Effects of Convergence on Exchange Rate and Inflation

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Summary:
This short note is based on earlier work on modeling nominal convergence[2] and outlines a simple methodology for modeling nominal convergence, based on the approach pioneered by Kattai (2007) for the Bank of Estonia's macro model. It begins by sketching out some of the shortcomings with using the Balassa Samuelson approach to model (and forecast) nominal convergence, and then sets out an alternative approach based on the principle of price level convergence. One key advantage of the simple model presented here is that a variety of different convergence scenarios can be fed into the model to compute the effects on inflation and the nominal exchange rate. Some simple computations are presented for the Moldovan case, and compared with those for other Central and Eastern European countries.

Disclaimer: The views expressed are those of the author and not necessarily those of De Nederlandsche Bank

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1. Introduction

As part of the ongoing process of nominal and real convergence, price levels in Central and Eastern European Countries (CEECs) will be rising relative to those in eurozone. One way of thinking about this process is as a gradual increase in the number of euros required to purchase a basket of consumer goods in a given CEEC. A rise in the relative price level means that the euro-cost of the basket rises over time. This rate of change is termed the *euro-denominated inflation rate*, as is denoted by γ. For the purposes of this exercise, γ can be thought of as exogenously determined. This is equal to the sum of own currency inflation, π, and the change in the nominal exchange rate Δs:

$$\gamma_j \equiv \pi_j + \Delta s \qquad (1)$$

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[2] Lewis (2007), *Hitting and Hoping: Meeting the Exchange Rate and Inflation Criteria During a Period of Nominal Convergence,* DNB Working Paper 130

Nominal convergence means that $\gamma_j > \pi_{EZ.}$ In the long run, the channel by which this convergence shows up depends on the monetary policy regime in place. For countries which fix their exchange rates to the euro[3], $\Delta s=0$ and hence all convergence takes place higher inflation. If a country has inflation targeting with the same target as the ECB[4], then it will have (on average) the same inflation rate as the eurozone $\pi_{EZ}=\pi_j$ and thus nominal convergence must show up entirely via a nominal exchange rate appreciation: $\Delta s>0$.

An intermediate case is where the CEEC has inflation higher than that of the eurozone, but below γ[5]. In this case, convergence shows up via a combination of an inflation differential and a nominal appreciation. A final case is where the CEEC has inflation which exceeds γ, and thus nominal convergence shows up via a nominal *depreciation* but inflation which more than compensates for the depreciation.[6,7]

This note analyses the likely effects on inflation and exchange rates under a variety of assumptions about the convergence process and the monetary policy regime in place. The remainder of the note is organised as follows. Section 2 sets out the limitations of using the Balassa Samuelson approach, section 3 presents an alternative model of modeling nominal convergence and section 4 presents the empirical results arising from the model. Section 5 concludes.

2. Problems with the Balassa Samuelson Approach

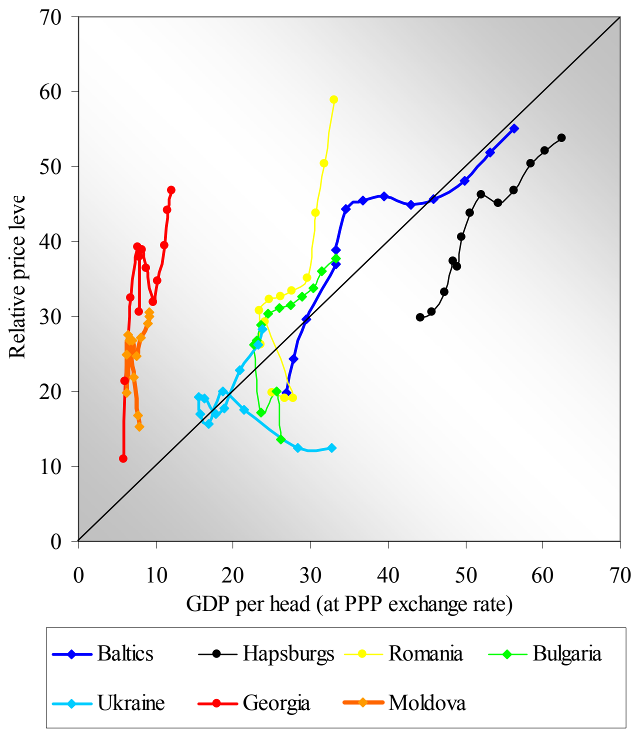
Nominal convergence is often thought of in terms of the Balassa-Samuelson approach. The canonical model stems from two papers by Balassa (1964) and Samuelson (1964), which aimed to explain the stylised fact that countries with lower per capita real income levels tended to have lower price levels.[8] This provides a simple way to tie together both nominal

