number of shortcomings. First, using potentially unrelated values for medium term potential output and current account can produce inconsistencies in the results[11]. Second, as these values are treated as exogenous, this approach prevents the FEER feeding back into the model, as it is indeed an output of the model. In other words, none of the effects the FEER is expected to have on both medium term output and current account are taken into account or embedded in the computation.

3.2 Model based approach.

This is the approach used in this paper. It makes use of a full macroeconomic/macroeconometric model to compute FEERs. The model could be describing a small open economy, with external variables simply exogenous to the model, or it could be a multicountry, global model of the world economy. The approach has already been implemented in a number of studies using macroeconomic models (see for example Barrel et al. (1991), Church (1992), Bayoumi et al. (1994)). However, it is relatively new in the context of a macroeconometric model: see for example Detken et al. (2002) for an application to the AWM model. The strategy followed in this last type of studies involves solving the model in use for a long enough number of periods in the future until it has reached its medium run equilibrium. The methodology produces a value for the FEER identified by the real exchange rate value at the end of the simulation period. The major requirement of this approach is for the model in use to have a well-defined equilibrium. Additionally, this method delivers a value for the FEER over future periods only. On the contrary, the methodology outlined in this paper allows also an analysis of the FEER from an historical perspective. Historic FEERs can be defined as the equilibrium exchange rates which would have prevailed in the economy in the absence of business cycles and shocks. To produce this result, the methodology outlined in this paper requires the use of a model specified in medium terms. If using an existing macroeconometric model, its medium term analogue must be first derived.

The advantages/disadvantages of this approach are opposite to those of the partial equilibrium approach discussed above. When using a model based methodology, medium term potential output and current account appear as endogenous variables in the model and therefore are consistent with each other and influenced by the FEER. The shortcomings of this approach are that it relies on specific models of the economy and therefore the computed FEER is indeed the equilibrium exchange rate conditional to the model assumptions. Furthermore, given the scale of the models in use and their usually high degree of recursivity, it could be difficult to understand the causes of any computed misalignment. Nevertheless, this approach allows conducting simulation exercises, which can be adopted to improve understanding of the determinants of the observed appreciation or depreciation over a certain time horizon. Furthermore, it can be argued that this method delivers more reliable FEER forecasts as it only uses projections which are usually computed and used as input in the normal forecasting process. To reiterate, to produce a FEER forecast, an independent stance/judgement has to be made only on variables which are of "second order" of importance with respect to potential output and current account.

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[11] However, some sensitivity analysis can be conducted to rule out this risk.

4 FEER determination within Nigem.

Nigem is the quarterly model of the National Institute of Economic and Social Research (NIESR). It is an estimated model of the World economy consisting of individual blocs describing each of the OECD economies, while the rest of the world is divided in a number of regions. For our analysis, we concentrate on the UK, the US, Japan, Germany and the Visegrad economies[12] blocs, while the rest of the world is taken as exogenous. The structure of the model is mostly symmetric across blocs.[13] The individual blocks are linked via a set of accounting identities guaranteeing consistency at the world level both in terms of trade and financial assets. The model is characterised by a neoclassical steady state with superimposed nominal rigidities and both forward looking and backward looking expectational dynamics. Specifically, consumers are backward looking, with consumption reacting to current and past incomes and net financial wealth. But wage bargainers are assumed to form forward-looking expectations. And financial market variables, such as long rates, exchange rates and equity prices are also forward looking. This brings the consequences of future events forward, thus affecting household behaviour. Fiscal and monetary policy rules close the model. The major economies are modelled using a minimum of 60 up to a maximum of 90 equations, of which approximately 20 are key behavioural equations, specified in the form of ECM type of equations. The model is widely used at the Institute and various private and government institutions (as well as Central Banks) both for forecasting and simulation purpose.

The model-based approach to the FEER computation discussed above is here applied to a modified version of the 2002q4 version of Nigem. For sake of simplicity, we consider only a subset of the model equations, namely those directly involved in the FEER computation, and treat any other irrelevant variables as exogenous. Our "reduced" version of the model therefore includes equations for import and export volumes and prices, consumption and investment volumes, CED deflator and potential output. The public sector is treated as exogenous as are also foreign assets and interest payments from abroad.

4.1 Construction of the medium run analogue model

Given our definition of FEER as the real exchange rate prevailing when the economy is at its medium run equilibrium, the first step in the FEER computation is the determination of a medium term analogue of Nigem. As the definition of medium run we adopt is one of flexi-price equilibrium, the underlying assumption we make is that inflation is at its expected level over the medium term horizon and output is at its potential level. Consequently, monetary policy is neutral and both nominal and real interest rates are exogenous.

To derive from a short run model its medium term analogue, it is necessary to eliminate all cyclical elements from the dynamic model. This involves elimination of the dynamic terms from the pricing equations[14] as well as elimination of the cyclical elements contained in the exogenous variables.

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[12] In Nigem, the bloc includes Poland, Hungary and Czech Republic.
[13] The Visegrad economies bloc, which includes the three largest accession countries, has a different structure with respect to that of the major economies blocs. In particular, there is no explicit supply side model or model of private consumption.
[14] According to the definition of medium term, those in the asset equations should be preserved.

Regarding the exogenous variables, their respective medium term value is defined as the trend extracted using a HP filter. Thus, setting the exogenous variables at their trend allows extrapolating from any volatility related to the cyclical factors embodied in these variables.

The equations in the medium term analogue of Nigem are of two types: accounting identities, taken directly from the dynamic model, and the long run relationships implied by the ECM equations used in Nigem. The constant terms in the non-identities equations are recomputed imposing a constant steady state growth rate for the variables in the dynamic part of these equations. Notice that, contrarily to the definition of medium run given at the previous section, asset dynamics are not formally included. Rather, we simplify these dynamics in the following way: whereas asset dynamics in the conventional sense imply for the accumulating asset in consideration a growth rate changing over time, we assume a constant growth rate. This is computed as an average of the historical growth rates. Therefore, the fact that, in our model, real (respectively nominal) variables do not necessarily increase at the same rate implies that this is *de facto* a model of the medium run of an economy. Furthermore, our model can be easily transformed in a model of the long run of an economy by simply imposing the identity between the growth rates, in line with conventional growth theories[15]. This is one of the advantages of adopting this simplified definition of medium run[16].

