Modelling Eastern Europe currencies in the run-up to joining the EMU

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Abstract

We make an attempt here to model and estimate the long run equilibrium value (PPP) for the currencies of the main converging countries (Czech Republic, Poland and Hungary). In order to do so we also consider in our model the effects on the long run equilibrium value of the productivity differentials and of the investment flows towards the converging economies. The issue is important under various respects: that of monetary policy along the converging path to EU and EMU, and that of the availability of a benchmark level when the exchange rate has to be fixed at the date of EMU entry.

Our estimations suggest, among many other things, that in the case of Poland the cost of carry is the main driver for the exchange rate, that the forint is still undervalued and that markets have very little doubts about Czech convergence.

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1. Introduction

The Purchasing Power Parity (PPP) hypothesis is probably one of the simplest and most controversial models of exchange rate determination. In its extreme version, it states that the equilibrium exchange rate between the currencies of any two countries equals the ratio of the two countries price levels[1]. For this reason it has almost always been referred to as an indicator of the long run equilibrium exchange rate. However, empirical literature is rich in results that do not fully support PPP. Various reasons have been put forward to explain this lack of empirical support: Balassa (1964) and Samuelson (1964) argue that productivity differentials between countries characterised by very different degrees of economic development cause a growing divergence in price dynamics, while Dornbush (1976) suggests that the presence of international capital markets and flows of capital can result in substantial departures from PPP. Furthermore, it is well known that PPP can fail because of the heterogeneity of the baskets of goods considered that hinders the perfect substitutability hypothesis on which PPP is based.

The issue of the long run equilibrium level for the exchange rate, and the effects on it from productivity differentials and international capital markets appear to be very relevant for countries of Central Europe. First of all, the gradual, and at the current stage almost irreversible, integration of countries like the Czech Republic, Poland and Hungary with the European Union has been favouring a substantial growth of trade between the two areas; second the stability of the governments in the area and the prospective Eastward enlargement of the EU in 2004 has attracted the attention of many investors that have channelled enormous flows of capital to Central European countries and markets. Finally, the commitment of prospective EU members to EMU after 2006 has, at least, two important implications related to some

[1] This intuition was already in Cassel's work of 1922: Money and Foreign Exchange after 1914.

concept of long run equilibrium value for the exchange rate. First, macroeconomic policies in Central European countries have to come to terms with the convergence process that entails, among other things in the long run, a convergence of interest rates to core European levels and, second, EMU membership poses the issue of choosing, some time down the road, an appropriate entry level for the exchange rate to the €. The first issue has enormous spill-over effects on the exchange rate, as the "convergence game" that most investors have played in the past with Italian and Greek bonds, has now become very trendy with Hungarian, Polish and, to a lesser extent, Czech fixed income products. The impact that the "convergence game" has had so far on Central European local currencies is very evident just by looking, for instance, at the sharp appreciation of the Hungarian forint that, in the recent past, has been moving at the strong edge of its ±15%-wide band. Furthermore, the fast productivity growth of the post transition period in Central European countries might well be consistent with a higher inflation rate and a stronger currency than in core Europe. This could obviously have important implications when the political decision about the EMU entry level of the exchange rate has to be made in a such way that does not raise major criticisms neither in core Europe, nor among new comers. Thus, a good and reliable estimate of the PPP value for the major currencies of Central European economies, that takes into account also the impacts of productivity and capital markets, could serve the purpose of having a long term benchmark.

2. A theoretical framework

In this section we elaborate more, from a theoretical point of view, on the main issues raised in section 1.

In his classic path breaking paper of 1976, Dornbush explains how the different speeds at which assets, driven by expectations, and commodities prices tend to adjust after a shock, can account for an "overshooting" of the exchange rate. This phenomenon causes a substantial, temporary deviation of the exchange rate from its stable, long-run equilibrium. For this reason it might be important to consider, in a model of PPP estimation, the short run effects of asset markets that, in the case of converging countries, can probably be approximated by interest rates. As Johansen and Juselius (1992) put it, excluding interest rates from a model of PPP "...would result in a model where the important short-run effects from the asset markets measured by the interest rates would not be accounted for, thus possibly invalidating the estimation of the long-run PPP".