[3] Currently this group comprises the Baltic states and Bulgaria.
[4] Slovakia the closest approximation to this case, with an avowed goal of inflation below 2% (as opposed to a symmetric 2% target)
[5] In this group we have the inflation targetters: Czech Republic (3% target), Hungary (3% target), Poland (2.5% target) and Romania (gradually declining target from 7.5% to 3.8% from 2005 to 2008).
[6] In this group comes (at least for the past five years) Georgia and Ukraine
[7] The cases where inflation in the CEEC is lower than the eurozone are not considered here because it is unlikely that inflation targeting regime would be set up which created inflation which was lower than the eurozone in the long-run.
[8] The crux of the story is that the law of one price (LoOP) only holds for tradeable goods, and thus non-

and real convergence. However, in this note, a B-S model is not used due to a number of important drawbacks.

First, a look at the nominal and real convergence actually observed in CEECs over the period 1995-2005 suggests there is no common relationship between the relative speed (or indeed directions) of relative price and income movements across countries (see figure 1). The Baltics (LV, LT, EE) and Hapsburgs (CZ, HU, PL, SK) appeared to converge primarily on nominal terms in the first five years, and then converge predominantly in real terms in the last five years. Moldova, Georgia and Romania have seen much stronger nominal convergence than real convergence throughout. Ukraine's experience shows it is even possible to experience a protracted fall in output (divergence in output levels) at the same time as converging in nominal terms.

Figure 1: Nominal and Real Convergence
Source: IMF



Second, econometric work on the estimating size of the B-S effect fails to reach a consensus on the likely size of the effect in each country. Surveys of the literature report a wide variation depending on the methodology and data used (See Йgert et al 2004; Йgert, 2006). Table 1 shows the results of various empirical work (taken from Йgert et al, 2004), split up into two categories- those studies which find relatively strong BS effects, and those which find relatively weak BS effects. For those countries where a number of studies exist, it is clear that there is a substantial variation in the size of the effect- ranging

tradeable prices can differ across countries, and hence generate differences in price levels. If productivity growth in the tradeable sector (relative to the non-tradeable sector) is higher in the CEEC, then raises wages in the tradeable sector, and by extension in the non-tradable sector. This leads to a rise in the relative price of non-tradeables. Since LoOP holds for tradeables, this relative price effect shows up as a rise in non-tradeable prices in the CEEC, which raises the relative price level of the CEEC.

from zero (or even negative) to four or five percentage points.

Third, the actual levels of real exchange rate appreciation seen in CEECs tend to be systematically higher than the empirical estimates of the BS effect. The bottom line of table 1 shows the real exchange rate appreciation based on Eurostat's internationally comparable consumer price level index (author's own calculations). For every country the observed appreciation is significantly higher than the average figure found in literature. Even if one restricts the average to those studies which find large effects (as determined by Иgert et al, 2004), the estimate figure is still significantly below the actual number for all countries bar Poland and Slovenia. In the Slovene case, the observed appreciation is far *lower* than that predicted by most empirical estimates. This could reflect either flaws in the theory or estimating of the B-S effect, or that other factors also generate nominal convergence.

Fourth, even if the theory were a perfect account of the underlying economic mechanisms, sufficiently disaggregated data is not available to quantify the size of the effect empirically. To correctly uncover the size of B-S effect, one first needs to decompose output (and prices) into tradable and non-tradable sectors. Output based measures exist only at a sectoral level, and an arbitrary decomposition must then be made. Moreover, goods typically contain both a tradable and non-tradable element, meaning that data on individual goods prices is not sufficient. In addition, data on productivity are incomplete and sparse, and so the majority of studies rely on labour rather than total factor productivity estimates.

Fifth, no consideration is given to the dynamic properties of the convergence property. In particular, the model outlined generates the result that the BS effect is not constant over time. However, a stylised fact of the convergence process is that real exchange rate appreciations are often stronger, the greater the initial price level disparity. Thus, one would expect the convergence effect to decline steadily over time.

Finally, and perhaps most importantly, the ultimate goal of the analysis is to consider what would happen under a variety of plausible convergence scenarios. The goal is not to come up with a single prediction of the likely convergence scenario. Instead, the focus is on asking a "what if" question, to see how countries would fare under a variety of different convergence scenarios.