4.2 The role of the residuals.

Two types of residuals have been added to the equations of the medium term model. The first are the residuals on the original Nigem equations (from now onwards, we will refer to them as dynamic residuals). They account for model misspecifications, in general, and for any breakdown of the equations, in particular[17]. In the medium term model their status is one of unexplained exogenous variables. Consequently, their medium term value is assumed to be the trend extracted with the HP filter.

A second type of residuals is added to the medium term equations to ensure that the medium term analogue model fits exactly the data (from now onwards, we will refer to them as medium term residuals). Thus, given that, when accounting for the dynamic residuals, the original Nigem model describes exactly the UK economy, the medium term residuals represent the difference between the dynamic and the medium term model. Setting them to zero, therefore, allows switching from the dynamic to the medium term model, as they account for the cyclical factors related to the flow dynamics (which need to be absent in the medium term model).

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[15] According to conventional growth theories, in the long run all real variables grow at the same rate. The same holds true also for the nominal variables. This is equivalent to say that all ratios are constant. Consequently, to obtain estimates for the long run equilibrium value of the various variables from our model it is sufficient to set the exogenous ratios to their constant long run value.

[16] A version of the medium term model including assets dynamics has also been produced. The profile of the computed FEER is broadly unchanged.

[17] Nigem is not regularly re-estimated, with some equations last estimated as late as in 1996. This implies that some of these residuals are indeed large.

4.3 Determination of the FEER.

The key equation in our model is the one determining the relative price of import (relative to domestic prices). It is obtained by inverting the import equation with the net trade ratio set at its medium term level. In contrast to the partial equilibrium approach, no priors need to be formulated about the medium term values of this ratio, as it is endogenously determined by the model as a function of domestic demand and exogenous factor costs adjustments. Thus, any exogenous shock to domestic demand would affect both the trade balance and the real exchange rate.

An equivalent and alternative approach involves computing the FEER as the real exchange rate that reconciles the current account ratio with its medium term value. Notice that this definition is the one usually adopted in the partial equilibrium approach to the FEER derivation. As the GDP accounting identity holds in Nigem in both real and nominal terms, the two approaches produce the same result.

The medium term model[18], derived from the original (dynamic) version of Nigem by eliminating the dynamic terms and imposing the identity between the net trade (or current account) ratio and its medium term level, matches the historical data due to the inclusion of the medium term residuals. To produce a FEER, it needs to be solved in a "medium term mode". This involves a sequential implementation of the following steps:

a) Switching off the cyclical elements embedded in the exogenous variables. This is done by substituting the medium term value of these variables to the historical data.

b) Switching off the cyclical elements embedded in the dynamic residuals.

c) Setting the medium run residuals at zero. As these residuals capture the cyclical elements which constitute the difference between the dynamic and medium term models, this third step *de facto* delivers the FEER.

The advantage of this step methodology is that it allows differentiating between the impact that the "structural" cyclical factors and the cyclical elements embedded in the exogenous variables have on the FEER. This type of analysis confers to the model based approach described in this paper a degree of accuracy and an informative value superior to the one provided by the partial equilibrium approach.

4.4 Results.

Over the second half of the nineties, the real exchange rates for the set of countries in consideration have been characterised by very strong trends. Over the period 1995q3-2000q4, the importers based real exchange rate has appreciated by 22% in the US and 19% in the UK; and it has depreciated by 5% and 18% in Japan and Germany, respectively. Over the 1990s the Visegrad economies have experienced strong appreciating exchange rates.[19] To the extent that the FEER is a medium term attractor for the real exchange rate, the FEER analysis is potentially very useful for understanding the

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[18] A full equation listing is available from the authors on request.

[19] Nigem computes an aggregated real effective exchange rate for the Visegrad economies group by weighting together the real effective exchange rates of the country members. The weights used are 1995 PPP weights.

nature and causes of real exchange rate movements. If the FEER shows the same appreciation (depreciation) as the real exchange rate, then it is possible to conclude that the real exchange rate trends are due to structural rather than cyclical factors. Consequently, the question of what has determined the real exchange rate appreciation or depreciation over the second half of the nineties becomes a question about the determinants of the FEER appreciation or depreciation.

In this section we present the results of the FEER analysis based on the model-based methodology described in the previous section in the context of Nigem. A simple way of summarising the three-steps procedure described above is that it consists in a gradual elimination of the effects of the cycle from the historical real exchange rate series so that what is left is exactly the FEER.

Charts (1a) to (1e), (2a) to (2e) and (3a) to (3e) plot the real exchange rate together with its medium term value obtained by solving the model via implementation of steps (a), (b) and (c) above, respectively, for each of the countries in consideration. Chart (4) contains a plot of the real exchange rate misalignment. Charts (5a) to (5d) contain the model implied estimates of the medium term sterling/dollar, DM/dollar and Yen/dollar bilateral exchange rates, together with a plot of the euro/sterling bilateral exchange rate[20]. The synthetic bilateral dollar exchange rate for the Visegrad economies defined by Nigem is plotted in Chart (5e) together with its medium term value as implied by the model-based methodology proposed in this paper. The baseline we use includes historical quarterly data for the period 1991q3-2002q3 and NIESR forecasts from then up to 2010q4. The choice of the starting date originates from the need of eliminating the distortionary impact of the German reunification. Over the forecast period, the real exchange rate is assumed to maintain approximately its appreciating trend, in the US and UK, and its depreciating trend in Japan and Germany[21].