As to the Balassa-Samuelson effect, theory suggests that productivity growth tends to be higher in the tradable goods sector than in the non-tradable one, and that this bias is higher in high-income countries. This tends to cause higher CPIs in wealthier countries and rising CPIs in fast growing ones, since high productivity growth in the tradable sector will push up wages in the entire economy, increasing the relative price of non-traded goods. Furthermore, the theory suggests, and Marston (1987) finds empirical evidence in the case of Japan and the US, that the currency of the country whose productivity grows more tends to appreciate in real terms against that of the country whose productivity grows less. Thus, in terms of expected results, one can say that, after detecting and checking for a long run relationship purely based on price levels differential, by considering also productivity differentials, we should find that the "augmented PPP" relationship is consistent with a stronger exchange rate.

3. Data and methodology

Our main purpose is to look for evidence of the long-run or structural determinants of the exchange rates under scrutiny. We therefore make use of prices (CPI), productivity (PROD) and interest rates (IR) as the explanatory variables. Prices – in the form of consumer price indices - are used to test the validity of the PPP hypothesis, while productivity is considered in order to check for the existence of any Balassa-Samuelson effect. Productivity data are obtained as the ratio between industrial production and employment figures (Ėgert, 2002), so as to get homogenous series. Productivity data have been smoothed with a 12-month moving average filter in order to reduce the volatility of the series, but this has not altered the final results. Finally we add short-run three-month interest rates to take into account the impact of the positive carry with respect to Euroland on financial flows movements.

All variables are expressed as differentials between the Euro Area and the Converging Europe data. Monthly data are used, where the series of the exchange and interest rates are aggregated through a monthly average of daily prices. The sample covers the 1991-2002 period. Summarising, the labels of the variables are as follows:

	exchange rates	prices	Productivity	interest rates
Czech Republic	CZK = ln(EUR/CZK)	C_PPP = $\ln(CPI_{CZK}/CPI_{€})$	C_PRO = $\ln(PROD_{€}/PROD_{CZK})$	C_IR = $IR_{€} - IR_{CZK}$
Hungary	HUF = ln(EUR/HUF)	C_PPP = $\ln(CPI_{HUF}/CPI_{€})$	C_PRO = $\ln(PROD_{€}/PROD_{HUF})$	C_IR = $IR_{€} - IR_{HUF}$
Poland	PLN = ln(EUR/PLN)	C_PPP = $\ln(CPI_{PLN}/CPI_{€})$	C_PRO = $\ln(PROD_{€}/PROD_{PLN})$	C_IR = $IR_{€} - IR_{PLN}$

In order to estimate a reasonable equilibrium level for these currencies, or convergence-to-equilibrium path, we look at the long-run relationship among the variables considered. We therefore proceed with a cointegration analysis, following the standard methodology suggested by Johansen (1995). At this stage, we are not interested in the short-run dynamics, which is why we do not make use of any model in differences but we simply employ the estimation results of the standard cointegration procedure, using variables in levels.

4. Empirical evidence

First, we start by evaluating the significance of the price variable only, to test the reliability of the PPP hypothesis. Successively, we add the productivity and the interest rate variables, in order to assess whether these may improve the understanding of the underlying dynamics of the exchange rates involved. For sake of simplicity, we refer to this latter specification as to the augmented-PPP relation.

In the case of the Czech koruna, the PPP hypothesis holds quite well (table 1). The cointegration relation is accepted at the 5% level, it is significant and the coefficient is close to unity. PPP is a good explanation of the EUR/CZK exchange rate especially from 1997 onwards[2] (fig. 1), but the most significant point is that there is a substantial convergence towards PPP levels throughout the full sample period. However we get an even much better explanation of the EUR/CZK trend dynamics if we add the productivity differential (fig. 1), using what we call the augmented PPP relation. Both cointegration and PPP still hold when productivity is included (table 2). This variable is significant and has the right sign. The augmented PPP relation provides a better approximation of the actual CZK behaviour both in terms of trend dynamics and precision – in the sense that the actual and fitted values are much closer to each other. The prominent role of productivity is easily understandable in the case of the Czech koruna, since the Czech Republic is the country which first underwent a process of modernisation among the three considered here. The augmented relation does not include interest rates since this variable proved not to be statistically significant, and therefore was skipped. A possible reason is that Czech interest rates are the lowest among the three countries considered, the spread to Euro Area rates is the most stable and the convergence took place at a much faster pace[3]. It is worth stressing that from 1997 onwards the gap between the simple and the augmented PPP relation tends to narrow considerably. This may be a consequence of the fact that marginal productivity gains are larger at the very beginning of any modernisation process and become smaller as time goes by. Alternatively, one might interprets these results as the consequence of the 3-year long recession that characterised the Czech economy after the 1997 crisis. During this recession, industrial production has been very weak. In 2002 the two specifications provide quite coincident results, which