3. A simple model of price convergence

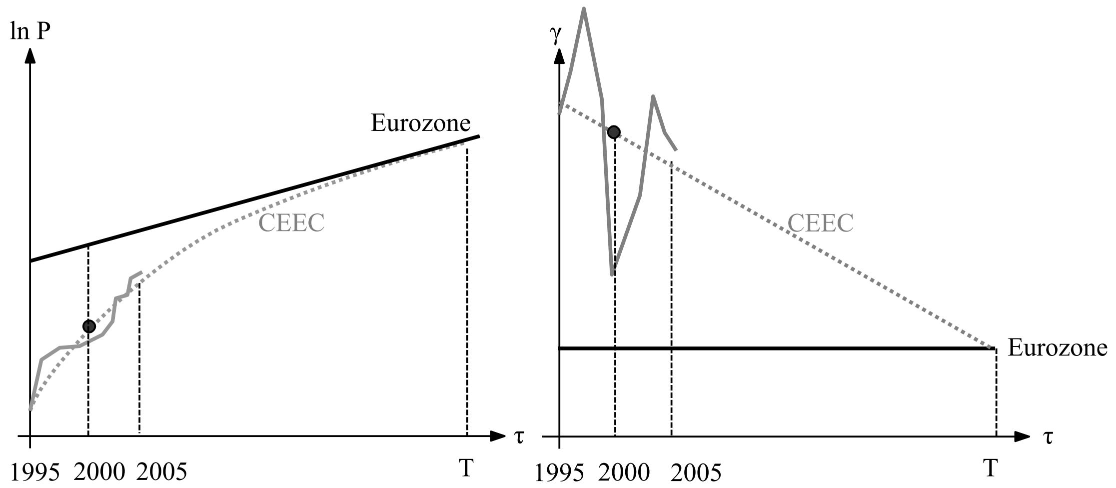
To get around the problems described above, an alternative approach is deployed, based on the model developed by Kattai (2005, 2007). This approach is based explicitly on the dynamic properties of the price level, and is derived assuming that the convergence comes to an end when a specific relative price is reached in the CEEC.

In short, this approach considers convergence in two variables- the relative price level, and γ with the constraint that convergence in both variables comes to an end at the same point. Simultaneous price level and inflation convergence generate smooth dynamics- and putting the two together implies another attractive property- that the bigger the price differential between a CEEC and the Eurozone at given point, the higher the inflation rate. This replicates the stylised fact that, γ tends to be higher during the initial phases of the convergence process, and then slows as price levels get closer.

It should be stressed at this stage that this approach is not so much a means of forecasting the actual convergence path, but rather allows the consideration of "what if" questions, about the effects of different convergence scenarios.

Eurostat's relative price level data begins in 1995 and runs up to 2005. This is used to estimate the trend price level and γ in the year 2000. Given these values it is then possible to project the convergence scenarios forward from 2000 onwards. A simple diagrammatic representation of the case where a country converges to Eurozone inflation rates and price levels is shown in figure 2.

Figure 2: Stylised Convergence Paths



These diagrams also provide an intuition for the methodology used to calculate convergence speeds. The dotted lines can be thought of as the underlying "trend" price levels and inflation rates, tied down by price convergence considerations, around which the actual observed figure will fluctuate.

Formally speaking this approach implies the following equation:

$$\frac{\bar{P}_{j,2000}}{\bar{P}_{EZ,2000}} e^{\int_0^T \left(\bar{\gamma}_{j,2000} - \frac{(\bar{\gamma}_{j,2000} - \bar{\pi}_{EZ})t}{T}\right) dt} = e^{\int_0^T \bar{\pi}_{EZ}} \qquad (2)$$

where $\bar{P}_{j,2000} / \bar{P}_{EZ,2000}$ is the trend relative price level between country *j* and the Eurozone in the year 2000 (the black dot in the left hand panel of figure 1) and where $\bar{\gamma}_{j,2000}$ denotes the trend value of γ in country *j* in 2000 (the black dot in the right hand panel of figure 1). In words, this means that euro-denominated inflation converges linearly to 0.02 (the Eurozone level) over time, and reaches the Eurozone level at exactly the same point, T, as the price level converges.

This approach can then be used to generate a number of hypothetical convergence scenarios. One key advantage of this approach is that the modeler can simulate a variety of different scenarios. Inevitably, the choice of scenario is to some extent arbitrary, but any projection of future convergence necessarily requires some arbitary assumption over the future path of productivity growth and/or price level evolution. By framing the assumptions in terms of convergence times/speeds is that the assumptions have a clear economic interpretation.