More in detail, charts (1a) to (1d) show the effect of setting the exogenous variables at their medium run. At this stage, the solution of the model ("xxRPM_MT_EN exog@mt") is still conditional to the cyclical elements contained in the dynamic and medium run residuals. Charts (2a) to (2d) show the solution obtained when Nigem's equations misspecifications are accounted for (the dynamic residuals are set at their trend). Finally, charts (3a) to (3d) show the effect of removing the remaining cyclical elements contained in the long run residuals, i.e. the FEER (denoted "xxRPM_MT_EN feer"). The FEERs profiles, given the absence of any impact from the cycle, are smooth.

The real exchange rate misalignments in Chart (4) show that, according to our analysis and subject to the assumption formulated to derive the medium term model, the period of sustained depreciation in the UK during the first half of the nineties was due to cyclical factors, with 1996 identified as the year when the real exchange rate returned to its medium term level. In the US the real exchange rate appears to be overvalued over most of the sample, the exception being 1995q3. The overvaluation is also predicted to be overturned as from 2002q3. The Japanese real exchange rate appears to have been overvalued over the first half of the nineties and largely undervalued over the second half. From 1999q1 onwards (with the exception of 2002q1), it has been constantly overvalued. As for Germany, the real exchange rate appears to have been undervalued over most of the period since 1996. Finally, the synthetic real exchange rate of the Visegrad economies appears to have been characterised by

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[20] The Euro/sterling bilateral exchange rate is computed using the DM/dollar and sterling/dollar exchange rates and the entry rate for the DM (1.95583 DM/€).

[21] In the charts, we plot the FEER over the period 1993q3-2005q4 only. This is done as a way of dealing with the initial and terminal conditions problem of the two sided HP filter we use to smooth the exogenous variables.

two overvaluation periods, the first lasting until 1997 q3 and the second lasting one year, from 1998 q2 until 1999 q3. Since then, the exchange rate appears to have been mostly undervalued.

Given the high sensitivity of FEERs estimates to the hypotheses underlying their computation, a comparison of our results to those provided by other studies is quite difficult. Table A compares the average bilateral exchange rates overvaluation over the year 2000 we have derived in this paper with the one computed in Wren-Lewis (2003). Whereas Wren-Lewis finds that all the exchange rates (euro/dollar, sterling/dollar, sterling dollar and euro/sterling) were undervalued[22], we find this was true only for the euro/dollar and euro/sterling exchange rates. The sterling/dollar exchange rate appears to have been approximately at the equilibrium, while the yen/dollar exchange rate was overvalued.

Notice that our results concerning the FEER value for the euro compare well with those derived in other studies. We find indeed that the euro was approximately 6.5% undervalued in 2000 compared to an undervaluation in the range of 5-27% as reported by Detken et al. (2002).

4.5 What determines FEER's movements?

4.5.1 US and UK

In this section, we conduct a simulation study to identify the determinants of the observed patterns in our computed FEERs. A commonly accepted explanation for the strong UK and US real exchange rate appreciation observed in the second half of the nineties is that it was due to the surge in financial wealth brought about by expectations of future large productivity growth. This is considered to have produced a sharp rise in the US and UK domestic demand relative to supply, causing an increase in their respective price levels and consequently the large observed appreciation. To see if this wealth based explanation is confirmed by our model-implied FEERs, we compute the FEERs which would have prevailed had net wealth both in the UK and the US grown less than it did in the post-1996 period (see charts (6a) and (6b) where we plot the historic net wealth series, their medium term value used in the FEER computation and the shocked series[23,24], for the US and the UK, respectively). As shown in charts (7a) to (7d), as effect of the lower real wealth, the FEER appreciation would have been considerably reduced in the US and the UK: over the period 1996q1 to 2002q4, the average rise would have been of 17% (instead of 24%) for the US and 10% (instead of 12%) for the UK. At the same time, the Japanese depreciation would have been considerably weaker (from an average of 17% to just 4%, over the period 1996q1 to 2002q4); but the German one marginally stronger (from an average of 8% to 9%, over the period 1996q1 to 2002q4). This result suggests that, while the

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[22] The results discussed here are those referred to by Wren-Lewis as "base case" (Table 4.3, p.36). Other results, obtained by changing some of the assumptions regarding the sustainable current accounts, are partly closer to our estimates.

[23] The shock we apply is a gradual fall in net wealth starting in 1995q3. From 2000q3 onwards, the shock applied is a 10% permanent fall.

[24] In Nigem, it is assumed that each economy produces only a single tradable good, which is either domestically consumed or exported. The absence of non-tradable goods implies that it is not possible to use the model to validate a Balassa-Samuelson explanation to the real exchange rate appreciation. In other terms, a positive productivity shock in Nigem always produces a depreciation of the exchange rate, as the supply response is quicker and more intense than the demand response, requiring a current account improvement to restore the equilibrium. A possible way of reproducing the type of real exchange rate responses suggested by the Balassa-Samuelson effect is by implementing a demand shock consistent with the demand response to a productivity shock.

Japanese depreciation was largely driven by external factors, the strength of demand in the US and the UK has had a positive effect on the German economy.

4.5.2 Visegrad economies.

The effects of a productivity shock in the US and the UK on the synthetic FEER for the Visegrad economies are negligible (see Chart (7e)). However, there is currently a considerable interest about the determinants of the strong real exchange rate appreciation observed throughout the nineties in the accession countries in general and the Visegrad economies in particular. Econometric studies suggest that the main causes are the productivity gains experienced by these countries in the tradable sector.[25] Furthermore, as many of these countries have a productivity level below that of the most advanced economies, these countries are also likely to continue experiencing further transition-specific productivity gains for still some time. Thus, it is reasonable to think that this appreciation could persist over the immediate future, implying that an increase in inflation could be expected, given that these countries exchange rates are pegged to the Euro. In turn, this could affect these countries qualification of the Maastricht entry criteria.

For most accession countries, limited data availability implies that econometric studies may be inconclusive and should be supported with alternative types of analysis.[26] To this extent, the model-based approach to the FEER determination proposed in this paper can be particularly useful not only to get a time varying equilibrium exchange rate consistent with the economic innovations experienced by these economies as modelled in Nigem, but also to test whether the observed real exchange rate appreciation in the Visegrad economies is the result of a catching up phenomenon.[27] Taking into account the limitations of Nigem in general and those related to the Visegrad economies bloc in particular[28], we simulate what the FEER would have been had these economies not experienced a sharp increase in productivity over the nineties via implementing an external shock to the residual on the aggregate supply equation (see Chart 8a). Chart 8b shows that the appreciation would have indeed been delayed until late 1998s, thus confirming our prior.