[2] Note that in the Spring of 1997, the Czech currency was hit by a speculative attack which led to its devaluation

[3] It is not by chance that the only normal-shaped yield curve in the lot is that of the Czech Republic. The curves of the other two countries are still inverted.

might perhaps be interpreted as a signal that the Czech Republic is well placed on the road to joining the EU club. In addition, both models suggest that the Czech koruna was undervalued for most of the last decade, it converged to its theoretical levels in 2001 but may be now considered overvalued.

Partially different results are obtained for the Hungarian forint. In this case too the simple PPP holds (table 3) and the actual market rate converges fast towards the long run equilibrium value in mid 2001, when the currency band was introduced (fig. 3), and the anti-inflationary credibility of the National Bank of Hungary enhanced. In the augmented PPP relation productivity again matters while interest rates are not significant (table 4). But results from the two specifications are quite different from each other. According to the simple PPP the forint has been undervalued until 2001, whereas the augmented PPP tells us that it is still undervalued at the current level (fig. 3). This may be consistent with the fact that productivity gains started later than in the case of the Czech Republic. This is probably why the path highlighted by the augmented relation becomes negatively sloped in 1999. This seems to better reflect the actual behaviour of the forint. As to now, the simple PPP provides an indication of overvaluation whereas according to the augmented PPP the HUF results to be still undervalued. It is worth stressing that markets seem to believe in the "augmented PPP" story. The HUF is currently under enormous pressure, and is constantly moving very close to the strong end of the wide band indicated by monetary authorities as the official target. But the actual value of the exchange rate lies at the same distance from both specifications, which in any case suggest that a "proper" value of the forint should, in any case, be in the lower hand of the band.

The case of the Polish zloty is different. The simple PPP specification – if present – is very weak (table 5). The price coefficient is too distant from unity, but albeit in a weaker sense there is an evident convergence to PPP across time. When the augmented relation is implemented the price variable is completely crowded out by the interest rate differential, while productivity in this case is not significant (table 6). The conclusion which can be drawn is that only interest rates drove the dynamics of the zloty (fig. 4), which is easy to understand in the wake of the fact that Polish interest rates have until very recently be the highest among the three countries under scrutiny (fig. 2). In any case, according to both models, the zloty is overvalued.

5. On the road to convergence

Once we have found out the main drivers of the EUR/CZK, EUR/HUF and EUR/PLN exchange rates, we try to plot a feasible convergence path until 2007, the likely date for EMU entry. In order to do this, we have to make some hypothesis about the evolution of prices, productivity and interest rates in the Euro Area and the Eastern Europe countries.

A specific Maastricht criterion is required on price dynamics for joining the euro, namely that inflation must be smaller than the 12-month average inflation of the three Euro Area countries with the lowest inflation plus a margin of 1.5%. We therefore allow for a gradual reduction of inflation differentials with respect to the Euro Area gradually, until these reach about 1.0%. As for productivity, the choice is more arbitrary. It is plausible to imagine some convergence of productivity growth of the Eastern Europe economies with respect to the Euro Area, within a margin of 2.0-2.5% for instance. Finally, for interest rates it is straightforward that these must entirely converge and become coincident not later than the end of 2006.

According to the augmented PPP relation, the Czech koruna could enter the EMU at a parity of 29 (fig. 5). It therefore should appreciate a bit more from the current value of 31. This is consistent with growing productivity levels in the Czech Republic if compared to those of the Euro Area. On the other hand, the inflation criterion implies that price level differentials remain quite stable in this case. So the tendency to appreciation is completely determined by the evolution of productivity. This is also clear if we look at the path implied by the simple PPP relation only, which would entail a weaker koruna parity at around 33 to the €. The conclusion in any case is that the koruna is very close to its equilibrium level, which could also be a plausible entry parity.