This model can be used to do two types of simulations. First, given estimated data for trend relative price levels and trend γ (the black points in figure 1) and an assumption about the end point of the convergence process (e.g. full price level equalization), one can the solve equation (2) for T, the time of convergence. Second, one can fix T, and then given assumptions about the endpoint of the convergence process and $\overline{P}_{j,2000} / \overline{P}_{EZ,2000}$, one can then solve for $\bar{\gamma}_{j,2000}$.

4. Empirical Results

The model is used to conduct four different simulations. Relative price levels are calculated using IMF data on GDP per capita, and GDP deflator. The ratio of GDP per capita at market exchange rates to GDP per capita at PPP exchange rates gives a measure of the relative price level. Since no data is available for the Eurozone, we proxy this with German data.
Ideally, one would like to be able to compare consumer price index inflation, but to do this requires a measure which is comparable across countries both in terms of rates of change (inflation rates) and also levels. Unfortunately the only data we have which satisfies this criterion is for the GDP deflator.

Combining data on relative price levels, and GDP deflator inflation in Germany, we can obtain a time series for γ in Moldova. Given this estimate of γ, we then plug this into the model, with the assumption that trend inflation in Germany is 2% per annum.[9]

These are then used to simulate four different scenarios:

<u>Scenario 1: 100% Price Level Convergence, Estimate T</u>

$\overline{P}_{j,2000} / \overline{P}_{EZ,2000}$ is estimated by taking the double exponent of the average of the double log of the relative price level between 1995 and 2005.[10] This gives a value of 0.246. $\bar{\gamma}_{j,2000}$ is estimated by taking the average value of γ between 1995 and 2005- and gives a value of 9.1% Assuming that full convergence is reached at time T (identical price levels in Moldova and the Eurozone), we can the solve for T

<u>Scenario 2: 100% Price Level Convergence, T=50</u>

T=50 by assumption. 50 years is taken as this is usually seen as an upper bound on the likely convergence time for most CEE EU members. $\overline{P}_{j,2000} / \overline{P}_{EZ,2000}$ is as above, and convergence is 100%. The model is then solved for $\bar{\gamma}_{j,2000}$

<u>Scenario 3: 80% Price Level Convergence, Estimate T</u>

The convergence process could come to an end before full price equalization is reached. The lowest three Eurozone members (bar Slovenia) Spain, Portugal and Greece have an average price level of around 80% of the eurozone level, therefore we take 80% as our benchmark figure. This implies the following equation

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[9] Over the period in question, the actual average GDP inflator inflation in Germany was 0.67%, less than HICP inflation over the same period. However, it seemed undesirable to assume that over the lifetime of the convergence process, a similar disconnect would exist- as this would have implied an enormous cumulative divergence in the two series.

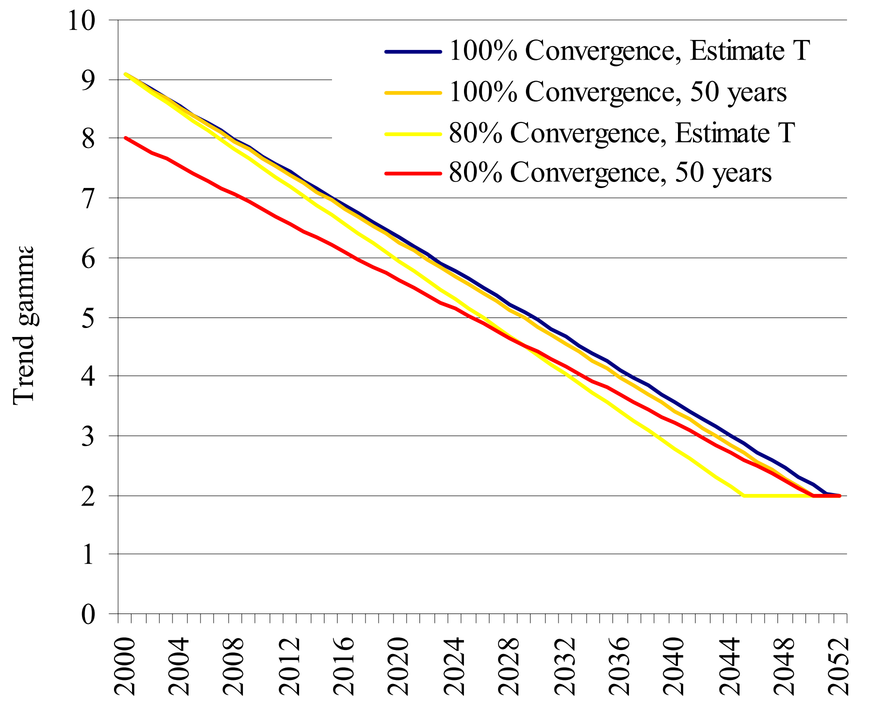
[10] The model implies that the double log of the relative price level is linear with respect to time, therefore taking the average of this, yields an estimate of "trend" value in the midpoint of the series.