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[25] See for example De Broeck et al. (2001).

[26] Fernandez et al. (2003) have recently discussed the possibility that a 2-steps panel estimation approach could be a solution to the limited data availability problem. The methodology they examine involves estimating the long run effect of productivity and economic development (expressed in terms of GDP per capita) on the real exchange rate using a Pooled Mean Group Estimator approach applied to 25 OECD countries. These long run elasticities, together with the appropriate intercept parameter, are then used to compute the equilibrium exchange rates for the accession countries.

[27] Coudert et al (2002) also use Nigem in their calculation of FEERs for the accession countries. They extract trade elasticities from the model and use them to construct a trade model. In accordance with the partial equilibrium methodology discussed earlier on, Coudert et al's FEERs are then computed by inverting the trade model under the assumption of exogenous output gap and sustainable current account. Barrel et al. (2002) use Nigem forecasts to specify paths for all the variables which are exogenous to the model they use for the FEER computation.

[28] In the literature, it has been argued that that the equilibrium exchange rate appreciation experienced by many accession countries is the result of a Balassa-Samuelson type of effect, that is of a higher productivity growth in the tradable sector with respect to the non-tradable sector. In Nigem, it is not however possible to verify this hypothesis as the model assumes that each country produces only one tradable good. Furthermore, there is not an explicit production function in the Visegrad economies bloc.

4.6 From the medium to the long run.

As recalled earlier, the model based approach to the FEER computation can also be used to derive long run equilibrium real exchange rates once all the exogenous variables are assumed to grow at their long run growth rate. Consequently, the long run real exchange rate is computed conditional to the assumed values for these rates. Setting these rates at their average value over the period 1993q3-2005q4 produces an estimate of the long run equilibrium exchange rate underlying the economy over that period. Charts (9a) to (9d) plot the long run real exchange rate along with the medium run reported in the charts (3a) to (3d) and the historical real exchange rate. The deviations of the FEER from the long run equilibrium so computed can be explained in terms of deviations of the exogenous variables (or rather their medium term level) from their average value over the period in consideration.[29] Table B reports the average implied overvaluation over the period 2002-2005 with respect to the medium and long run equilibrium real exchange rate for the four countries[30]. Based on the assumption that the "state of the world" remains unchanged with respect to the one forecasted in 2002q4, these estimates provide an indication about the future developments of the real exchange rate over the medium and long run.[31]

5 Conclusions and further research.

In this paper, a model-based methodology for computing FEERs has been illustrated and applied to the NIESR's Nigem. Although the path obtained for the FEER is function of the model in use and its assumptions, the methodology is general and allows for differentiating the misalignment in cyclical factors and model related uncertainty. This, together with the simultaneity between the FEER and the demand/supply components which characterises the full-scale models of the UK, US, Germany, Japan and Visegrad economies included in Nigem, represents the main advantage of the model-based approach with respect to the partial equilibrium approach. An additional advantage is that the model-based methodology can be easily extended to allow for the determination of the long run equilibrium exchange rate.

However, it is necessary to point out that, whatever the method in use, any quantitative analysis of FEERs is bound to produce results which are strictly dependant on the formulated assumptions and therefore need to be interpreted with a significant degree of judgement when used for policy assessments.[32] The same degree of judgement has to be applied when evaluating the information content of any computed misalignment.

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[29] This analysis, which would provide further information about the determinants of the FEER (and, consequently, the real exchange rate) appreciations/depreciations, is part of our future research project.

[30] Notice that, as the version of the model we use is version 2002q4, these average forecasts are based on the forecasts for the exogenous variables as made in 2002q4.

[31] It is important to stress that, given the way the FEER and long run equilibrium exchange rate computations are implemented in the context of the model-based approach, their paths can never differ widely from the actual real exchange rate path. Therefore, if the model-based methodology is implemented for forecasting purposes, it is essential to refer always to the latest available forecasts on the exogenous variables. Consequently, the figures in Table A were only accurate at the time of the 2002q4 forecast.

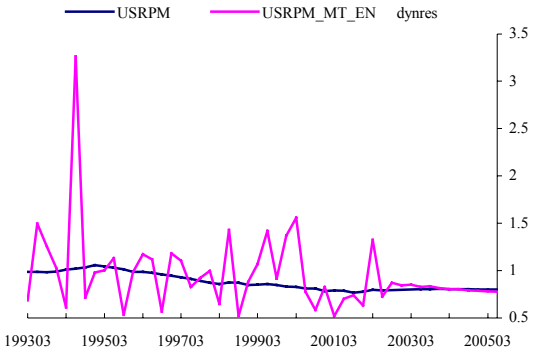
[32] Notice that a similar point applies also to the partial equilibrium approach as well as to more econometric methodologies. Furthermore, the dependency on the hypotheses is magnified by limitations in data availability as in the case of the Visegrad economies. To this regard, Barrell et al (2002) compute FEERs "corridors" rather than point estimates for the accession countries.

The aim of this paper was to describe the model based methodology rather than provide FEERs forecasts. To compute them we would need to use more up to date versions of the model, as well as carefully evaluate the projections for the exogenous variables. Further research on the model-based approach to the FEER computation will involve designing and running sensitivity tests to assess the impact of the assumptions required by the methodology on the results (for instance, testing the sensitivity of the FEER profile to the use of the HP filter to eliminate the cyclical elements embodied in the exogenous variables).