The case of the forint is not so straightforward. The augmented PPP relation would see an appreciation from the current value of 235 to 210 (fig. 6), which is outside the ±15% range around the current parity of 276.10. This path stems from rising productivity levels in Hungary with respect to the Euro Area. If we look at the simple PPP relation, the results point to the opposite direction. In the wake of converging inflation, prices in Hungary have to rise in relative terms, which implies a weaker forint by the time of EMU entry, at 277, that is marginally above the current central parity.

Finally the zloty at 3.90 appears to be overvalued (fig. 7) and should weaken towards 4.50 by the time of EMU entry, in the wake of falling Polish interest rates – now 6.5-7.0% higher – to the corresponding Euro Area levels. Slightly different results are obtained looking at the simple PPP condition, since this would still imply a weaker zloty than is now at 4.10, but stronger than the one stemming from the interest rates relation. Given the weak power of the estimated PPP equation (table 6) we are more inclined to accept the indications coming from the alternative specification. In any case, both formulations bring in the same direction with respect to the current level of the zloty.

7. Concluding remarks and open issues

The paper provides simple but straightforward results. While it appears that PPP, in its simplest form, holds quite clearly for the forint and the Czech koruna, the empirical evidence for a long term relationship for the Polish zloty is not so strong. Furthermore, turning to our "augmented PPP", it is interesting to stress that productivity matters for the Czech Republic and for Hungary, where the transition process has been going on at a faster pace, while in the case of Poland, the force driving exchange rates has been the very favourable cost of carry, a consequence of the very high inflation of the first years of transition. It is also worth stressing that, according to our estimates, the Hungarian forint appears to be the currency with the highest upside potential along the road towards EMU. On the other hand, our projections of future PPP levels suggest that the Czech currency has basically reached already its long term equilibrium value, while the Polish zloty appears to be slightly overvalued.

What lacks in our simple model is the capacity to capture short term deviations from the long term fair value. As these markets become more liquid and more interesting for international investors, temporary misalignments from equilibrium provide trading opportunities that it might be interesting to exploit. Thus it would probably be useful to devote some resources in modelling and analysing short run deviations, without loosing sight of the long term equilibrium path. This can easily be implemented through an ECM formulation.

Table 1

Series: CZK C_PPP
Trend assumption: No deterministic trend (restricted constant)
Lags interval (in first differences): 1 to 1
Unrestricted Cointegration Rank Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None *	0.20	20.47	19.96	24.60
At most 1	0.02	2.01	9.24	12.97

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Trace test indicates 1 cointegrating equation(s) at the 5% level
Trace test indicates no cointegration at the 1% level

Normalized cointegrating coefficients (std.err. in parentheses)

CZK	C_PPP	Constant
1	-0.95	-3.27
	-0.42	-0.08

Table 2

Series: CZK C_PPP C_PRO
Trend assumption: No deterministic trend (restricted constant)
Lags interval (in first differences): 1 to 4
Unrestricted Cointegration Rank Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.30	49.68	34.91	41.07
At most 1	0.03	6.16	19.96	24.60
At most 2	0.02	2.03	9.24	12.97

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Trace test indicates 1 cointegrating equation(s) at both 5% and 1% levels

Normalized cointegrating coefficients (std.err. in parentheses)

CZK	C_PPP	C_PRO	Constant
1	-1.09	-0.82	-3.40
	-0.22	-0.29	-0.03

Table 3

Series: HUF H_PPP
Trend assumption: No deterministic trend (restricted constant)
Lags interval (in first differences): 1 to 4
Unrestricted Cointegration Rank Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.19	29.28	19.96	24.60
At most 1	0.02	2.59	9.24	12.97

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Trace test indicates 1 cointegrating equation(s) at both 5% and 1% levels

Normalized cointegrating coefficients (std.err. in parentheses)

HUF	H_PPP	Constant
1	-1.04	-4.89
	-0.05	-0.04

Table 4

Series: HUF H_PPP H_PRO
Trend assumption: No deterministic trend (restricted constant)
Lags interval (in first differences): 1 to 4
Unrestricted Cointegration Rank Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.27	42.82	34.91	41.07
At most 1	0.15	18.38	19.96	24.60
At most 2	0.07	5.99	9.24	12.97