$$\frac{\overline{P}_{j,2000}}{\overline{P}_{EZ,2000}} e^{\int_0^T \left(\overline{\gamma}_{j,2000} - \frac{(\overline{\gamma}_{j,2000} - \overline{\pi}_{EZ})t}{T} \right) dt} = 0.8 \cdot e^{\int_0^T \overline{\pi}_{EZ}} \qquad (3)$$

$\overline{P}_{j,2000} / \overline{P}_{EZ,2000}$ and $\overline{\gamma}_{j,2000}$ are calculated as for scenario 1.

These are shown diagrammatically in figure 3:

Figure 3: Convergence Scenarios



These are depicted in table 2, alongside the trend nominal appreciation under a variety of different inflation targets.

Table 2: Convergence Simulations

	T	$\bar{\gamma}_{j,2007}$	Nominal appreciation if		
			π_{targ}=2%	π_{targ}=4%	π_{targ}=5%
S1: 100% conv, estimate T	51	8.1	6.1	4.1	3.1

S2: 100% conv, T=50	50	8.1	6.1	4.1	3.1
S3: 80% conv, estimate T	45	8.0	6.0	4.0	3.0
S4: 80% conv, T=50	50	7.1	5.1	3.1	2.1

This table gives an indication of the likely trend nominal appreciations under a variety of inflation targets. A 2% target is associated with a trend appreciation of 5-6%, a 4% target with an appreciation of 3-4% per year, and a 5% target with a 2-3% appreciation. To fully absorb likely real convergence effect without recourse to the exchange rate would require an inflation target of 7-8%.

5. Conclusions

This short note analyses the likely size of price convergence effects on inflation and the exchange rate using a simple model of price convergence. The results are reasonably similar across all four scenarios chosen. They imply a real appreciation of around 5-6 percentage points per annum.

How this real appreciation shows up depends on the exchange rate regime. If the exchange rate is fixed, then this implies a domestic inflation rate of 7-8%. Alternatively put, this means that an inflation target of 7-8% should not generate a trend appreciation of the nominal exchange rate. A lower inflation target would imply some trend appreciation in this model. A 2% target implies a 5-6% trend appreciation per annum, a 5% target implies a 2-3% appreciation per annum.

The likely size of these appreciations is of relevance for policymakers, because they determine the size of the "benchmark appreciation", beyond which exchange rate movements will exert a downward effect on inflation. If exchange rate movements simply reflect a readjustment of the relative price of tradeable and non-tradeable goods, then exchange rate "passthrough" onto consumer prices is zero. If the exchange rate appreciation is more (less) than can be attributed to productivity related factors, then it will begin to have a downward (upward) effect on inflation. Understanding the likely size of these effects is important for policymakers who wish to target inflation, because the effect that exchange rate movements will have on inflation depends on their magnitude relative to the trend value.

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Table 1: Empirical Estimates of the Balassa Samuelson Effect (taken from Йgert et al 2006)

Study	Czech R.	Estonia	Hungary	Latvia	Lithuania	Poland	Slovakia	Slovenia
Backй et al. (2003); a	0		4.1			9		3.1
Golinelli and Orsi (2002); a	3.7		1.55			4.5		
Rosati (2002); a	0.55	1.6	3.5			3.75		1.6
Rother (2000); a								2.15
Sinn and Reutter (2001); a	2.3	2.8	6.3			3.6		2.8
Average	***1.64***	***2.2***	***3.86***			***5.21***		***2.41***
Burgess et al. (2003)		0.43		0.4	0.47			
Йgert (2002a)	0.2		1.5			1.35	-0.1	0.6
Йgert (2002b)	0.2		1.4			1.85	-0.7	-0.5
Йgert (2003)			0.65					
Йgert et al. (2003)	-0.2	0.1	0.75	-0.3	-0.1	1.6	1.5	0.7
Felk et al. (2002)	-0.29							
Halpern and Wyplosz (2001); a	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Kovбcs (2001)			1.5					
Kovбcs and Simon (1998)			1.6					
Kovбcs (2002)	0.1		1.9					0.7
Mihaljek and Klau (2003); a	-0.3		1			0.8	0	0
Average	***0.04***	***0.45***	***1.28***	***0.23***	***0.32***	***1.24***	***0.26***	***0.35***
Actual Appreciation 1995-2005 (author's own calculations)	3.94	4.76	5.74	7.40	4.29	3.03	0.48	4.29