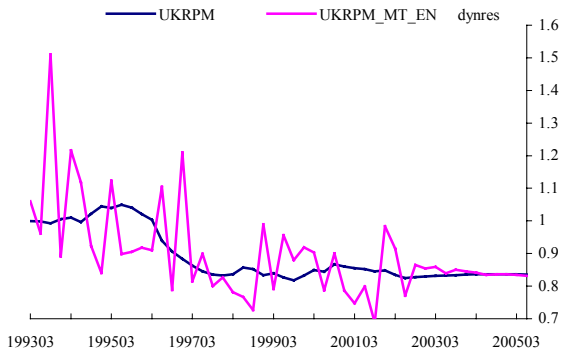
Appendix: Charts and tables.

Chart 1: Real exchange rate computation – setting the exogenous variables at their medium term level.

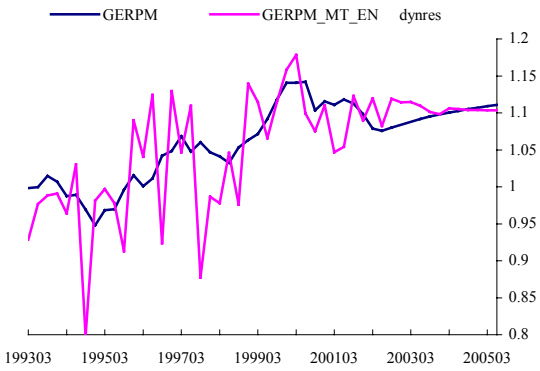
1a: US



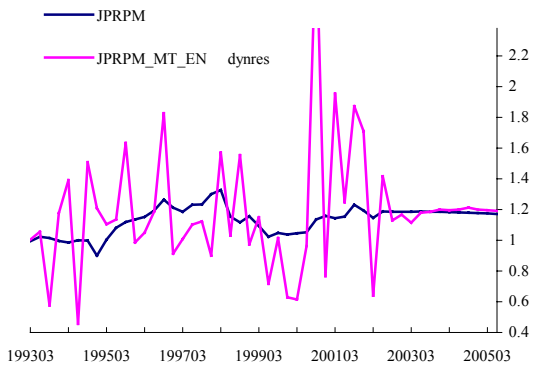
1b: UK



1c:Germany



1d: Japan



1e: Visegrad

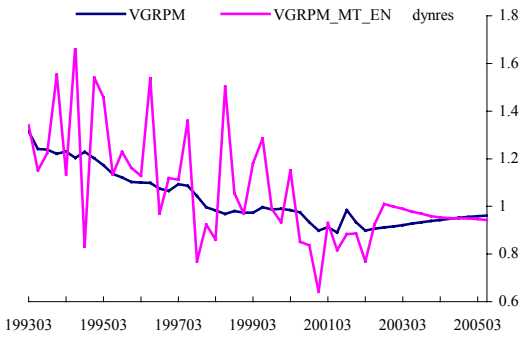
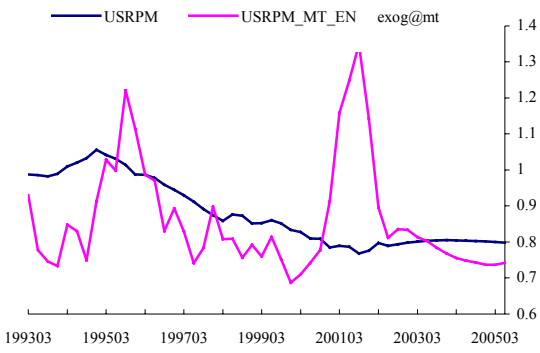
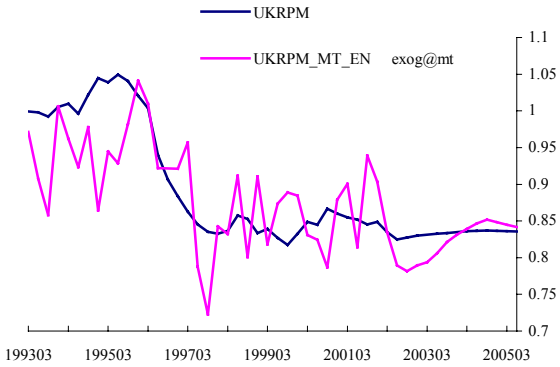


Chart 2: Real exchange rate computation – setting the dynamic residuals at their medium term level.