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Trace test indicates 1 cointegrating equation(s) at both 5% and 1% levels

Normalized cointegrating coefficients (std.err. in parentheses)

HUF	H_PPP	H_PRO	Constant
1	-1.00	-1.24	-5.22
	-0.21	-0.32	-0.07

Table 5

Series: PLN P_PPP
Trend assumption: No deterministic trend (restricted constant)
Lags interval (in first differences): 1 to 3
Unrestricted Cointegration Rank Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.27	40.24	19.96	24.60
At most 1	0.05	5.19	9.24	12.97

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Trace test indicates 1 cointegrating equation(s) at both 5% and 1% levels

Normalized cointegrating coefficients (std.err. in parentheses)

PLN	P_PPP	Constant
1	-0.77	-1.68
	-0.48	-0.09

Table 6

Series: PLN P_IR
Trend assumption: No deterministic trend (restricted constant)
Lags interval (in first differences): 1 to 1
Unrestricted Cointegration Rank Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None *	0.17	23.83	19.96	24.60
At most 1	0.03	3.67	9.24	12.97

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Trace test indicates 1 cointegrating equation(s) at the 5% level
Trace test indicates no cointegration at the 1% level

Normalized cointegrating coefficients (std.err. in parentheses)

PLN	P_IR	Constant
1	-0.01	-1.50
	-0.01	-0.10

Figure 1

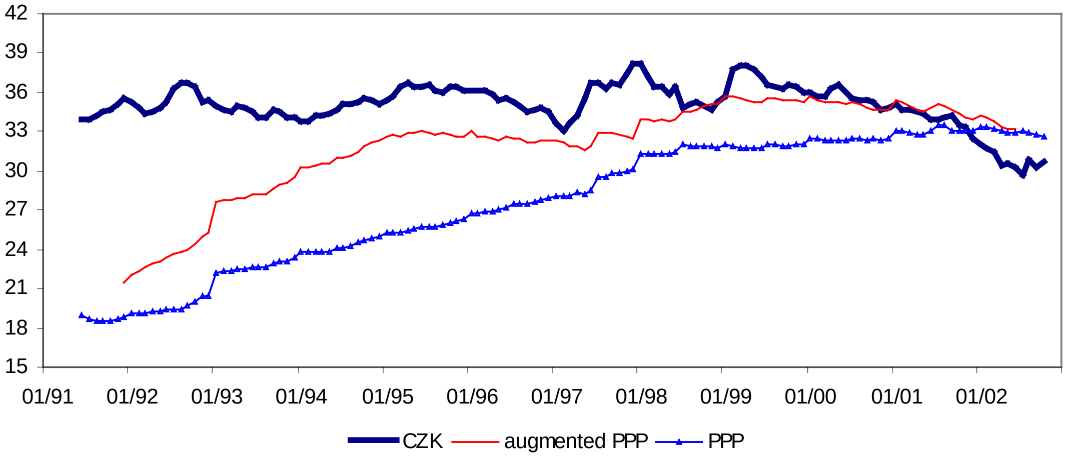


Figure 2

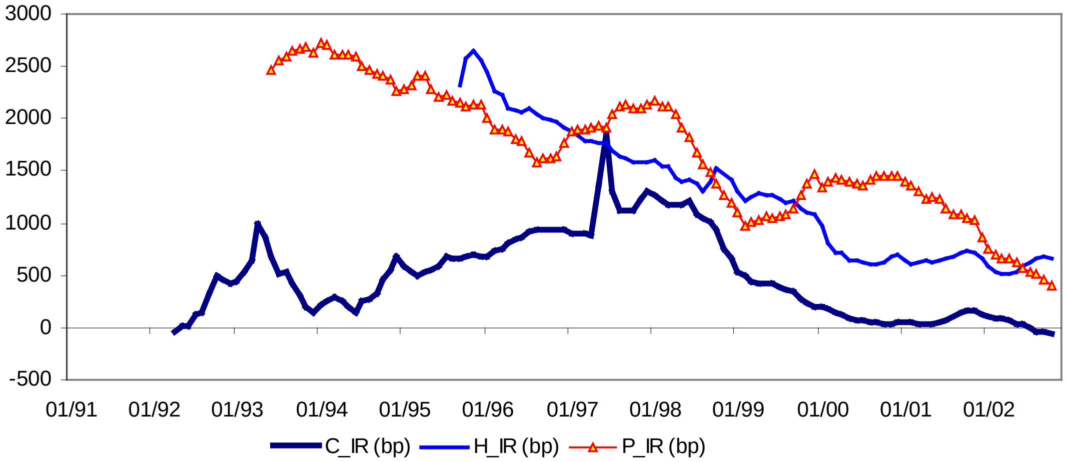


Figure 3

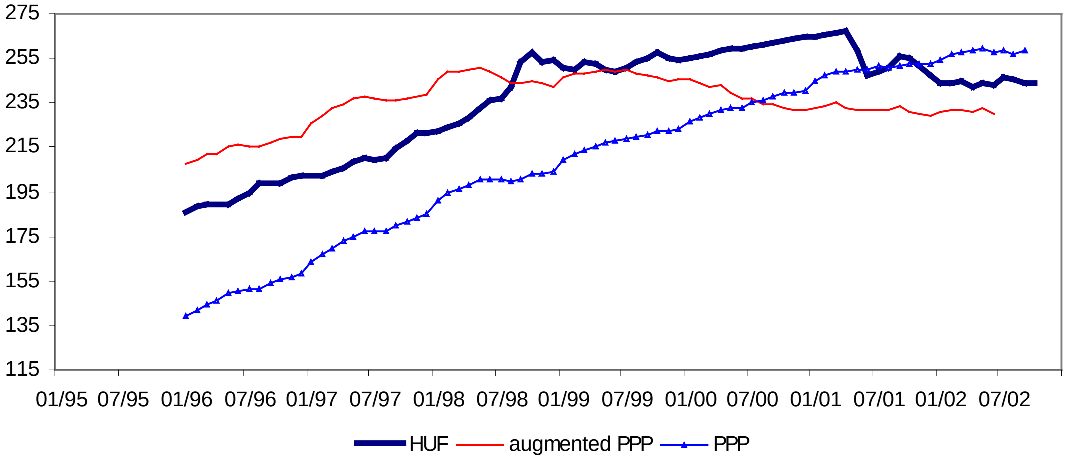
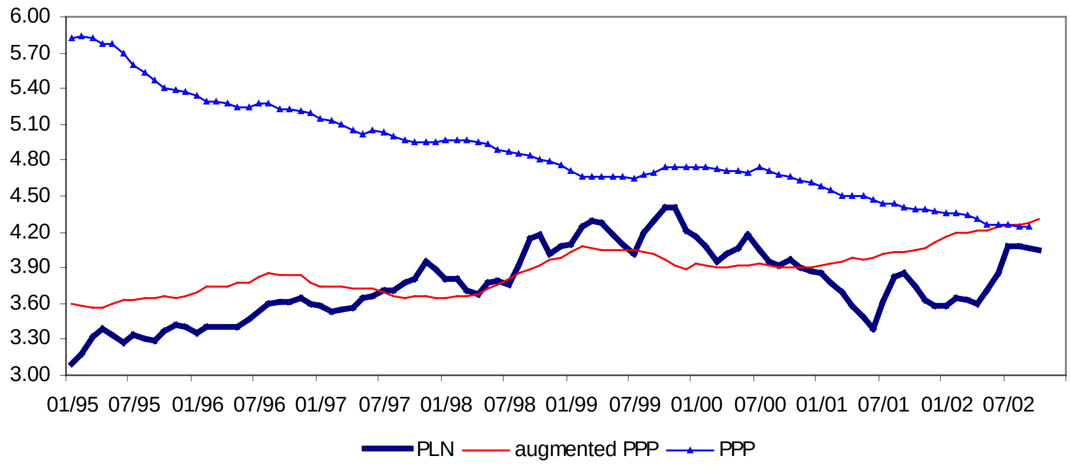