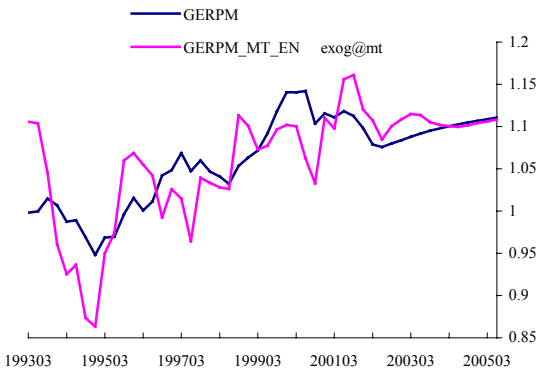
2a: US



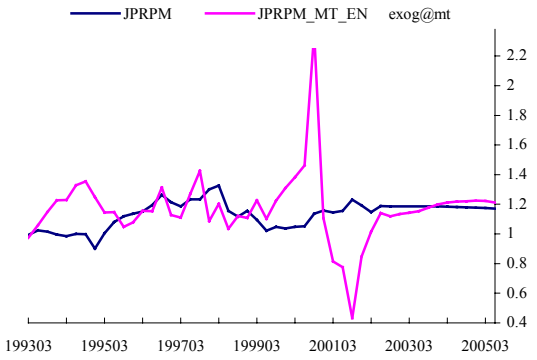
2b: UK



2c:Germany



2d: Japan



2e: Visegrad

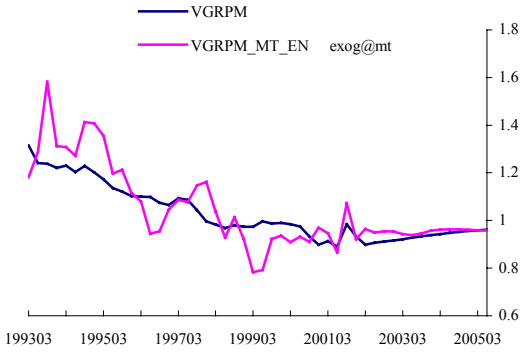
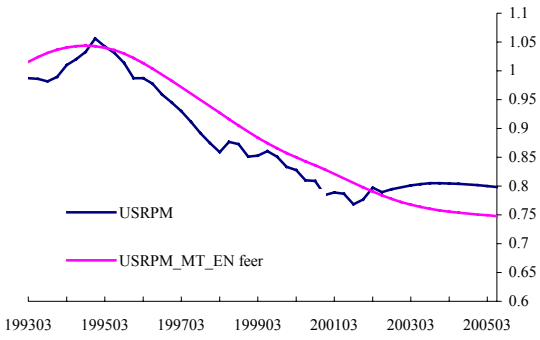
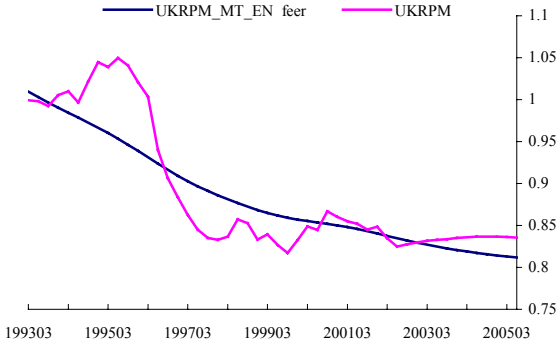


Chart 3: Real exchange rate computation – historic values and FEER.

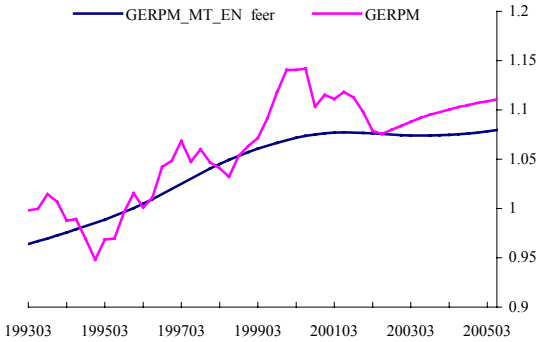
3a: US



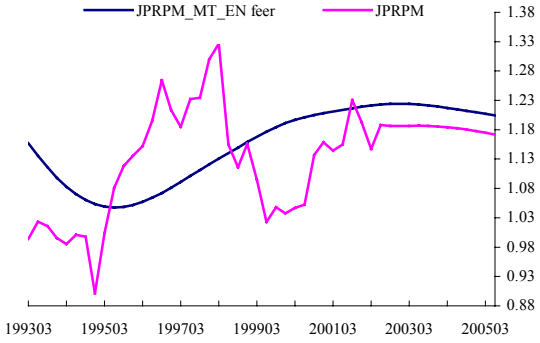
3b: UK



3c:Germany



3d: Japan



3e: Visegrad

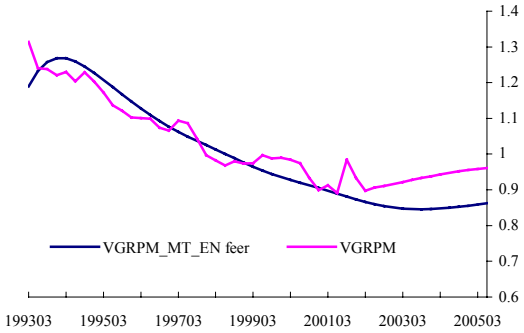


Chart 4: Misalignment – historic values minus FEER.

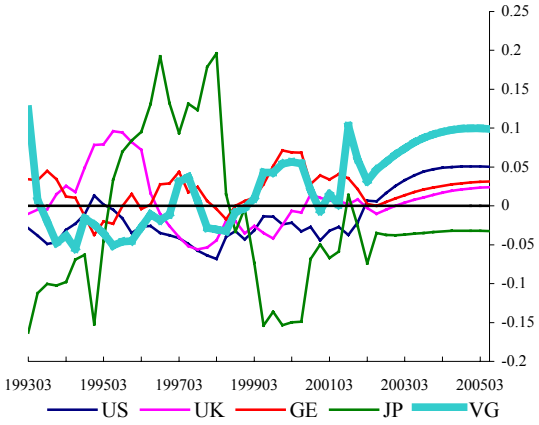
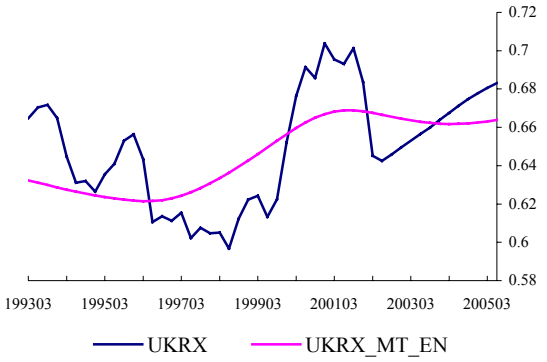
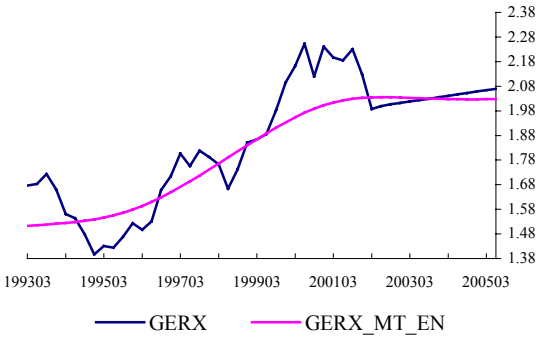


Chart 5: Medium term bilateral nominal exchange rates.

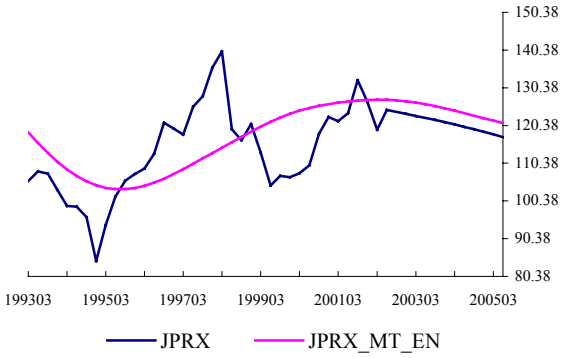
5a: Sterling/dollar



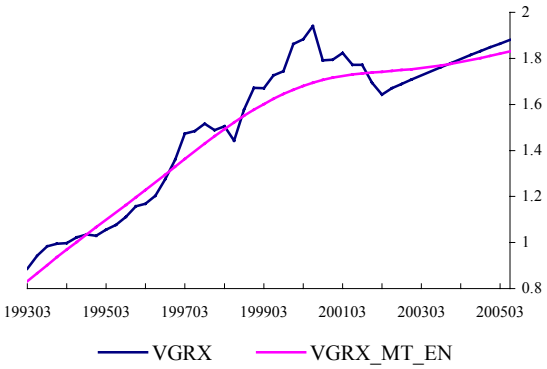
5b: DM/dollar



5c: Yen/dollar



5d: Synthetic Visegrad rate vs dollar



5e: euro/sterling

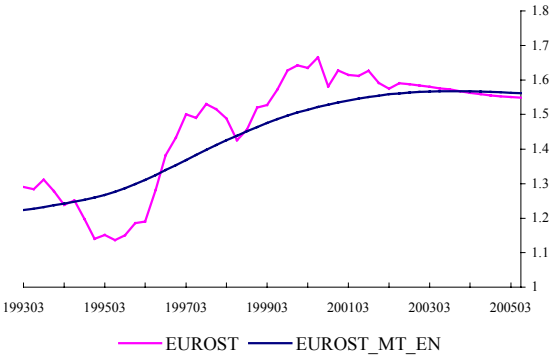


Chart 6: An exogenous net wealth shock in the US and UK.

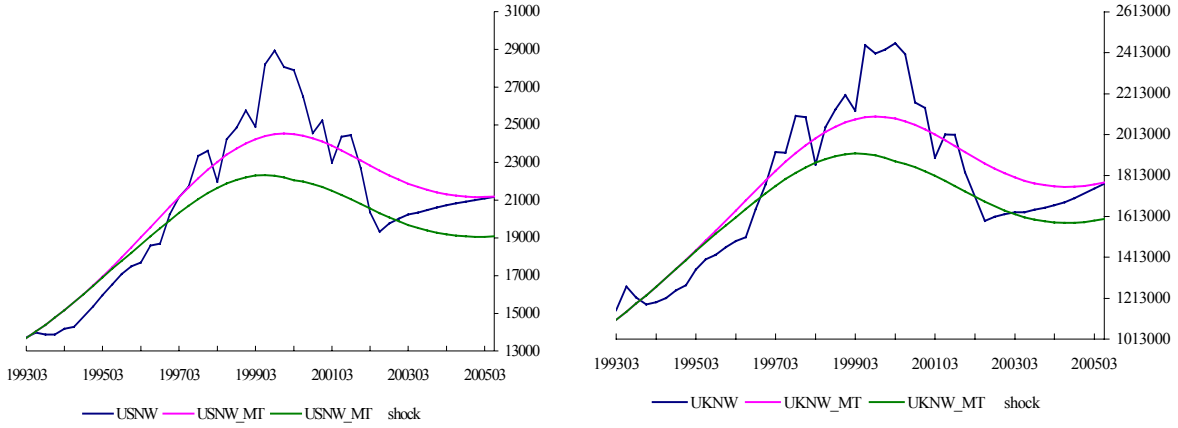
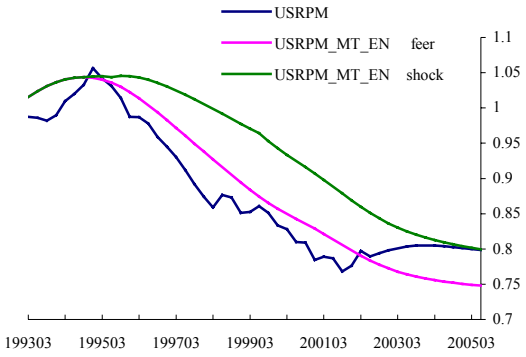
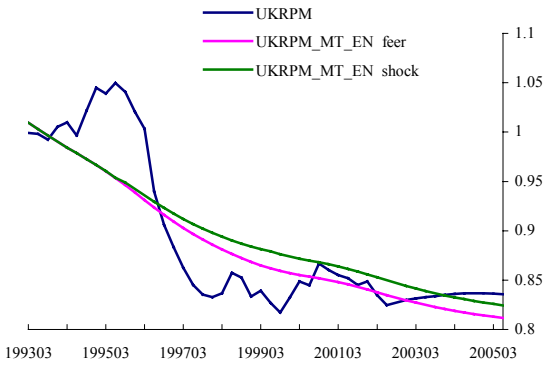


Chart 7: Impulse response to a combined US-UK net wealth shock.