Figure 4



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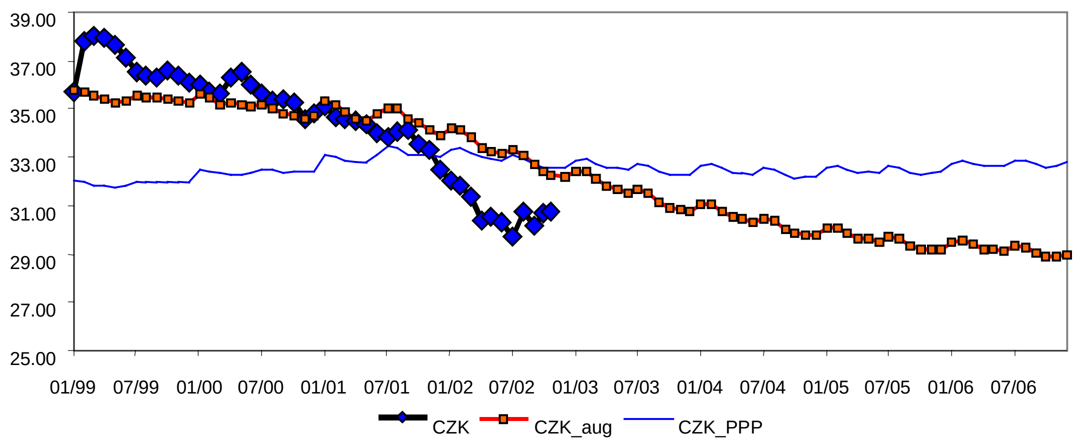

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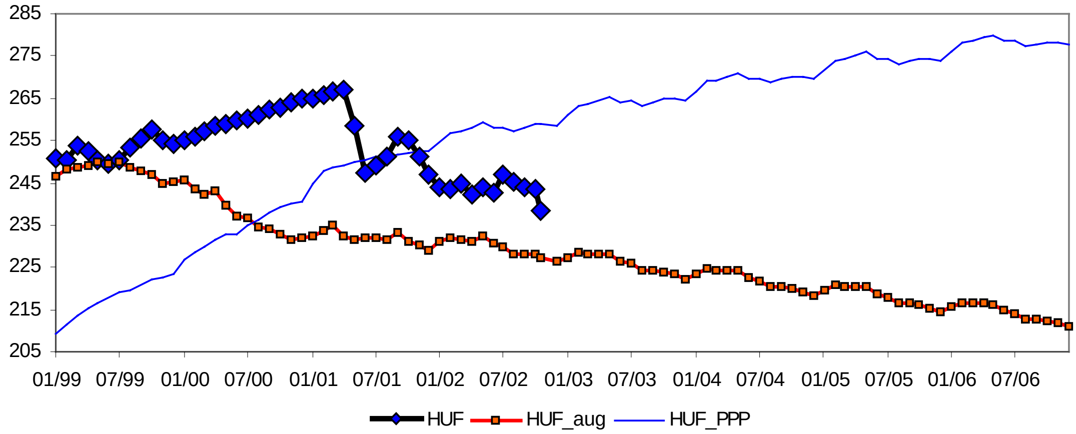

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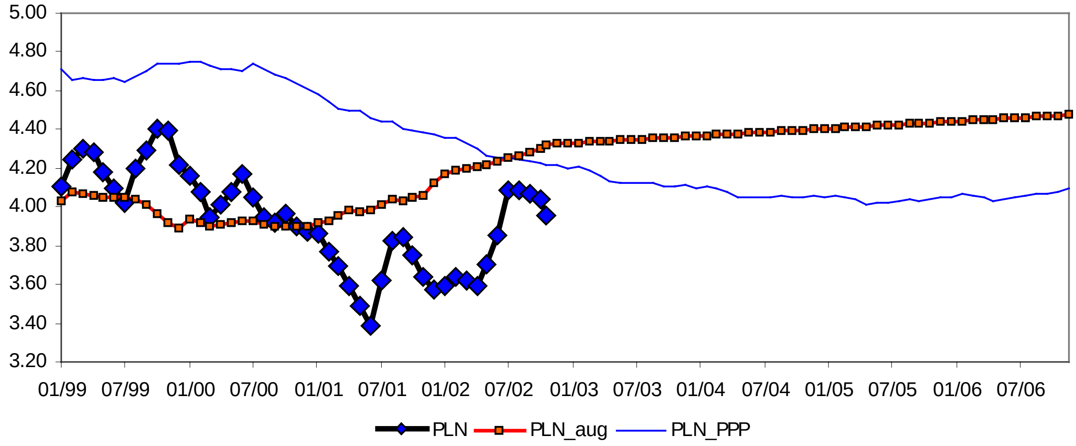
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