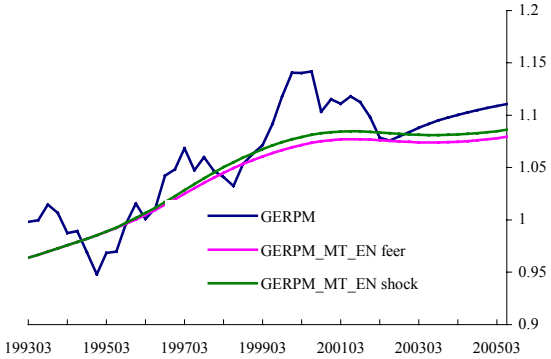
7a: US



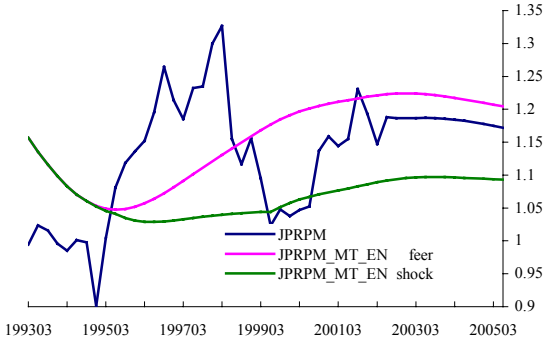
7b: UK



7c: Germany



7d: Japan



7e: Visegrad

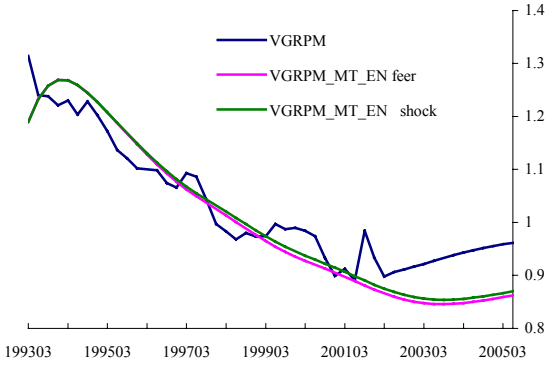
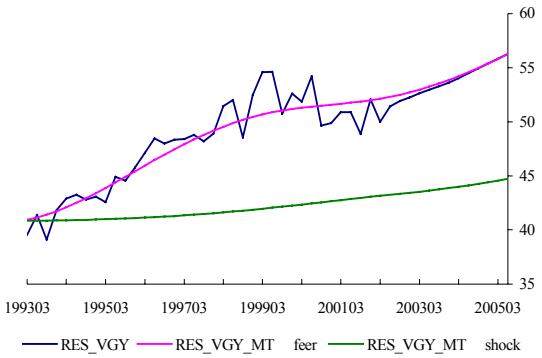


Chart 8: Impulse response to a productivity shock in the Visegrad economies.

8a: Productivity shock in Visegrad economies



8b: Impulse repsonse to the productivity shock

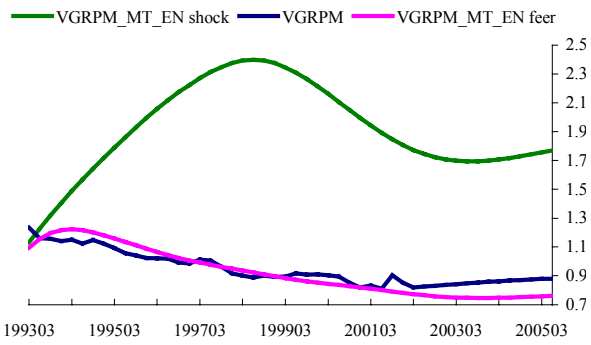
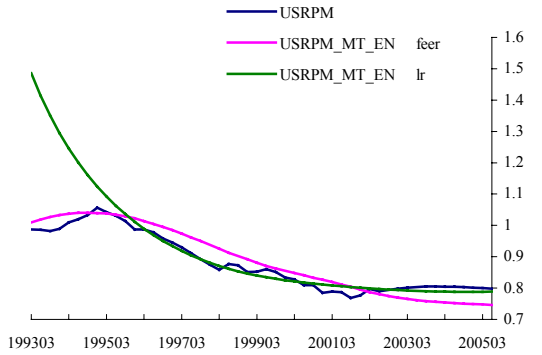
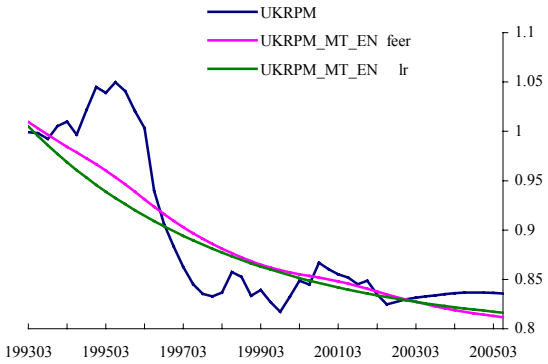


Chart 9: Short, medium and long run real exchange rate

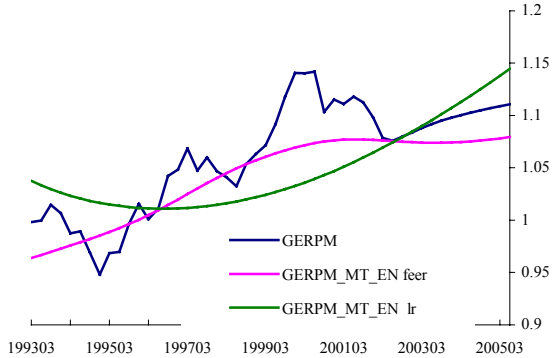
9a: US



9b: UK



9c: Germany



9d: Japan

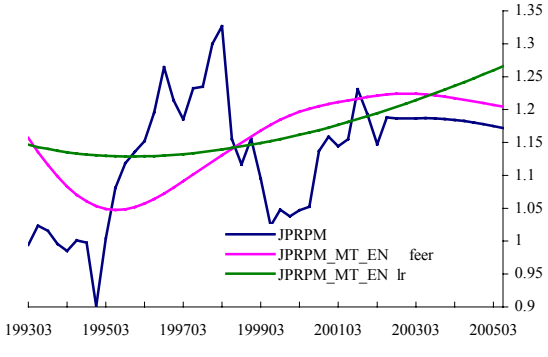


Table A: Average medium run bilateral exchange rate overvaluation in 2000 (in percentage)

	This study	Wren-Lewis (2003)
Euro/dollar	9.284854	27.90698
Sterling/dollar	0.404937	9.52381
Yen/dollar	-12.93891	8.571429
Euro/sterling	8.819446	16.05839

Table B: Average medium and long run overvaluation for the period 2002-2005 (in percentage)

	MR overvaluation	LR overvaluation
US	4.98	5.85
UK	0.86	1.21
Japan	-0.73	-3.23
Germany	1.46	-0.32

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